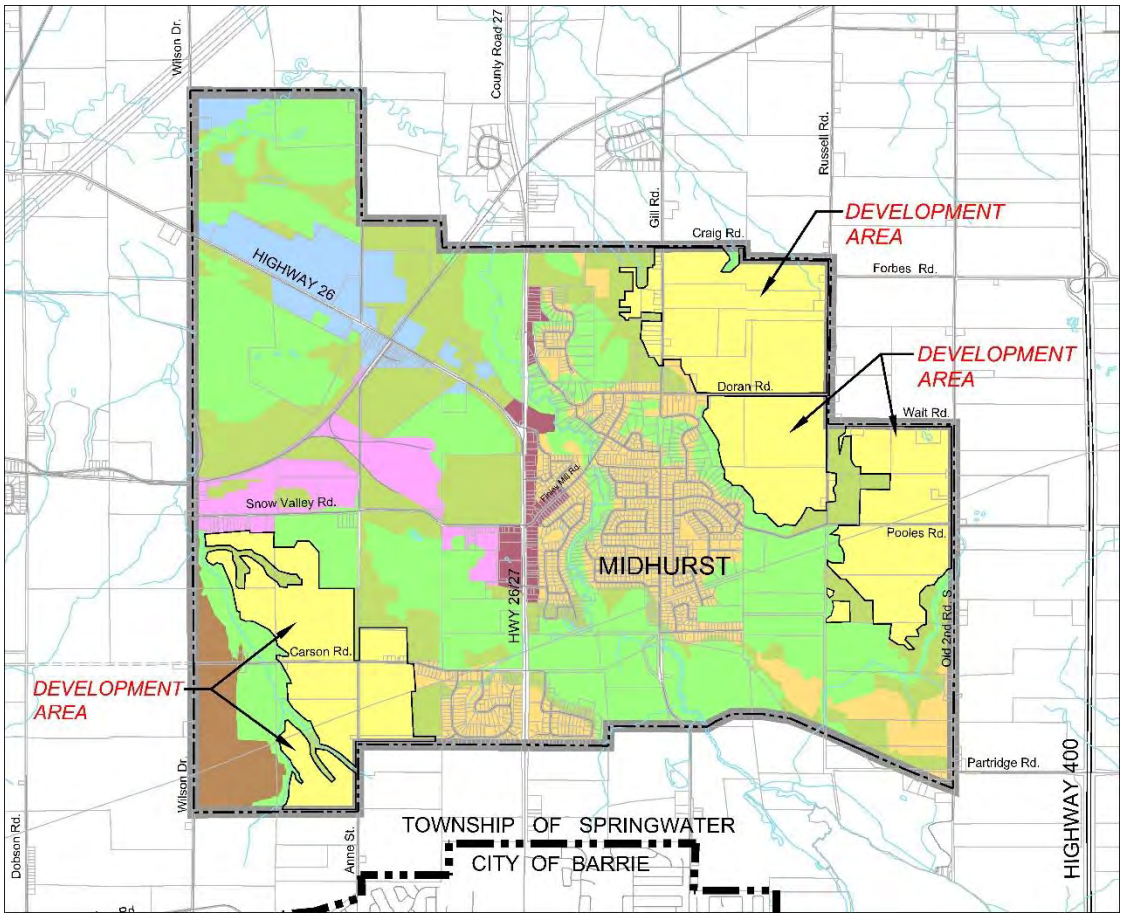
Township of Springwater

Midhurst Water, Wastewater & Transportation (Phase 3 and 4)

Environmental Study Report



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Appendix J to M

APPENDIX 'J'

Hydrogeological Study, Midhurst Water Supply Exploration Program – Golder Associates Ltd., May 2018
&
Report on Carson and Doran Neighbourhoods Proposed Water Supply Groundwater Modelling – Golder Associates Ltd., May 2018

Report on Carson and Doran Neighbourhoods Water Supply – Midhurst Secondary Plan: Supplementary Hydrologic Modelling – Golder Associates Ltd., January 2017

May 2018

HYDROGEOLOGICAL STUDY

Midhurst Water Supply Exploration Program, Township of Springwater, Ontario

Submitted to:
The Township of Springwater c/o Ainley & Associates
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REPORT

Report Number: 13-1170-0040

Distribution:

4 Copies - Midhurst Development Doran Road Inc.
1 Copy –– Midhurst Landowners Group Carson Road Development Inc.
1 Copy - Golder Associates Ltd.

Golder Associates

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Executive Summary

The Midhurst Landowner's Group retained Golder Associates Ltd. (Golder) to conduct a water supply exploration program and well development program as part of Phases 3 and 4 of the Municipal Class Environmental Assessment for the Midhurst Secondary Plan area. Phases 1 and 2 of the Class Environmental Assessment identified Aquifers A3 and A4 as the preferred alternative for water supply development. Aquifer A3 is a regionally extensive aquifer and is the source of water for the municipally serviced areas of existing Midhurst and Snow Valley, among others. The A3 Aquifer was the target for the exploration program.

Field work was conducted between December 2013 and October 2014. Well drilling was completed at ten sites, and included the installation of four 203 mm nominal test wells. The test wells were constructed with 203 mm diameter steel casing with stainless steel screens and were pumped with submersible pumping equipment. These wells were designed and constructed to exceed the standards in Ontario Regulation 903. Each well was developed to yield clear, sand-free water. The test wells generally underwent stepped rate pumping tests, constant rate pumping tests, suspended sediment tests, and comprehensive water quality tests. The monitoring wells were completed using a PVC casing, and airlifted following installation. Water quality sampling was conducted at all observation well locations.

Numerical groundwater modelling was completed to assist in the evaluation of the sustainability of, and potential groundwater impacts from, the long-term operation of water supply wells at the test well locations. The modelling was undertaken using an updated version of the existing three-dimensional (3D) Kempenfelt Bay FEFLOW numerical model. The model was calibrated and then used to assess potential drawdown, well interference, and baseflow losses as a result of the additional pumping at the water supply wells.

Test well TW22 was constructed at Site 1 (Snow Valley Road). A 72-hour pumping test was conducted at a rate of 36.5 L/s. The drawdown at the end of the pumping test was 23.03 m and the available drawdown is 69 m. Observation well monitoring in the vicinity indicated a weak connection between the deep pumping zone and shallower aquifers. Water quality samples collected at both 1 hour and 36 hours from the pumping well met the ODWS for all parameters tested. Interpolation of the drawdown versus time data indicated that at 20 years of well operation at 36.5 L/sec the drawdown is predicted to be 27.6 m or 40% of the available drawdown.

Test Well TW21 was constructed at Site 3 (Old Second Road South). A 72-hour pumping test was conducted at a rate of 27.8 L/s, and the drawdown at the end of the pumping test was 45.23 m. Shallow observation well monitoring in the vicinity did not show any response to pumping. Water quality samples collected after 24 and 72 hours from the pumping well met the ODWS for all parameters tested, with the exception of colour. Interpolation of the drawdown versus time data for TW21 indicated that after 20 years of well operation at 20 L/sec the drawdown was predicted to be 36 m or 59% of the available drawdown.

Test well TW34 was constructed at Site 7 (Snow Valley West). A 72-hour pumping test was conducted at a rate of 20 L/s, and the drawdown at the end of the pumping test was 15.46 m. Water level monitoring in the vicinity showed no response to the pumping in private wells or observation wells constructed in shallower aquifers. Water quality samples collected after 24 hour and 71 hours from the pumping well met the ODWS for all parameters tested, with the exception of iron, methane, and manganese. The water had a slight sulphurous odour and an

acceptable taste. Interpolation of the drawdown versus time data for TW34 indicated that after 20 years of well operation at 20 L/sec the drawdown is predicted to be 16.7 m or 13% of the available drawdown.

Test well PW1 was constructed at Site 10. Both a 72-hour and 48-hour pumping test were conducted at a rate of 45 L/s, with drawdown at the end of the 72-hour pumping test of 19.45 m. Observation well monitoring in the vicinity in the shallow aquifer showed no response to the pumping. Interpolation of the drawdown versus time data for PW1 indicated that after 20 years of well operation at 45 L/sec the drawdown is predicted to be 24 m or 40% of the available drawdown.

Wells installed as part of the water supply exploration program conducted in the Midhurst area have a sum capacity of 129.3 L/sec. Wells have been tested in the Doran Road area that had a water production rate of 72.8 L/sec. Both well sites in this area can support twinned wells and a potential of production rate of 140 L/sec. Wells have been tested in the Carson Road area that had a water production rate of 56.5 L/sec. Well sites in this area can support twinned wells, and a potential production rate of 81 L/s. Based on the potential for twinning, 221 L/sec is available from groundwater resources in the area. Numerical groundwater modelling indicates that a future water taking of 221 L/sec is sustainable from the Regional A3/A4 Aquifer in the area. The additional pumping is not expected to adversely affect the performance of the existing Midhurst, Barrie, or Snow Valley water supply systems.

The firm capacity of the water supply system can be addressed by the construction of additional alternative supply wells at each of the test well sites. The presence of suitable aquifer materials at each site is sufficiently predictable to allow for the planning of additional lands to be set aside for the construction of additional wells. It is expected that any two of the wells would be operated simultaneously, resulting in drawdown among the wells similar to that demonstrated during the various pumping tests.

The hydrogeological assessment has addressed source water protection through the development of well capture zones (eventual wellhead protection areas) paired with existing aquifer vulnerability mapping. The assessment indicates that the water supply system has a low vulnerability to surficial contaminants and causes minimal interference to surrounding municipal wells. The modelling analysis conducted in this study provides the foundation for meeting the Technical Rules: Assessment Report requirements as governed by the Clean Water Act, 2006. An Assessment Report will ultimately be prepared by the South Georgian Bay Lake Simcoe source protection committee.

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1.0 INTRODUCTION

The Midhurst Landowner's Group retained Golder Associates Ltd. (Golder) to conduct a water supply exploration program and well development program as part of Phases 3 and 4 of the Municipal Class Environmental Assessment for the Midhurst Secondary Plan area. Phases 1 and 2 of the Class Environmental Assessment identified Aquifers A3 and A4 as the preferred alternative for water supply development.

1.1 Scope of Work

The objective of the work was to evaluate the potential sources of potable water supply for residential land development applications in Midhurst. The scope of work included:

- Identify locations for test drilling;
- Conduct service locates for buried utilities;
- Conduct preliminary contaminant source identification;
- Investigate sites with pilot hole drilling, logging and sampling;
- Conduct grain size analyses and determine the potential for pilot hole locations for well construction;
- Conduct water quality monitoring at observation wells;
- Construct municipal grade test wells;
- Conduct stepped rate and constant rate pumping tests;
- Conduct water quality assessments at production well locations;
- Prepare a hydrogeological assessment of the groundwater resources of the area;
- Prepare a water budget for the proposed development lands; and,
- Undertake a numerical groundwater modelling analysis to assess potential impacts of the proposed water supply pumping on the groundwater system.

2.0 ASSESSMENT PROCEDURE

2.1 Site Selection Procedure

Field work was conducted between December 2013 and October 2014. Well drilling was completed at ten sites, namely: Site 1: Snow Valley Road (Gravel Pit); Site 2: Pooles Road; Site 3: Old Second Road; Site 4: Doran Road; Site 5: Anne Street; Site 6: Hickling Farm; Site 7: Snow Valley Road (West); Site 8: Walt Road; Site 9: Old Second (Coutts); and Site 10: Russell Road (Alliance). The wells were drilled on lands owned by the proponents, The Midhurst Landowner's Group. The locations of the observation wells and test wells constructed as part of the water supply exploration are shown on Figures A-1 to A-6.

Well drilling was done to evaluate the presence and characteristics of the two main municipal water supply aquifers in Simcoe County, Regional Aquifers A3 and A4 (Golder, 2004). It was anticipated that Aquifer A3 would be present throughout the area; however, it was also recognized that flowing artesian conditions may exist in the

low-lying valley areas. When selecting well drilling locations, Golder took this into consideration in order to avoid flowing conditions. Well drilling into Aquifer A3 at ground surface elevations of below approximately 230 metres above sea level (masl) in the Doran Road area and below 225 masl in the Carson Road area were avoided. However, even with these precautions, one flowing well was intersected.

2.2 Observation Well and Test Well Construction

Observation wells and test wells were constructed at the ten locations for the groundwater supply exploration program between January 2014 and April 2014 (Figure A-1 to A-6). Observation wells, defined as 50 mm in diameter, were drilled by Allan Wright Water Wells Inc. using a mud rotary rig. The wells were installed at all sites and screened within select intervals of Aquifers A1, A2, A3 and A4 (provided these units were encountered during drilling). Each observation well location was developed using air lift pumping to remove the drilling fluids from the well bore and aquifer surrounding the well screen. Water quality was collected from the screened intervals to document the water quality of the aquifer units. The as-built driller logs are contained in Appendices B to K.

Test wells, defined as being constructed with 203 mm diameter steel casing with stainless steel screens, are intended to be pumped with submersible pumping equipment. These wells were designed and constructed to exceed the standards in Ontario Regulation 903 as they will remain as municipal water supply wells for the Midhurst Development when required. Grain size analysis was completed on the Aquifer A3 materials at most locations in order to determine the most favourable locations for setting well screens and to determine the gradation for the filter pack and screen slot size (Appendices B to K). The test wells were only installed at pilot holes where the potential for water supply was promising. Each well was developed to yield clear, sand-free water. The test wells underwent stepped rate pumping tests, constant rate pumping tests, suspended sediment tests, and comprehensive water quality tests.

2.2.1 Site 1: Snow Valley Road (Gravel Pit)

A total of seven wells were installed at the Snow Valley Road Site (Gravel Pit) (Figure A-2), namely: OW19#6 (i.e. TW19), TW22, OW19#1, OW19#2, OW19#3, OW19#4 and OW19#5. The borehole (TW19) was completed to a depth of 100 metres below ground level (mbgl) on January 13 and 14, 2014. The borehole intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-7. The target Aquifer A4 was encountered between 81 to 95 mbgl at TW19/14. A 50 mm 10-slot well screen was placed from 93.9 mbgl to 96.9 mbgl in Aquifer A4 (Figure B-1), and the well was re-designated as OW19#6 (from TW19).

A second borehole (TW22) was drilled on February 4, 2014 to a depth of 95.4 mbgl. The borehole intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-7. The target Aquifer A4 was encountered between 75 mbgl to 95 mbgl. A 203 mm diameter well with 9.1 m of nominal 203 mm diameter, 50-slot well screen was placed in Aquifer A4 from 81.1 m to 89.9 m with a sand pack from 72 m to 90 m (Figure B-2).

Five additional observation wells were installed in Aquifers A1, A2 and A3. OW19#1 was drilled on March 7, 2014 to a depth of 16.1 mbgl. A 50 mm diameter, 10-slot screen was placed in Aquifer A2 between 13.1 mbgl and 16.1 mbgl (Figure B-1). OW19#2 was drilled on March 7, 2014 to a depth of 23.4 mbgl. A 50 mm 10-slot screen was placed in Aquifer A3 between 20.4 mbgl and 23.4 mbgl (Figure B-1). OW19#3 was drilled on February 28, 2014 to a depth of 35.3 mbgl. A 150 mm 16-slot screen was placed in Aquifer A3 between 34.1 mbgl and 35.3 mbgl (Figure B-1). OW19#4 and OW19/14-#5 were drilled on April 11, 2014 to a depth of 64.0 mbgl and 73.2 mbgl, respectively. A 50 mm 10-slot screen was placed in Aquifer A3 between 61.0 and 64.0 mbgl at OW19#4 and between 70.1 mbgl and 73.2 mbgl at OW19#5 (Figure B-1).

2.2.2 Site 2: Pooles Road

Three boreholes were drilled at the Pooles Road Site (Figure A-3), namely: TW20, TW25 (i.e. TH25) and TW28 (i.e., OW28), all of which are located along Pooles Road near the Russell Road intersection. The first borehole (TW20) was completed to a depth of 152 mbgl on January 15 and 16, 2014, and intersected Aquifers A1, A2, A3, and A4 as shown in Figure A-8. Aquifer A4 was encountered between 137 mbgl to 148 mbgl and Aquifer A3 was encountered between 126 mbgl to 133 mbgl. A 150 mm well with 1.5 m of 12-slot well screen was placed in Aquifer A3 between 60.4 m and 61.9 m (Figure C-1). The grain size analysis for TW20 can be found on Figure C-3 which indicates a medium sand aquifer with screen slot sizes ranging from 18 to 20 for the Aquifer A3 portion of this test hole.

A second borehole (TW25) was drilled on February 19 and 20, 2014 to a depth of 131.4 mbgl. The borehole intersected Aquifers A1, A2, and A3 as shown on Figure A-8. Aquifer A3 at this location was finer grained than at TW20 and the borehole (re-designated TH25) was abandoned according to Ontario Regulation 903 (Figure C-2).

A third borehole (TW28) was drilled on March 26 and 27, 2014 to a depth of 133 mbgl. The borehole intersected Aquifers A1, A2, and A3 as shown on Figure A-8. Aquifer A3 was encountered at 108 mbgl to 133 mbgl. A 50 mm well with 10-slot screen was placed in Aquifer A3 between 129.3 mbgl and 132.3 mbgl (Figure C-1), and the borehole was re-designated OW28.

Observation well OW3 is located near TW20 and was constructed under a separate investigation by Golder (2008). OW3 is constructed on Pooles Road to a depth of 66.2 mbgl approximately 30 m northeast of TW20. A 50 mm well screen was placed in Aquifer A1 between 34.4 mbgl and 41.2 mbgl as well as a 50 mm well screen in Aquifer A2 between 59.5 mbgl and 66.2 mbgl (Figure C-1).

2.2.3 Site 3: Old Second Road

Two boreholes, TW21 and TW24, were drilled at the Old Second Road Site (Figure A-3). The first borehole (TW21) was completed to a depth of 151 mbgl on January 20, 2014. The borehole intersected Aquifers A1, A2 and A3 as shown in Figure A-8. The target Aquifer A3 was encountered between 112 mbgl to 131 mbgl. A 203 mm diameter well with 12.1 m of nominal 203 mm diameter, 12-slot screen and 3.1 m of 6-slot screen was placed between 113.0 m and 128.2 m with a sand pack between 103.0 m and 128.2 m (Figure D-1).

A second borehole (TW24) was drilled on February 18 and 19, 2014 to a depth of 134 mbgl. The borehole intersected Aquifers A1, A2 and A3 as shown on Figure A-8. The target Aquifer A3 was encountered at 107 mbgl to 132 mbgl. A 50 mm well screen was place in Aquifer A3 from 125.0 to 131.1 mbgl (Figure D-2), and the well was designated as OW24.

An existing observation well (OW1) located near TW21 was constructed under a separate investigation (Golder, 2008). TW1/08 is constructed on Old Second Road South to a depth of 91 mbgl approximately 300 m northeast of TW21. A 50 mm well screen was placed in Aquifer A1 between 16 mbgl and 19 mbgl as well as a 50 mm well screen in Aquifer A2 between 73 mbgl and 82 mbgl (Figure D-2).

2.2.4 Site 4: Doran Road

One borehole was drilled at the Doran Road Site (Figure A-4). The borehole (TW23) was completed to a depth of 137 mbgl on February 10 and 13, 2014. The borehole intersected Aquifers A1, A2 and A3 as shown on Figure A-8. The target Aquifer A3 was encountered between 125 mbgl to 140 mbgl. Aquifer A3 at this location was not

adequate for water supply and thus TW23 was re-designated as TH23 and abandoned in accordance with Ontario Regulation 903 (Figure E-1).

2.2.5 Site 5: Anne Street

One borehole was drilled at the Anne Street Site (Figure A-5). The borehole (TW26) was completed to a depth of 152 mbgl on March 18 through March 21, 2014. The pilot hole intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-9. The target Aquifers A3 and A4 were not adequate for water supply and thus TW26 was re-designated as TH26, and abandoned in accordance with Ontario Regulation 903 (Figure F-1).

2.2.6 Site 6: Hickling Farm

One borehole was drilled at the Hickling Farm Site (Figure A-2). The borehole (TW27) was completed to a depth of 102 mbgl on March 26 through March 27, 2014. Due to rapidly warming temperatures and snow melt the drilling equipment had to be moved off the site and on June 2 to 5, 2014 a second TW27 borehole was completed to a depth of 140 mbgl. The borehole intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-9. Aquifers A3 and A4 were encountered but were not adequate for water supply and thus TW27 was re-designated as TH27 and abandoned in accordance with Ontario Regulation 903 (Figure G-1).

2.2.7 Site 7: Snow Valley Road (West)

A total of six boreholes were drilled at the Snow Valley Road Site (West) (Figure A-6). The first borehole TW29 (OW29#4) was completed to a depth of 106 mbgl on April 16, 2014. The borehole intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-10. The target Aquifer A4 was encountered between 89 mbgl to 104 mbgl. A 50 mm observation well was placed in Aquifer A4 between 96.6 mbgl and 99.6 mbgl (Figure H-1), and designated as OW29#4. Additionally, a test well (TW34) was drilled on August 5 and August 6, 2014 to a depth of 104 mbgl, intersecting Aquifers A1, A2, A3 and A4 as shown on Figure A-10. The target Aquifer A4 was encountered at 90 mbgl to 105 mbgl. A 200 mm diameter well with 9 m of 50-slot well screen was placed in Aquifer A4 from 94 m to 103 m with a sand pack from 88 m to 103 m (Figure H-1).

A second borehole (TW33) was drilled on June 9, 2014 to a depth of 36.6 mbgl. The borehole intersected Aquifers A1 and A2 and reached the top of Aquifer A3 as shown on Figure A-10. The target Aquifer A3 was encountered at 36.6 mbgl but flowing conditions were encountered so drilling was stopped and the borehole (re-designated as TH33) was abandoned in accordance with Ontario Regulation 903 (Figure H-2).

Three additional observation wells were installed in Aquifers A1, A2 and A3. OW29#1 was drilled on September 6, 2014 to a depth of 4.3 mbgl. A 50 mm 10-slot screen was placed in Aquifer A1 between 2.7 mbgl and 4.3 mbgl (Figure H-1). OW29#2 was drilled on September 7, 2014 to a depth of 21.3 mbgl. A 50 mm 10-slot screen was placed in Aquifer A2 between 18.3 mbgl and 21.3 mbgl (Figure H-1). OW29 #3 was drilled on September 7, 2014 to a depth of 54.9 mbgl. A 50 mm 10-slot screen was placed in Aquifer A3 between 51.8 mbgl and 54.9 mbgl (Figure H-1).

2.2.8 Site 8: Walt Road

Two boreholes were drilled at the Walt Road Site (Figure A-3) during June 2 to 4, 2014 to a depth of 143.3 mbgl. Borehole TW30 intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-11. The target Aquifer A4 was encountered at 137.2 to 143.3 mbgl. An observation well was placed in Aquifer A4. A 50 mm well screen was placed between 125.0 to 143.3 mbgl (Figure I-1) and designated as OW30. The grain size analysis for OW30 is provided on Figure I-3.

A second borehole (TW31) was drilled on June 6, 2014 to a depth of 122.0 mbgl. The borehole intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-11. The target aquifer was encountered at 99.7 to 118.9 mbgl. The target aquifers encountered at TW31 were not as high yielding as those encountered at TW30 and henceTW31 was re-designated TH31 and abandoned according to the Ontario Regulation 903 (Figure I-2).

An existing observation well (OW4) is located near OW30 and was constructed under a separate investigation (Golder, 2008). TW4#1 and TW4#2 are constructed on Walt Road, approximately 240 m to the southwest of OW30, to a depth of 44.2 mbgl and 57.9 mbgl, respectively. A 50 mm screen is placed in Aquifer A1 between 41.2 and 44.2 mbgl (OW4#1) and a 50 mm is placed in Aquifer A2 between 51.8 to 57.9 mbgl (Figure I-2).

2.2.9 Site 9: Coutts

A borehole was drilled at the Coutts Site (Figure A-3) on June 9 to 10, 2014 to a depth of 138.7 mbgl. The borehole (TW32) intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-8. The target Aquifer A4 was encountered between 112.8 mbgl to 134 mbgl. An observation well was planned to be placed in Aquifer A4 from 115.8 mbgl to 118.9 mbgl but the well casing was vandalized, resulting in the abandonment of TW32 (re-designated OW32) in accordance with Ontario Regulation 903 (Figure J-1). The grain size analysis for TW32 can be found on Figure J-2.

An existing observation well (OW2) is located near TW32 and was constructed under a separate investigation by Golder (2008). OW2#1 and OW2#2 are constructed on Pooles Road to a depth of 32.0 and 61.9 mbgl, respectively, approximately 110 m to the northeast of TW32. A 50 mm screen is placed in Aquifer A1 between 29.0 and 32.0 mbgl (OW2#1) and a 50 mm is placed in Aquifer A2 between 55.8 to 61.9 mbgl (Figure J-1).

2.2.10 Site 10: Alliance

A borehole was drilled at the Alliance Site (Figure A-4) on July 10 and 11, 2014 to a depth of 125.0 mbgl. The borehole (TW35) intersected Aquifers A1, A2, A3 and A4 as shown on Figure A-12. The target Aquifer A4 was encountered between 109.7 mbgl and 123.7 mbgl. A 50 mm observation well was placed in Aquifer A4 between 118.9 mbgl to 121.9 mbgl (Figure K-1), and designated as OW35.

An existing test well (PW1) is located near OW35 and was constructed under a separate investigation by Wilson Associates of Stratford on the proposed Alliance Development. A 254 mm diameter well was placed in Aquifer A3 with 10 and 12 slot screen between 110.3 and 125.6 mbgl (Figure K-2).

2.3 Water Quality Testing

Water quality samples were collected from select observation well locations (Table A-2). The samples were analyzed for general chemistry parameters. The water samples were collected in laboratory prepared bottles and couriered to either Caduceon Analytical Laboratories in Ottawa or Central Ontario Analytical Laboratory in Orillia for analysis. The water quality analysis results can be found in Appendix L.

Table A-2: Water Quality Sampling Locations

Site	Well	Unit	Date	Analysis
Snow Valley (Gravel Pit)	OW19#1 OW19#2 OW19#4 OW19#5	A1 A2 A3 A3	23-May-2014 23-May-2014 30-May-2014 30-May-2014	General Chemistry
Snow Valley (Gravel Pit)	TW22	A4	16-Apr-2014	• Two bacteria samples collected during the first 24 hours of pumping • General Chemistry at 1 hour of pumping • Item 31 of the Ontario Drinking Water Standards after 24 hours of pumping
Old Second	OW24	A3/A4	04-Jun-2014	General Chemistry
Snow Valley (West)	OW29	A4	23-May-2014	General Chemistry
Walt Road	OW30	A3/A4	04-Jun-2014	General Chemistry
Old Second	OW1#1	A1	30-May-2014	General Chemistry
Pooles Road	OW3#1 OW3#2	A1 A2	28-May-2014	General Chemistry
Walt Road	OW4#1 OW4#2	A1 A2	30-May-2014	General Chemistry
Hickling Farm	OW8I OW8D House Well	A3 A4 A1	28-May-2014 04-Jun-2014 30-May-2014	General Chemistry
Alliance	PW1	A4	July 22, 2014	General Chemistry

2.4 Numerical Modelling

Numerical groundwater modelling was completed to assist in the evaluation of the sustainability of, and potential groundwater impacts from, the long-term operation of water supply wells at the test well locations. The modelling was undertaken using an updated version of the existing three-dimensional (3D) Kempenfelt Bay FEFLOW numerical model. Model input parameters including layer elevations, hydraulic conductivity and storage terms were updated in accordance with new information obtained from the recent drilling and aquifer testing programs described herein. Subsequently, the model underwent a calibration process until simulated groundwater levels and Willow Creek baseflow rates satisfactorily corresponded to conditions observed in the field. The model was then utilized to assess potential drawdown, well interference and baseflow losses as a result of the additional pumping at the water supply wells. A detailed description of the model analysis and results is provided in Appendix M.

3.0 EXISTING CONDITIONS

3.1 Physical Setting

Midhurst is located in the Simcoe Upland and Lowland physiographic regions as defined by Chapman and Putnam (1984). The Lowland area is located at elevations below approximately 230 masl and is occupied by Little Lake, Willow Creek and Matheson Creek; all of which flow through the Minesing Swamp via the Nottawasaga River on route to Georgian Bay. The upland areas are drained by relatively few small streams, which attest to the sandy nature of the upland area. The Upland area is largely underlain by relatively permeable soils with favourable recharge characteristics. The Lowland area hosts wetland areas around Little Lake and along Willow Creek between Midhurst and the Minesing Swamp.

3.2 Hydrogeological Setting

The MOE water well database and digital topographic maps have been used to prepare a location map and hydrogeological cross-sections through the exploration area (see Figure A-1 for cross-section locations). The aquifers have been classified into four regional aquifers referred to as Aquifers A1 through A4 (Golder, 2004). Aquifer A1 is present under the Upland area while Aquifer A2 can be present in both Upland and Lowland areas. Aquifers A3 and A4 are found predominantly between elevations of approximately 170 masl to 110 masl. The thickness and distribution of aquifers present in the area are shown on Figures A-7 through A-13.

Aquifer A1 is the uppermost aquifer in the area and is mainly under unconfined, or partially confined, water table conditions. It is present at elevations above approximately 240 masl, which limits its presence mainly to Upland areas. Aquifer A1 either pinches out or merges with Aquifer A2 in the steeply sloping lands between Upland and Lowland areas. Typically, there is a strong vertical downward hydraulic gradient between Aquifers A1 and A2. These aquifers are commonly used for private domestic well supplies.

Aquifer A2 is found between elevations of approximately 225 masl to 200 masl in the Upland area and at slightly lower elevations in Lowland areas. This aquifer appears to be under confined artesian or confined water table conditions in Upland areas and under unconfined water table conditions or flowing artesian conditions in valley areas. In some areas, especially on the flanks of the Uplands, water well records indicate the confining layer is absent between Aquifers A1 and A2.

Aquifer A3 is a regionally extensive aquifer and is the source of water for the municipally serviced areas of existing Midhurst and Snow Valley, among others. This aquifer has been observed at most deep wells throughout the Willow Creek Valley and to the north in the Matheson Creek Valley. While Aquifer A3 is found in Upland areas as well as Lowland areas its presence in Upland areas is more variable than in the valleys. The aquifer is under confined artesian conditions and is overlain by a lacustrine silt and clay confining layer (referred to as hydrostratigraphic unit C2) with varying thicknesses. This water supply aquifer is part of a tunnel channel aquifer complex that is similar to other tunnel channel aquifers that are used to supply communities such as Angus, Barrie, CFB Borden, Hillsdale, Anten Mills and Wasaga Beach.

Aquifer A4 represents the lowest portion of the regional aquifer system and previous to this investigation had been primarily recognized in the deepest municipal wells in the City of Barrie and Wasaga Beach. Aquifer A4 is typically found between elevations of approximately 125 masl to 110 masl.

The Uplands to the south are likely of glaciofluvial or subglacial origin and consist of sandy deposits. The Lowlands to the north occupied by Willow Creek may be underlain by glaciolacustrine silts and clay and/or organic muck.

The upgradient lands are thought to provide significant recharge for the deep regional aquifer system (Golder, 2004).

3.3 Groundwater Recharge and Flow

The groundwater flow in the deep confined aquifer system (Aquifers A3 and A4) is governed by regional topographic features, while groundwater flow in the upper aquifer system (Aquifers A1 and A2) is mainly governed by local surface topography and discharge to surface water features. The regional groundwater flow pattern for Aquifers A3 is illustrated on Figure A–14. The potentiometric map surface is based upon recorded static water levels for wells constructed since approximately 1950.

The flow in the lower aquifers is generally towards the west with a horizontal hydraulic gradient of 0.004 to 0.005 m/m. Groundwater flows from the Oro upland area to the west toward a regional topographic low located in the Nottawasaga River Valley at an elevation of approximately 180 masl. The valleys of Willow Creek and Matheson Creek are right bank tributaries to the Nottawasaga River. These streams receive discharge from Aquifers A1 and A2 along their length, while Aquifers A3 and A4 remain confined and ultimately discharge to Nottawasaga Bay.

The creek and river valleys in Simcoe County have been recognized as containing high yielding aquifers and are a focus for groundwater flow. The strongly channelized shape of the valleys is considered to be a result of a sub-glacial erosional process that created what are known as tunnel valleys. Within the tunnel valleys, coarse-grained aquifer materials are common and there is a well-documented history of high yielding wells within the valleys. Thick and uniformly sorted sand deposits are found on the flanks of the coarse-grained valley gravels. These aquifers also serve as conduits that have relatively high groundwater flow velocities. The surface expression of the tunnel valleys terminates to the east of the Nottawasaga River Valley; however, large, high capacity aquifers have been identified in the lowland areas at Wasaga Beach, CFB Borden/Angus, Alliston and Beeton.

3.4 Existing Private Water Supplies

Private water supply wells throughout the area are constructed mainly in Aquifers A1 and A2 where they are present. The water yield of these aquifers is adequate to more than adequate for individual private water supplies or small communal supplies (Table A-1). In the lowland area to the west, mainly shallow dug wells are used because of the extremely high above ground head in the confined aquifer (Aquifer A3).

In the Russell Road area, almost all of the private wells are constructed in Aquifers A1 and A2. In this area, the confining layer below Aquifer A2 is uniformly thick and is described as silt and clay in water well records. Aquifer A2 wells are prolific producers where private water supplies are not the drilling objective, as demonstrated at TW13/08 that was pumped at 4.5 L/s. Whereas Aquifers A1 and A2 may provide water supply to small domestic wells, Aquifer A3 and A4 wells are typically the choice for municipal supply wells and have good drawdown to well yield ratios.

3.5 Existing Barrie Municipal Water Supplies

There are 17 municipal wells constructed in the City of Barrie; three wells are located in the north part, one is located in the south part and 11 are constructed in the central and lakeshore areas. The three wells located in the north end (Wells 9, 13 and 16) will be of focus herein.

The City of Barrie (Barrie) Well 9 has a well casing diameter of 0.305 mm and was tested at 75.8 L/s. Barrie Well 13 has a well casing diameter of 0.356 mm and was tested at 75.8 L/s. Both wells are located on Johnson Street in the north east part of Barrie. Barrie Well 16 has a well casing diameter of 0.400 mm, was tested at 90.9 L/s and is located on Brownwood Drive in the north part of Barrie. Wells 9, 13 and 16 are operated at rates of 43, 53 and 64 L/s, respectively.

3.6 Existing Midhurst Municipal Water Supplies

There are currently four wells supplying water to the existing development of Midhurst. Three are within the existing development of Midhurst and the fourth is located on Carson Road in the Glenbrook Subdivision. Midhurst Well 4, located on Green Pine Drive, has a well casing diameter of 203 mm and was tested at 19 L/s. Midhurst Well 2 and Well 3 have diameters of 150 mm and 305 mm, respectively. Both are located on Idlewood Drive. The wells are operated at rates of 23, 7.2 and 34 L/sec, respectively. The Carson Road Well has a diameter of 203 mm and was tested at 19 L/sec but is operated at 12.4 L/sec. This reduction in yield is due to demand rather than the ability of the well to support the taking.

All of the Midhurst wells take water from Aquifer A3, which is found at elevations between 152 masl to 186 masl in the Midhurst area. The combined permitted taking of the four Midhurst wells is 76.96 L/sec. It is understood that the MDD (maximum day demand) for existing development in Midhurst is approximately 45 L/sec; the supply from the wells therefore has an excess permitted capacity of approximately 30 L/sec.

4.0 WATER SUPPLY POTENTIAL

The water supply potential has been assessed with borehole drilling, observation well construction, test well construction, and aquifer testing at Sites 1, 3, 7, and 10. All of the well drilling and aquifer testing was contracted to Allan Wright Water Wells Inc. of Hillsdale (License Number 5528). The work was conducted using conventional mud rotary drilling equipment. The wells constructed as part of the investigation are all built to municipal standards and have been designed by Golder based on hydrogeological experience, stratigraphic logging, and grain size analyses. The experience gained from previous municipal well construction and earlier investigations for this area (Wilson, 2008 and Golder, 2008) provided aquifer testing information that indicates high well yields are obtainable from Aquifer A3/A4 in this area.

4.1 Site 1: Snow Valley Road Site (TW22)

A brown/grey, medium grained sand aquifer was encountered between 79.9 mbgl and 95.4 mbgl at TW22 and similar conditions were present at the location of OW19. The aquifer is correlated to Aquifer A4 as shown in Figure A-7. The borehole logs for this site are shown in Figures B-1 and B-2. The gradation analyses for the Aquifer A4 portion of the aquifer at OW19 indicated a potential screen with a slot size of 16 to 20 would be appropriate for a production well on this site. Coarser aquifer material was encountered at TW22 and a 50-slot screen was selected for the completion (Figures B-3 and B-4).

4.1.1 Well Construction and Development

A 203 mm diameter well (TW22) was constructed with a nominal 203 mm diameter, 50-slot stainless steel well screen between 81.1 and 89.9 mbgl. Following construction the well was developed using air lift pumping at rates up to 45 L/sec. The theoretical transmitting capacity of the well screen is 61 L/sec.

A stepped rate pumping test was conducted on April 14, 2014. The test consisted of three 60 minute steps at rates of 17.5, 27.0 and 36.5 L/s. Table B-3 provides a summary of the step test data for TW22, OW19#4, OW19#5 and OW19#6.

Table B-3: Stepped Rate Pumping Test Results

Pumping Rate (L/s)	Drawdown at TW22	Drawdown at OW19/14#4	Drawdown at OW19/14#5	Drawdown at OW19/14#6
17.5	9.48	0.75	1.35	0.59
27.0	14.7	1.27	2.09	1.02
36.5	20.17	1.81	2.86	1.44

A 72-hour pumping test was also conducted from April 15, 2014 to April 17, 2014 at a rate of 36.5 L/s (Figures B-5 to B-7). During the test, data loggers were placed in OW19#1, OW19#2, OW19#3, OW19#4, OW19#5, OW19#6 and OW9/01. Water levels were also manually taken at TW22, OW19#4, OW19#5 and OW19#6 (Figures B-5 to B-11).

4.1.2 Aquifer Testing Results

TW22 has demonstrated the ability to yield 36.5 L/s for a period of 72 hours while recording a drawdown within the well of 23.03 m (Figures B-5 to B-7). Within a few minutes of the start of the pumping test, the deep observation wells established a steady drawdown trend of approximately 0.9 m per log cycle (Figure B-7 to B-11). All on-site wells reacted to the pumping except the shallowest observation well (OW09-01) which is constructed in the till at the base of the sand and gravel deposit in the pit at a depth of 7.6 m. Although a short-term test (72 hours), this is a positive indication for minimal interactions with the upper Aquifer A1.

Well screen intervals at OW19#5 and OW19#6 are separated by a 3.7 m thick layer described as sandy till. The reaction of the two well screens at these observation wells indicates a hydraulic connection between aquifer units Aquifer A3 and A4, which are discussed as Aquifer A3/A4 at this site. The drawdown vs distance graph (Figure B-12) indicates the strong hydraulic connection of OW19#5 and OW19#6 and the weaker connection of shallower observation wells. The shallower wells are separated from the deep Aquifer A3/A4 aquifer unit by a confining layer, described as clay, between 61 and 71 m at TW19 and TW22 (Figure B-1 and B-2).

Off-site water levels were monitored at several locations on Site 6 (Hickling) (Figure B-6). Water levels did not decline at these observation wells as a result of the operation of TW22.

The aquifer is under semi-confined conditions with a transmissivity of approximately 600 m^2/day and a storativity of $4.6x10^{-4}$ was calculated using the Cooper-Jacob analytical method. The Thiem analytical method indicates a similar transmissivity of 580 m^2/day, suggesting the aquifer conditions are relatively homogenous and isotropic in the vicinity of TW22.

4.1.3 Water Quality Testing

Water quality samples were collected from OW19#1, OW19#2, OW19#4, OW19#5 and TW22 (Tables L-1 and B-2). Water quality samples were collected at TW22 during the pumping test after 1 hour and 36 hours of pumping.

Additionally, water quality samples were collected from OW19#1, OW19#2, OW19#4, and OW19#5 after the pumping test was completed. In Aquifer A1 and A2 the general chemistry of the groundwater is acceptable;

however, signs of road salt impact that decrease with depth are observed at the location of OW19 (Appendix L). The chloride concentration decreases steadily from 530 mg/L in OW19#2 to 30 mg/L in TW22.

Water quality samples collected at both 1 hour and 36 hours met the ODWS for all parameters tested. The nitrate concentration was/ below the ODWS standard but is higher than expected, at 7.9 mg/L at 1 hour and 7.7 mg/L after 36 hours. The elevated nitrate at this site is likely attributable to the intensive livestock agriculture that was formerly present in the capture zone. Dissolved VOC and pesticide concentrations were below their respective detection levels. Aesthetically, the groundwater has no discernible odour and has an acceptable taste. At the request of the Township, the well was retested in early October and sampled for trihalomethane (THM) formation testing. The laboratory results indicate that THM levels met ODWS criteria (Table B-2).

4.1.4 Water Supply Potential

Treatment of nitrate is proposed for the water from TW22 and OW19. Details regarding nitrate treatment and alternatives will be completed by Black and Veatch.

Extrapolation of the drawdown versus time data for TW22 indicates there is an abundant water supply. The pumping level at the end of the pumping test indicates a drawdown of 23 m compared with an available drawdown of 69 m or 34% of the available drawdown. At 20 years of well operation at 36.5 L/sec the drawdown would be 27.6 m or 40% of the available drawdown.

Based on the pumping tests, there is potential to twin the water supply at this location without impacting the ability of TW22 to provide its design yield and without adversely affecting other water supply wells in the area. An evaluation of the mutual interference between TW22 and a second well to be constructed at the location of OW19 (Figure B-14) indicates that each of the wells could be pumped at a rate of 36.5 L/sec (Table B-4). Groundwater flow modelling indicates that the offsite interference at the nearest well (Vespra Hills Golf Course) would be approximately 1.5 m under long term pumping conditions. This amount of drawdown is not expected to reduce the capacity of the well.

4.1.5 Municipal Well Construction

TW22 is constructed with a 203 mm diameter casing and 9.1 m of well screen that has a theoretical transmitting capacity of 61 L/sec. The static water level is approximately 12 m below the ground level and long term pumping levels are expected to be approximately 40 m below ground level. A submersible well pump capable of yielding 36.5 L/sec with a below ground head of 40 m is a viable option for this well. A production well at the location of OW19 (i.e. TW19; Figure B-14) would have a similar construction to TW22, but with a longer well screen because the aquifer is finer grained.

Table B-4: Extrapolation of 20 Year Drawdown at Maximum Day Rate

Well	Pumping Rate (L/sec)	Drawdown Due to Pumping (m)	Interference from Twin Well (m)	Drawdown + Interference (m)	Available Drawdown (m)
TW22	36.5	27.4	5.9	33.3	65
Twin Well (TW19)	36.5	5.9	27.4	33.3	65

4.2 Site 3: Old Second Road South (TW21)

A brown, fine to medium grained sand aquifer was encountered between 95 mbgl and 134 mbgl at TW21 and similar conditions were noted at OW24 (Figures D-1 and D-3). The aquifer is correlated to Aquifer A3 as shown on Figure A-8. The gradation analyses for Aquifer A3 indicate the aquifer is composed of fine to medium grained sand (Figure D-3).

4.2.1 Well Construction and Development

A 203 mm diameter well (TW21) was constructed with 16.6 m of nominal 203 mm diameter, 12-slot and 6-slot stainless steel well screen between 113.0 and 128.2 mbgl. Following construction the well was developed using air lift pumping at rates up to 30 L/sec prior to testing.

A stepped rate pumping test was conducted on July 30, 2014. The test consisted of three 60 minute steps at rates of 18.9, 25.3 and 31.6 L/s. Table D-3 provides a summary of the step test data for TW21 and OW24. After the stepped rate pumping test OW24 was further developed as a result of the lack of drawdown seen during the test.

Table D-3: Stepped Rate Pumping Test Results

Pumping Rate (L/s)	Drawdown at TW21	Drawdown at OW24
18.9	23.1	0.02
25.3	37.3	0.05
31.6	49.4	0.09

A 72-hour pumping test was also conducted from July 31 to August 3, 2014 at a rate of 27.8 L/s (Figures D-5 to D-7). During the test, data loggers were placed in TW24, OW1#1 and OW1#2, OW2#1 and OW2#2, OW3#1 and OW3#2, TW28, OW4#1 and OW4#2, OW30, TW35 and TW17 (Figures D-5 to D-11).

4.2.2 Aquifer Testing Results

TW21 has demonstrated the ability to yield 27.8 L/s for a period of 72 hours while recording a drawdown of 45.23 m (Figures D-5 and D-7). The wells constructed in Aquifer A3 within 2,500 m of TW21 (OW24, OW28, OW30, OW35) reacted to the withdrawal of water from the aquifer, however TW17, which is located 4.7 km to the north did not react to the water taking. The interference at the observation wells is significantly less than that noted in the drawdown at TW21 with 47 m of drawdown at TW21 and 2.5 m of interference at OW24, which is located 155 m to the west. The fine nature of the aquifer acts to increase the well losses in the well, thereby reducing the unit well yield from wells in this area.

The observation wells constructed in Aquifer A1 and A2 did not react to the operation of TW21 (Figure D-6). The lack of drawdown in Aquifer A1 also means that there could not have been a reduction in the water level in surface water features.

An aquifer transmissivity of 470 m^2/day and storativity of $3.3x10^{-4}$ was calculated using the Cooper-Jacob analytical method. A transmissivity of 524 m^2/day is calculated using the Thiem equation (Figure D-12). The results of the two methods of calculation are very similar indicating uniform aquifer conditions in the area.

4.2.3 Water Quality

Water quality samples were collected from TW21 (Table D-2) and OW1#1 (Table L-1). In Aquifer A1 the general chemistry of the groundwater was acceptable; however, the nitrate concentration (24.3 mg/L) at OW1#1 was above the ODWS guideline. Water quality samples from TW21 were collected during the pumping test at 24 hours and 72 hours of pumping (Table D-2). The samples collected at both 24 hour and 72 hours meet the ODWS for all parameters tested with the exception of color which had a concentration of 8 TCU. The nitrate concentration was below the ODWS standard at 3.3 mg/L and 3.1 mg/L at 24 hours and 72 hours, respectively. VOC and pesticide concentrations were below their respective detection limits. Aesthetically, the groundwater at TW21 had no discernable odour and an acceptable taste.

4.2.4 Municipal Well Construction

Table D-4 (below) demonstrates that TW21 could be paired with another close by well ("twinned") to result in the site's water production being increased to 40 L/sec. The calculation assumes that both the existing well and a new well on the site operate continuously at the maximum day rate indefinitely. This is an overestimation and in reality the wells will operate at approximately 50% of their respective MDD rates, therefore the drawdown in the aquifer will be less.

The drilling and sampling of OW24 indicates the site of OW24 would support the construction of a 20 L/sec water supply well. The aquifer materials at OW24 are similar to those at TW21 and testing has indicated that the aquifer could support additional water taking. A proposed design for a 203 mm diameter well is presented in Figure D-4. The 12.2 m long well screen would have a theoretical transmitting capacity of approximately 27 L/sec. The actual yield of the site would have to be evaluated with test well construction and pumping tests; however, the pumping test of TW21 indicates that a twin well is theoretically viable.

The ability for two wells at the site, TW21 and the twin well, to each yield 20 L/sec was evaluated during the pumping test of TW21 by monitoring the water level change in OW24. The drawdown trend established during the 72-hour test interpolated for the Wells to 20-years indicates that there would be 4.0 m of drawdown at OW24. It is reasonable to assume that if a twin well located at OW24 (i.e. TW24) and was operated at 20 L/sec it would also have 4.0 m of interference at TW21. Therefore, by adding the drawdown at TW21 to the interference from the twin at TW24, the resulting drawdown at TW21 would be 40 m. The same would be true for the twin at TW24, as shown in Table D-4.

Table D-4: Extrapolation of 20 Year Drawdown at Maximum Day Rate

Well	Pumping Rate (L/sec)	Drawdown Due to Pumping (m)	Interference from Twin Well (m)	Drawdown + Interference (m)	Available Drawdown (m)
TW21	20	36	4.0	40	61
Twin Well (TW24)	20	4.0	36	40	67

There is 21 to 27 m of available drawdown remaining after accounting for drawdown and interference to accommodate pumping equipment and declines in well efficiency that may occur as the wells age.

4.3 Site 7: Snow Valley West Site (TW34)

A brown coloured, fine to medium grained sand aquifer was encountered between 89.0 mbgl and 104.2 mbgl at the TW34 Snow Valley (West) site. The aquifer is correlated with Aquifer A4 as shown on Figure A-10. The borehole log for this well is shown in Figure H-1. The gradation analyses for the Aquifer A4 in TW34 and OW29 indicated a fine to medium sand aquifer with 50% particle sizes ranging from 0.3 to 0.45 mm (12 to 18-slot; Figures H-3 and H-4).

4.3.1 Well Construction and Development

A 203 mm diameter well (TW34) was constructed with 9 m of nominal 203 mm diameter 20-slot stainless steel well screen between 94.0 mbgl and 103.0 mbgl. Following construction, the well was developed using air lift pumping to remove drilling fluids.

A stepped rate pumping test was conducted on September 8, 2014. The test consisted of three 60 minute steps at rates of 17.7, 22.7 and 27.8 L/s. Table H-3 provides a summary of the step test data for TW34 and OW29#1, #2, #3 and #4.

Table H-3: Stepped Rate Pumping Test Results

Pumping Rate (L/s)	Drawdown at TW34	Drawdown at OW29#1	Drawdown at OW29#2	Drawdown at OW29#3	Drawdown at OW29#4
17.7	9.52	0	0	0	2.61
22.7	13.46	0	0	0	3.69
27.8	16.31	0	0	0	4.52

A 72-hour pumping test was conducted from September 9, 2014 to September 11, 2014 at a rate of 20 L/s (Figure H-5). During the test, data loggers were placed in Aquifer A1 (OW29#1 and BH8-1), Aquifer A2 (OW29#2, house 1, house 2, house 3, house 4), Aquifer A3 (OW29#3, SVR OW, SV OW1, SV OW2, SVPark OW) and Aquifer A4 (OW29#4) (Figures H-5 to H-11).

4.3.2 Aquifer Testing Results

TW34 has demonstrated the ability to yield 20 L/s for a period of 72 hours while recording a drawdown of 15.46 m (Figure H-5). TW34 and OW29#4 establish a steady drawdown trend of approximately 1 m/log cycle until approximately 1,000 minutes into the test. Between 1,000 minutes and the end of the test, the drawdown trend steepens to 2.8 m/log cycle. There was 15.46 m of drawdown at TW34 and 6.29 m of drawdown at TW29#4 at the end of the 72 hour pumping test. The available drawdown at TW34 is 71.5 m of available drawdown between the static water level and the top of the well screen, and at the end of the pumping test approximately 21.6% of the available drawdown was used.

Water levels were monitored at a variety of locations with wells constructed in Aquifer A1, Aquifer A2 or Aquifer A3. Well locations included four private residences, three municipal observation wells, two commercial wells, and one well at the closed Simcoe County landfill on George Johnson Road. None of these wells reacted to the pumping of TW34.

Aquifer transmissivity of approximately 305 m^2/day was calculated from data recorded at OW29#4 using the Copper-Jacob analytical method. A storativity of $1.5x10^{-5}$ was calculated from OW29#4 data.

4.3.3 Water Quality

Water quality samples were collected from TW34 (Table H-2) and OW29#4 (Table L-1). Water quality samples were collected at OW29#4 following installation of the observation well and prior to construction of TW34. Water quality samples were also collected from TW34 during the pumping test after 24-hours and 71 hours.

The results from the 24-hour sample indicated that the water is bacteria free and had nitrate concentrations below detection limits and chloride and sodium that were 1.4 and 5.2 mg/L, respectively. The iron concentration (1.45 mg/L) was above the ODWS aesthetic guideline of 0.3 mg/l and the manganese concentration (0.289 mg/L) was above the ODWS aesthetic guideline of 0.05 mg/L. VOC and pesticide concentrations were also below their respective detection limits. The water had a slight sulphurous odour and an acceptable taste. It is important to note that the parameters only exceed the aesthetic guideline (i.e., non-human health issue), however, will be treated regardless at the proposed water treatment plant. Gas, which is presumed to be methane, could be seen in the discharge water.

4.3.4 Long Term Pumping Levels and Interference

OW29#4 was the only observation well that experienced interference due to the operation of TW34 (Figure H-5). Nearby private wells were monitored throughout the pumping of TW34 and no drawdown was measured (Figures H-6 to H-10). The water taking from this well site is not expected to adversely affect the normal operation of the private wells in the area.

Water levels were closely monitored in a very shallow observation well (OW29#1) which is just upstream of a spring line. This monitoring location was unaffected by the water taking from Aquifer A4. The confining layer composed of hard grey clay between 32.9 m and 50 m depth forms a hydraulic barrier between Aquifer A3 and Aquifer A2, and there is a sequence of silt and clay layers between 71 mbgl and 89 mbgl that isolates Aquifer A3 from the drawdown that occurred in Aquifer A4 during the pumping test. The operation of wells constructed in Aquifer A4 did not affect the surface water levels in Aquifer A1; therefore there is little potential for the taking of water from Aquifer A4 to adversely affect the flow of springs or surface water levels.

The ability for two wells at the site, TW34 and a twin well (at site of OW29) to each yield 20 L/sec was evaluated during the pumping test of TW34 by monitoring the water level change at OW29#4. Extrapolating the drawdown trend established during the last two days of the 72-hour test to 20-years and indicates that there would be 16.7 m of drawdown at the location of OW29. It is reasonable to assume that if a twin well is located at OW29 and is operated at 20 L/sec it would have 16.7 m of interference at TW34. Therefore, by adding the drawdown at TW34 to the interference from the twin at TW29, the resulting drawdown at each well would be 44 m, as shown in Table H-4.

Table H-4: Extrapolation of 20 Year Drawdown

Well	Pumping Rate (L/sec)	Drawdown (m)	Interference (m)	Drawdown + Interference (m)	Available Drawdown (m)
TW34	20	16.7	27.3	44	71.6

Well	Pumping Rate (L/sec)	Drawdown (m)	Interference (m)	Drawdown + Interference (m)	Available Drawdown (m)
Twin Well OW29#4	20	27.3	16.7	44	70.5

There is 26.5 to 27.6 m of available drawdown remaining after accounting for drawdown and interference to accommodate pumping equipment and declines in well efficiency that may occur as the wells age.

4.4 Site 10: Alliance Site (PW1)

A fine brown sand aquifer was encountered between 109.7 mbgl and 123.7 mbgl at OW35. The aquifer was correlated with Aquifer A3 as shown on Figure A-10. The borehole log for this well is shown in Figure K-1. The gradation analyses for the Aquifer A3 portion of this test hole indicated a fine sand aquifer with the 50% grain sizes ranging from 0.25 to 0.35 mm, or 9 to 14-slot (Figure K-3).

Water quality samples were collected from PW1 during the test (Table K-2). Laboratory analytical results from the collected samples met the ODWS parameters, with the exception of iron, the concentration of which (0.383 mg/L) exceeded the aesthetic guideline of 0.3 mg/L. The nitrate concentration was below the detection limits and chloride and sodium concentrations were 2.1 and 5.2 mg/L, respectively. Aesthetically the water from Aquifer A3 at PW1 had a faint sulphurous odour and no discernable taste. Previous testing of the water indicated it met the ODWS standards for all health related parameters (Wilson, 2008).

4.4.1 Well Construction and Development

A 254 mm diameter well (PW1) was previously constructed with 15.6 m of nominal 254 mm diameter, 10-slot and 12-slot stainless steel well screen between 110.0 and 125.6 mbgl.

Wilson Associates tested PW1 in 2008 as well at a rate of 45 L/sec and a maximum drawdown of 19.45 m after 72 hours was observed. A 48-hour pumping test was also conducted from July 31 to August 3, 2014 at a rate of 45 L/s (Figure K-4 to K-7). During the test, data loggers were placed in all aquifers present in the area. Shallow aquifers within 30 m of PW1 were monitored to assess the potential impact on near-by private water supply wells and impacts to surface water resources. Deep Aquifer A3/A4 wells were monitored at various distances from PW1 to assess the potential impact on other municipal water supply wells in the area.

4.4.2 Aquifer Testing Results

PW1 has demonstrated the ability to yield 45 L/s for a period of 72 hours and drawdown characteristics were confirmed in at 48-hour pumping test where drawdown of 17.94 m was recorded (Figures K-4 to K-11). A steady drawdown trend was established in Aquifer A3/A4 wells within the first 10 minutes of the pumping test at PW1 and TW35 (Figures K-7 and K-8) and this trend continued for the duration of the test.

Drawdown was observed in all of the observation wells installed in Aquifers A3/A4. The more distant observation wells located at between 1,500 and 2,400 m from PW1 began reacting to the withdrawal of water between 300 and 1,100 minutes after pumping commenced (Figures K-9, K-10, and K-11). TW17 is also constructed in Aquifer A3, at a distance of 2.5 km and showed a very slight amount of drawdown just before the end of the first day of testing.

Water levels were monitored in Aquifer A1 locations at OW1#1, OW2#1, OW3#1, and OW4#1 and at Aquifer A2 locations at OW1#2, OW2#2, OW3#2, OW4#2, (Figures K-5 and K-6) and the on-site TH3 (Wilson, 2008). Water levels in the Aquifer A1 and A2 wells were not affected by the pumping of PW1. Water levels in surface water features in the area are supported by discharge from Aquifer A1; therefore no change in surface water levels is expected because Aquifers A1 and A2 were not affected.

Aquifer transmissivity was calculated to be 560 m^2/day and storativity was calculated to be $2x10^{-4}$ using the Copper-Jacob analytical method. The drawdown in Aquifer A3 at the end of the pumping test was plotted against the distance from PW1 (Figure K-12). The transmissivity calculated using the Thiem equation resulted in an aquifer transmissivity of 550 m^2/day. The agreement of the Cooper-Jacob solution and the Thiem solution indicates that Aquifer A3 is a large, relatively isotropic and homogenous aquifer.

4.4.3 Municipal Well Construction

Table K-3 illustrates that PW1 could be twinned to increase the site's water production rate to 100 L/sec. The following assessment was done assuming that both the existing well and a new well on the site operate continuously at the maximum day rate indefinitely. This assessment indicates acceptable results even though the duration of pumping used is an overestimate of the actual water taking by approximately 50%.

The drilling and sampling of OW35 indicates the site of OW35 would support the construction of a 55 L/sec water supply well. The well drilling and production well design methods employed at other locations during this investigation indicate that the aquifer materials at OW35 were slightly coarser than at PW1 and, with the use of a gravel pack well design, the aquifer could support the construction of a 305 mm diameter well with an 18-slot well screen and a uniformly graded sand filter pack. The theoretical transmitting capacity of the well screen described above would be 62 L/sec. The actual yield of the site would have to be evaluated with test well construction and pumping tests; however, the open area of the well screen in the twin well is higher than in PW1 indicating a greater water supply potential than PW1. Also, pumping tests at PW1 indicate the aquifer at this location yields good water supplies.

The ability for two wells at the site, PW1 and the twin well, to yield at total of 100 L/sec was evaluated during the pumping test of PW1 by monitoring the water level change in OW35. The drawdown trend established during the 48-hour test is the same as was established during the 72-hour test (Wilson, 2008) and extrapolation of the drawdown trend to 20-years indicates that there would be 9.5 m of drawdown at OW35 (Figure K-13). It is reasonable to assume that if a twin well (i.e. TW35) is located at OW35 and is operated at 55 L/sec it would have 22% more drawdown at PW1 than at OW35 (i.e. 11.6 m of interference at PW1). Adding the drawdown at PW1 (24 m) to the interference from the twin at OW35 the resulting drawdown at PW1 would be 35.6 m. The total drawdown at TW35 is expected to be 38.8 m, as shown in Table K-3.

Table K-3: Extrapolation of 20 Year Drawdown at Maximum Day Rate

Well	Pumping Rate (L/sec)	Drawdown Due to Pumping (m)	Interference from Twin Well (m)	Drawdown + Interference (m)	Available Drawdown (m)
PW1	45	24	11.6	35.6	59.9
Twin Well (at OW35)	55	29.3	9.5	38.8	59.9

There is 21.1 to 23.3 m of available drawdown remaining after accounting for drawdown and interference to accommodate pumping equipment and declines in well efficiency that may occur as the wells age.

4.5 Firm Capacity

The Firm Capacity of the water supply system can be addressed by the construction of additional Alternative Supply Wells at each of the municipal well sites. The presence of suitable aquifer materials at each of the proposed well sites is sufficiently predictable to allow for the planning of additional lands to be set aside for the construction of additional wells. There should be an offset from the existing wells of between 80 to 100 m to allow for mutual drawdown among the wells, the operation of the wells in the wellfield should be such that any two of the wells can be operated simultaneously, hence the drawdown among the wells would be similar to what has been demonstrated during the various pumping tests. Figure 1 shows the location of Alternative Supply wells, which are identified as ASW 1, ASW2, and ASW3.

5.0 NUMERICAL GROUNDWATER MODELLING

Numerical groundwater modelling was undertaken to assess any long-term hydrogeological impacts that may occur as a result of the proposed water supply pumping (221 L/s at full build-out). Potential impacts were assessed on the basis of incremental aquifer drawdown, well interference, and baseflow losses in Willow Creek (baseflow is the component of stream flow provided by groundwater discharge). In addition, capture zones for the proposed wells and aquifer vulnerability were assessed. A detailed description of the model background, construction, calibration and results is provided in Appendix M whereas a brief synopsis of the modelling analysis is provided below.

The modelling was conducted using an updated version of the pre-existing Barrie (or “Kempenfelt Bay”) groundwater model, originally constructed in the early 2000s in support of the South Simcoe Groundwater Study (Golder, 2004). The model was developed using the flow-code software FEFLOW and provides a computer-based, mathematical representation of the three-dimensional (3D) hydrogeologic system as understood through available physiographic mapping, borehole logs, well water levels, aquifer testing results, stream flow measurements and other field observations. The model domain is regional in scale, encompassing an area of 746 km^2 (Figure 1 of Appendix M). The Willow Creek watershed, wherein the proposed developments are located, lies almost entirely within the model domain.

An Existing Conditions model scenario was refined and further calibrated in Midhurst and greater Willow Creek watershed areas in accordance with recent drilling, aquifer testing, and stream flow data. Subsequently, a Future Conditions model scenario, which added the new wells at their prescribed rates and screened intervals, simulated anticipated water taking at full build-out.

The following results were obtained from the model simulations:

- The additional Carson and Doran water takings resulted in drawdown of up to 10 m in Aquifer A3 in the area of the Doran Neighbourhood, with a lateral zone of influence reaching 6 km from the proposed development.
- Well interference at surrounding municipal systems was minimal (1.7 metres or less) and is not expected to adversely affect well operation.

- Percent baseflow reductions at Willow Creek were highest during the late summer period. The maximum reduction simulated was about 9% in the Midhurst area. The Willow Creek catchment experienced between 3% to 7% baseflow loss depending on the time of year.
- Capture zones for the Midhurst and Paddy Dunn's Circle and Carson and Doran Neighbourhood wells were developed by delineating the 2 year, 5 year, 10 year and 25 year capture zones at each well. Most capture zones were directed east to northeast in conformance with regional flow patterns emanating from the Oro-Medonte uplands. The 25-year time of travel zones reached upgradient distances ranging from about 1 km to 5 km in length.
- Water supply Aquifers A3 and A4 had a "low vulnerability" Aquifer Vulnerability Index (AVI) in the areas of the capture zones.

6.0 CONCLUSIONS

- Aquifer A3 and Aquifer A4 are the primary targets for water supply development in the Midhurst area. The existing municipal water supply wells are constructed in the Regional Aquifer A3.
- Aquifer A3 was intersected at all boreholes drilled in the in the Doran Road area and analysis of pumping test data indicated that the hydraulic characteristics of the aquifer are relatively consistent across the area. At several locations the aquifer material was found to be too fine-grained for the construction of a high capacity water supply well.
- Aquifer A3/A4 is present throughout the Carson Road area. Confined artesian conditions were noted over the western part of the area, and semi-confined conditions over the eastern part. The aquifer material was not considered suitable for high capacity well construction at all locations.
- Water supply exploration conducted in the Doran Road and Carson Road area resulted in the construction of groundwater supply wells with a sum capacity of 129.3 L/sec. Testing has been completed that indicates three of these sites can support twinning of the wells and 221 L/sec is available from groundwater resources in the area.
- Wells have been tested in the Doran Road area that had a water production rate of 72.8 L/sec. Both well sites in this area can support twinned wells and a potential of production rate of 140 L/sec. There are other potential well sites in the area that would support smaller yielding water supply wells if required.
  - TW21 had a tested yield of 27.8 L/sec. TW21 and a twinned well at OW24 could both operate at 20 L/sec, for a total operating capacity of 40 L/sec
  - PW1 had a tested yield of 45 L/sec. The site is capable of supporting a yield of 100 L/sec with the construction of a twin well at the location of OW35, with PW1 operating at 45 L/sec and the twin well operating at 55 L/sec.
- Wells have been tested in the Carson Road area that had a water production rate of 56.5 L/sec. Well sites in this area can support twinned wells, and a potential production rate of 81 L/s.
  - TW22 has a tested yield of 36.5 L/sec, and a twinned well could be installed at this location. With installation and operation of a twinned well it may be possible to ameliorate the higher than expected

nitrate concentration noted at TW22 with a lower nitrate concentration source. Alternatively, the nitrate can be treated at a water treatment plant.

- TW34 has a tested yield of 20 L/sec and the site is capable of yielding 40 L/sec with a twinned well at or near the location of TW29 and both wells could operate at 20 L/sec.

- The firm capacity of the water supply system can be addressed by the construction of additional alternative supply wells at each of the test well sites. The presence of suitable aquifer materials at each site is sufficiently predictable to allow for the planning of additional lands to be set aside for the construction of additional wells. It is expected that any two of the wells would be operated simultaneously, resulting in drawdown among the wells similar to that demonstrated during the various pumping tests.

- Groundwater at all of the test wells was fresh, bacteria free and calcium bicarbonate hydrogeochemical type. A summary of individual test well results during the pumping tests is as follows:

  - TW22: all tested parameter concentrations were below their respective ODWS guidelines. The chloride concentration was 38 mg/L, and nitrate concentrations were below the ODWS but were higher than expected at 7.7 mg/L. The measured nitrate concentrations at this site were attributed to the intensive livestock agriculture in the capture zone for this well. This activity has ceased and it is expected that the nitrate rich water will flush out of the system in the future. The changes in groundwater chemistry throughout the stratigraphic profile at this location indicate that the aquifer at TW22 is protected from direct contact with surface water by several relatively thin confining layers. VOC, pesticide, and TMH concentrations were below their respective detection levels. The water had no discernable odour and an acceptable taste.

  - TW21: all tested parameter concentrations were below their respective ODWS guidelines. The chloride concentration was 28 mg/L, and the nitrate concentration was 3.1 mg/L. VOC and pesticide concentrations were below their respective detection limits. The water had no discernable odour and an acceptable taste.

  - TW34: all tested parameter concentrations were below their respective ODWS guidelines, with the exception of iron (1.45 mg/L) and manganese (0.289 mg/L). The chloride concentration was 1.2 mg/L and the nitrate concentration was below the detection limit. VOC and pesticide concentrations were also below their respective detection limits. The water was noted to be degassing (presumed to be methane) and a slight sulphurous odour, and an acceptable taste.

  - Elevated concentrations of the parameters mentioned above may be treated to meet ODWS at a water treatment plant.

- Numerical groundwater modelling indicates that the future water taking of 221 L/sec is sustainable from the Regional A3/A4 Aquifer in the area. The additional pumping is not expected to adversely affect the performance of the existing Midhurst, Barrie, or Snow Valley water supply systems.

- Water level monitoring was conducted at the former Vespra landfill, located on George Johnson Road and in other Aquifer A1 and A2 locations in the Snow Valley area. No interference was noted in any of the shallow aquifers and numerical modelling indicates minimal impact to surface water resources.

7.0 LIMITATIONS

This preliminary hydrogeological assessment was prepared for Midhurst Development Doran Road Inc. and Carson Road Development Inc. to support the water supply portion of a Class Environmental Assessment for proposed development in the Midhurst Secondary Plan area. This report is based on borehole drilling, pumping tests and water quality analyses collected during this investigation and previous hydrogeological investigations conducted in 2008. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the sole responsibility of such third parties.

Golder has conducted test drilling and testing at specific locations, the stratigraphic conditions between these locations may change.

8.0 CLOSURE

We trust this document meets your current requirements. Should you have any questions or comments, please do not hesitate to contact the undersigned.

Report Signature Page

GOLDER ASSOCIATES LTD.



John Easton, M.Sc., P.Geo.

JAE/DH/plc

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9.0 REFERENCES

Chapman and Putnam (1984). The Physiography of Southern Ontario, Third Edition.

Golder (2008). *Report On Hydrogeological Study, Midhurst Water Supply Exploration Program, Supporting Document, Midhurst Class EA, Township of Springwater, Ontario.* 08-1170-0081. Submitted to: Midhurst Development Doran Road Inc. and Carson Road Development Inc. December 2008.

Golder, WHI and Ainley (2004). *South Simcoe Municipal Groundwater Study.* Prepared for South Simcoe Groundwater Partnership. S41W01. August 2004.

Wilson Associates (2008). Preliminary Analysis of Production Well 1 Pumping Test Data, Midhurst Road Alliance Inc. Development. October, 2008.

APPENDIX A

Site Location Maps

HIGHWAY 26

HIGHWAY 26

GILL ROAD

BAYFIELD STREET

RUSSELL ROAD

DORAN ROAD

WALT ROAD

POOLES ROAD

OLD SECOND

SNOW VALLEY ROAD

CARSON ROAD

WILSON DRIVE

Carson Road

Paddy Dunn's Circle

Greenacres

Idlewood Drive

Midhurst

Snow Valley

SPRINGWATER

BARRIE

Black Cr

Willow Cr

Little Lake

PROJECT NORTH // GEODETIC

A
A'
B
B'
C
C'
D
D'
E
E'
F
F'

TH33
OW29
TW34
OW19
TW22
OW9
OW8
TH27
OW11; TW13
TH26
OW10
OW15
OW35
PW1
TH23
OW4
TH31
OW30
TW18
TH25
OW3
TW20
OW28
OW32
OW25
OW24
OW1
TW21

PLAN LEGEND

- Existing Municipal / Public Supply Well
- Proposed Municipal Well Site
- 2008 Investigations
- 2014 Investigations
- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary

NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Mapped features are approximate and Not to Scale

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Plotted 11x17 Landscape

metres

PROJECT

MIDHURST WATER SUPPLY EXPLORATION

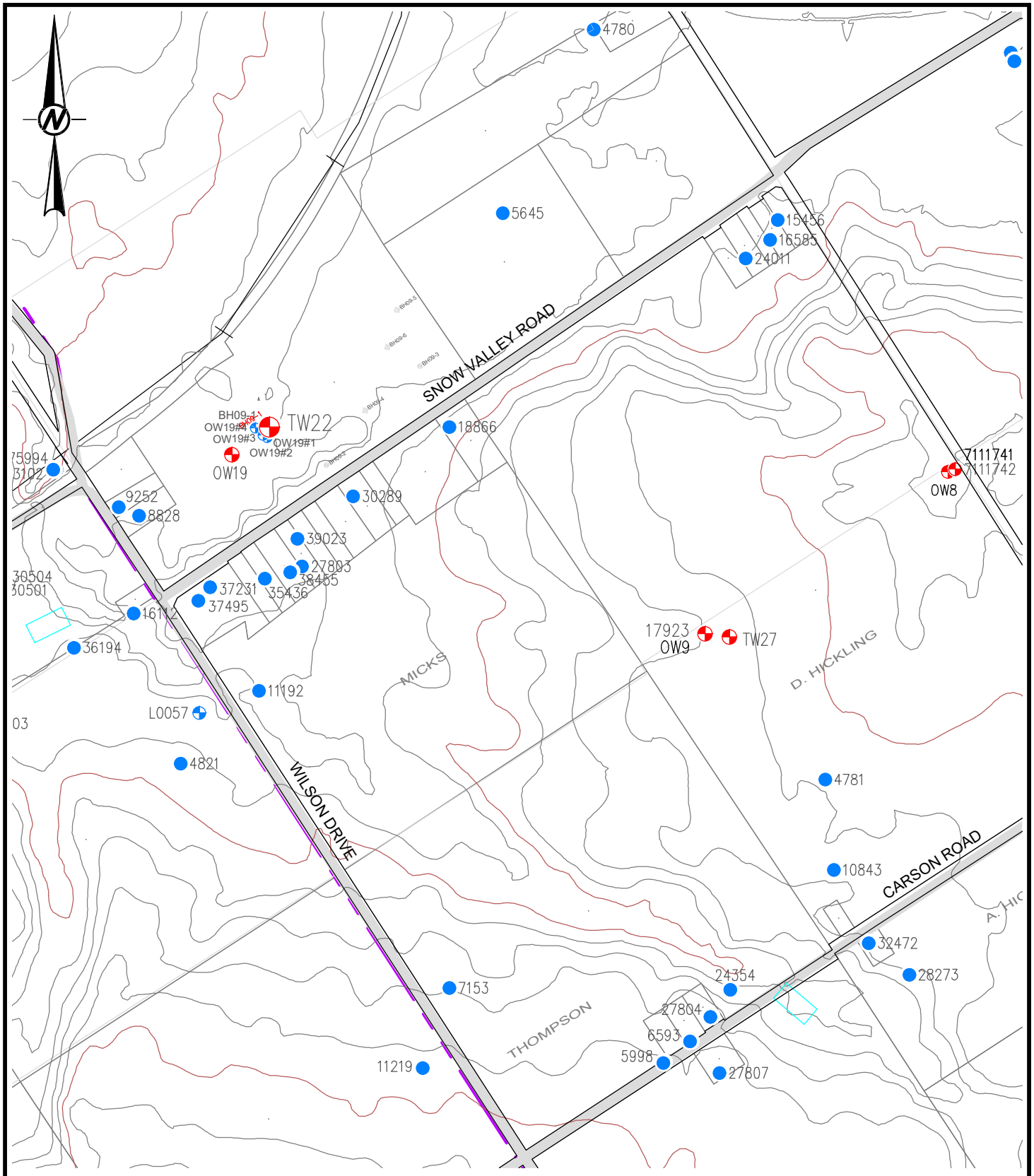
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AREA LOCATION MAP

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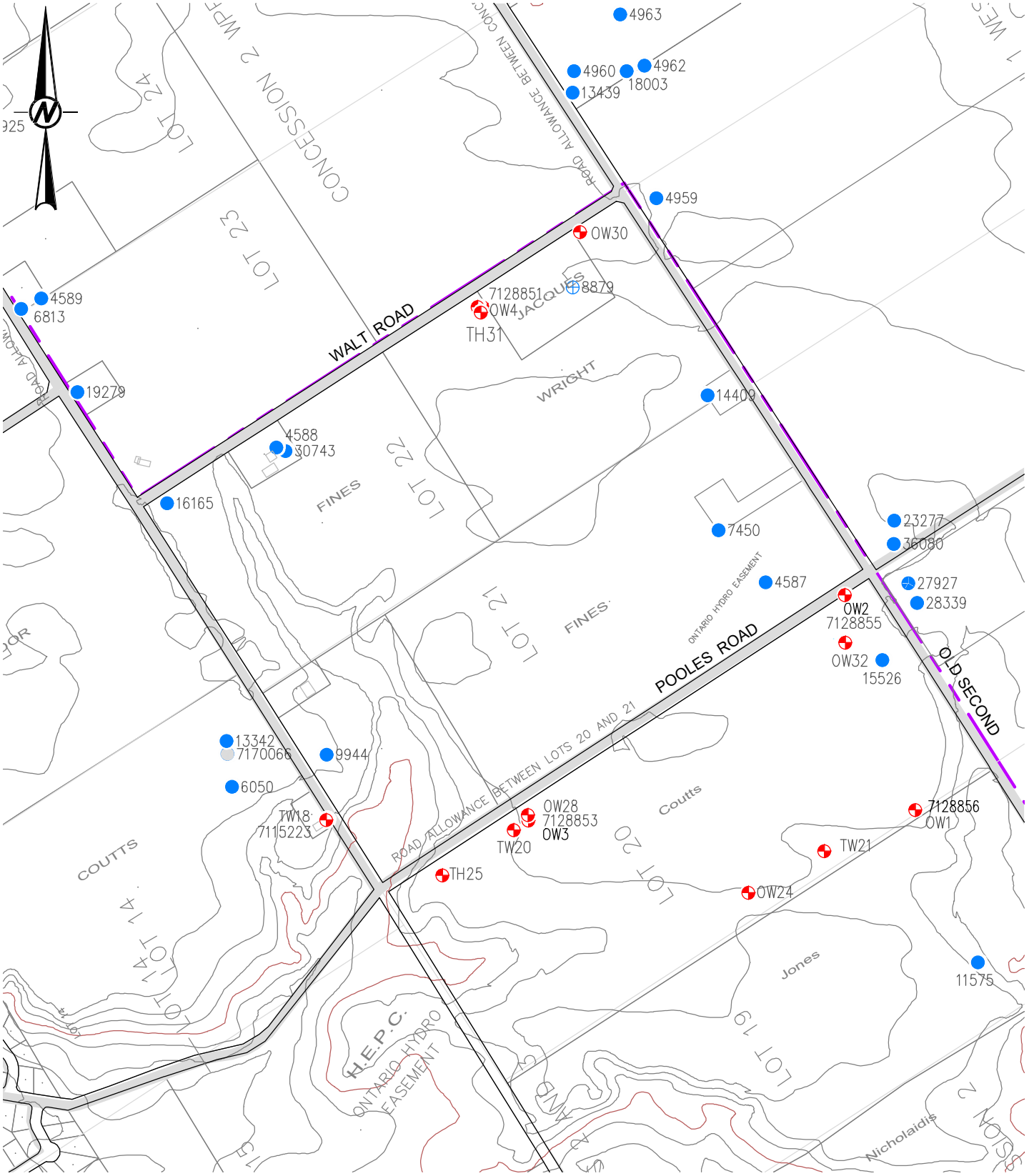
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SITE LOCATION MAP
SNOW VALLEY ROAD (GRAVEL PIT) AND D. HICKLING FARM

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-2

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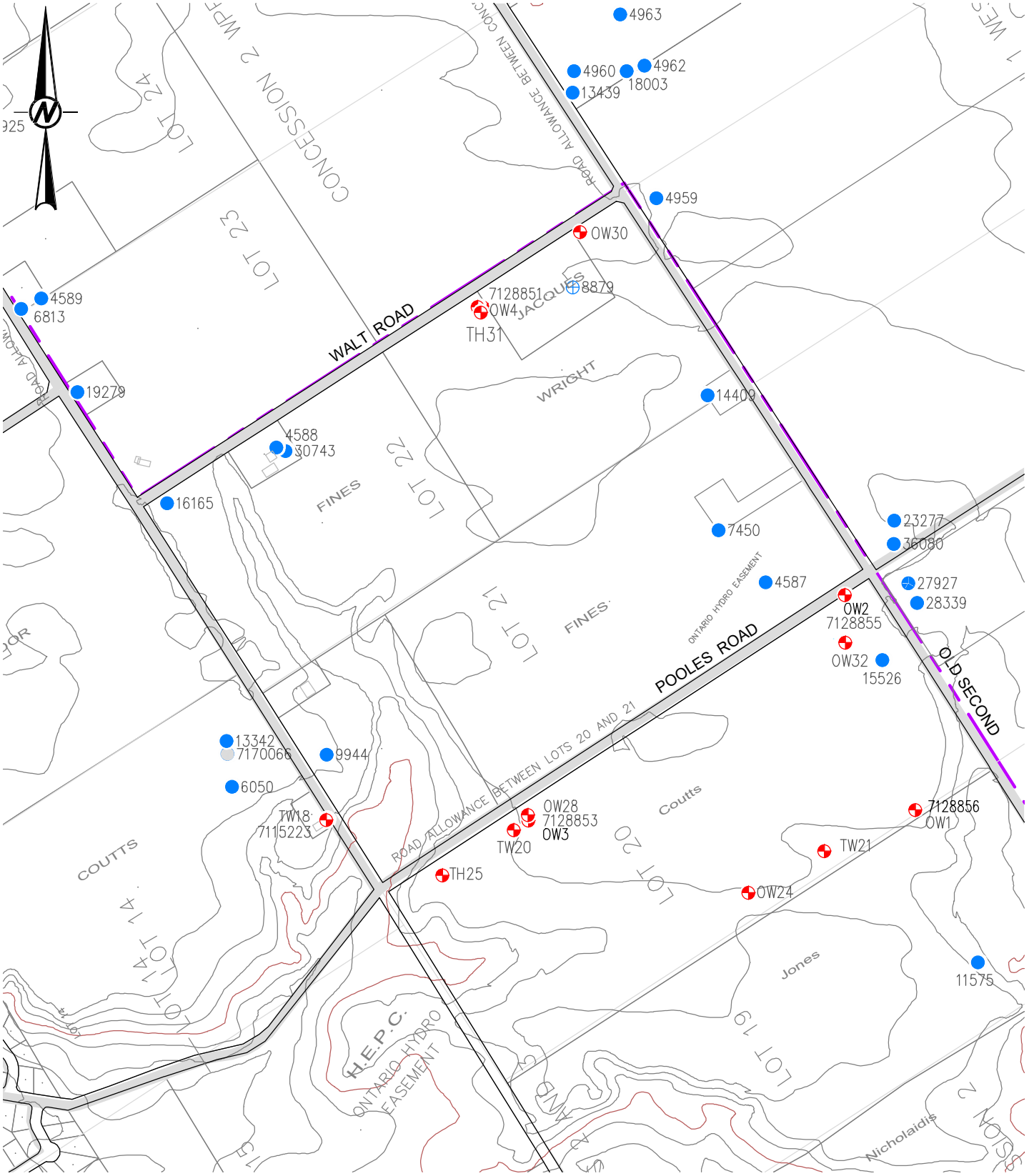
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SITE LOCATION MAP
POOLES ROAD; OLD 2ND ROAD; COUTTS FARM

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-3

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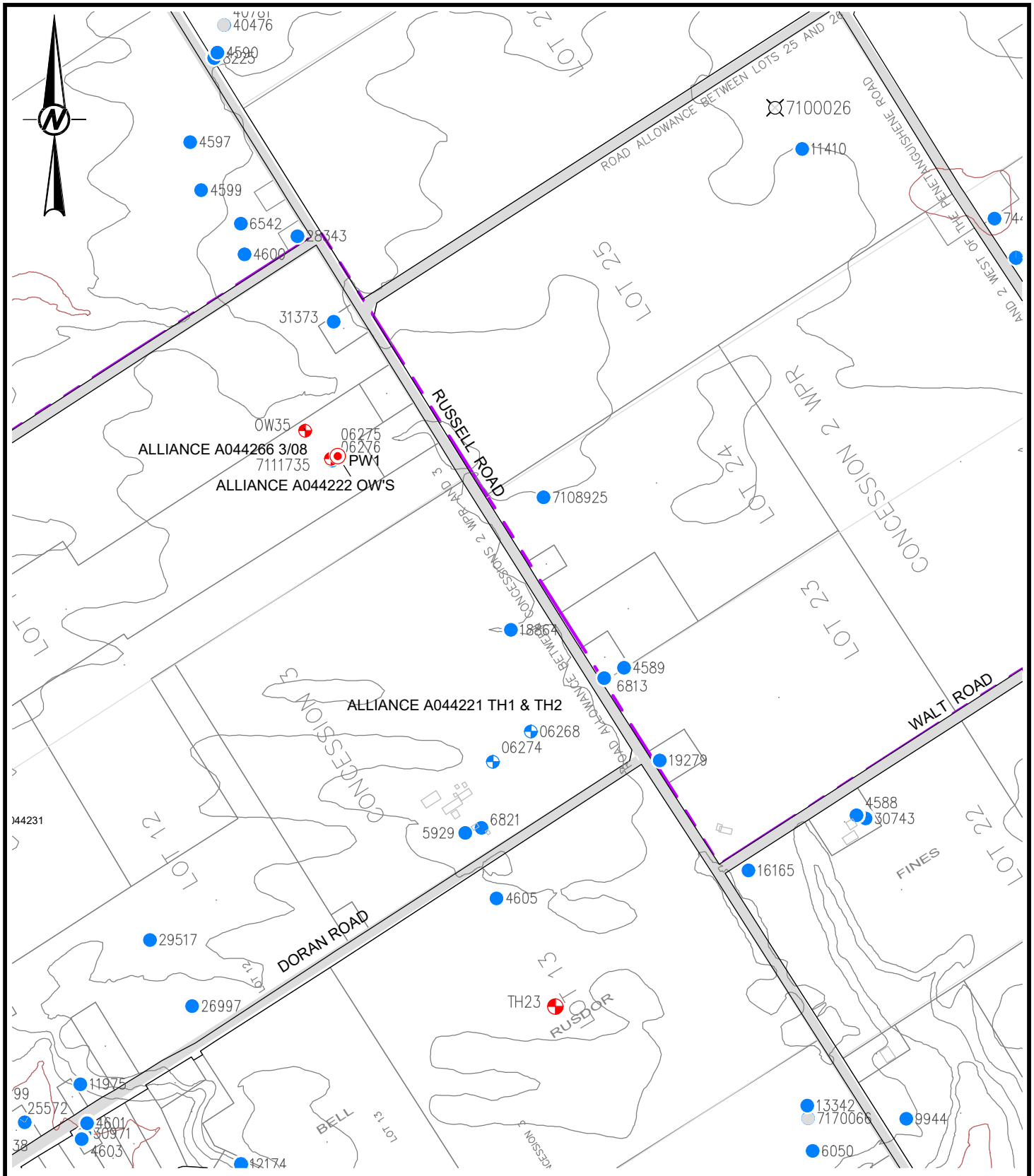
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SITE LOCATION MAP
POOLES ROAD; OLD 2ND ROAD; COUTTS FARM

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-3

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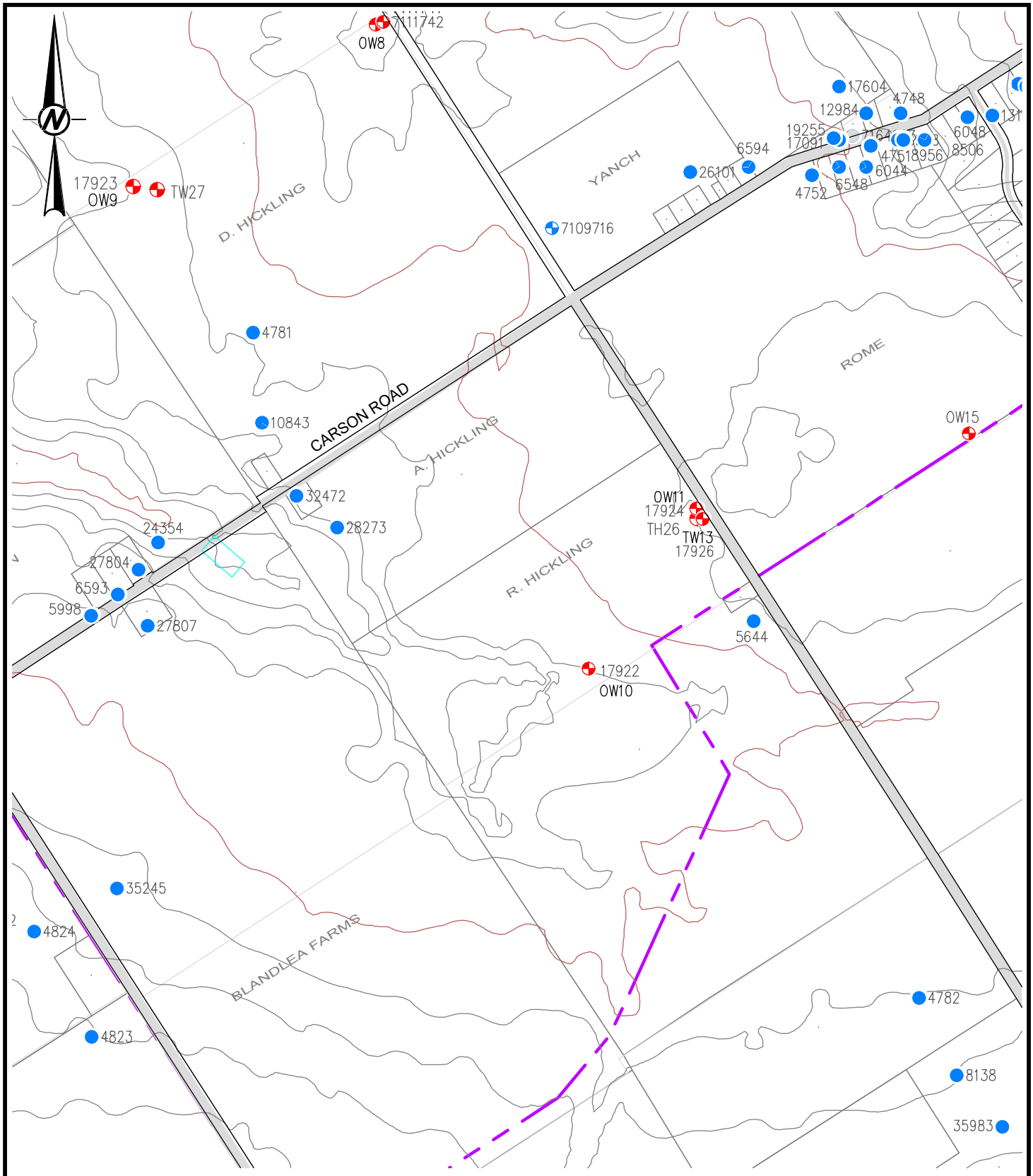
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SITE LOCATION MAP
DORAN ROAD

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **A-4**

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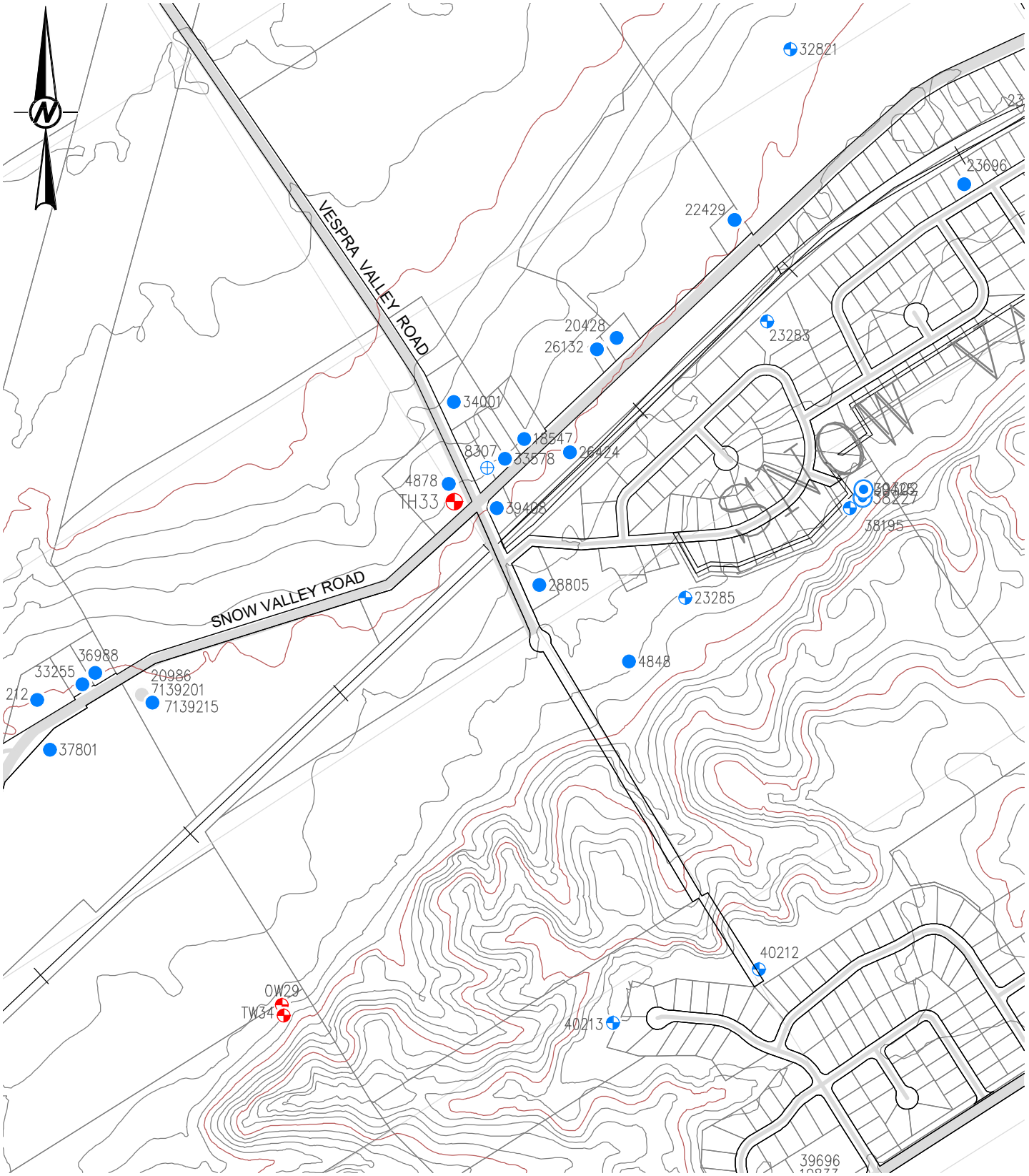
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SITE LOCATION MAP
ANNE STREET

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-5

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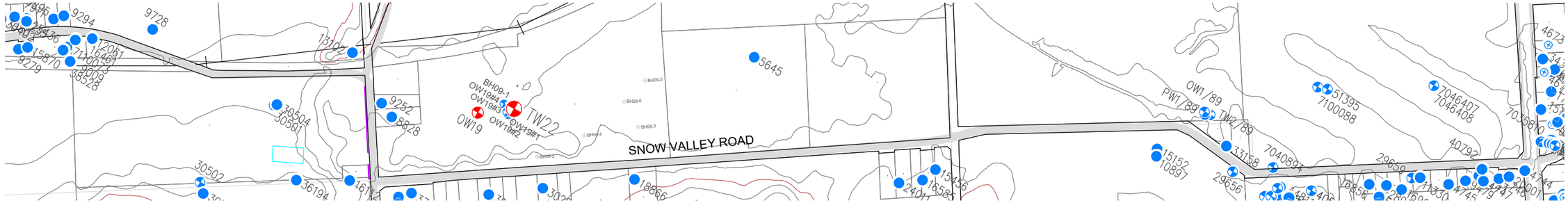
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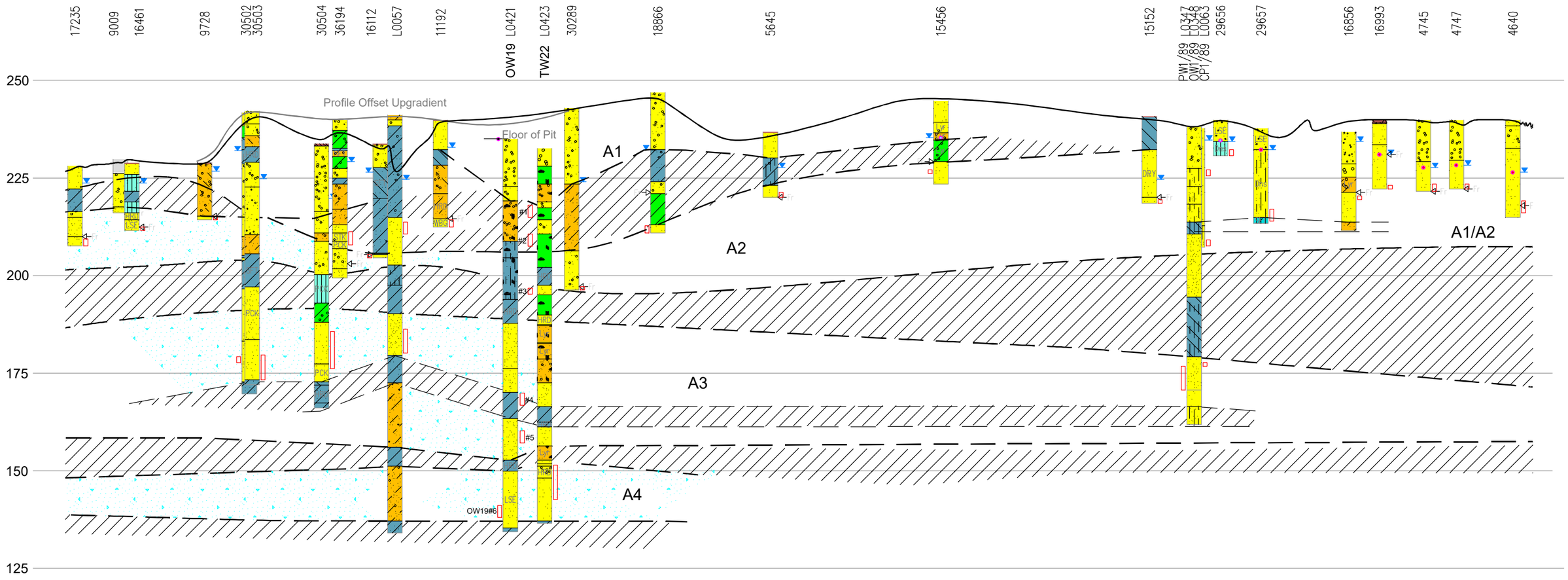
SITE LOCATION MAP
SNOW VALLEY ROAD (WEST)

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **A-6**

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Refer to Figure A-13 for Legend and Notes

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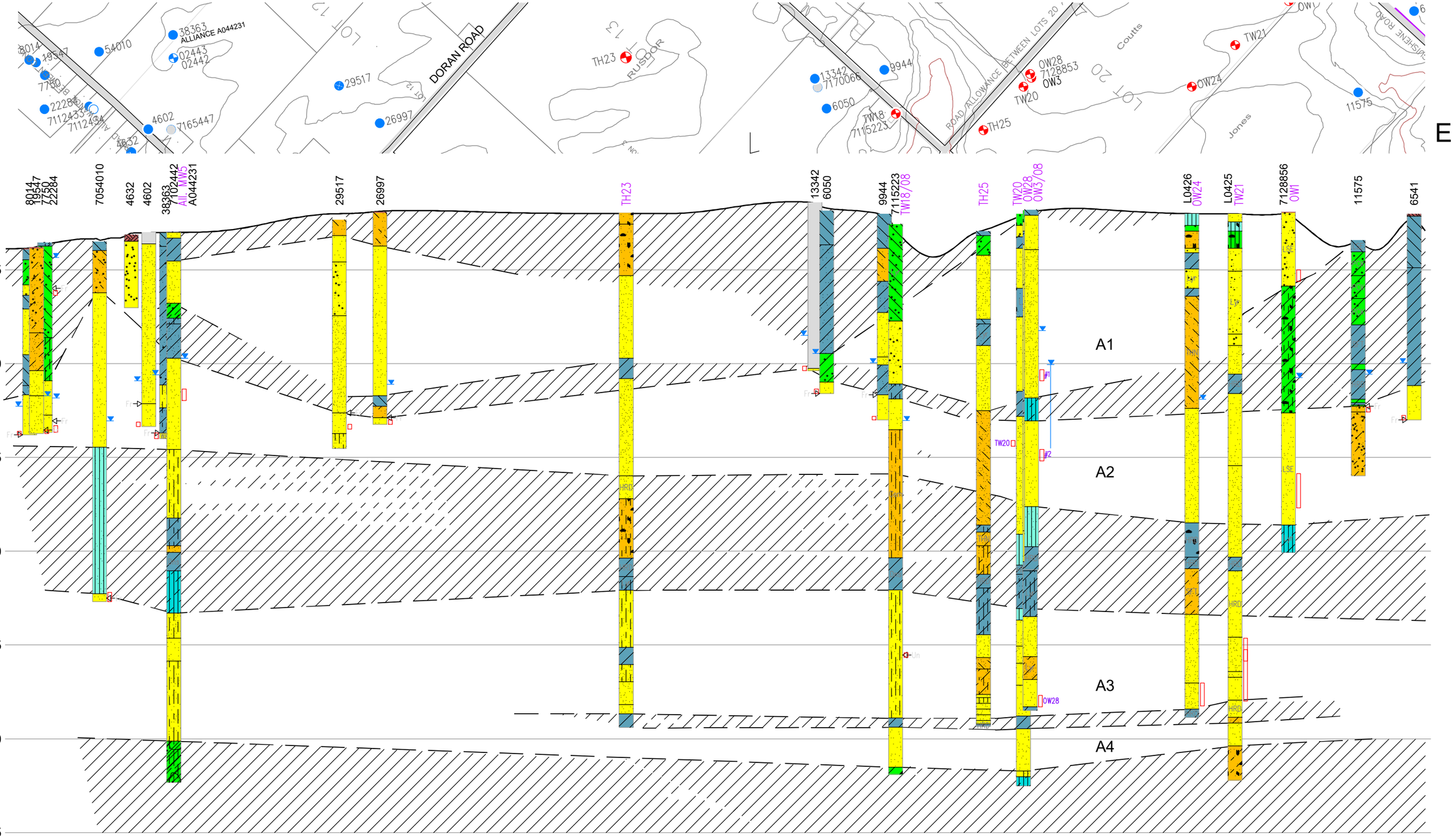
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MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **A-7**

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Refer to Figure A-13 for Legend and Notes

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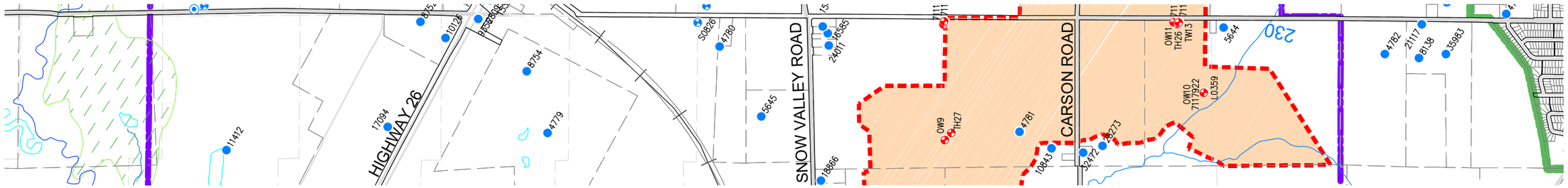
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PROJECT No. 13-1170-0040
REV.

TITLE
HYDROGEOLOGICAL SECTION B - B'

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-8

PLOT DATE: March 10, 2016
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBSITE.dwg: [Figure A-8]



N

S

34381 34379 11412 | 17094 | 8752 | 10126 | 9356 | 8754 | 4779 | S0826 | 4780 | 5645 | 15456 16585 | OW9 OW8 | 4781 | 10843 | 32472 | 28273 | 7117924 L0428 | 7117922 | 5644 | 4782 | 8138 21117 | 9829 | 4757

MIDHURST COMMUNITY LIMITS

SITE

OGS BH31 (Offset) | TW22 (Offset) L0423 | TH27 (Offset) | OW11 TH26 | OW10

OW9#1 OW8 OW9#2

GRADE AT OW9 & TH27

SA

A1

A1 / A2

A2

A3

A4

TW13

Offset

ELEVATION: metres above Sea-level

275 250 225 200 175 150

0 200 500 1000 1500

SCALE 1:20000 metres

Plotted Tabloid 11X17

Refer to Figure A-13 for Legend and Notes

Golder Associates

Barrie, Ontario, Canada

FILE No.	1311700040CBAREA.dwg
PROJECT No.	13-1170-0040
REV.	
SCALE	AS SHOWN
DATE	2016-03-10
DESIGN	
CAD	JPR
CHECK	DPD
REVIEW	JAE

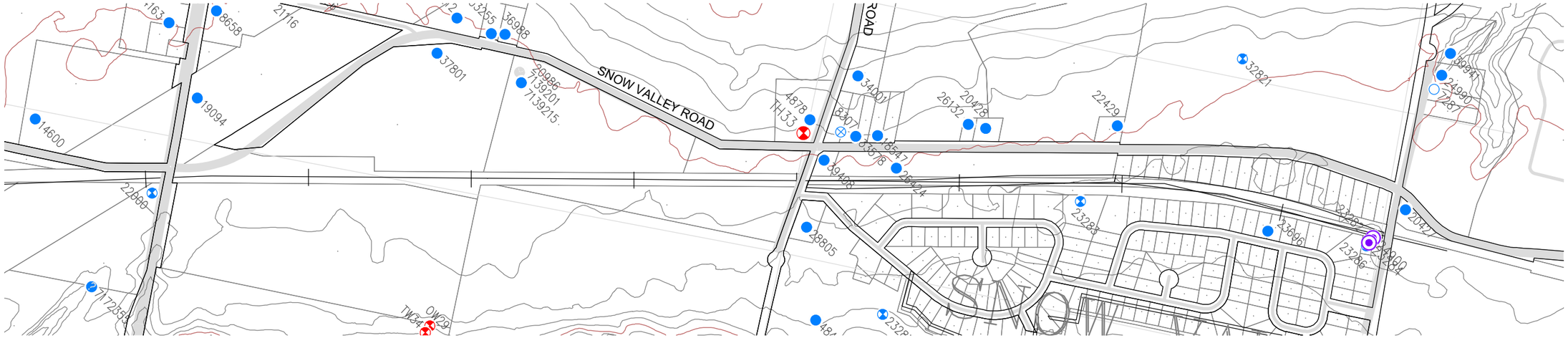
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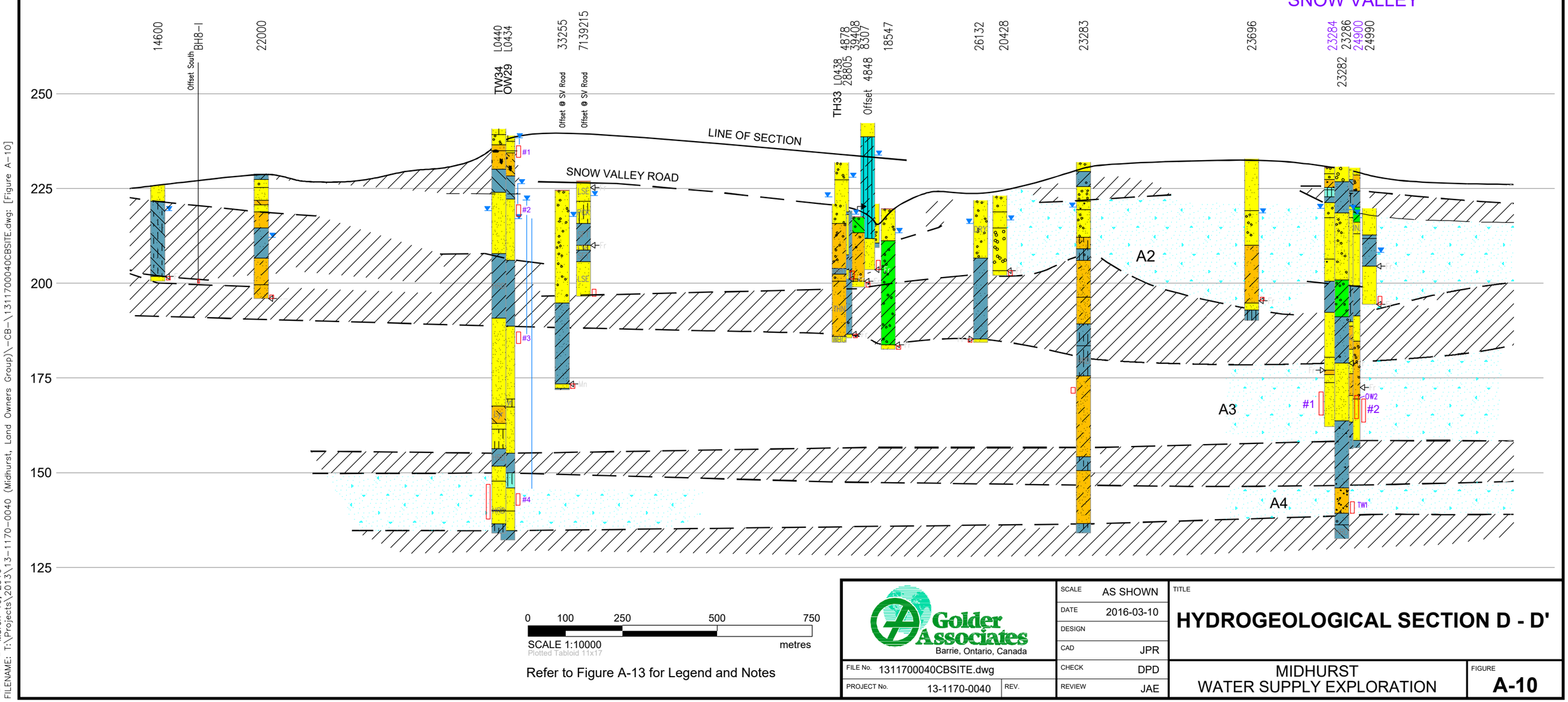
HYDROGEOLOGICAL SECTION C - C'

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **A-9**

PLOT DATE: March 10, 2016
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBAREA.dwg





0 100 250 500 750

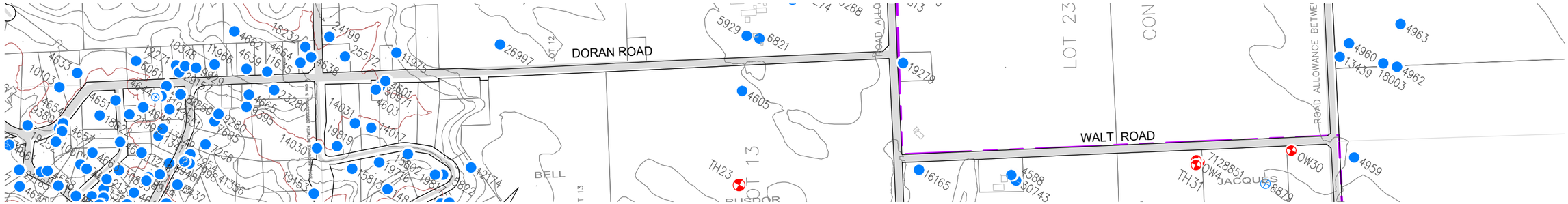
SCALE 1:10000 metres

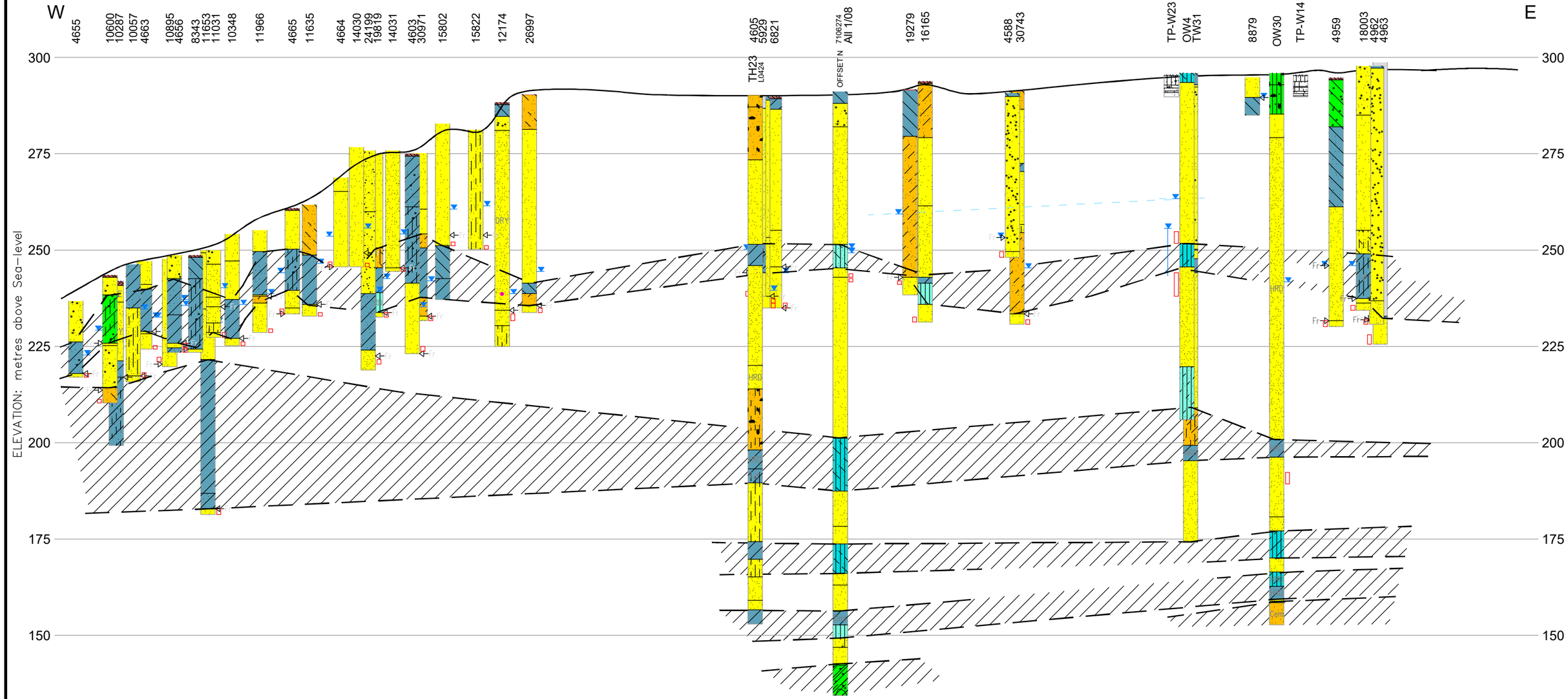
Plotted Tabloid 11x17

Refer to Figure A-13 for Legend and Notes

Golder Associates Barrie, Ontario, Canada	SCALE AS SHOWN	TITLE	
	DATE 2016-03-10	**HYDROGEOLOGICAL SECTION D - D'**	
	DESIGN		
	CAD JPR		
FILE No. 1311700040CBSITE.dwg	CHECK DPD		
PROJECT No. 13-1170-0040 REV.	REVIEW JAE	MIDHURST WATER SUPPLY EXPLORATION	FIGURE **A-10**

PLOT DATE: March 10, 2016
FILENAME: I:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBSITE.dwg: [Figure A-10]





0 100 250 500 750

SCALE 1:10000 metres

Plotted Tabloid 11x17

Refer to Figure A-13 for Legend and Notes

Golder Associates
Barrie, Ontario, Canada

FILE No.	1311700040CBSITE.dwg
PROJECT No.	13-1170-0040
REV.	
SCALE	AS SHOWN
DATE	2016-03-10
DESIGN	
CAD	JPR
CHECK	DPD
REVIEW	JAE

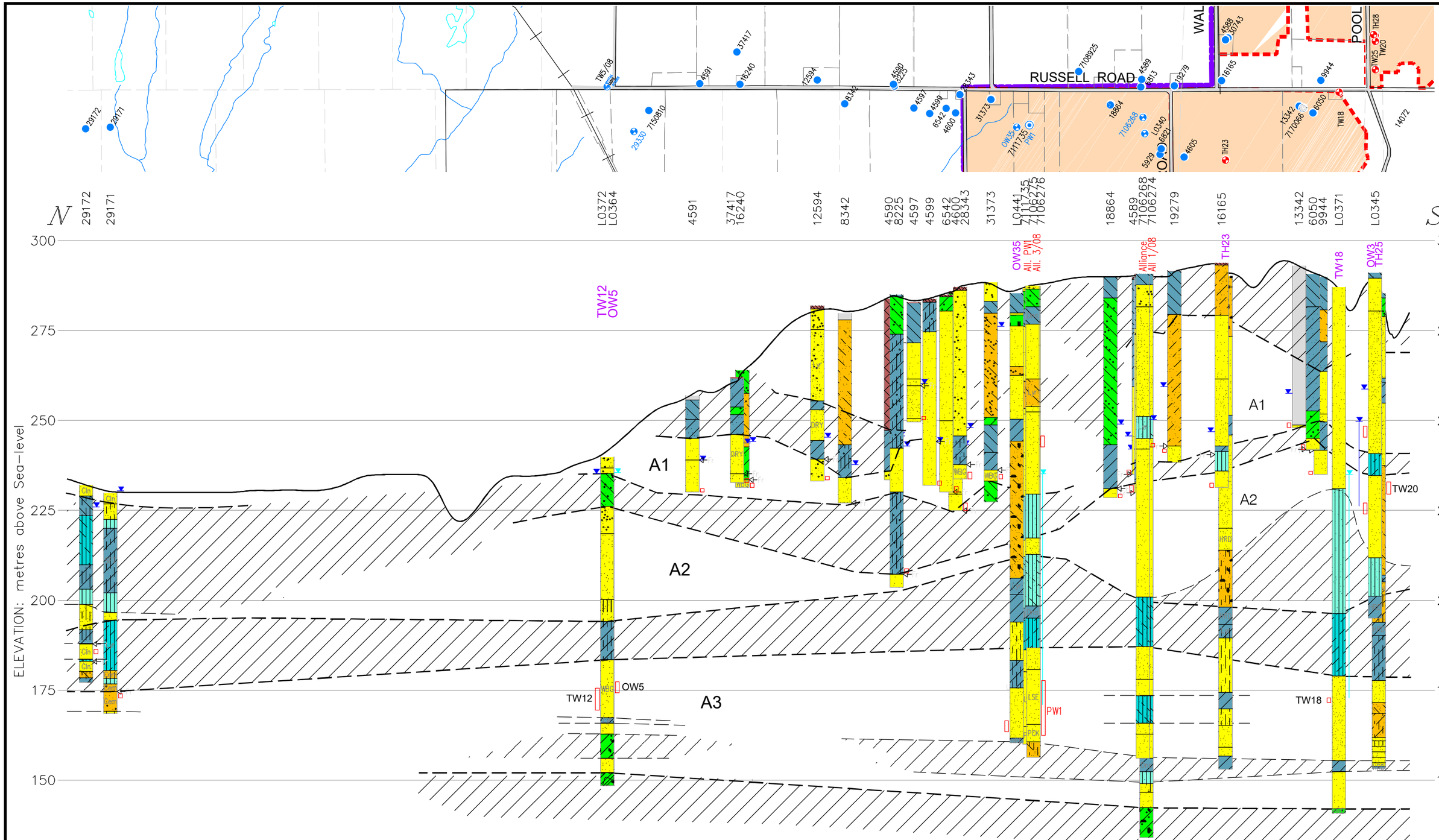
TITLE

HYDROGEOLOGICAL SECTION E - E'

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **A-11**

PLOT DATE: March 10, 2016
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBSITE.dwg: [Figure A-11]



Refer to Figure A-13 for Legend and Notes

PLOT DATE: March 10, 2016
FILENAME: I:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBAREA.dwg

Golder Associates
Barrie, Ontario, Canada

FILE No.	1311700040CBAREA.dwg
PROJECT No.	13-1170-0040
REV.	

SCALE	AS SHOWN
DATE	2014-10-01
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

HYDROGEOLOGICAL SECTION F - F'

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-12

STRATIGRAPHIC PATTERN

- Unoxidized CLAY, Blue, Grey, White, or Undefined CLAY
- Oxidized CLAY, Brown, Red, Yellow
- SILT
- SAND
- GRAVEL
- STONES, Rounded GRAVEL, PEBBLES
- BOULDER
- TILL
- SHALE
- DOLOSTONE
- LIMESTONE
- CRYSTALLINE ROCK

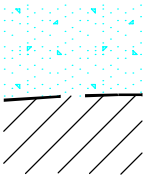
GENERIC MATERIALS

- UNKNOWN OR PREVIOUSLY DUG
- PEAT/LOAM
- SANDS & GRAVELS
- GRANULAR TILL
- SILT
- SILT CLAYEY
- CLAY
- TILL
- LIMESTONES
- SHALES
- PRECAMBRIAN

	SECONDARY/ SOME	TRACE	MINOR	
Clayey				Clay
Silty				Silt
Sandy				Granular

- Screen
- Recorded Static Water Level
- Water Producing Zone
- Flowing Well
- 23453 MOE Recorded Private Well

STRATIGRAPHY (see Notes)



AQUIFER

HYDROSTRATIGRAPHIC CONTACT

CONFINING MATERIAL

MAP SYMBOLS

- Shallow Dug or Bored <10 m
- Deep Bored Well >10 m
- Drilled Overburden Well
- Test or Observation Well
- Test Pit
- Drilled Bedrock Well
- Sandpoint
- Municipal / Public Supply

NOTES

On all sections, boundaries between soil strata have been determined only at well and test well locations. Between the wells and test wells, boundaries are not proven but are assumed from geological evidence.

Wells are located to MOE Water Well Bulletin Data. Locations and elevations are subject to field verification.

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-04
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

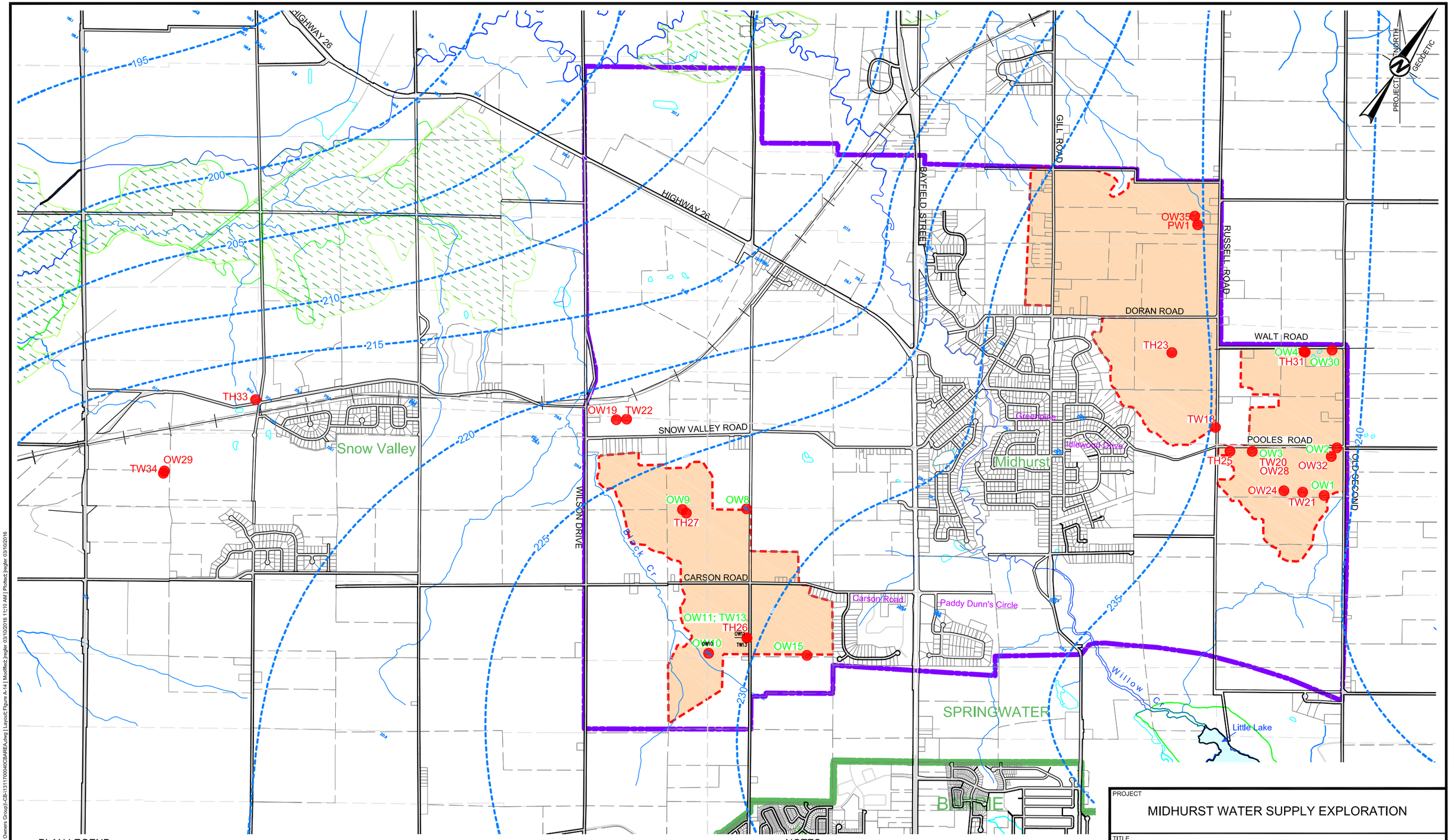
HYDROGEOLOGICAL SYMBOLS

FILE No. 1311700040CBSITE.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
A-13

PLOT DATE: October 1, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBSITE.dwg: [Figure A-13]



PLAN LEGEND

- Existing Municipal / Public Supply Well
- Proposed Municipal Well Site
- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Lower Aquifer Equipotential Line (masl)

NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Mapped features are approximate and Not to Scale
4. Lower Aquifer Potentiometric Surface, Golder 2007 Tier 3 Groundwater Studies

0 200 500 1000 2000

SCALE 1:30000 metres

Plotted 11x17 Landscape

PROJECT

MIDHURST WATER SUPPLY EXPLORATION

TITLE

EQUIPOTENTIAL SURFACE
LOWER AQUIFERS

Golder Associates

PROJECT No.	13-1170-0040		FILE No.	1311700040CBAREA
DESIGN			SCALE	AS SHOWN
CADD	JPR	2016-03-10	FIGURE	
CHECK	DPD	2016-03-10		A-14
REVIEW	JAE	2016-03-10		

T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)-CB\13117700040CBAREA.dwg | Layout: Figure A-14 | Modified: jregler 03/10/2016 11:10 AM | Plotted: jregler 03/10/2016

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4585	1 16	Jul-67	604973 4921695	286.8	3.7	-			4.0	9			4608 BR	WS DO	**MOE# 5704585** 0.0 TPSL 0.3 GRVL 1.2 MSND 4.0
4587	2 21	Nov-64	603719 4923275	292.9	49.4	Fr	51.2	-1.2	44.8	14	60	45.1	5510 CT	WS DO	**MOE# 5704587** 0.0 TPSL 0.3 CLAY 7.3 CLAY MSND STNS 8.2 CLAY MSND 21.6 MSND 43.6 CLAY MSND HPAN 49.4 MSND 53.6
4588	2 22	Aug-64	602814 4923524	290.8	37.5	Fr	41.1	-1.5	37.5	45	120	40.2	1510 CT	WS ST	**MOE# 5704588** 0.0 BRWN CLAY 0.9 GRVL MSND 41.1 CSND 42.7
4589	2 24	Sep-67	602378 4923800	290.8	61.0	Fr	58.8	-1.8	48.8	91	90	51.8	1510 CT	WS ST	**MOE# 5704589** 0.0 TPSL CLAY TPSL 0.9 BRWN CLAY 15.2 CSND 51.8 CLAY MSND HPAN 57.9 CSND 61.0
4597	3 10	Apr-66	601566 4924784	282.9	23.2	Fr	31.7	-0.9	22.6	32	120	27.4	3203 CT	WS ST	**MOE# 5704597** 0.0 TPSL 0.3 BRWN CLAY 11.3 BRWN MSND 21.3 FSND 23.2 FSND MSND 32.3 FSND 33.2
4598	3 10	Jul-60	600352 4924239	278.0	46.3	Fr	46.3	-2.4	36.6	68	120	38.1	1510 CT	WS ST	**MOE# 5704598** 0.0 BRWN CLAY BLDR 9.1 WHTE CLAY HPAN 30.5 FSND 33.5 BLUE CLAY 42.7 CSND 48.8
4599	3 10	Sep-66	601587 4924694	283.8	39.6	Fr	50.6	-1.2	39.6	45	120	43.3	1510 CT	WS ST	**MOE# 5704599** 0.0 TPSL 0.9 HPAN 9.1 CSND 51.8
4600	3 11	Jun-66	601668 4924574	285.9	61.0	Fr	58.8	-2.1	42.7	45	120	44.2	1510 CT	WS ST	**MOE# 5704600** 0.0 TPSL CLAY TPSL 0.6 BRWN CLAY STNS 25.9 HPAN STNS 42.7 FSND 56.4 MSND 61.0
4601	3 12	Jun-60	601374 4922948	276.8	28.7	Fr	27.4	-1.2	19.5	23	120	25.6	1510 CT	WS DO	**MOE# 5704601** 0.0 RED MSND 7.6 GRVL 22.9 CSND 28.7
4602	3 12	Jun-65	600970 4923311	285.0	45.7	Fr	50.6	-1.2	39.6	45	120	42.1	1510 CT	WS ST	**MOE# 5704602** 0.0 PRDG 3.0 FSND 45.7 CSND 51.8
4603	3 12	May-66	601364 4922918	274.9	51.8	Fr	50.0	-1.2	39.6	23	120	44.2	1510 CT	WS DO	**MOE# 5704603** 0.0 TPSL 0.6 CLAY MSND STNS 13.7 HPAN 33.5 MSND 51.8
4604	3 13	Jun-55	601679 4922249	244.4	10.7	Fr	11.6	-1.2	4.0	27	90	5.5	1510 JT	WS DO	**MOE# 5704604** 0.0 MSND 2.4 CLAY LMSN 5.2 BLUE CLAY 10.7 BLDR GRNT 12.8
4605	3 13	Jun-65	602140 4923369	289.9	45.7	Fr	50.6	-1.2	39.6	45	120	42.7	1510 CT	WS ST	**MOE# 5704605** 0.0 PRDG 3.0 FSND 38.1 HPAN 45.7 CSND 51.8
4606	3 15	Nov-64	602503 4921247	235.6	11.0	Fr	11.0	-1.2	3.7	14	120	9.1	1510 CT	WS DO	**MOE# 5704606** 0.0 TPSL MSND 0.9 RED MSND STNS 4.0 QSND 11.0 FSND 12.2
4607	3 15	Jul-66	602497 4921307	236.8	9.1	Fr	11.0	-0.9	5.2	27	60	10.1	2514 CT	WS DO	**MOE# 5704607** 0.0 MUCK 0.6 MSND 6.1 CSND GRVL 6.4 YLLW MSND 11.6 CLAY 12.2
4627	4 9	Jul-58	599421 4923634	239.0	24.4	Fr			9.1	14	720	21.3	1419 DM	WS DO	**MOE# 5704627** 0.0 TPSL 0.6 MSND 21.3 QSND 24.4
4628	4 9	Jun-66	599358 4923765	238.7	4.3	Fr			3.7	9			4608 BR	WS DO	**MOE# 5704628** 0.0 FSND 6.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4629	4 10	Sep-64	599844 4923125	249.9	13.7	Fr	14.0	-1.2	9.1	18	480	12.8	1510 CT	WS DO	**MOE# 5704629** 0.0 BRWN CLAY MSND 1.2 HPAN 13.7 FSND 15.2
4630	4 10	Jul-66	599575 4923354	241.7	13.1	Fr			13.1	9			4608 BR	WS DO	**MOE# 5704630** 0.0 FSND 16.2
4631	4 11	Jan-52	600589 4923754	279.8	44.8	Fr	43.6	-4.3	36.9	209	30	37.8	5510 CT	WS DO	**MOE# 5704631** 0.0 TPSL 1.2 CLAY STNS 4.3 MSND CLAY 14.6 MSND 27.1 CLAY 32.9 CLAY MSND 43.0 MSND 47.9
4632	4 11	Apr-56	600910 4923264	284.4					NR				1637 CT	AS -	**MOE# 5704632** 0.0 TPSL 1.8 GRVL 19.5
4633	4 12	Jan-59	600712 4922583	253.0	12.2	Fr			12.2	32	180	13.4	1510 JT	WS DO	**MOE# 5704633** 0.0 CLAY 12.2 CSND 19.8
4634	4 11	Nov-61	600340 4922566	243.8	28.0	Fr	28.0	-1.8	20.7	68	120	22.6	1510 CT	WS PU	**MOE# 5704634** 0.0 GRVL MSND STNS 4.0 HPAN BLDR 13.7 BLUE CLAY STNS 25.9 HPAN STNS 28.0 GRVL 29.9
4635	4 12	Aug-62	600617 4922353	239.9	25.6	Fr	26.2	-1.2	16.5	159	120	18.3	1510 CT	WS DO	**MOE# 5704635** 0.0 MSND GRVL 4.6 HPAN MSND 25.6 CSND 27.4
4636	4 12	Mar-64	600510 4922462	243.8	22.9	Fr			16.8	14	120	19.8	1510 CT	WS PU	**MOE# 5704636** 0.0 RED MSND STNS 3.0 MSND CLAY STNS 16.8 HPAN 22.9 GRVL 24.4
4637	4 11	Jun-64	600953 4923213	285.0	42.7	Fr	50.0	-1.2	42.7	45	60	44.5	1510 CT	WS DO	**MOE# 5704637** 0.0 BRWN CLAY 1.2 GRVL HPAN 50.0 CSND 51.2
4638	4 11	Oct-66	601187 4922906	271.9	39.3	Fr	44.8	-0.9	36.6	23	120	38.1	4715 CT	WS ST	**MOE# 5704638** 0.0 PRDG 2.4 CLAY MSND 39.3 FSND 45.7
4639	4 11	Dec-67	601065 4922801	260.9	8.8	Fr	8.8	-0.9	4.6	18	120	9.8	2514 CT	WS DO	**MOE# 5704639** 0.0 TPSL MSND 0.3 YLLW MSND BLDR 9.8 FSND CLAY 12.8 BRWN CLAY 14.6
4640	4 12	Jul-51	600646 4921717	239.9	21.9	Fr	20.7	-3.0	13.4	18	90	14.9	5510 CT	WS DO	**MOE# 5704640** 0.0 FSND 1.5 MSND GRVL 7.3 MSND 25.0
4641	4 12	Sep-53	600980 4922400	246.9	15.8	Fr	21.0	-1.2	7.3	23	60	10.4	1637 JT	WS DO	**MOE# 5704641** 0.0 MSND 7.6 SILT 15.2 CLAY 15.8 FSND 20.7 CSND 22.3
4642	4 12	Jun-56	600950 4922068	237.7	17.7	Fr			3.4	36	120	5.5	1510 JT	WS DO	**MOE# 5704642** 0.0 CLAY 3.4 HPAN 9.8 BLUE CLAY 22.9
4643	4 12	Aug-58	600470 4922210	229.8	15.2	Fr			15.2	32	120	16.5	1510 JT	WS DO	**MOE# 5704643** 0.0 TPSL 1.8 GRVL 11.6 CSND 19.5
4644	4 12	Aug-59	600907 4922629	249.9	9.1	Fr	11.3	-1.8	8.2	18	120		1510 JT	WS DO	**MOE# 5704644** 0.0 BRWN CLAY 9.1 CSND 13.1
4645	4 12	Aug-59	600894 4922592	249.9	16.5	Fr	16.5	-1.8	9.4	27	120		1510 JT	WS DO	**MOE# 5704645** 0.0 BRWN FSND 18.3
4646	4 12	Apr-61	600980 4922366	243.8	24.4	Fr	22.6	-1.8	12.2	45	120		1510 JT	WS DO	**MOE# 5704646** 0.0 RED MSND 4.3 CLAY MSND 15.2 CSND 24.4
4647	4 12	May-61	601011 4921953	236.8	17.7	Fr	15.8	-1.8	11.6	18	120		1510 JT	WS DO	**MOE# 5704647** 0.0 GRVL 9.8 FSND 15.2 CSND 17.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4648	4 12	Aug-62	600541 4922389	240.8	14.9	Fr	17.4	-1.5	9.4	45	120	11.6	1637 CT	WS DO	**MOE# 5704648** 0.0 BRWN CLAY 1.8 GREY CLAY 9.8 CLAY MSND 14.9 MSND 18.9
4649	4 12	Aug-62	600968 4922275	237.7	19.2	Fr	19.5	-1.2	12.8	23	120	14.6	1510 CT	WS DO	**MOE# 5704649** 0.0 FSND 3.7 HPAN CLAY 19.2 CSND 20.7
4650	4 13	Apr-65	600659 4921693	240.8	22.6	Fr	21.3	-1.2	15.2	23	120	18.3	1510 CT	WS DO	**MOE# 5704650** 0.0 RED MSND 0.6 GRVL STNS 12.2 FSND 22.6
4651	4 12	Aug-65	600827 4922573	248.1	19.2	Fr	18.0	-1.2	11.9	23	120	14.6	4715 CT	WS DO	**MOE# 5704651** 0.0 MSND 7.6 CLAY 17.7 CSND 18.0 CLAY MSND 18.3 FSND CSND 19.2
4652	4 12	Feb-65	600896 4922340	242.9	62.2	Fr	62.2	-0.9	9.8	45	120	44.8	2514 CT	WS DO	**MOE# 5704652** 0.0 MSND 0.9 MSND CLAY 21.3 BLUE CLAY FSND 45.1 BLUE CLAY 56.4 WHTE MSND SILT 62.2 MSND 63.1
4653	4 12	Aug-65	600851 4922392	246.0	17.7	Fr	19.8	-1.2	13.1	23	180	14.3	4715 CT	WS DO	**MOE# 5704653** 0.0 PRDG 11.0 MSND 17.7 FSND 21.0
4654	4 12	Sep-65	600745 4922459	247.2	16.2	Fr	19.2	-1.2	15.8	23	720	15.8	4715 CT	WS DO	**MOE# 5704654** 0.0 MSND 15.8 GRVL 16.2 MSND 20.4
4655	4 12	Feb-66	600731 4922272	236.8	18.9	Fr	18.9	-0.9	14.0	23	180	15.2	4715 CT	WS DO	**MOE# 5704655** 0.0 MSND GRVL BLDR 10.7 CLAY MSND GRVL 18.9 MSND 19.8
4656	4 12	Mar-66	600888 4922490	248.7	22.9	Fr	22.9	-1.2	13.1	18	240	19.8	4715 CT	WS DO	**MOE# 5704656** 0.0 MSND GRVL 6.1 CLAY MSND 15.5 GREY CLAY 22.9 FSND 24.1 CLAY MSND 25.3
4657	4 12	Jul-66	600742 4922444	244.8	18.0	Fr	18.0	-0.9	9.1	27	330	17.7	2514 CT	WS DO	**MOE# 5704657** 0.0 TPSL 0.3 MSND GRVL BLDR 6.1 GREY FSND 9.1 BLUE CLAY 18.0 MSND 19.8
4658	4 12	Aug-66	600771 4922339	242.9					NR				4715 CT	AS -	**MOE# 5704658** 0.0 CLAY GRVL 11.0 GRVL BLDR 12.8 CLAY MSND 17.4 CLAY 24.1 CLAY SILT 28.7 MSND SILT 31.4 CLAY 33.5
4659	4 12	Aug-66	600758 4922329	242.9	17.4	Fr	19.8	-0.9	17.4	23	120	17.7	4715 CT	WS DO	**MOE# 5704659** 0.0 MSND GRVL 13.1 MSND 13.4 MSND GRVL 17.4 FSND CSND 20.7
4660	4 12	Dec-66	601062 4922417	246.9	19.8	Fr	20.1	-0.9	7.6	23	120	10.7	4715 CT	WS DO	**MOE# 5704660** 0.0 MSND 1.2 BRWN CLAY BLDR 10.7 BRWN CLAY MSND 12.2 MSND 21.0
4661	4 12	May-67	600657 4922346	237.4	18.9	Fr	18.6	-1.2	14.6	9	120	18.0	3203 CT	WS DO	**MOE# 5704661** 0.0 TPSL 0.6 BRWN CLAY MSND 5.5 CLAY MSND STNS 18.9 MSND 19.2 MSND GRVL CLAY 19.8
4662	4 12	Jun-67	600993 4922866	264.9	22.9	Fr	21.6	-1.2	12.2	36	120	18.3	1510 CT	WS DO	**MOE# 5704662** 0.0 TPSL MSND 3.7 CLAY MSND 12.2 HPAN 20.7 CSND 22.9

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4663	4 12	Oct-67	600843 4922433	245.4	18.3	Fr	21.9	-0.9	14.6	27	180	19.8	3203 CT	WS DO	**MOE# 5704663** 0.0 YLLW MSND 6.1 GREY MSND 7.3 GREY CLAY 18.3 FSND 18.9 GREY MSND 22.9
4664	4 12	Sep-67	601171 4922881	268.8	23.2	Fr	21.9	-1.2	15.2	23	60	18.3	1510 CT	WS DO	**MOE# 5704664** 0.0 RED MSND 3.7 CSND 23.2
4665	4 12	Sep-67	601102 4922750	260.9	27.4	Fr	26.2	-1.2	16.8	45	60	19.8	1510 CT	WS PU	**MOE# 5704665** 0.0 TPSL MSND 0.6 MSND 10.7 HPAN CLAY 21.3 FSND 25.9 CSND 27.4
4666	4 13	Jul-53	600986 4921851	238.0	15.8	Fr	18.3	-1.2	12.2	45	60	16.8	1637 JT	WS DO	**MOE# 5704666** 0.0 GRVL MSND 15.2 FSND 18.3 CSND 19.8
4667	4 13	Jul-54	601023 4921723	237.7	15.5	Fr	17.1	-1.2	13.4	36	60	15.2	1637 JT	WS DO	**MOE# 5704667** 0.0 TPSL MSND 0.9 CSND 9.8 GRVL MSND CLAY 13.4 FSND 17.1 MSND CSND 18.3
4668	4 13	Sep-54	601078 4921880	235.6	14.9	Fr	17.4	-1.2	14.9	27	120	16.2	1637 JT	WS DO	**MOE# 5704668** 0.0 FSND 5.2 CSND GRVL 13.1 GRVL CLAY 14.6 FSND 17.1 CSND 18.6
4669	4 13	Sep-55	600709 4921700	239.9	12.8	Fr			10.4	32	120	12.2	1510 JT	WS DO	**MOE# 5704669** 0.0 GRVL 3.7 CSND 25.6
4670	4 13	Sep-55	600911 4921635	239.0	11.6	Fr	20.7	-2.4	10.4	27	120	12.5	1510 JT	WS DO	**MOE# 5704670** 0.0 GRVL 6.1 MSND 23.2
4671	4 13	Oct-56	601093 4921737	234.4	12.2	Fr	19.8	-3.0	11.6	27	60	12.2	1510 JT	WS DO	**MOE# 5704671** 0.0 MSND 22.9
4672	4 13	Apr-58	601092 4921934	235.0	13.1	Fr			13.1	23	120	14.6	1510 JT	WS DO	**MOE# 5704672** 0.0 GRVL 7.9 TPSL MSND 12.2 CSND 18.3
4673	4 13	Sep-58	600749 4921564	239.9	9.8	Fr	13.4	-1.8	9.8	32	120	10.7	1510 JT	WS DO	**MOE# 5704673** 0.0 GRVL 9.8 MSND 15.2
4674	4 13	Sep-58	600853 4921403	239.9	10.4	Fr	12.2	-1.8	9.4	27	120	10.7	1510 JT	WS CO	**MOE# 5704674** 0.0 GRVL 10.4 CSND 14.0
4675	4 13	Oct-60	600944 4921708	239.0	17.7	Fr	15.8	-1.8	11.6	23	60		1510 JT	WS DO	**MOE# 5704675** 0.0 GRVL 12.2 CSND 17.7
4676	4 13	Dec-60	600773 4921502	239.9	17.7	Fr	15.8	-1.8	11.6	27	60		1510 JT	WS DO	**MOE# 5704676** 0.0 GRVL 10.4 CSND 17.7
4677	4 13	Oct-61	600787 4921511	239.9	16.5	Fr	16.5	-1.8	12.2	23	120		1510 JT	WS DO	**MOE# 5704677** 0.0 CSND 10.7 MSND 18.3
4678	4 13	Oct-61	600875 4921430	239.9	19.8	Fr	19.5	-1.2	8.5	55		10.4	1637 CT	WS DO	**MOE# 5704678** 0.0 MSND 19.8 CSND 20.7
4679	4 13	Oct-62	601062 4922290	239.9	1.2	Fr			NR				1510 CT	WS DO	**MOE# 5704679** 0.0 BRWN CLAY 1.2 CSND 4.9 QSND 33.5
4680	4 13	May-63	601312 4922245	239.9	16.5	Fr	15.2	-1.2	3.0	23	60		1510 JT	WS DO	**MOE# 5704680** 0.0 MSND TPSL 3.0 MSND CLAY 15.2 CSND 16.5
4681	4 13	Sep-63	600984 4921810	237.7	19.8	Fr	18.6	-1.2	12.2	23	60	15.2	1510 CT	WS DO	**MOE# 5704681** 0.0 RED MSND 12.2 FSND 19.8
4682	4 13	Jan-65	601299 4922228	239.9	16.5	Fr	16.8	-0.9	2.4	23	120	5.5	1510 CT	WS DO	**MOE# 5704682** 0.0 TPSL 1.8 RED MSND 16.5 CSND 17.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4683	4 13	Apr-65	600967 4921752	239.0	13.1	Fr	17.7	-1.8	13.1	23	120	15.2	1626 DM	WS DO	**MOE# 5704683** 0.0 PRDG 12.5 GRVL 15.8 GREY MSND 19.5
4684	4 13	Jun-65	600876 4921433	239.9	15.8	Fr	17.4	-1.2	11.3	23	120	14.6	4715 CT	WS DO	**MOE# 5704684** 0.0 GRVL 6.1 FSND 15.8 FSND CSND 18.6
4685	4 13	Jun-66	600860 4921527	239.9	19.5	Fr	18.3	-1.2	12.2	23	120	16.8	1510 CT	WS PU	**MOE# 5704685** 0.0 TPSL 0.3 RED MSND 9.1 CSND 12.2 FSND 19.5
4686	4 13	Jun-66	600888 4921472	239.9	18.9	Fr	17.7	-1.2	12.2	23	120	15.2	1510 CT	WS DO	**MOE# 5704686** 0.0 TPSL 0.3 GRVL 9.1 MSND 18.9
4687	4 13	Jun-67	601389 4922193	239.9	24.4	Fr	23.2	-1.2	3.7	23	120	15.2	1510 CT	WS DO	**MOE# 5704687** 0.0 TPSL 0.3 RED TPSL 12.2 CLAY MSND 15.2 FSND 21.3 MSND 24.4
4688	4 14	Sep-54	601162 4920950	235.0	16.2	Fr	14.9	-1.2	4.9	14	120	10.7	5510 CT	WS DO	**MOE# 5704688** 0.0 MSND 16.2
4689	4 14	May-56	601059 4921122	237.1	20.7	Fr			7.9	14	120	8.2	5510 CT	WS DO	**MOE# 5704689** 0.0 MSND GRVL HPAN 18.9 MSND 20.7
4690	4 14	Aug-59	600974 4921221	236.8	11.0	Fr	13.4	-1.8	11.0	14	120		1510 JT	WS DO	**MOE# 5704690** 0.0 GRVL 12.2 MSND 15.2
4691	4 14	Nov-59	600967 4921265	236.8	14.9 8.2	Fr Fr	14.9	-1.8	8.2	32	120	9.1	1510 JT	WS DO	**MOE# 5704691** 0.0 GRVL 16.8
4692	4 14	Nov-59	601105 4921077	235.9	18.3	Fr	16.5	-1.8	6.1	18	120	7.6	1510 CT	WS DO	**MOE# 5704692** 0.0 GRVL 6.1 MSND 18.3
4693	4 14	Aug-60	601292 4920819	234.7	10.4	Fr	11.3	-1.5	4.0	14	180	8.5	1637 CT	WS DO	**MOE# 5704693** 0.0 MSND 4.6 GREY CLAY STNS 10.4 FSND 12.8
4694	4 14	Jul-62	601832 4921754	235.9	13.4	Fr	11.6	-1.8	6.1	23	120		1510 JT	WS DO	**MOE# 5704694** 0.0 RED MSND 1.8 GRVL MSND 11.6 MSND GRVL 13.4
4695	4 14	Sep-64	601006 4921950	236.8	18.0	Fr	18.0	-1.2	11.0	14	120	11.0	4715 CT	WS DO	**MOE# 5704695** 0.0 MSND 2.4 CSND FSND 7.0 MSND SILT GRVL 19.2 GREY CLAY 21.3
4696	4 14	Jul-65	601169 4920980	234.7	4.9	Fr	15.2	-1.5	4.9	18	120	6.4	1626 DM	WS DO	**MOE# 5704696** 0.0 TPSL 0.3 RED MSND 1.5 GREY FSND 13.7 GREY MSND 16.8
4697	4 14	Sep-65	601189 4920916	234.7	4.6	Fr	13.1	-1.8	3.7	18	120		1626 DM	WS DO	**MOE# 5704697** 0.0 PRDG 4.3 GREY FSND 9.1 GREY MSND STNS 12.8 GREY CSND 15.2
4698	4 14	Dec-65	601237 4920973	234.7	5.2	Fr	14.3	-1.5	5.2	23	240	8.2	1626 DM	WS DO	**MOE# 5704698** 0.0 PRDG 2.4 GREY MSND 13.7 GREY CSND STNS 16.8
4699	4 15	Aug-57	602176 4921262	234.7	16.8	Fr			2.4	23	120	3.7	5510 CT	WS DO	**MOE# 5704699** 0.0 TPSL MSND 0.3 MSND 11.6 CLAY STNS 15.5 MSND 19.2
4700	4 15	Apr-58	601286 4920780	234.7	9.4 3.4	Fr Fr			2.1	23	180	3.7	1510 JT	WS CO	**MOE# 5704700** 0.0 FSND 3.4 QSND 5.5 CLAY 9.4 GRVL 12.2

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4701	4 15	Aug-61	601375 4920755	234.7	13.7	Fr	13.7	-2.4	1.5	23	180		1510 JT	WS DO	**MOE# 5704701** 0.0 FSND 13.7 CSND 16.2
4702	4 15	Jul-62	601791 4921064	230.7	13.4	Fr	12.5	-1.2	7.6	9	60	11.9	2514 CT	WS DO	**MOE# 5704702** 0.0 FSND 13.7 BLUE CLAY 15.5
4703	4 15	Apr-65	601374 4920654	234.7	2.4	Fr	8.8	-1.8	2.4	27	270	4.6	1626 DM	WS DO	**MOE# 5704703** 0.0 TPSL 0.3 GRVL 1.8 GREY CLAY 7.3 CSND 10.7
4704	4 15	May-65	602056 4921479	236.8	17.4	Fr	17.4	-0.9	3.0	64	90	13.7	2514 CT	WS DO	**MOE# 5704704** 0.0 FILL 0.3 MSND 10.7 BLUE CLAY STNS 16.8 MSND 18.6
4705	4 15	Jul-65	601822 4921326	234.7	18.9 13.4	Fr Fr	20.4	-0.9	3.0	68	60	15.8	2514 CT	WS DO	**MOE# 5704705** 0.0 PRDR 13.4 MSND 15.8 BLUE CLAY 18.9 FSND MSND 21.3
4706	4 15	Mar-68	601322 4920741	234.7	24.4	Fr	23.2	-1.2	0.6	45	60	18.3	1510 CT	WS CO	**MOE# 5704706** 0.0 TPSL 0.3 RED MSND 3.7 CLAY MSND 12.2 BLUE CLAY 21.3 CSND 24.4
4707	5 16	Jul-65	601418 4920153	245.1	21.3	Fr	23.2	-1.2	12.2	18	120	18.9	1510 CT	WS DO	**MOE# 5704707** 0.0 FSND 9.1 FSND CLAY 21.3 MSND 24.4
4710	4 17	Apr-55	602001 4919736	269.7	48.8 12.2	Fr Fr			22.9	14	5760	45.7	2529 CT	WS ST	**MOE# 5704710** 0.0 MSND 36.6 GRVL 37.8 MSND 71.6 GRVL CSND 73.2
4735	5 9	Jul-63	599419 4923439	237.4	6.1	Fr	23.2	-0.9	5.5	14	120	22.9	4816 CT	WS DO	**MOE# 5704735** 0.0 RED MSND 2.7 BLUE CLAY 3.7 GREY FSND 27.4
4736	5 9	Jun-67	599421 4923244	212.8	25.0	Fr	23.8	-1.2	12.8	45	120	18.9	1510 CT	WS DO	**MOE# 5704736** 0.0 TPSL MSND 6.4 MSND CLAY 12.2 FSND 21.3 CSND 25.0
4737	5 11	May-52	599160 4921941	233.8	19.2	Fr	19.2	-3.4	12.2	23	30	12.8	5510 CT	WS DO	**MOE# 5704737** 0.0 TPSL MSND 0.3 FSND 19.2 MSND 22.6
4738	5 11	Oct-59	598949 4921903	229.8	5.8	Fr	10.4	-1.2	5.8	23	180	6.7	1510 JT	WS DO	**MOE# 5704738** 0.0 MSND 1.8 FSND 11.6
4739	5 11	Mar-64	599142 4921721	233.8	19.5	Fr	17.7	-1.8	10.4	23	60		1510 JT	WS DO	**MOE# 5704739** 0.0 RED MSND 11.0 FSND 19.5
4740	5 11	Nov-66	599343 4921971	235.9	24.4	Fr	23.2	-1.2	12.2	45	60	13.7	1510 CT	WS DO	**MOE# 5704740** 0.0 TPSL 0.3 RED MSND 7.6 CLAY MSND 21.3 MSND 24.4
4741	5 12	Jun-62	599685 4921958	240.8	28.7	Fr	26.8	-1.8	16.5	18	120		1510 JT	WS PU	**MOE# 5704741** 0.0 GRVL 21.3 FSND 28.7
4742	5 14	Jul-56	600926 4920905	235.0	23.5	Fr	20.4	-3.0	2.4	14	120	7.0	5510 CT	WS PU	**MOE# 5704742** 0.0 TPSL 0.3 MSND GRVL 11.6 CLAY MSND BLDR 19.2 MSND 23.5
4743	5 14	Sep-59	600764 4921207	239.9	15.2	Fr			9.1	23	120	10.7	1419 CT	WS DO	**MOE# 5704743** 0.0 PRDG 8.8 GRVL 11.9 FSND 15.2 GRVL 16.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4744	5 14	Jan-60	600853 4921274	239.9	12.2	Fr	16.5	-1.8	10.7	18	120	12.2	1510 JT	WS CO	**MOE# 5704744** 0.0 CSND GRVL 12.2 MSND 18.3
4745	5 14	Feb-60	600711 4921153	239.9	18.3	Fr	16.5	-1.8	12.2	23	180	12.8	1510 JT	WS DO	**MOE# 5704745** 0.0 GRVL 10.7 CSND 18.3
4746	5 14	Oct-60	600809 4921226	239.9	16.2	Fr	15.2	-0.9	11.6	45	60	12.8	1510 CT	WS DO	**MOE# 5704746** 0.0 GRVL 12.2 CSND 16.2
4747	5 14	Dec-60	600780 4921202	239.9	17.7	Fr	16.5	-1.2	11.6	45	120	13.7	1510 CT	WS DO	**MOE# 5704747** 0.0 GRVL 10.4 CSND 17.7
4748	5 15	May-66	600927 4919921	266.7			15.2	-1.2	11.6	18	120	13.7	4715 CT	WS DO	**MOE# 5704748** 0.0 MSND 14.9 FSND 16.5 MSND SILT 18.0
4749	5 16	Nov-51	601798 4919738	275.8	28.7	Fr	27.7	-3.4	19.2	18	30	31.1	5510 CT	WS ST	**MOE# 5704749** 0.0 PRDG 15.2 MSND 31.1
4750	5 16	Sep-65	601450 4920165	245.1	18.3	Fr	26.2	-1.2	12.2	23	120	18.3	1510 CT	WS DO	**MOE# 5704750** 0.0 BRWN CLAY 0.9 BRWN CLAY STNS 15.2 FSND 18.3 MSND 27.4
4751	5 16	Jun-66	600871 4919860	271.9	20.4	Fr	20.7	-1.2	16.8	18	120	18.3	4715 CT	WS DO	**MOE# 5704751** 0.0 MSND 16.5 CLAY MSND 20.4 FSND 21.9 MSND 22.3
4752	5 16	Sep-67	600760 4919805	275.2	30.5	Fr	29.3	-1.2	22.9	45	60	24.4	1510 CT	WS DO	**MOE# 5704752** 0.0 TPSL 0.9 CLAY MSND 11.6 FSND 25.9 CSND 30.5
4777	6 8	May-52	596735 4922632	194.8	3.7	Fr			FLW				5510 CT	WS ST	**MOE# 5704777** 0.0 TPSL 0.6 MSND CLAY STNS 4.0 BLUE CLAY 19.5 CLAY MSND 36.6
4778	6 11	Jan-59	599010 4921933	230.7	14.3	Fr	13.4	-0.9	7.0	32	120	13.7	2514 CT	WS DO	**MOE# 5704778** 0.0 PRDG 6.1 MSND 14.3
4779	6 11	Feb-59	598498 4921373	210.9	40.8	Fr			-3.0	114	90	4.6	2514 CT	WS DO	**MOE# 5704779** 0.0 TPSL 0.3 MSND 1.2 BLCK MUCK FSND CLAY 33.2 FSND 35.4 BLUE CLAY 39.6 MSND 40.2 GRVL 40.8
4780	6 13	Oct-67	599282 4920915	239.9	18.9	Fr			16.8	9			4608 BR	WS CO	**MOE# 5704780** 0.0 MSND 18.9
4781	6 15	Dec-67	599715 4919511	271.0	27.4	Fr	28.3	-1.8	21.3	36	120	25.9	1510 CT	WS ST	**MOE# 5704781** 0.0 TPSL 0.6 BRWN CLAY 5.8 HPAN 27.4 CSND 30.5
4818	7 9	Sep-51	596940 4921859	219.8	21.3	Fr	20.1	-2.4	17.4	9	30	18.0	5510 CT	WS ST	**MOE# 5704818** 0.0 PRDG 10.7 MSND 15.8 CLAY GRVL 19.5 MSND 23.8
4819	7 9	Oct-58	596167 4921693	199.9	10.4	Fr	10.1	-1.8	5.8	32	180	7.0	1510 JT	WS DO	**MOE# 5704819** 0.0 BRWN CLAY 1.8 BLUE CLAY 10.4 GRVL 11.9
4820	7 10	Jun-59	597015 4921778	221.0	19.8	Fr	16.2	-3.7	12.5	14	120	13.1	5510 CT	WS DO	**MOE# 5704820** 0.0 TPSL 0.3 MSND 1.2 MSND CLAY STNS 2.7 MSND CLAY 4.3 BLUE CLAY MSND BLDR 16.2 MSND 19.8

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
4821	7 14	Dec-66	598509 4919541	246.9	30.5	Fr	29.3	-1.2	16.8	45	120	19.8	1510 CT	WS ST	**MOE# 5704821** 0.0 TPSL 0.6 BRWN CLAY 4.9 HPAN BLDR 28.0 CSND 30.5
4822	7 16	Sep-57	599195 4918411	289.0	22.9	Fr			18.3	23		30.5	2529 CT	WS ST	**MOE# 5704822** 0.0 FSND 36.6 CSND 38.1
4824	7 16	Aug-61	599305 4918390	285.9	36.6	Fr	30.5	-3.7	22.3	273	1200	25.9	1413 CT	WS ST	**MOE# 5704824** 0.0 CLAY STNS 6.1 MSND GRVL 22.3 MSND 36.6
4848	8 14	Jan-65	596266 4918298	242.3	38.7	Fr	36.3	-2.4	8.5	36	240	21.3	3414 CT	WS CO	**MOE# 5704848** 0.0 BRWN MSND 3.7 SILT CLAY 30.5 FSND 38.7
4878	9 13	May-67	595932 4918627	219.2	32.6	Fr	32.6	-0.9	0.9	9	120	19.8	4715 CT	WS DO	**MOE# 5704878** 0.0 CLAY MSND 15.8 MSND 16.2 CLAY MSND GRVL 32.6 MSND GRVL 33.5
4952	1 17	Oct-59	604813 4922101	286.2					NR				1510 JT	AS -	**MOE# 5704952** 0.0 BLUE CLAY 82.3
4953	1 17	Oct-59	604768 4922133	289.0					NR				4102 CT	AS -	**MOE# 5704953** 0.0 BLUE CLAY 30.5
4954	1 17	Sep-63	604718 4922118	287.7	12.8	Fr	11.6	-1.2	6.1	91	120	6.7	1510 CT	WS ST	**MOE# 5704954** 0.0 CLAY 6.1 MSND 10.7 CSND 12.8
4959	1 22	Dec-64	603517 4923986	294.7	63.1 48.8	Fr Fr	63.1	-1.5	48.8	23	240	61.0	1510 CT	WS ST	**MOE# 5704959** 0.0 TPSL 0.6 BRWN CLAY STNS 12.8 BRWN CLAY MSND 33.5 FSND 63.1 MSND 64.6
4960	1 23	Aug-55	603364 4924221	297.8	62.8	Fr	61.3	-1.5	46.9	23	60	49.7	5510 CT	WS ST	**MOE# 5704960** 0.0 TPSL 0.3 MSND GRVL STNS 52.4 BLUE CLAY 57.6 QSND 58.8 GRVL 62.8
4993	2 16	Nov-58	604837 4921693	286.8					NR				5510 CT	AS -	**MOE# 5704993** 0.0 BRWN CLAY STNS MUCK 26.8 MSND 28.7 HPAN 29.3 BRWN CLAY MSND 42.7
4994	2 17	May-56	604678 4922031	283.8	9.1	Fr			1.2	23	120	4.3	2529 CT	WS DO	**MOE# 5704994** 0.0 CLAY 1.2 CLAY MSND 9.1 GRVL 9.8
5644	6 17	May-68	600652 4918971	278.0	25.3	Fr	30.5	-0.9	17.4	36	90	30.2	2514 CT	WS DO	**MOE# 5705644** 0.0 FILL 0.3 BRWN CLAY MSND 3.7 CSND 21.3 FSND CLAY 25.3 YLLW FSND 31.4
5645	6 14	Jun-68	599112 4920571	236.8	16.8	Fr	15.5	-1.2	9.1	45	120	15.2	1510 CT	WS DO	**MOE# 5705645** 0.0 TPSL 0.3 MSND 6.7 HPAN 13.7 CSND 16.8
5648	4 12	Feb-68	600992 4922451	249.9	15.8	Fr	20.7	-1.8	12.2	36	120	18.3	3203 CT	WS DO	**MOE# 5705648** 0.0 TPSL 0.3 CLAY MSND 5.5 YLLW MSND 14.0 GREY CLAY MSND 15.8 GREY FSND 22.6 CLAY 22.9
5929	3 12	Apr-70	602082 4923491	289.9	51.8	Fr	53.6 52.4	-1.2 -1.2	50.3	45	120	50.3	1510 CT	WS ST	**MOE# 5705929** 0.0 BRWN CLAY TPSL 0.9 GREY MSND 36.6 GREY FSND 51.8 GREY CSND 54.9
5997	4 13	May-68	601262 4922221	239.9	13.7	Fr	17.1	-0.9	12.5	18	120	14.3	1204 CT	WS DO	**MOE# 5705997** 0.0 MSND GRVL 18.0 GREY CLAY 18.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
5998	6 15	Jun-68	599412 4918981	270.1	24.7	Fr	27.4	-0.9	NR	32	120		1204 CT	WS DO	**MOE# 5705998** 0.0 CLAY MSND BLDR 4.0 CLAY GRVL 24.7 MSND GRVL CLAY 26.8 MSND 28.3
5999	5 14	Jun-68	600582 4921041	239.9	10.7	Fr	14.3	-0.9	7.9	18	120	11.6	1204 CT	WS DO	**MOE# 5705999** 0.0 GRVL 10.7 MSND 15.2 GREY CLAY 15.5
6006	4 14	Aug-68	601147 4921316	229.8	10.1	Fr	16.2	-1.8	7.9	32	60	9.1	1204 CT	WS DO	**MOE# 5706006** 0.0 TPSL 0.3 MSND GRVL 7.9 CSND 18.0
6044	5 16	Apr-68	600862 4919821	272.8	24.4	Fr	23.2	-1.2	15.2	23	120	19.8	1510 CT	WS DO	**MOE# 5706044** 0.0 TPSL 0.3 RED MSND 14.9 CLAY MSND 21.9 MSND 24.4
6045	5 16	Jan-68	601472 4920192	244.4	30.5	Fr	29.3	-1.2	6.1	23	120	18.3	1510 CT	WS DO	**MOE# 5706045** 0.0 HPAN STNS 27.4 CSND 30.5
6048	5 16	Jun-68	601052 4919914	260.0	15.2	Fr	12.8	-2.4	11.6	14	120	12.8	1510 CT	WS DO	**MOE# 5706048** 0.0 TPSL 0.3 MSND 9.1 CLAY MSND 15.2
6050	3 14	May-68	602732 4922896	290.8	48.8	Fr	47.5	-1.2	38.1	45	120	47.2	1510 CT	WS ST	**MOE# 5706050** 0.0 BRWN CLAY 9.1 CLAY MSND 38.1 BLUE CLAY STNS 45.7 CSND 48.8
6051	4 10	May-68	599861 4923001	243.8	19.8	Fr	18.6	-1.2	13.7	45	120	16.8	1510 CT	WS DO	**MOE# 5706051** 0.0 TPSL MSND 0.3 RED MSND STNS 17.7 CSND 19.8
6057	3 15	Oct-68	602162 4921481	237.7	12.2	Fr	11.0	-1.2	4.6	27	60	9.1	1510 CT	WS DO	**MOE# 5706057** 0.0 TPSL 0.6 BRWN CLAY MSND 10.7 MSND 12.2
6059	3 15	Nov-68	602112 4921521	236.8	14.6	Fr	13.4	-1.2	4.6	45	60	6.7	1510 CT	WS DO	**MOE# 5706059** 0.0 TPSL 0.6 MSND 10.7 CSND 14.6
6061	4 11	Dec-68	600822 4922681	253.9	19.8	Fr	18.6	-1.2	9.1	50	60	15.2	1510 CT	WS CO	**MOE# 5706061** 0.0 TPSL 1.5 BRWN CLAY MSND 12.2 FSND 15.2 CSND 19.8
6220	5 9	Feb-69	599491 4923391	237.7	18.3	Fr	17.1	-1.2	10.7	18	60	16.8	1510 CT	WS DO	**MOE# 5706220** 0.0 OBDN 1.5 RED MSND 13.7 FSND 18.3
6236	4 13	Apr-69	600792 4921521	239.9	12.2	Fr	14.3	-0.9	10.1	23	120	10.7	1204 CT	WS DO	**MOE# 5706236** 0.0 TPSL 0.3 MSND GRVL 3.7 MSND 15.2
6239	4 13	Apr-69	601512 4922371	249.9	11.9	Fr	14.3	-0.9	6.7	18	120	11.0	1204 CT	WS DO	**MOE# 5706239** 0.0 MSND 6.4 BRWN CLAY 9.1 GREY CLAY 11.9 MSND 15.2
6280	4 14	May-69	601212 4921051	234.7	57.9 54.9	Fr Fr	56.1	-2.4	3.4	227	1440	14.6	4816 CT	WS DO	**MOE# 5706280** 0.0 FSND 9.1 GREY CLAY SILT 32.3 GREY CLAY 45.4 SILT 52.1 FSND 57.0 MSND 58.5
6432	4 12	Jul-69	601062 4922471	253.0	26.5	Fr	26.5	-1.2	4.9	18	120	7.3	1204 CT	WS DO	**MOE# 5706432** 0.0 MSND 14.0 GREY CLAY 25.6 SILT 26.5 FSND 27.7
6541	1 19	May-69	604312 4922741	289.9	54.9	Fr	53.6	-1.2	39.6	45	120	45.7	1510 CT	WS DO	**MOE# 5706541** 0.0 TPSL CLAY 0.6 BRWN CLAY 14.3 BLUE CLAY 45.7 CSND 54.9

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
6542	3 11	Aug-69	601661 4924631	285.0	54.9	Fr	53.3	-1.5	41.1	45	120	47.2	1510 CT	WS ST	**MOE# 5706542** 0.0 TPSL CLAY 0.6 CLAY STNS 4.6 CSND 35.1 MSND 54.9
6548	5 16	May-69	600812 4919821	274.9	27.4	Fr	26.2	-1.2	18.3	23	60	21.3	1510 CT	WS DO	**MOE# 5706548** 0.0 TPSL 0.3 RED MSND 20.4 FSND CLAY 24.4 MSND 27.4
6552	1 16	Jun-69	604962 4921721	287.7	61.0	Fr	58.5	-2.4	36.6	45	120	48.8	1510 CT	WS DO	**MOE# 5706552** 0.0 TPSL 0.6 BRWN CLAY STNS 9.1 HPAN 54.9 CSND 61.0
6588	9 16	Aug-69	595612 4916521	292.9	41.5	Fr	42.7	-2.7	41.8	14	150	41.8	1204 CT	WS DO	**MOE# 5706588** 0.0 FILL GRVL 0.9 BRWN MSND GRVL CLAY 18.6 GREY GRVL MSND 29.9 GREY MSND 45.7
6589	4 13	Aug-69	600620 4921750	239.9	13.4	Fr	20.1	-0.9	12.5	23	75	14.0	1204 CT	WS DO	**MOE# 5706589** 0.0 MSND GRVL 6.1 MSND 21.0
6593	6 15	Aug-69	599462 4919021	268.8	21.9	Fr	25.9	-1.2	14.0	18	60	19.8	1204 CT	WS DO	**MOE# 5706593** 0.0 BRWN CLAY MSND 0.3 GREY MSND CLAY BLDR 6.1 GREY MSND CLAY 19.8 GREY GRVL MSND CLAY 20.4 BRWN MSND CLAY 21.9 BRWN MSND SILT 29.0 BLUE CLAY MSND 35.1
6594	5 15	Sep-69	600642 4919821	276.8	23.8	Fr	29.0	-0.9	20.4	18	60	23.8	1204 CT	WS DO	**MOE# 5706594** 0.0 BRWN FILL 0.9 MSND CLAY 5.5 MSND 30.2 SILT 32.0
6620	4 13	Aug-69	601412 4922211	239.9	22.3	Fr	23.8	-0.9	1.8	23	60	15.2	3203 CT	WS DO	**MOE# 5706620** 0.0 TPSL 0.3 MSND 11.9 CLAY 15.8 MSND CLAY 16.5 CLAY 22.3 MSND GRVL 24.1 MSND 24.7
6813	2 24	Sep-69	602341 4923781	289.9	54.9	Fr	53.6	-1.2	44.2	45	60	51.8	1510 CT	WS DO	**MOE# 5706813** 0.0 TPSL CLAY 0.6 BRWN CLAY 14.3 BLUE CLAY 30.5 CSND 54.9
6818	4 13	Oct-69	600942 4921621	238.7	19.8	Fr	18.6	-1.2	12.2	23	60	15.2	1510 CT	WS DO	**MOE# 5706818** 0.0 TPSL MSND 0.3 MSND GRVL 15.2 MSND 19.8
6821	3 12	Sep-69	602112 4923501	289.9	54.9 44.2	Fr Fr	53.6	-1.2	45.7	18	60	51.8	1510 CT	WS ST	**MOE# 5706821** 0.0 TPSL CLAY 0.6 CLAY MSND 3.4 CSND 34.7 FSND 44.2 CSND 54.9
6835	3 13	Sep-69	601612 4922341	249.9	23.5	Fr	23.5	-0.9	4.0	36	90	6.7	1204 CT	WS DO	**MOE# 5706835** 0.0 MSND 1.8 GREY MSND CLAY BLDR 7.3 GREY CLAY GRVL BLDR 14.6 GREY CLAY 18.9 GREY CLAY MSND GRVL 23.5 MSND 24.7
6849	4 13	Nov-69	601362 4922241	239.9	21.3	Fr	20.1	-1.2	1.2	23	60	9.1	1510 CT	WS DO	**MOE# 5706849** 0.0 TPSL 0.3 RED MSND 4.6 HPAN CLAY 12.2 MSND CLAY 18.3 CSND 21.3
6929	4 14	Nov-69	600962 4921271	236.8	9.8	Fr	15.2	-0.9	9.8	14	60	12.5	1204 CT	WS DO	**MOE# 5706929** 0.0 PRDG 7.9 BRWN MSND 16.2

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
6959	4 12	Dec-69	600862 4922321	240.8	14.3	Fr	15.5	-1.5	9.4	32	90	12.5	2514 CT	WS DO	**MOE# 5706959** 0.0 FILL 0.6 MSND BLDR 3.4 GREY CLAY BLDR 5.5 YLLW FSND 14.3 GREY MSND 17.1
7052	4 12	Jan-70	600572 4922361	240.8	30.5	Fr	27.4	-3.0	18.3	14	120	24.4	1510 CT	WS DO	**MOE# 5707052** 0.0 RED MSND STNS 19.8 MSND GRVL STNS 27.4 FSND 30.5
7075	4 12	Mar-70	600922 4922351	243.8	18.3	Fr	20.4	-0.9	12.2	27	60	15.2	3203 CT	WS DO	**MOE# 5707075** 0.0 BRWN MSND 9.1 GREY CLAY MSND 17.1 GREY MSND CLAY 18.3 GREY MSND 21.3
7076	4 13	Mar-70	601362 4922171	239.9	15.8	Fr	18.0	-0.9	1.8	9	60	15.8	3203 CT	WS DO	**MOE# 5707076** 0.0 BRWN TPSL 0.3 BRWN MSND 6.1 BRWN MSND GRVL 8.5 GREY MSND CLAY 15.8 GREY MSND GRVL 18.9
7153	6 15	May-70	599012 4919121	264.9	27.4	Fr	25.9	-1.5	15.2	23	120	18.3	1510 CT	WS ST	**MOE# 5707153** 0.0 BRWN CLAY BLDR 9.1 HPAN STNS 21.3 FSND 27.4
7155	8 9	Apr-70	594711 4921121	192.9	27.4	Fr			FLW				1510 CT	WS DO	**MOE# 5707155** 0.0 TPSL MSND 0.3 MSND CLAY 3.7 BLUE CLAY 24.4 FSND 27.4
7209	4 12	Feb-69	600922 4922331	241.7					NR				4715 CT	AS -	**MOE# 5707209** 0.0 GREY CLAY 32.0
7254	4 12	May-70	601052 4922551	255.7	22.3	-	27.7	-0.9	15.2	45	60	18.3	3203 CT	WS DO	**MOE# 5707254** 0.0 BRWN MSND 12.8 BRWN MSND CLAY 16.2 GREY CLAY MSND 22.3 GREY MSND 28.7
7256	4 12	Jun-70	601072 4922591	261.2	26.2	Fr	28.7	-0.9	19.5	27	60	24.1	3203 CT	WS DO	**MOE# 5707256** 0.0 BRWN MSND 14.0 GREY CLAY 25.6 GREY MSND 29.6
7262	8 9	Mar-70	595571 4921361	189.9	23.8	Fr	23.8	-0.9	-4.9	136	120	15.2	2514 CT	WS DO	**MOE# 5707262** 0.0 TPSL 0.3 YLLW MSND CLAY 3.7 GREY CLAY 22.6 YLLW MSND CSND 24.7
7287	7 12	Jun-70	596938 4919690	224.9	9.1 5.5	Fr Fr			5.5	23	60	7.6	4608 BR	WS DO	**MOE# 5707287** 0.0 GREY MSND 9.1
7448	1 24	Jul-70	603071 4924641	299.9	65.5	Fr	67.1	-1.2	54.9	45	120	57.9	1510 CT	WS ST	**MOE# 5707448** 0.0 BRWN TPSL 0.6 CLAY MSND STNS 15.2 HPAN 27.4 GRVL 39.6 CSND 65.5 FSND 68.6
7450	2 21	Aug-70	603632 4923371	292.9	51.8	Fr	50.6	-1.2	42.7	23	60	45.7	1510 CT	WS ST	**MOE# 5707450** 0.0 BRWN CLAY STNS 5.8 BLUE CLAY STNS 27.1 GREY CSND 47.2 CSND 51.8
7492	3 15	Sep-70	602672 4921401	239.0	19.8	Fr	20.7	-1.2	4.9	45	60	7.6	1510 CT	WS DO	**MOE# 5707492** 0.0 BRWN MSND 0.6 GREY CSND 7.0 HPAN STNS 19.8 CSND 21.9
7494	4 10	Sep-70	599841 4922971	240.8	15.2	Fr	18.3	-1.2	12.2	23	60	13.7	1510 CT	WS DO	**MOE# 5707494** 0.0 RED MSND 9.1 GREY CSND GRVL 15.2 CSND 19.8

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7605	4 12	Oct-70	601062 4922651	259.1	21.6	Fr	29.0	-0.9	21.6	32	60	24.7	3203 CT	WS DO	**MOE# 5707605** 0.0 BRWN MSND CLAY 5.5 BRWN MSND 11.9 GREY CLAY 21.0 GREY CLAY MSND 21.6 BRWN MSND 29.9
7700	4 13	Sep-70	601462 4922221	240.8	21.3	Fr			2.4	45	60	15.2	2514 CT	WS DO	**MOE# 5707700** 0.0 YLLW MSND 16.8 BLUE CLAY MSND GRVL 21.3 GRVL 21.6
7734	4 14	Oct-70	602022 4921501	236.8	11.9	Fr	11.9	-0.9	2.4	68	90	9.1	2514 CT	WS DO	**MOE# 5707734** 0.0 TPSL 0.3 BRWN MSND CLAY SILT 4.3 YLLW MSND 12.8
7735	3 15	Jul-70	602712 4921431	239.9	7.3	Fr	8.2	-0.9	4.9	23	120	7.6	2514 CT	WS DO	**MOE# 5707735** 0.0 TPSL 0.3 RED MSND 1.5 GREY CLAY MSND GRVL 7.3 YLLW MSND 9.1
7750	4 11	Oct-70	600741 4923521	281.9	47.2	Fr	48.5	-1.8	41.1			41.1	1510 CT	WS ST	**MOE# 5707750** 0.0 CLAY TPSL 0.6 BRWN CLAY STNS 25.0 HPAN STNS 36.6 RED MSND 45.7 MSND 50.3
7767	4 14	May-71	601192 4920921	234.7	16.2	Fr	15.2	-0.9	2.4	9	60	14.0	3203 CT	WS DO	**MOE# 5707767** 0.0 BLCK TPSL 0.3 BRWN SAND CLAY 9.8 BRWN SAND 16.2
7839	4 14	Dec-70	601912 4921681	234.7	12.2	Fr	15.2	-1.5	3.7	36	60	6.1	1510 CT	WS DO	**MOE# 5707839** 0.0 RED MSND STNS 4.3 HPAN 13.7 MSND 16.8
7910	3 14	May-71	601982 4921761	235.6	13.4	Fr	13.4	-1.2	3.0	45	60	3.0	1510 CT	WS DO	**MOE# 5707910** 0.0 RED TPSL SAND 0.6 HPAN STNS 9.1 HPAN 12.2 CSND 14.6
7911	7 13	May-71	597552 4919765	226.8	1.2	Fr	13.7	-1.5	4.9	23	60	4.9	1510 CT	WS DO	**MOE# 5707911** 0.0 BRWN CLAY MSND 0.9 MSND STNS 9.1 BLUE CLAY MSND 12.2 MSND 15.2
7948	3 15	May-71	602462 4921281	235.9	9.1	Fr	9.1	-0.9	3.0	14	90	9.1	2514 CT	WS DO	**MOE# 5707948** 0.0 BRWN CSND FSND 9.1 BRWN FSND 10.1
7952	3 15	Apr-71	602162 4921481	237.7	16.8	Fr	17.1	-1.2	3.7	45	60	4.6	1510 CT	WS DO	**MOE# 5707952** 0.0 TPSL SAND 0.3 RED SAND 8.2 HPAN 14.9 CSND 18.3
7980	7 13	Jun-71	597499 4919737	225.6	15.2	Fr	15.2	-1.2	6.1	23	60	6.1	1510 CT	WS DO	**MOE# 5707980** 0.0 MSND 1.2 CLAY MSND STNS 13.7 MSND 16.8
7981	3 13	Jul-71	601492 4922511	260.9	30.5	Fr	31.1	-1.2	21.3	23	60	24.4	1510 CT	WS DO	**MOE# 5707981** 0.0 BRWN TPSL MSND 0.9 WHTE CSND 27.4 MSND 30.5 FSND 32.3
7983	3 15	Jun-71	602112 4921521	236.8	14.9	Fr	14.9	-1.2	3.0	23	60	6.1	1510 CT	WS DO	**MOE# 5707983** 0.0 BRWN TPSL SAND 0.6 RED SAND 6.7 HPAN STNS 13.4 MSND 16.8
7984	3 14	Jun-71	602052 4921631	236.8	12.2	Fr			3.7	23	60	6.1	1510 CT	WS DO	**MOE# 5707984** 0.0 BRWN TPSL 0.6 HPAN 5.8 HPAN GRVL 12.2 MSND 13.7

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7985	3 13	Jul-71	601532 4922471	260.3	29.0	Fr	29.3	-1.2	18.3	45	60	19.8	1510 CT	WS DO	**MOE# 5707985** 0.0 BRWN OBDN MSND 6.4 CSND 25.9 WHTE MSND 30.5
7998	4 12	Apr-71	601062 4922531	254.5	27.4 23.8	Fr Fr	26.5	-0.9	14.3	45	60	17.4	3203 CT	WS DO	**MOE# 5707998** 0.0 BRWN SAND 11.9 GREY CLAY SILT 23.8 GREY SAND 26.2 BRWN SAND 27.4
8006	3 15	Jan-71	602812 4921501	241.7	37.2	Fr	36.9	-0.9	5.5	23	120	22.9	3203 CT	WS DO	**MOE# 5708006** 0.0 BRWN SAND FILL 0.9 BRWN SAND 3.0 BRWN CLAY 4.6 GREY CLAY 19.2 GREY CLAY STNS SILT 37.2 GREY SAND 37.8
8008	4 12	Jun-71	601002 4922341	242.9	15.5	Fr	14.6	-0.9	4.0	23	60	11.3	3203 CT	WS DO	**MOE# 5708008** 0.0 BLCK TPSL 0.6 BRWN SAND 3.0 GREY CLAY SAND 8.8 BRWN SAND 9.4 GREY CLAY 10.7 BRWN SAND 15.5
8014	4 11	Jun-71	600711 4923571	280.7	49.7	Fr	48.8	-0.9	42.1	27	90	42.7	3203 CT	WS DO	**MOE# 5708014** 0.0 BLCK TPSL 0.3 YLLW CLAY 3.0 GREY CLAY STNS 9.8 GREY SAND GRVL 12.5 BRWN CLAY 16.2 BRWN SAND 28.3 BRWN CLAY 36.6 BRWN CLAY SAND 39.0 BRWN SAND 49.7
8135	4 13	Aug-71	601472 4922421	253.9	16.5	Fr	16.5	-1.2	10.7	18	60	15.2	1510 CT	WS DO	**MOE# 5708135** 0.0 RED SAND 4.6 HPAN STNS 12.2 CSND 18.3
8137	1 16	Jul-71	605062 4921621	285.0	45.7	Fr	45.7	-1.2	42.7	45	60	45.7	1510 CT	WS DO	**MOE# 5708137** 0.0 BRWN CLAY TPSL 0.6 BRWN CLAY STNS MSND 8.2 HPAN STNS 25.6 CSND 35.1 WHTE HPAN 45.7 CSND 51.8
8216	4 12	Jun-71	601002 4922271	236.8	19.2	Fr	20.4 19.5	-0.9 -0.9	12.2	27	60	15.8	1204 CT	WS DO	**MOE# 5708216** 0.0 BRWN SAND 11.0 GREY CLAY SAND 19.2 BRWN FSND 21.3
8225	2 27	Sep-71	601611 4924941	285.0	77.7	Fr	76.2	-1.2	42.1	45	60	42.1	1510 CT	WS ST	**MOE# 5708225** 0.0 BRWN CLAY TPSL 0.6 BRWN CLAY STNS 11.0 HPAN SAND 42.7 CSND 54.9 GREY HPAN 77.7 CSND 81.4
8260	5 11	Aug-71	599462 4921971	239.9					12.2	23	90	16.5	3203 CT	WS DO	**MOE# 5708260** 0.0 BLCK TPSL 0.3 YLLW MSND STNS 7.3 GREY MSND 21.0 BRWN MSND CLAY 21.9
8264	5 11	Aug-71	599180 4921807	233.8	6.4	Fr	13.7	-0.9	10.7	18	121	12.8	3203 CT	WS DO	**MOE# 5708264** 0.0 YLLW MSND 6.4 GREY MSND 14.6
8307	8 13	Sep-71	596004 4918656	219.8	8.8	Fr			8.8	14	60	10.4	4608 BR	WS DO	**MOE# 5708307** 0.0 GREY GRVL 10.4 GREY CLAY 11.6
8341	3 15	Oct-71	602162 4921471	237.7	18.3	Fr	17.4	-0.9	3.0	23	60	10.7	1510 CT	WS DO	**MOE# 5708341** 0.0 TPSL 0.3 RED SAND 6.4 CLAY SAND 15.2 CLAY 17.4 CSND 18.3

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8343	4 12	Oct-71	600992 4922441	248.7	24.4	Fr	24.4	-0.9	11.6	23	60	15.2	1510 CT	WS DO	**MOE# 5708343** 0.0 BRWN TPSL 0.6 BRWN CLAY SAND 6.1 HPAN CLAY 24.4 CSND 25.3
8497	4 14	Jun-71	602042 4921521	236.8	7.6	Fr	10.1	-0.9	3.4	27	60	6.7	3203 CT	WS DO	**MOE# 5708497** 0.0 BRWN SAND 11.0
8506	5 16	Oct-71	600972 4919871	266.4	19.8 17.7	Fr Fr	18.9	-0.9	9.1	18	90	15.5	3203 CT	WS DO	**MOE# 5708506** 0.0 YLLW SAND 7.3 GREY SAND 11.9 YLLW SAND CLAY 17.7 GREY SAND 19.8
8540	4 15	Dec-71	602192 4921271	234.7	6.1	Fr			4.3	9	60	6.1	4608 BR	WS DO	**MOE# 5708540** 0.0 BRWN SAND 5.2 GREY CLAY 6.7
8658	9 13	Nov-71	594753 4917849	224.9	7.6	Fr			2.7	32	90	6.1	2514 CT	WS DO	**MOE# 5708658** 0.0 TPSL 0.3 YLLW SAND GRVL BLDR 7.6 GRVL 8.2
8747	4 13	Mar-72	601032 4921691	236.8	13.1	Fr	17.4	-0.9	13.1	18	90	16.2	1204 CT	WS DO	**MOE# 5708747** 0.0 GREY GRVL 9.1 BRWN SAND 18.3
8752	6 10	Mar-72	598611 4922161	224.9	28.0 22.9	Fr Fr	23.2	-4.6	6.1	446	1890	21.6	2402 CT	WS IR	**MOE# 5708752** 0.0 SAND 4.3 HPAN 11.0 MSND 29.0
8753	5 11	Feb-72	599961 4922621	235.0	30.5 27.4	Fr Fr	29.3	-1.2	18.6	91	360	29.0	2402 CT	WS DO	**MOE# 5708753** 0.0 SAND OBDN 8.2 CLAY 16.5 SAND 25.9 MSND 30.8
8754	6 11	Feb-72	598690 4921614	218.8	67.4 64.0	Fr Fr	65.5 64.3	-1.5 -1.2	5.2	191	600	59.7	2402 CT	WS PU	**MOE# 5708754** 0.0 SAND 21.9 CLAY 50.6 FSND 63.7 CSND 65.5 MSND 67.4
8825	4 11	May-72	600041 4922821	241.7	64.3	Fr	63.1	-1.2	13.1	36	120	45.7	3414 CT	WS DO	**MOE# 5708825** 0.0 TPSL 0.3 CLAY SAND GRVL 21.3 CLAY 45.7 SILT 62.5 MSND 64.3
8827	5 11	May-72	599062 4921821	232.0	9.8	Fr	15.5	-1.5	9.1	9	60	14.6	1204 CT	WS DO	**MOE# 5708827** 0.0 BRWN SAND 17.4 GREY SILT SAND 27.4
8828	6 13	Apr-72	598431 4920005	233.8	27.7	Fr	28.0	-0.9	5.8	27	60	10.7	1204 CT	WS DO	**MOE# 5708828** 0.0 BRWN SAND GRVL 3.7 GREY SAND GRVL CLAY 9.1 GREY CLAY SAND 27.7 BRWN SAND 29.0
8879	2 22	Jul-72	603362 4923821	294.7	5.2	Fr			5.2	14	60	7.3	4608 BR	WS DO	**MOE# 5708879** 0.0 GREY SAND 5.2 BRWN CLAY 9.8
8917	4 15	May-72	602062 4921471	236.8	14.6 12.8	Fr Fr	13.7	-0.9	2.4	73	60	12.2	2514 CT	WS DO	**MOE# 5708917** 0.0 YLLW SAND 8.5 BRWN CLAY SAND STNS 12.8 YLLW MSND CSND 14.6
8938	5 16	Jun-72	600922 4919871	269.7	48.8 46.3	Fr Fr	47.9	-0.9	27.4	36	60	33.5	3203 CT	WS DO	**MOE# 5708938** 0.0 BRWN SAND 12.5 BRWN SAND CLAY 15.5 GREY CLAY 42.1 GREY CLAY SAND 43.9 GREY SAND CLAY 46.3 SAND 48.8

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
8956	5 16	Apr-72	600932 4919871	268.8	46.6 44.2	Fr Fr	45.7	-0.9	25.9	36	75	32.0	3203 CT	WS DO	**MOE# 5708956** 0.0 BRWN TPSL 0.3 YLLW SAND 6.7 GREY SAND 12.2 YLLW SAND CLAY 16.8 GREY CLAY SILT 32.0 GREY CLAY 40.2 GREY SAND CLAY 44.2 GREY SAND 46.6
8960	3 13	Jun-72	601672 4922211	242.9	21.3 19.5	Fr Fr	20.4	-0.9	3.7	36	60	15.5	3203 CT	WS DO	**MOE# 5708960** 0.0 BRWN SAND 5.5 GREY CLAY 11.6 GREY CLAY STNS 17.1 GREY GRVL SAND CLAY 19.2 GREY CLAY 19.5 GREY SAND 21.3
8966	3 13	Jun-72	601712 4922181	242.9	18.3	Fr	18.9	-0.9	3.0	27	60	13.7	3203 CT	WS DO	**MOE# 5708966** 0.0 BRWN SAND 4.6 GREY CLAY SILT 10.4 GREY CLAY STNS 15.8 GREY GRVL SAND 17.7 GREY CLAY 18.3 GREY SAND 19.8
8976	4 13	Jan-72	601042 4921881	236.8	23.2 15.2	Un Fr	22.3	-0.9	15.2	18	120	18.3	3203 CT	WS DO	**MOE# 5708976** 0.0 TPSL 0.3 BRWN SAND CLAY 2.4 BRWN SAND 23.2
8983	4 13	Apr-72	601062 4921821	235.9	20.7 18.3	Fr Fr	19.8 18.9	-0.9 -0.9	11.6	36	120	19.8	2514 CT	WS PU	**MOE# 5708983** 0.0 BRWN SAND GRVL 7.6 YLLW MSND FSND 20.7
9009	7 13	Jun-72	597666 4919744	229.8	13.7 12.2	Fr Fr	12.5	-1.2	3.7	23	60	6.1	1510 CT	WS DO	**MOE# 5709009** 0.0 PRDG 3.7 SAND STNS 12.2 FSND 13.7
9015	4 13	Jan-72	601122 4922228	237.7	18.3	Fr	18.3	-1.2	3.0	23	60	6.1	1510 CT	WS DO	**MOE# 5709015** 0.0 RED SAND 3.0 RED SAND STNS 7.6 HPAN CLAY 16.8 FSND 19.8
9016	2 17	Jun-72	604562 4922191	283.8					NR				1510 CT	AS -	**MOE# 5709016** 0.0 BRWN CLAY 3.7 HPAN 12.8 BLUE CLAY HPAN 102.7
9114	3 15	Sep-72	602952 4921571	246.9	9.1	Fr			9.1	23	90	14.9	4608 BR	WS DO	**MOE# 5709114** 0.0 GREY SAND 2.1 GREY CLAY STNS 16.5
9116	3 13	Sep-72	601732 4922131	240.8	4.9	Fr			4.9	23	30	6.4	4608 BR	WS DO	**MOE# 5709116** 0.0 GREY SAND 8.5
9252	6 13	Aug-72	598393 4920021	233.8	28.0	Fr	28.3	-0.9	4.6	9	60	25.9	1204 CT	WS DO	**MOE# 5709252** 0.0 BRWN SAND GRVL 3.7 GREY CLAY SAND 28.0 BRWN SAND 29.3
9264	5 11	Oct-72	599810 4922188	242.9	24.4	Fr	24.4	-3.0	18.0	159	120	22.3	4816 RC	WS PU	**MOE# 5709264** 0.0 SAND 13.7 GRVL 14.6 SAND 27.4
9272	4 14	Apr-72	601451 4921941	236.5	21.3	Fr	20.7 18.9	-1.8 -1.8	7.9	218	480	14.3	4816 RC	WS PU	**MOE# 5709272** 0.0 FSND 5.8 MSND FSND 22.6 GREY CLAY SAND 49.1 CLAY GRVL 53.0 SAND GRVL 53.6 CLAY 57.3 GRVL 57.6 CLAY 68.3 SILT FSND 80.5 CLAY 86.9
9279	7 13	Oct-72	597572 4919691	228.9	15.2	Fr	14.0	-1.5	4.6	36	120	11.6	4816 CT	WS DO	**MOE# 5709279** 0.0 SAND 0.9 CLAY SAND 4.9 CLAY 6.7 FSND 15.5
9280	4 12	Oct-72	601062 4922671	264.3	23.8 20.7	Fr Fr	20.7	-3.0	9.4	45	120	18.0	4816 CT	WS DO	**MOE# 5709280** 0.0 MSND 14.6 FSND 23.8

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
9289	3 15	Jun-72	602712 4921421	239.0	18.0 16.2	Fr Fr	16.5	-0.9	4.0	45	120	12.8	4816 CT	WS DO	**MOE# 5709289** 0.0 SAND GRVL 8.5 GREY CLAY 10.7 SAND 16.2 CSND 18.0
9291	4 13	Jul-72	600932 4921571	239.0	20.4	Fr	19.2	-1.2	10.4	9	120	18.3	4816 CT	WS DO	**MOE# 5709291** 0.0 PRDG 12.2 FSND 20.4
9292	7 10	Jul-72	597061 4921861	222.8	32.3	Fr	32.3	-1.2	10.4	18	120	28.0	4816 CT	WS DO	**MOE# 5709292** 0.0 SAND 9.1 SAND CLAY 15.8 SAND SILT 31.7 FSND 33.5
9294	7 13	Jul-72	597626 4919816	228.9	18.3	Fr	17.4	-1.2	4.6	23	60	16.8	4816 CT	WS DO	**MOE# 5709294** 0.0 SAND 10.1 CLAY 12.8 FSND 18.6
9295	7 13	Jul-72	597608 4919797	228.9	19.8	Fr	19.2	-1.2	4.6	32	60	16.2	4816 CT	WS DO	**MOE# 5709295** 0.0 SAND 3.7 CLAY 8.5 FSND 20.4
9307	5 12	May-72	599652 4922001	240.5	25.9	Fr	25.6	-1.2	17.1	50	210	25.3	4816 RC	WS PU	**MOE# 5709307** 0.0 SAND 8.5 GRVL SAND 14.6 FSND 25.6 MSND 27.1 CLAY SAND 38.1
9326	4 17	Oct-72	602844 4920577	232.9	64.6	Fr	67.1	-4.6	-3.0	200	120		2801 RC	TH NU	**MOE# 5709326** 0.0 BRWN SAND 0.9 GREY CLAY SAND 6.4 GREY CLAY 18.9 GRVL SAND CLAY 20.1 GREY CLAY 49.4 GREY CLAY SAND 51.2 GREY FSND CLAY STNS 57.3 GREY CLAY SAND 64.9 GREY FSND CLAY STNS 70.7 GREY FSND CLAY 74.7 GREY CLAY 79.2 GREY CLAY SAND GRVL 82.6 GREY CLAY SAND GRVL 85.0 GREY CLAY SAND 87.2 GREY CLAY SAND GRVL 91.7 SAND GRVL 98.1 BLDR GRNT 99.1 GREY CLAY GRVL 109.7 BRWN LMSN 111.3
9327	4 16	Jan-72	602550 4920870	229.8	72.2 65.5	Fr Fr	65.5	-6.7	4.0	255	360	5.5	2801 RC	TH NU	**MOE# 5709327** 0.0 BLCK MUCK 1.5 WHTE FSND CLAY 5.2 GREY CLAY FSND 12.8 GREY CLAY 16.8 GREY FSND CLAY 46.9 GREY GRVL SAND 47.5 GREY CLAY 54.6 GREY SAND CLAY 61.3 GREY CLAY 65.8 GREY SAND GRVL CLAY 73.5 GREY CLAY 78.3 GREY SAND GRVL CLAY 91.4 SAND GRVL 96.9 BRWN LMSN 99.1
9354	5 11	Oct-72	599212 4921971	233.8	15.2	Fr	14.9	-1.2	11.9	23	60	12.2	1510 CT	WS DO	**MOE# 5709354** 0.0 RED CSND 12.2 BLCK FSND 16.2
9355	5 11	Oct-72	599292 4921981	234.7	16.8 15.2	Fr Fr	15.5	-1.2	10.7	23	60	13.7	1510 CT	WS DO	**MOE# 5709355** 0.0 RED SAND 12.2 MSND 16.8
9356	5 11	Nov-72	598770 4921940	226.8	14.6	Fr	13.1	-1.8	9.8	23	60	13.7	1510 CT	WS DO	**MOE# 5709356** 0.0 RED SAND 12.8 MSND 14.9
9380	4 12	Sep-72	600752 4922441	244.8	19.5 16.2	Fr Fr	18.0	-1.5	7.0	27	240	17.7	2514 CT	WS DO	**MOE# 5709380** 0.0 YLLW SAND BLDR 11.6 YLLW FSND 16.2 YLLW SAND 19.5
9381	3 15	Sep-72	602782 4921471	239.9	11.6 8.5	Fr Fr	10.7	-0.9	6.1	32	150	10.7	2514 CT	WS DO	**MOE# 5709381** 0.0 YLLW SAND 11.6

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
9382	4 13	Oct-72	600962 4921471	235.9	19.5 15.2	Fr Fr	17.7	-1.8	11.9	73	60	17.7	2514 CT	WS DO	**MOE# 5709382** 0.0 BRWN SAND GRVL 9.1 YLLW MSND 19.5
9383	4 13	Oct-72	600962 4921451	235.9	18.6 15.2	Fr Fr	17.1	-1.5	11.6	82	60	15.8	2514 CT	WS DO	**MOE# 5709383** 0.0 BRWN SAND GRVL 9.1 YLLW MSND FSND 18.6
9384	4 13	Oct-72	601052 4921771	237.1	22.6 21.3	Fr Fr	21.6	-0.9	12.8	91	120	20.4	2514 CT	WS DO	**MOE# 5709384** 0.0 SAND GRVL 11.9 BRWN SAND CLAY 21.3 CSND 22.6
9392	4 11	Nov-72	600382 4922421	239.9	29.0 27.1	Fr Fr	28.0 27.1	-0.9 -0.9	17.1	41	90	26.8	2514 CT	WS DO	**MOE# 5709392** 0.0 BRWN SAND GRVL BLDR 25.9 SAND GRVL 29.0
9393	4 11	Oct-72	600362 4922411	240.8	31.1 29.9	Fr Fr			18.3	18	210	29.9	2514 CT	WS DO	**MOE# 5709393** 0.0 BRWN SAND GRVL 0.6 GREY SAND 1.5 BRWN SAND GRVL CLAY 29.9 BRWN SAND GRVL SILT 31.1
9394	4 12	Nov-72	600472 4922351	232.9	30.2 29.0	Fr Fr	29.3	-0.9	18.6	27	220	29.0	2514 CT	WS DO	**MOE# 5709394** 0.0 SAND GRVL BLDR 16.8 BRWN SAND GRVL CLAY 30.2
9395	4 12	Oct-72	601112 4922721	267.3	26.2 19.2	Fr Fr	25.0	-0.9	18.0	91	90	21.3	2514 CT	WS DO	**MOE# 5709395** 0.0 YLLW SAND 4.6 BRWN CLAY 15.2 GREY CLAY FSND 19.2 YLLW MSND 26.2
9426	3 14	Sep-72	601962 4921801	235.3	4.6	Fr			4.6	23	60	6.4	4608 BR	WS DO	**MOE# 5709426** 0.0 GREY SAND 7.3
9479	5 14	Oct-72	600742 4921181	239.9	11.0	Fr	14.9	-0.9	11.0	55	60	11.6	1204 CT	WS DO	**MOE# 5709479** 0.0 BRWN SAND GRVL 15.8
9520	5 16	Sep-72	601472 4920191	244.8	24.4 16.2	Fr Fr	23.5	-0.9	16.2	32	60	20.1	3203 CT	WS DO	**MOE# 5709520** 0.0 BRWN CLAY 2.4 BRWN SAND 24.4
9521	5 16	Sep-72	601382 4920123	246.0	25.0 15.8	Fr Fr	24.1	-0.9	15.8	45	60	20.7	3203 CT	WS DO	**MOE# 5709521** 0.0 BRWN CLAY 2.7 BRWN SAND 25.0
9533	4 13	Dec-72	601362 4922171	239.9	19.8 18.6	Fr Fr	18.9	-0.9	9.1	32	60	13.7	3203 CT	WS DO	**MOE# 5709533** 0.0 BRWN SAND 17.7 BRWN CLAY 18.6 BRWN SAND CLAY 19.8
9550	3 15	May-72	602892 4921521	239.9	41.5 39.3	Fr Fr	40.5	-0.9	8.5	32	60	27.4	3203 CT	WS DO	**MOE# 5709550** 0.0 BLCK TPSL 0.6 BRWN SAND 4.9 GREY CLAY STNS 18.9 GREY CLAY GRVL 39.3 GREY SAND 41.5
9553	3 13	Sep-72	601762 4922181	241.7	21.0 19.2	Un Fr	20.1	-0.9	0.3	36	75	16.8	3203 CT	WS DO	**MOE# 5709553** 0.0 BRWN SAND CLAY STNS 6.1 GREY CLAY SAND 8.5 GREY CLAY 15.8 BRWN SAND CLAY 19.2 BRWN SAND 21.0
9554	3 15	Sep-72	602472 4921281	235.9	11.9 10.1	Fr Fr	11.0	-0.9	3.0	18	60	9.4	3203 CT	WS DO	**MOE# 5709554** 0.0 BRWN SAND CLAY 6.1 GREY SAND CLAY BLDR 7.6 GREY SAND GRVL 10.1 GREY SAND 11.9
9607	4 9	Jan-73	599361 4923721	237.7	7.6	Fr			7.6	14	60	10.4	4608 BR	WS DO	**MOE# 5709607** 0.0 GREY SAND 11.6
9728	7 13	Jan-73	597827 4919896	227.7	13.7	Fr	13.7	-0.9	2.1	14	65	12.2	3203 CT	WS DO	**MOE# 5709728** 0.0 BLCK TPSL 0.3 BRWN SAND STNS CLAY 13.7 BRWN SAND 14.6

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
9743	3 13	Jan-73	601502 4922521	264.3	30.5	Fr	29.6	-1.2	22.9	23	120	25.9	4816 CT	WS DO	**MOE# 5709743** 0.0 FSND 24.4 MSND 30.8
9929	4 12	May-73	600957 4922741	254.8	22.3	Fr	26.2	-0.9	14.9	45	60	18.0	3203 CT	WS DO	**MOE# 5709929** 0.0 BRWN SAND CLAY 13.1 GREY CLAY 22.3 BRWN SAND 27.1
9939	5 11	Apr-73	599249 4921990	234.7	12.2	Fr	16.8	-0.9	2.4	18	90	9.1	3203 CT	WS DO	**MOE# 5709939** 0.0 BRWN SAND 12.2 BRWN SAND 17.7
9944	2 21	Jun-73	602907 4922956	289.9	48.2	Fr	53.9	-0.9	39.6	45	75	44.2	3203 CT	WS DO	**MOE# 5709944** 0.0 BRWN CLAY SAND 9.1 BRWN SAND CLAY 18.0 GREY CLAY SAND 26.2 BRWN SAND 38.1 GREY FSND 40.2 GREY CLAY SAND 48.2 BRWN SAND 54.9
10026	9 13	Jun-73	594867 4918029	223.7	5.5	Fr			4.9		60	5.5	1830 BR	WS DO	**MOE# 5710026** 0.0 TPSL SNDY DNSE 0.3 BRWN MSND STNS PCKD 1.5 BRWN CLAY SNDY PCKD 5.5 GREY MSND LOOS 5.8 GREY CLAY SNDY STNS 7.6
10057	4 12	Jun-73	600832 4922394	246.3	29.0	Fr	28.0	-1.2	11.6	45	120	30.5	4816 RC	WS DO	**MOE# 5710057** 0.0 CLAY SAND 11.3 FSND SILT 29.0 FSND 30.5
10099	4 10	Jun-73	599923 4922806	239.0	18.3	Fr	19.8	-1.5	12.2	45	120	12.2	1510 CT	WS DO	**MOE# 5710099** 0.0 BRWN TPSL 1.2 BRWN SAND 21.3
10100	4 15	Jul-73	601362 4920641	234.7	23.2 6.1	Fr Fr	2.7	-1.2	1.2	23	120	19.8	1510 CT	WS ST	**MOE# 5710100** 0.0 BRWN FILL GRVL 1.5 BRWN MSND 6.1 GREY CSND 10.7 GREY CLAY SNDS 19.8 GREY HPAN 23.2 CSND 25.3
10103	4 12	Aug-73	600692 4922531	250.2	14.6	Fr	26.2	-0.9	13.7	36	120	15.2	1510 CT	WS DO	**MOE# 5710103** 0.0 PRDG 3.7 BRWN SAND GRVL 4.6 GREY CLAY 13.7 YLLW FSND 14.3 MSND 27.1
10126	6 10	May-73	598611 4922021	224.9	27.4 25.9	Fr Fr	26.2	-1.2	6.7	91	240		2402 CT	WS DO	**MOE# 5710126** 0.0 SAND 13.4 SAND SILT 21.9 MSND 27.4
10181	3 13	Aug-73	601662 4922291	246.9	17.7	Fr	18.3	-0.9	4.6	45	60	11.6	1204 CT	WS DO	**MOE# 5710181** 0.0 BRWN SAND 0.9 BRWN SAND CLAY GRVL 6.1 BRWN SAND 8.5 BRWN SAND GRVL CLAY 10.7 GREY CLAY SAND 17.7 BRWN SAND 19.2
10286	4 12	Oct-73	600812 4922321	242.0	17.7	Fr	18.6	-0.9	14.9	14	120	17.1	1510 CT	WS DO	**MOE# 5710286** 0.0 BRWN TPSL SNDY LOOS 0.6 GRVL BLDR LOOS 4.9 BRWN FSND 17.1 BRWN MSND 17.7 GREY MSND 19.5 GREY CLAY SAND SLTY 19.5
10287	4 12	Sep-73	600812 4922321	242.0	25.0	-			NR				1510 CT	AS -	**MOE# 5710287** 0.0 BRWN TPSL LOOS 1.2 GRVL LOOS 5.5 GREY FSND DRY 20.7 GREY CLAY SAND 25.0 GREY CLAY SAND MUCK 42.7
10288	4 12	Sep-73	600812 4922321	242.0					NR				1510 CT	AS -	**MOE# 5710288** 0.0 BRWN TPSL LOOS 0.9 GRVL LOOS 4.3 YLLW SAND 15.5 YLLW FSND CLAY LYRD 18.0 GREY SAND CLAY SLTY 18.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
10332	3 13	Sep-73	601622 4922346	249.9	24.1	Fr	25.3	-0.9	4.6	36	80	7.6	3203 CT	WS DO	**MOE# 5710332** 0.0 BRWN SAND STNS 7.6 GREY CLAY SAND STNS 24.1 GREY SAND 26.2
10336	4 10	Aug-73	600551 4923821	278.3	37.2	Fr	48.5	-0.9	30.5	36	90	39.6	3203 CT	WS DO	**MOE# 5710336** 0.0 BRWN SAND CLAY STNS 20.7 BRWN CLAY 37.2 BRWN SAND 49.4
10348	4 12	Aug-73	600932 4922731	254.2	27.1	Fr	28.0	-0.9	18.3	36	70	22.9	3203 CT	WS DO	**MOE# 5710348** 0.0 BRWN SAND 7.0 BRWN SAND 17.1 GREY CLAY 27.1 GREY SAND 29.0
10366	7 9	Sep-73	595815 4921748	192.9	18.3	Fr	19.8	-1.5	3.4	136	120	7.0	2514 CT	WS DO	**MOE# 5710366** 0.0 TPSL 0.3 GREY CLAY 12.5 GREY SAND CLAY GRVL 18.3 GREY MSND 21.3 GREY SAND CLAY 22.6
10403	5 11	Sep-73	599160 4921990	233.8	12.2	Fr	14.9	-0.9	9.4	32	90	14.6	2514 CT	WS DO	**MOE# 5710403** 0.0 YLLW FSND CLAY 15.8
10599	5 11	Nov-73	598892 4921958	228.9	6.1	Fr	12.8	-0.9	5.8	27	60	9.1	1204 CT	WS DO	**MOE# 5710599** 0.0 BRWN SAND 9.8 BRWN SAND STNS 13.7
10600	4 12	Dec-73	600752 4922411	245.1	29.9 17.7	Fr Fr	32.3	-0.9	14.3	23	120	22.9	1510 CT	WS DO	**MOE# 5710600** 0.0 BRWN TPSL 0.6 BRWN SAND GRVL 5.2 GREY HPAN BLDR 17.7 BRWN SAND 18.3 GREY SAND STNS 29.3 BRWN SAND CLAY 33.2
10722	5 10	Jan-74	599361 4922571	234.7	53.0 19.5	Fr Fr	53.3	-1.5	17.7	18	360	19.5	2340 CT	WS DO	**MOE# 5710722** 0.0 BLCK FILL 0.3 BRWN SAND CLAY FILL 0.9 BRWN SAND SILT FGRD 14.6 BLGR CLAY SILT PORS 19.5 GREY SAND SILT FGRD 21.6 BLUE CLAY SILT PCKD 25.0 BRWN SAND STNS CLAY 25.3 BLGR SAND CLAY SILT 37.5 BLUE CLAY PCKD DNSE 53.0 GREY SAND SILT LOOS 55.8 GREY SILT 55.8
10725	4 13	Jan-74	601489 4922122	239.9	17.1 13.4	Fr Fr	20.1	-1.8	12.8	14	120	18.9	1510 CT	WS DO	**MOE# 5710725** 0.0 BRWN TPSL SAND 0.6 BRWN GRVL SAND 9.8 GREY SAND CLAY 13.4 GREY SAND STNS SILT 17.1 GREY SAND CLAY 19.2 GREY MSND STNS 21.9
10833	9 15	Jan-74	596612 4917321	314.9	70.1	Fr	71.6	-1.5	61.3	45	90	73.2	2514 CT	WS DO	**MOE# 5710833** 0.0 TPSL LOOS DKCL 0.3 RED SAND LOOS 1.5 GREY HPAN BLDR PCKD 16.8 YLLW SAND LOOS 26.2 BRWN CLAY SAND PCKD 31.7 GREY SAND SILT PCKD 59.4 YLLW FSND LOOS 70.1 YLLW SAND PCKD 73.2
10843	6 15	Jan-74	599731 4919342	266.7	16.8	Fr	22.6	-1.8	16.8	45	90	19.8	3203 CT	WS DO	**MOE# 5710843** 0.0 BRWN TPSL 0.3 BRWN SAND STNS PCKD 11.9 BRWN SAND LOOS DRY 16.8 BRWN SAND WBRG 24.4
10895	4 12	Sep-73	600921 4922429	247.8	27.4	Fr	25.6	-1.2	15.2	18	120	22.9	4816 CT	WS DO	**MOE# 5710895** 0.0 SAND 20.7 FSND 28.0
10896	4 14	Sep-73	602014 4921483	236.8	20.4	Fr	18.0	-1.2	5.2	27	120	14.9	4816 CT	WS DO	**MOE# 5710896** 0.0 FSND 20.4 CLAY 20.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
10897	5 14	Aug-73	600069 4920855	240.8	20.1	Fr	19.5	-1.5	5.8	91	120	18.9	4816 CT	WS IN	**MOE# 5710897** 0.0 SAND GRVL 6.4 CLAY SAND 12.8 GREY FSND 20.1 BRWN FSND 22.3
10985	6 11	May-74	598861 4921971	228.9	18.3	Fr	19.2	-0.9	9.1	14	110	17.1	1204 CT	WS DO	**MOE# 5710985** 0.0 GREY FSND LOOS 8.2 GREY SILT FSND 16.8 GREY FSND SILT CLAY 19.5 GREY FSND 20.7
10989	8 16	Mar-74	596962 4917121	314.9	56.4	Fr	64.3	-1.8	56.4	27	60	57.9	1204 CT	WS DO	**MOE# 5710989** 0.0 BRWN SAND 21.0 GREY SAND GRVL CLAY 22.9 GREY CLAY 25.3 BRWN SAND 27.7 BRWN SAND GRVL CMTD 54.6 BRWN SAND 66.1
11031	4 12	May-74	600919 4922638	249.9	14.6	Fr	21.3	-1.2	9.8	32	120	12.2	1452 CT	WS DO	**MOE# 5711031** 0.0 BRWN GRVL STNS 3.7 GREY FSND 12.2 GREY FSND 14.6 FSND 18.9 YLLW FSND SILT 21.3 YLLW MSND 22.6
11034	4 12	Nov-73	600521 4922268	221.6					NR				1510 CT	AS -	**MOE# 5711034** 0.0 BRWN SAND GRVL 5.5 GREY HPAN 17.1 SAND GRVL 23.2 STNS 23.5
11144	8 8	Jun-74	594311 4921171	219.8	44.8 21.9	Fr Fr	46.0	-0.9	25.3	45	120	29.0	1452 CT	WS DO	**MOE# 5711144** 0.0 BRWN FILL 0.6 BRWN TPSL 1.2 YLLW GRVL SAND 7.9 YLLW FSND 15.8 GREY CLAY 32.0 GREY FSND SILT CLAY 36.6 GREY HPAN CLAY LYRD 44.8 YLLW FSND MSND 46.9
11192	6 14	Apr-74	598656 4919677	239.9	25.3	Fr	25.6	-1.8	7.0	45	60	15.2	3203 CT	WS DO	**MOE# 5711192** 0.0 BRWN TPSL 0.3 YLLW SAND 7.6 BRWN CLAY 11.6 BRWN SAND GRVL CLAY 18.9 GREY SAND CLAY HARD 25.3 BRWN SAND WBRG 27.4
11218	4 12	Feb-74	600947 4922494	249.9	9.1	Fr	22.6	-0.9	9.1	27	70	13.7	3203 CT	WS DO	**MOE# 5711218** 0.0 PRDG 1.5 BRWN SAND CLAY 12.5 BRWN SAND 23.5
11219	7 15	Feb-74	598962 4918971	271.3	18.3	Fr	19.8	-1.8	9.1	45	60	13.7	3203 CT	WS DO	**MOE# 5711219** 0.0 BRWN TPSL 0.3 YLLW SAND GRVL STNS 6.1 BRWN SAND GRVL STNS 18.3 BRWN SAND WBRG 21.6
11276	4 11	Jul-74	600150 4922418	224.9	31.7	Fr	30.2	-1.2	19.5	23	120	25.0	1413 RC	WS DO	**MOE# 5711276** 0.0 GRVL 10.7 GREY CLAY STNS 25.9 GREY SAND 31.7
11277	4 11	Jul-74	600143 4922415	224.9	32.0	Fr	30.8	-1.2	19.2	27	120	24.4	1413 RC	WS DO	**MOE# 5711277** 0.0 BRWN SAND GRVL 12.2 BLUE CLAY SAND 24.4 BRWN SAND 32.0
11296	3 13	Jun-74	601712 4922221	243.8	91.1 17.7	Fr Fr	96.6	-3.0	14.9	341	1440	21.9	4816 RC	WS MU	**MOE# 5711296** 0.0 SAND STNS 7.0 CLAY GRVL 17.7 SAND GRVL 25.3 CLAY SILT 43.6 CLAY GRVL 51.2 SILT CLAY 72.2 CLAY 86.9 SAND GRVL 101.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
11326	9 8	Aug-74	594252 4921086	219.8	32.3	Fr	41.8	-0.9	22.9	23	120	29.0	1452 CT	WS DO	**MOE# 5711326** 0.0 BLCK TPSL STNS SAND 0.6 BRWN GRVL 8.5 YLLW SAND 9.8 GREY SAND CLAY 11.6 GREY FSND 18.3 GREY CLAY 32.3 GREY SAND SILT 38.4 YLLW MSND 42.7
11330	5 14	Aug-74	600644 4921132	239.9	10.1	Fr	14.9	-0.9	10.1	27	65	11.3	1204 CT	WS DO	**MOE# 5711330** 0.0 GREY CSND 2.7 GREY GRVL 6.1 GREY CSND CGVL 15.8
11410	2 25	Feb-74	602711 4924771	294.7	78.6	Fr	78.6	-2.4	47.5	136	1200	68.6	2402 CT	WS IR	**MOE# 5711410** 0.0 SAND 3.0 CLAY 6.1 HPAN 14.0 SAND 16.2 GRVL 20.4 SAND GRVL 22.9 HPAN 63.4 CLAY 67.1 SAND 76.2 GRVL 81.1
11412	6 9	Mar-74	597606 4922599	205.4	21.0	Fr			-1.8				2402 CT	WS IR	**MOE# 5711412** 0.0 SAND 0.9 CLAY BLDR 4.0 SAND 10.1 CLAY 12.5 SAND 21.0
11575	2 19	Nov-74	604112 4922571	282.9	44.2	Fr	44.5	-1.2	35.7	45	90	36.0	2801 RC	WS DO	**MOE# 5711575** 0.0 BRWN CLAY SNDY LOOS 3.0 GREY CLAY STNS PCKD 9.4 GREY CLAY GRVL PCKD 15.5 GREY CLAY STNS PCKD 22.6 GREY CLAY SOFT 32.9 GREY CLAY GRVL BLDR 34.4 GREY CLAY HARD 42.4 GREY CLAY GRVL 43.3 GREY CLAY 43.9 GREY CLAY GRVL BLDR 44.2 GRVL SAND CLAY 45.7 GRVL SAND CLAY 62.8
11635	4 12	Aug-74	601112 4922821	261.8	25.9	Fr	28.0	-0.9	15.2	36	120	18.3	3203 CT	WS DO	**MOE# 5711635** 0.0 BRWN SAND CLAY 13.1 GREY CLAY 25.9 BRWN SAND 29.0
11653	4 12	Jul-74	601012 4922471	249.9	67.1	Fr	67.1	-1.5	18.6	32	120	65.8	2514 CT	WS DO	**MOE# 5711653** 0.0 YLLW SAND FILL 0.3 BRWN SAND TPSL 0.6 YLLW SAND 15.2 GREY SAND 28.3 GREY CLAY 63.1 GREY CLAY FSND VERY 67.1 GREY FSND 68.6
11656	3 14	Sep-74	602012 4921671	235.9	8.8	Fr	10.1	-0.9	2.7	23	210	8.2	2514 CT	WS DO	**MOE# 5711656** 0.0 YLLW SAND GRVL 5.5 YLLW GRVL SILT STNS 8.8 YLLW CSND 11.0
11846	4 10	Oct-74	599911 4922821	239.9	20.1	Fr	17.7	-1.2	10.7	23	120	16.5	4816 CT	WS DO	**MOE# 5711846** 0.0 SAND GRVL 10.7 SAND CMTD 15.2 FSND 20.1
11867	10 15	Sep-74	595466 4916545	289.9	86.9	Fr	85.0	-0.9	66.8	36	300		4816 RC	WS DO	**MOE# 5711867** 0.0 CLAY 2.7 CLAY GRVL 23.2 SAND GRVL 32.3 SAND GRVL CMTD 42.1 SAND SILT 47.9 SAND 51.2 SILT 61.9 CLAY 78.6 MSND FSND 87.2
11966	4 12	Aug-74	600992 4922771	255.1	17.1	Fr	25.6	-0.9	16.5	27	60	18.6	1204 CT	WS DO	**MOE# 5711966** 0.0 GREY CSND 5.5 GREY CLAY SAND 16.8 GREY CSND 17.1 GREY SAND CLAY 18.9 GREY FSND 26.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
11975	3 12	Jan-75	601362 4923021	282.9	51.2 36.6	Fr Fr	53.0	-1.8	46.6	23	120	48.5	1452 CT	WS ST	**MOE# 5711975** 0.0 BRWN TPSL STNS 0.6 BRWN SAND GRVL CLAY 16.5 GREY CLAY STNS 36.6 YLLW SAND CLN SHRP 38.4 GREY HPAN STNS 43.0 YLLW MSND GRVL DRY 51.2 YLLW FSND MSND WBRG 55.8
11983	3 14	Dec-74	601910 4921975	238.0	78.9	Fr	73.2	-4.6	2.7	646	1441	14.9	4816 RC	WS MU	**MOE# 5711983** 0.0 SAND GRVL 2.4 SAND CLAY LYRD 14.9 FSND 16.8 CLAY 24.1 MSND 29.6 FSND 41.5 CLAY 52.4 FSND 64.9 CLAY SAND SILT 72.8 MSND 78.9
11984	3 13	Jun-74	601899 4922306	251.2	91.1 17.7	Fr Fr	96.6	-3.0	14.9	341	1440	21.9	4816 RC	WS MU	**MOE# 5711984** 0.0 SAND STNS 7.0 CLAY GRVL 17.7 SAND GRVL 25.3 CLAY SILT 43.6 CLAY GRVL 51.2 SILT CLAY 72.2 FSND 86.9 CLAY 91.1 SAND GRVL 101.5
12061	7 13	Nov-74	597713 4919803	228.6	7.6	Fr	16.5	-0.9	6.1	36	130	9.1	3203 CT	WS DO	**MOE# 5712061** 0.0 BRWN CLAY 7.6 BRWN SAND 17.4
12071	3 14	Dec-74	602012 4921671	235.9	8.2	Fr	8.2	-0.9	1.5	91	60	4.3	2514 CT	WS DO	**MOE# 5712071** 0.0 TPSL DKCL 0.3 BRWN MSND CSND 9.1
12072	3 13	Jun-74	601912 4922321	251.2	91.1 17.7	Fr Fr	96.6	-3.0	14.9	341	1440	21.9	4816 RC	WS MU	**MOE# 5712072** 0.0 SAND STNS 7.0 CLAY GRVL 17.7 SAND GRVL 25.3 CLAY SILT 43.6 SILT CLAY 72.2 FSND 86.9 CLAY 91.1 SAND GRVL 101.5
12098	5 16	Jan-75	601162 4919971	253.9	7.3	Fr	8.2	-1.5	2.4	32	60	7.6	2514 CT	WS DO	**MOE# 5712098** 0.0 FILL LOOS 0.6 BRWN CLAY SOFT 2.7 GREY CLAY GRVL SAND 5.8 YLLW SAND SILT PCKD 7.3 YLLW SAND LOOS 9.8
12099	4 9	Feb-75	599411 4923671	239.0	16.2	Fr			7.3	64	60	15.8	2514 CT	WS DO	**MOE# 5712099** 0.0 TPSL DKCL 0.3 BRWN SAND BLDR 1.2 BRWN MSND 11.0 GREY CLAY SAND 16.2 YLLW MSND CSND 18.6
12173	4 13	May-75	601112 4922071	230.7	13.7	Fr	16.8	-0.9	8.5	23	120	12.2	1452 CT	WS DO	**MOE# 5712173** 0.0 BRWN TPSL SAND STNS 0.9 YLLW CSND CGVL 11.0 YLLW MSND 14.6 YLLW FSND 17.7
12174	3 12	May-75	601662 4922871	288.3	53.9	Fr	54.9	-1.8	49.7	23	120	51.5	1452 CT	WS DO	**MOE# 5712174** 0.0 BRWN TPSL STNS 0.6 BRWN CLAY SAND 3.7 BRWN GRVL SAND 7.3 YLLW FSND MSND DRY 53.9 YLLW FSND 57.9 GREY FSND SILT DRTY 63.4
12271	4 12	May-75	600912 4922721	254.2	22.3	Fr	19.8	-1.2	NR	36	120	19.2	4816 CT	WS DO	**MOE# 5712271** 0.0 MSND 14.6 GREY FSND 18.6 BRWN FSND 22.3
12500	4 11	Jul-75	600162 4922521	239.3			29.0	-0.9	18.3	136			5206 RC	WS DO	**MOE# 5712500** 0.0 BRWN SAND BLDR 9.1 GRVL CLAY 31.7
12522	6 11	Sep-75	598961 4921971	229.8	12.2	Fr	14.3	-1.2	8.2	23	120	13.1	1452 CT	WS DO	**MOE# 5712522** 0.0 BLCK TPSL SAND 0.6 BRWN SAND STNS DRY 12.2 YLLW FSND STNS MSND 15.8

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12595	4 13	Oct-75	601012 4921571	235.9	12.8	Fr	18.9	-1.2	12.2	23	120	16.5	1452 CT	WS DO	**MOE# 5712595** 0.0 BLCK TPSL SAND 0.6 YLLW FSND 1.8 YLLW GRVL STNS 9.8 BRWN SAND 15.2 YLLW SAND CLAY LYRD 20.1
12884	3 14	Mar-76	602012 4921771	236.8	6.4	Fr	7.3	-0.9	1.8	68	60	3.7	1452 CT	WS DO	**MOE# 5712884** 0.0 BLCK TPSL SAND 0.3 BRWN MSND 6.4 YLLW MSND FSND 8.2
12926	5 11	Nov-75	599412 4921971	239.0	28.3 13.7	Fr -	28.0	-1.5	13.7	73	60	18.3	2340 CT	WS DO	**MOE# 5712926** 0.0 BLCK SAND TPSL 0.3 BRWN MSND LOOS 2.4 BRWN MSND CLAY PCKD 18.3 BRWN SAND GRVL PCKD 21.6 GREY FSND SILT PCKD 22.6 BRWN CLAY SILT PCKD 26.8 BRWN SAND LOOS 29.6
12984	5 15	Feb-76	600862 4919921	269.7	18.3	Fr	24.4	-0.9	NR	23	120	21.3	3660 CT	WS DO	**MOE# 5712984** 0.0 BRWN SAND DRY 24.4 YLLW MSND 25.6
13060	3 15	Jan-76	602312 4921271	234.7	9.8	Fr	9.8	-1.2	2.1	18	140	10.1	2514 CT	WS DO	**MOE# 5713060** 0.0 YLLW SAND SILT 9.8 YLLW FSND 11.0
13071	4 13	Mar-76	601412 4922411	253.0	23.2	Fr	23.5	-0.9	13.1	64	60	21.9	2514 CT	WS DO	**MOE# 5713071** 0.0 BRWN FSND CLAY 11.0 GREY CLAY 18.6 BRWN CLAY SAND 23.2 YLLW MSND FSND 24.4
13102	7 13	May-75	598271 4920091	221.9	25.0	Fr	25.9	-0.9	4.0	91	60	13.7	2514 CT	WS DO	**MOE# 5713102** 0.0 PRDG 9.1 GREY SAND SILT BLDR 25.0 WHTE FSND MSND 26.8
13114	9 16	Jul-75	595692 4916551	296.0	46.6	Fr			42.1	23	80	45.7	2514 CT	WS DO	**MOE# 5713114** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL BLDR 20.4 BRWN SAND GRVL LOOS 39.6 GREY SAND CLAY 46.6 YLLW SAND 48.2
13127	9 16	Sep-75	595582 4916501	292.0	78.6	Fr	78.6	-2.4	69.5	45	120	76.2	2514 CT	WS DO	**MOE# 5713127** 0.0 TPSL LOOS DKCL 0.3 BRWN CLAY PCKD 1.8 BRWN CLAY SAND PCKD 8.2 YLLW SAND GRVL BLDR 43.6 YLLW SAND SILT PCKD 47.2 YLLW SAND PCKD 50.3 GREY SAND CLAY LYRD 61.9 GREY CLAY HARD 78.6 GREY SAND PCKD 81.1
13138	5 16	Oct-75	601098 4919917	311.8	37.8	Fr	38.7	-1.2	18.0	18	60	37.8	2514 CT	WS DO	**MOE# 5713138** 0.0 TPSL LOOS 0.3 BRWN CLAY BLDR PCKD 4.3 BRWN CLAY SAND PCKD 6.1 GREY CLAY SAND PCKD 7.3 YLLW SAND SILT PCKD 9.8 GREY SILT PCKD 14.3 GREY CLAY STKY 21.6 GREY CLAY SNDY HARD 37.8 YLLW SAND PCKD 39.9
13148	3 14	Dec-75	602182 4921431	237.7	7.3	Fr	7.6	-0.9	3.0	45	120	7.3	2514 CT	WS DO	**MOE# 5713148** 0.0 BRWN SAND CLAY 5.2 YLLW SAND 8.5
13190	4 13	Apr-76	600972 4921471	235.9	12.5	Fr	21.0	-1.2	11.9	32	120	15.5	1452 CT	WS DO	**MOE# 5713190** 0.0 BLCK TPSL 0.6 BRWN FILL SAND TPSL 1.5 YLLW GRVL SNDY 9.8 BRWN SAND STNS 16.2 YLLW FSND 22.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
13313	4 10	Jul-76	599851 4922931	239.9	16.8	Fr	23.8	-0.9	14.9	27	60	19.8	1204 CT	WS DO	**MOE# 5713313** 0.0 BRWN SAND GRVL BLDR 11.9 BRWN SAND CLAY DRTY 16.8 BRWN FSND 24.7
13342	3 14	Jun-76	602722 4922981	292.9			43.6	-1.2	35.4	32	120		1452 CT	WS DO	**MOE# 5713342** 0.0 PRDR 44.2 FSND MSND 44.8
13343	3 14	Jun-76	602162 4921471	237.7	7.3	Fr			1.8	14	120	4.9	1452 CT	WS DO	**MOE# 5713343** 0.0 BLCK TPSL SAND DRY 0.6 BRWN SAND 1.8 BRWN GRVL STNS LOOS 4.9 GREY CLAY STNS 7.6 BRWN SAND CLAY LYRD 11.3
13344	4 14	Jun-76	601712 4921971	237.7					1.8	45	120	3.7	1452 CT	WS DO	**MOE# 5713344** 0.0 BLCK TPSL SAND 0.6 BRWN SAND STNS 1.8 GREY GRVL CLAY 8.2 GREY CLAY SAND STNS 12.8 GREY CSND STNS 15.5
13345	4 13	Jul-76	601212 4922161	239.0	18.0	Fr	19.5	-0.9	5.8	32	120	9.1	1452 CT	WS DO	**MOE# 5713345** 0.0 BLCK TPSL SAND 0.6 BRWN CLAY 1.2 RED SAND STNS 9.1 GREY GRVL CLAY LOOS 16.8 GREY SAND STNS CLAY 20.4 SILT 20.4
13412	4 12	Feb-75	600962 4922551	252.4	17.1	Fr	18.6	-0.9	12.8	32	60	15.2	3203 CT	WS DO	**MOE# 5713412** 0.0 BRWN SAND 4.3 BRWN CLAY 6.7 GREY CLAY SAND 8.8 GREY CLAY 17.1 GREY SAND 19.5
13439	1 23	May-75	603362 4924181	297.8	56.7	Fr	60.0	-0.9	50.3	32	60	53.3	3203 CT	WS DO	**MOE# 5713439** 0.0 BRWN SAND CLAY STNS 47.9 GREY CLAY 56.7 BRWN SAND 61.9
13549	4 12	Aug-76	600962 4922571	250.9	18.0	Fr	20.1	-0.9	11.6	32	120	14.0	1452 CT	WS DO	**MOE# 5713549** 0.0 BRWN FILL SAND SOFT 2.4 BRWN SAND SOFT 3.7 GREY GRVL SAND SOFT 6.4 GREY CLAY SAND STNS 13.4 YLLW SAND SOFT 15.5 YLLW FSND 21.0 GREY SAND SILT 21.0
13551	4 12	Sep-76	600952 4922621	250.5	17.7	Fr	19.5	-0.9	11.3	23	120	13.7	1452 CT	WS DO	**MOE# 5713551** 0.0 BRWN TPSL SAND 0.6 BRWN FILL SAND 2.4 GREY SAND CLAY STNS 6.1 GREY FSND 18.3 YLLW SAND 20.4 GREY SAND SILT 20.4
13598	5 14	Jul-76	600762 4921121	237.7	8.2	Fr	8.2	-1.8	-0.9	14	60	9.4	2514 CT	WS DO	**MOE# 5713598** 0.0 TPSL LOOS 0.3 GREY CLAY PCKD 1.8 GREY HPAN BLDR HARD 8.2 YLLW FSND CLAY LYRD 10.1
13603	3 15	May-76	602412 4921271	234.7	7.9	Fr	7.9	-0.9	4.9	18	60	8.5	2514 CT	WS DO	**MOE# 5713603** 0.0 TPSL LOOS DKCL 0.3 BRWN SAND LOOS 1.5 YLLW SAND PCKD 3.4 YLLW SAND GRVL SILT 7.9 YLLW SAND LOOS 8.8
13610	7 9	Jul-76	596111 4921821	198.7	19.2	Fr	19.5	-0.9	6.1	55	90	11.3	1204 CT	WS DO	**MOE# 5713610** 0.0 BRWN CLAY SOFT 4.9 BRWN CLAY SAND SOFT 11.0 GREY CLAY SILT 19.2 GREY CSND 20.4

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13634	4 12	Sep-76	600912 4922321	240.8					NR				1452 CT	WS DO	**MOE# 5713634** 0.0 BRWN TPSL STNS LOOS 1.2 BRWN SAND STNS 3.7 GRVL 6.1 GREY CLAY SAND 14.6 GREY CLAY STNS 16.2 GREY CLAY SILT 21.3
13635	4 12	Sep-76	600912 4922371	243.8	14.6	Fr	16.5	-0.9	7.0	45	60	10.1	1452 CT	WS DO	**MOE# 5713635** 0.0 BRWN TPSL SAND 0.6 BRWN SAND LOOS 4.6 GREY SAND STNS LOOS 6.7 GREY SAND CLAY LYRD 9.1 YLLW FSND 17.4
13838	4 10	Sep-76	600551 4923821	278.3	48.8	Fr	49.1	-0.9	35.7	27	60	42.7	1204 CT	WS DO	**MOE# 5713838** 0.0 BRWN SAND CLAY 13.7 BRWN SAND 29.6 GREY SAND CLAY 39.6 BRWN SAND 50.0
13842	4 13	Sep-76	601162 4922121	235.9	18.3	Fr	18.9	-0.9	13.4	18	120	16.5	1452 CT	WS DO	**MOE# 5713842** 0.0 BRWN TPSL 1.2 BRWN GRVL FILL 2.1 YLLW SAND STNS 7.0 YLLW GRVL 9.8 YLLW SAND STNS 15.2 GREY SAND SILT CLAY 19.8
13845	4 13	Oct-76	601172 4922121	235.9	18.3	Fr	17.4	-0.9	10.7	14	120	14.6	1452 CT	WS DO	**MOE# 5713845** 0.0 BRWN SAND FILL LOOS 0.9 BRWN SAND STNS 4.9 BRWN SAND GRVL 10.7 GREY GRVL SAND CLAY 12.8 GREY SAND GRVL CLAY 18.3 GREY SAND GRVL CLAY 19.2
13846	4 13	Oct-76	600862 4921641	239.9	18.3	Fr	19.2	-0.9	13.1	45	180	15.8	1452 CT	WS DO	**MOE# 5713846** 0.0 BRWN SAND STNS LOOS 3.0 GREY CGVL CSND 9.1 GREY SAND GRVL 12.2 BRWN SAND STNS 17.4 BRWN SAND LOOS 21.0
14017	3 12	Jan-77	601402 4922831	276.8	39.9	Fr	40.2	-1.2	35.7	36	60	40.2	2514 CT	WS DO	**MOE# 5714017** 0.0 BRWN SAND BLDR 3.0 BRWN SAND 24.4 BRWN SAND CLAY 25.9 GREY CLAY SAND SILT 39.9 BRWN FSND MSND 41.5
14018	5 16	Jan-77	601290 4920065	248.1	6.4	Fr	7.3	-1.5	-0.3	23	60	7.6	2514 CT	WS DO	**MOE# 5714018** 0.0 BRWN SAND CLAY STNS 6.4 YLLW FSND 8.8 BRWN CLAY 8.8
14023	5 11	Oct-76	599482 4922001	239.9	26.8	Fr	26.8	-0.9	11.9	41	120	23.5	2514 CT	WS DO	**MOE# 5714023** 0.0 PRDG 13.1 YLLW SAND SILT 26.8 YLLW MSND 27.7
14030	3 12	Dec-76	601312 4922721	276.8	27.4	Fr	30.2	-0.9	21.0	82	60	28.0	2514 CT	WS DO	**MOE# 5714030** 0.0 YLLW SAND 31.1
14031	3 12	Dec-76	601362 4922821	275.8	30.5	Fr	30.5	-0.9	21.6	45	120	27.7	2514 CT	WS DO	**MOE# 5714031** 0.0 FSND MSND 30.5 YLLW MSND 31.4
14124	4 13	May-77	600962 4921571	237.7	17.4	Fr	16.2	-1.2	6.1	23	180	15.2	4004 CT	WS DO	**MOE# 5714124** 0.0 UNKN 1.2 BRWN CLAY BLDR 10.7 SAND CLAY 15.2 SAND DRTY 18.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
14137	4 13	Mar-77	600912 4921671	238.7	13.4	Fr	19.8	-2.1	11.9	36	120	16.2	1452 CT	WS DO	**MOE# 5714137** 0.0 BRWN TPSL LOOS 0.6 BRWN SAND STNY 1.2 BRWN GRVL 12.2 GREY SAND FGRD 22.3 GREY SILT 22.3
14157	4 13	Nov-76	601062 4921821	235.9	19.2	Fr	20.1	-0.9	13.1	45	120	15.2	1452 CT	WS DO	**MOE# 5714157** 0.0 BRWN TPSL LOOS 0.6 BRWN FILL STNS SAND 1.2 BRWN GRVL SAND HARD 10.7 BRWN SAND STNS LOOS 17.4 BRWN GRVL SAND LOOS 18.3 BRWN SAND LOOS 21.6
14163	10 13	Jan-76	594692 4917752	224.9	21.6	Fr	22.3	-0.9	10.7	45	90	15.2	3203 CT	WS DO	**MOE# 5714163** 0.0 BRWN SAND 4.6 GREY SAND CLAY WBRG 9.8 GREY CLAY 21.6 GREY SAND GRVL 23.2
14220	9 13	Apr-76	594834 4918011	223.1	21.6	Fr	22.3	-0.9	6.1	45	90	11.3	3203 CT	WS DO	**MOE# 5714220** 0.0 FILL 1.5 BRWN SAND GRVL 7.0 GREY CLAY SILT 12.5 GREY CLAY 21.6 GREY SAND WBRG 23.2
14356	4 9	Jun-77	599411 4923671	239.0	10.7	Fr	17.4	-0.9	7.0	23	90	13.4	3135 CT	WS DO	**MOE# 5714356** 0.0 BRWN CLAY 4.6 SAND HARD PCKD 11.6 SAND LOOS WBRG 18.3
14409	2 22	Jun-77	603612 4923621	293.8	50.3	Fr	52.1	-1.2	44.5	32	60	45.7	1452 CT	WS DO	**MOE# 5714409** 0.0 BRWN CLAY STNS 2.4 BRWN SAND STNS 6.7 YLLW SAND DRY 36.0 GREY CLAY 38.4 GREY SAND CLAY 41.8 GREY CLAY 43.3 GREY SAND CLAY 48.8 GREY SAND 50.9 GREY SAND FGRD 53.3
14414	9 13	Jun-77	594674 4917826	220.4	11.9	Su	11.9	-0.9	2.7	14	60	10.7	3660 CT	WS DO	**MOE# 5714414** 0.0 BLCK TPSL 0.3 GREY SAND GRVL DRY 11.9 GREY SAND GRVL WBRG 12.8
14597	5 16	Jul-77	601212 4920021	249.9	6.7	Fr	7.9	-0.9	0.3	5	85	7.9	1222 CT	WS DO	**MOE# 5714597** 0.0 BRWN GRVL FILL 0.9 BRWN CLAY SAND 6.7 BRWN SAND FGRD 9.1
14600	10 13	Sep-77	594622 4917373	225.9	24.1	Fr	24.1	-0.9	6.7	55	105	14.3	1222 CT	WS DO	**MOE# 5714600** 0.0 BRWN FSND 4.3 BRWN CLAY SAND SILT 24.1 GREY SAND 25.3
14811	5 14	Nov-77	600365 4920942	236.5	15.2	Fr	17.4	-1.2	7.3	32	60	12.2	1452 CT	WS IN	**MOE# 5714811** 0.0 BRWN TPSL STNS 0.6 YLLW GRVL STNY LOOS 7.9 GREY SAND SILT FGRD 19.2
14812	5 11	Nov-77	599112 4921921	232.9	14.0	Fr	17.1	-0.9	8.8	23	120	13.1	1452 CT	WS DO	**MOE# 5714812** 0.0 BRWN FILL SAND 0.3 BLCK TPSL SAND 0.9 BRWN SAND 14.0 YLLW FSND MSND 18.0
14813	4 13	Nov-77	601412 4922271	240.8	15.8	Fr	19.5	-0.9	2.4	23	60	6.7	1452 CT	WS DO	**MOE# 5714813** 0.0 BLCK TPSL SAND 0.3 BRWN FILL SAND STNS 1.2 BRWN SAND LOOS 4.6 BRWN CLAY SAND STNS 8.5 BRWN GRVL SAND 14.9 GREY CLAY SAND 15.8 BRWN SAND 20.4

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
14844	3 12	Nov-77	601512 4922721	280.4	52.4	Fr	50.3	-1.2	41.5	36	120	46.9	4816 CT	WS DO	**MOE# 5714844** 0.0 SAND 14.6 SAND GRVL 16.8 SAND 32.6 GREY CLAY 42.7 SAND CMTD 45.4 MSND 48.5 FSND 52.4
14996	4 15	Oct-77	602162 4921321	234.7	18.9	Fr	18.9	-0.9	FLW	32	80	7.6	3135 CT	WS DO	**MOE# 5714996** 0.0 BLCK TPSL 0.9 BRWN SAND 4.3 GREY CLAY SILT SAND 18.9 GREY SAND 19.8 GREY SAND CLAY 20.4
15074	3 15	Jul-77	602462 4921271	235.9	20.1	Fr	20.1	-0.9	NR	91	120		2514 CT	WS DO	**MOE# 5715074** 0.0 PRDR 8.8 BRWN CLAY SAND 20.1 YLLW SAND CGRD 21.0
15152	5 15	Apr-78	600062 4920871	240.8	20.7	Fr	21.3	-0.9	16.2	23	60	17.7	3660 CT	WS DO	**MOE# 5715152** 0.0 BLCK TPSL 0.3 BRWN CLAY 8.5 BRWN SAND DRY 20.7 BRWN SAND 22.3
15324	4 13	Jul-78	601112 4921821	234.7	14.6	Fr	16.8	-0.9	13.1	18	120	15.2	1452 CT	WS DO	**MOE# 5715324** 0.0 BRWN TPSL SAND 0.6 BRWN SAND CGRD 2.7 GREY GRVL 7.9 GREY SAND STNS 18.3 GREY CLAY 18.3
15326	5 11	Jul-78	598911 4921921	228.9	10.4	-	12.5	-0.9	5.8	23	120	9.4	1452 CT	WS DO	**MOE# 5715326** 0.0 BRWN TPSL SAND 0.6 BRWN SAND LOOS 7.9 GREY GRVL SAND 10.1 BRWN MSND FSND 13.7
15353	7 9	Jul-78	596711 4922421	189.9	40.5	Fr	40.5	-0.9	FLW	23	60	35.1	1222 CT	WS DO	**MOE# 5715353** 0.0 BRWN FSND 1.5 GREY CLAY SILT 40.5 GREY SAND 41.5
15374	5 11	Jul-78	599412 4921921	239.0	21.3	Fr	22.3	-1.2	14.6	36	90	19.8	3602 CT	WS DO	**MOE# 5715374** 0.0 BRWN SAND 0.6 CLAY SNDY 21.3 BRWN SAND WBRG 23.5
15456	6 14	Aug-78	599626 4920558	244.8	15.5	Fr	17.7	-0.9	9.4	23	75		4816 RC	WS DO	**MOE# 5715456** 0.0 MSND 5.5 MSND GRVL LYRD 8.2 GRVL CLAY LYRD 10.1 CLAY GRVL LYRD 15.5 MSND 21.3
15462	4 13	Jul-77	601512 4922171	239.9	18.9	Fr	17.4	-1.8	3.4	14	180	8.5	1452 CT	WS DO	**MOE# 5715462** 0.0 PRDR CLAY STNS 18.9 BRWN GRVL CLAY 19.2 GREY SILT 19.5
15526	2 20	Jul-78	603935 4923131	290.8	47.5 18.3	Fr -	53.9	-1.2	43.3	32	60	47.5	1452 CT	WS ST	**MOE# 5715526** 0.0 PRDG 1.5 YLLW CLAY 18.3 BRWN CLAY GVLY 36.6 BRWN SAND STNS 47.2 YLLW FSND CLN 55.2
15527	4 14	Aug-78	601212 4921021	234.7	33.5 17.1	Fr -	34.1	-0.9	1.8	32	60	10.7	1452 CT	WS DO	**MOE# 5715527** 0.0 BLCK TPSL SAND 0.3 YLLW FILL SAND 1.5 BRWN SAND 6.4 GREY SILT STNS DRTY 17.7 GREY CLAY SOFT 33.5 BRWN FSND 35.4
15530	4 14	Sep-78	601112 4921121	235.9	12.5	Fr	16.8	-0.9	4.9	23	60	14.0	1452 CT	WS DO	**MOE# 5715530** 0.0 PRDG 3.0 MSND LOOS 17.7 CLAY SILT SAND 17.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
15754	4 13	Dec-78	600812 4921421	239.9	18.6	Fr	20.4	-0.9	10.7	68	60	10.7	1452 CT	WS DO	**MOE# 5715754** 0.0 BLCK TPSL SAND 0.6 BRWN SAND GRVL DRY 18.6 BRWN CSND 21.9
15755	4 13	Dec-78	600912 4921521	239.0	21.3	Fr	22.6	-1.2	12.2	32	60	20.1	1452 CT	WS DO	**MOE# 5715755** 0.0 PRDG 1.8 BRWN GRVL 9.8 BRWN FSND 24.1 GREY SILT 24.1
15802	3 12	Jul-78	601512 4922821	282.9	29.0	Fr	30.8	-0.9	22.3	36	120	25.9	2514 RC	WS DO	**MOE# 5715802** 0.0 YLLW SAND 31.7 BRWN CLAY 40.2 BLUE CLAY 45.7
15813	3 12	Aug-78	601412 4922721	285.0	36.9	Fr	36.9	-1.2	28.0	55	120	36.0	2514 RC	WS DO	**MOE# 5715813** 0.0 BRWN SAND 17.7 BRWN SAND CLAY 36.9 BRWN FSND MSND 38.1
15822	3 12	Oct-78	601612 4922821	281.3	27.4	Fr	30.2	-0.9	19.8	55	60	27.4	2514 CT	WS DO	**MOE# 5715822** 0.0 BRWN SAND SILT 31.1
15870	7 13	Oct-78	597589 4919706	228.9	9.8	Fr	15.8	-0.9	3.7	45	60	8.2	1222 CT	WS DO	**MOE# 5715870** 0.0 GREY SAND GRVL 4.6 GREY SAND CLAY 9.8 GREY FSND 16.8
15970	4 13	Jan-79	601062 4921871	235.9	17.7	Fr	18.9	-2.1	12.2	23	120	14.0	1452 CT	WS DO	**MOE# 5715970** 0.0 PRDG 1.2 BRWN SAND STNS DRY 11.6 BRWN FSND DRY 17.7 BRWN SAND WBRG 21.3 WHTE CLAY 21.3
16103	4 14	Apr-79	601012 4921571	235.9	2.4	Fr	14.0	-0.9	2.4	114	60	4.3	3203 CT	WS DO	**MOE# 5716103** 0.0 BRWN TPSL 0.3 BRWN SAND CLAY 2.4 BRWN SAND 14.9
16104	4 14	Apr-79	601712 4921371	234.7	10.7	Fr	12.8	-0.9	6.1	23	60	10.7	3203 CT	WS DO	**MOE# 5716104** 0.0 BRWN SAND 13.7 GREY SAND 15.8 GREY CLAY 28.0
16105	7 9	Jun-78	596761 4922171	197.8	18.0	Fr	21.9	-0.9	14.9	45		16.5	3203 CT	WS DO	**MOE# 5716105** 0.0 TPSL 0.3 BRWN SAND CLAY 7.0 BRWN SAND GRVL PCKD 18.0 BRWN SAND 22.9
16112	7 13	Jun-79	598421 4919822	233.8	28.3	Fr	28.3	-0.9	7.3	55	60	12.8	1222 CT	WS DO	**MOE# 5716112** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL STNS 6.1 BRWN CLAY SAND SOFT 14.0 GREY CLAY SAND BLDR 28.3 GREY FSND 29.3
16165	2 23	May-79	602612 4923421	293.8	53.3	Fr	61.3	-1.2	46.9	45	90	49.4	1452 CT	WS DO	**MOE# 5716165** 0.0 BLCK TPSL 0.6 GREY SAND CLAY 14.6 BRWN CSND 32.3 GREY FSND 50.9 GREY CLAY 52.4 GREY SILT 57.9 GREY CSND 62.5
16325	4 9	Aug-79	599661 4923571	244.8	12.2	Fr	14.9	-1.2	9.8	23	120	11.9	1452 CT	WS DO	**MOE# 5716325** 0.0 BRWN FSND 17.4
16460	5 11	Jul-79	599784 4922159	241.4			24.4	-2.4	17.1	45	300	21.6	4816 RC	WS PU	**MOE# 5716460** 0.0 SAND GRVL LYRD 15.2 MSND 28.7 CLAY 29.0 MSND 36.9 FSND CLAY 44.8 CLAY 47.2

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
16461	7 13	Sep-79	597679 4919780	228.9	16.5	Fr	16.5	-0.9	5.2	36	120	10.7	3660 CT	WS DO	**MOE# 5716461** 0.0 BLCK TPSL 0.3 WHTE SAND 3.0 GREY SILT SAND 7.3 BLUE CLAY 10.1 BRWN SILT 12.8 BRWN FSND HARD 14.6 BRWN FSND LOOS 17.4
16462	5 11	Jul-79	599755 4922017	241.7	25.9	-	25.9	-2.4	16.5	68	480	22.6	4816 RC	WS PU	**MOE# 5716462** 0.0 FSND GRVL 12.2 FSND 16.8 MSND FGVL LYRD 21.3 MSND 25.3 CLAY 25.9 MSND 29.6 CLAY 30.5
16466	7 8	Aug-79	595561 4921921	189.9	36.0	Fr	36.9	-1.2	-3.0				4816 RC	WS DO	**MOE# 5716466** 0.0 CLAY SOFT 29.0 SILT CLAY SAND 36.0 FSND SILT 39.3 SILT CLAY 53.3 CLAY SAND 58.5 SAND SILT 75.3 LMSN 76.8
16585	6 14	Nov-79	599612 4920521	246.0	12.5	Fr	19.8	-1.2	12.5	32	120	19.5	4816 CT	WS DO	**MOE# 5716585** 0.0 MSND 18.3 FSND 22.3
16587	4 15	Nov-79	602112 4920921	229.8	20.7	Fr	21.3	-0.9	0.6	36	120	6.1	3203 CT	WS DO	**MOE# 5716587** 0.0 BLCK TPSL 0.3 BRWN SAND 2.1 GREY SILT CLAY 5.5 GREY CLAY 20.7 GREY SAND 22.3 GREY SAND CLAY 22.3
16745	4 11	Jul-79	600262 4922471	239.9	29.3	Fr	29.9	-0.9	14.3	18	90	29.0	2514 RC	WS DO	**MOE# 5716745** 0.0 YLLW SAND 23.8 YLLW SAND CLAY 29.3 YLLW SAND 30.8
16801	4 15	Jun-80	601812 4921221	232.9	6.1	Fr	9.8	-0.9	2.4	36	75	8.5	3203 CT	WS DO	**MOE# 5716801** 0.0 BRWN SAND 10.7 GREY CLAY 10.7
16856	5 14	Apr-80	600546 4921056	239.3	15.5	Fr	16.5	-0.9	2.4	45	120		4816 RC	WS CO	**MOE# 5716856** 0.0 FGVL SAND 8.2 CGVL 11.6 CGVL CLAY LYRD 15.5 MSND 23.2 SAND CLAY 25.3
16922	5 11	Jul-80	599144 4921727	234.1	47.5	Fr	47.5	-1.2	11.9	36	60		1467 CT	WS IN	**MOE# 5716922** 0.0 GREY FILL 1.2 BRWN SAND 17.1 GREY FSND VERY SLTY 31.7 GREY CLAY STNS 45.7 GREY CLAY GRVL LYRD 47.5 GREY FSND 49.1 CLAY 49.1
16993	5 14	Aug-80	600620 4921085	239.9	8.8	Fr	16.8	-0.9	8.8	27	90	12.5	1222 CT	WS DO	**MOE# 5716993** 0.0 GREY FILL 0.6 BLCK TPSL 0.9 GREY SAND BLDR 6.4 GREY SAND 17.7
17091	5 16	Oct-80	600812 4919871	274.9	28.0	Fr	28.0	-2.1	14.6	18	120	28.3	1467 CT	WS DO	**MOE# 5717091** 0.0 BRWN SAND 21.3 GREY SAND CLAY 28.0 BRWN FSND VERY 30.8 GREY CLAY 30.8
17094	5 11	Sep-80	598111 4922021	222.8	14.9	Fr	15.2	-1.2	NR	23	60	12.8	1467 CT	WS DO	**MOE# 5717094** 0.0 PRDG 6.1 BRWN SAND 14.9 GREY SAND CLAY 16.5
17235	7 13	Nov-80	597525 4919754	226.5	18.0	Fr	18.6	-1.8	4.3	45	60	12.2	1467 CT	WS DO	**MOE# 5717235** 0.0 BRWN SAND 5.8 GREY CLAY SAND 11.6 BRWN SAND STNS 13.1 BRWN FSND VERY 18.0 BRWN FSND LTCL 20.4

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
17236	5 11	Nov-80	599112 4921812	232.9	18.9	Fr	19.5	-1.8	8.8	18	120	17.7	1467 CT	WS DO	**MOE# 5717236** 0.0 BRWN SAND 10.4 GREY SAND 18.9 BRWN FSND VERY 21.6
17456	1 16	Apr-81	605012 4921621	285.0	41.8	-	46.9	-1.2	41.8	23	150	43.6	3135 CT	WS DO	**MOE# 5717456** 0.0 TPSL 0.3 SAND 5.5 SAND GRVL PCKD 25.0 SAND DRY 41.8 FSND 48.2
17604	5 15	Jul-81	600812 4919971	271.0	16.8	Fr	17.7	-1.8	13.4	23	60	16.8	1467 CT	WS DO	**MOE# 5717604** 0.0 BLCK TPSL 0.3 BRWN SAND 21.0 GREY SAND CLAY LYRD 33.5
17606	4 13	May-81	600812 4921471	239.9	17.7	Fr	20.1	-0.9	10.7	36	60	12.2	1467 CT	WS DO	**MOE# 5717606** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL DRY 12.8 BRWN SAND DRY 17.7 BRWN CGVL CSND 21.0
17758	7 9	Sep-81	595716 4921496	191.7	12.2	Fr	13.4	-0.9	FLW	45	30		1467 CT	WS DO	**MOE# 5717758** 0.0 BRWN TPSL 0.3 BRWN SAND LOOS 1.2 GREY CLAY LOOS 11.9 GREY CLAY SILT 12.2 BRWN CSND 14.6 GREY SAND SLTY 14.6
17760	7 10	Sep-81	597099 4921391	194.8	5.8	Fr	14.6	-0.9	FLW	45		5.5	1467 CT	WS DO	**MOE# 5717760** 0.0 RED TPSL SAND 0.9 GREY CLAY STNS 5.8 GREY MSND 15.8 GREY CLAY HARD 15.8
17967	4 12	Sep-81	600612 4922271	232.6	22.9	Fr	22.9	-0.9	9.1	23	60	22.6	2514 CT	WS DO	**MOE# 5717967** 0.0 YLLW SAND GRVL STNS 10.4 YLLW CLAY SAND 11.0 YLLW SAND SILT LYRD 22.9 YLLW SAND SILT 23.8
18003	1 23	Mar-81	603462 4924221	297.8	60.4	Fr	62.2	-1.2	51.8	45	195	56.4	3203 CT	WS DO	**MOE# 5718003** 0.0 BRWN SAND STNS GRVL 12.8 BRWN SAND 42.7 BRWN FSND SILT CLAY 48.8 GREY CLAY SILT LYRD 60.4 BRWN SAND GRVL 61.6 BRWN SAND 63.4
18023	4 12	Apr-82	600462 4922371	235.9	15.5	Fr	28.0	-0.9	13.1	14	840	24.1	1467 CT	WS DO	**MOE# 5718023** 0.0 BLCK TPSL 0.6 BRWN SAND LTCL 7.0 GREY GRVL 15.5 GREY SAND STNS CMTD 29.3
18061	1 16	Sep-81	605012 4921621	285.0	44.2	Fr	50.6	-0.9	44.2	32	90	47.2	3135 CT	WS DO	**MOE# 5718061** 0.0 BLCK TPSL 0.3 BRWN SAND DRY 44.2 BRWN SAND 51.5
18232	4 12	Jul-82	601162 4922921	269.1			30.8	-1.5	17.4	45			4816 CT	WS DO	**MOE# 5718232** 0.0 BRWN SAND 25.3 FSND 32.6 CLAY 32.6
18298	7 9	Dec-82	596161 4921721	199.9	10.4	Fr	11.0	-1.2	5.8	9	1440	11.0	1467 CT	WS DO	**MOE# 5718298** 0.0 PRDG 1.5 GREY CLAY 10.4 BRWN FSND 12.2 GREY FSND CLAY DKCL 12.2
18391	4 15	Sep-81	601962 4921621	234.7	12.2	Fr	11.3	-1.8	2.4	59	120	7.3	4816 RC	WS DO	**MOE# 5718391** 0.0 FSND 14.6
18481	4 15	Jun-82	602212 4921221	233.8	19.5	Fr	19.8	-0.9	-0.3	41	60	18.3	2514 CT	WS DO	**MOE# 5718481** 0.0 FILL 1.5 SAND SILT 11.0 GREY SAND SILT 19.5 YLLW SAND SILT 20.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
18544	4 13	Apr-83	601661 4922219	243.2	20.4	Fr	20.7	-0.9	10.1	23	60	17.7	1467 CT	WS DO	**MOE# 5718544** 0.0 BRWN TPSL 0.3 BRWN GRVL 4.9 BRWN SAND 20.4 GREY SAND 21.6
18545	4 13	Apr-83	601062 4921721	237.4	15.5	Fr	18.9	-1.2	12.2	18	360	18.9	1467 CT	WS DO	**MOE# 5718545** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL 9.4 BRWN SAND 15.5 GREY SAND 20.1
18547	8 13	Aug-82	596072 4918710	219.8	36.0	Fr	36.3	-0.9	6.4	27	600	33.5	3135 CT	WS DO	**MOE# 5718547** 0.0 TPSL 0.3 SAND GRVL STNS 8.5 CLAY GRVL STNS 36.0 SAND 37.2
18551	4 14	Mar-83	601062 4921071	235.9	14.9	Fr	16.2	-1.2	4.0	45	60	12.2	1467 CT	WS DO	**MOE# 5718551** 0.0 BRWN SAND FILL 0.3 GREY SAND 14.9 BRWN CSND 16.2
18581	1 18	May-83	604612 4922421	286.8	75.6	Fr	75.9	-0.9	43.9	68	60	54.9	3660 CT	WS ST	**MOE# 5718581** 0.0 BLCK TPSL 0.3 BRWN SAND 6.1 GREY CLAY GRVL 15.2 BLUE CLAY 59.4 GREY CLAY SAND 70.1 GREY SILT 71.9 GREY SAND GRVL CMTD 75.6 BRWN FSND WBRG 76.8
18621	7 10	Jul-83	597086 4921738	220.4	26.8	Fr	26.2	-1.2	14.3	18	120	26.8	1467 CT	WS DO	**MOE# 5718621** 0.0 BRWN TPSL 0.3 BRWN SAND STNS GRVL 16.5 BRWN CSND 18.9 GREY CLAY SAND 27.4 GREY SAND GRVL CMTD 27.4
18622	4 13	Jul-83	600812 4922521	246.6	12.2	Fr	14.9	-1.2	7.6	32	120	11.9	1467 CT	WS DO	**MOE# 5718622** 0.0 BRWN TPSL 0.3 BRWN SAND CLAY 6.4 GREY CLAY 12.2 GREY CLAY SAND 14.9 BRWN SAND 16.2 GREY CLAY 16.5
18625	5 16	Aug-83	601353 4920073	246.9	21.6	Su	21.6	-1.2	9.1	23	900	18.3	1467 CT	WS DO	**MOE# 5718625** 0.0 BRWN SAND CLAY 5.8 BRWN GRVL 11.9 GREY SAND GRVL CMTD 17.1 GREY CLAY 21.6 GREY FSND CLAY LYRD 22.9 GREY CLAY 22.9
18641	8 9	May-83	595411 4921471	189.9			31.4	-0.9	FLW	182			4816 RC	WS ST	**MOE# 5718641** 0.0 TPSL 0.3 MSND 0.9 GREY MSND CLAY 14.0 CSND CLAY 16.2 FSND CLAY 27.7 MSND CLAY 29.3 MSND 32.0 FSND CLAY 33.5 GREY CLAY FGVL SNDY 53.6 GREY FSND SILT CLAY 61.0
18677	3 12	Aug-83	601111 4923071	282.9	44.2	Fr	47.9	-0.9	41.1	36	60	48.8	3660 RC	WS DO	**MOE# 5718677** 0.0 BRWN CLAY 6.1 BRWN SAND CLAY 22.9 WHTE SAND GRVL 44.2 BRWN MGVL MSND LOOS 49.4
18711	4 15	Aug-83	601262 4920721	234.7	14.9	Fr	14.9	-0.9	2.7	23	120	13.4	1467 CT	WS DO	**MOE# 5718711** 0.0 PRDG 3.0 GREY CLAY SAND GRVL 14.9 GREY SAND 15.8 GREY CLAY 15.8
18712	4 13	Sep-83	601412 4922321	244.8	11.0	Fr	14.6	-1.2	3.4	36	120	8.8	1467 CT	WS DO	**MOE# 5718712** 0.0 BRWN SAND 5.8 BRWN SAND CLAY 7.9 BRWN CGVL CSND 11.0 GREY MSND 12.2 GREY SAND 14.6 UNKN 15.8

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
18774	4 13	Sep-83	601412 4922321	244.8			11.9	-1.8	1.2	45			4816 CT	WS DO	**MOE# 5718774** 0.0 SAND CLAY LYRD 9.1 FSND 15.2
18775	3 14	Sep-83	601894 4921956	237.7	70.7	-	70.7	-7.9	2.1	2187	1440		4816 RC	WS MU	**MOE# 5718775** 0.0 SAND CLAY FGVL 7.3 GREY CLAY SILT GRVL 32.9 MSND PCKD 37.8 GREY FSND CLAY SLTY 60.0 MSND 63.4 GREY CLAY SLTY 66.1 FSND SILT CLAY 71.3 MSND SILT 80.5 FSND CLAY SILT 96.6
18864	3 11	Jun-83	602165 4923871	289.9	58.8	Fr	60.4	-0.9	40.8	45	90	44.2	2514 RC	WS DO	**MOE# 5718864** 0.0 BRWN CLAY 5.8 BRWN CLAY GRVL 46.6 BLUE CLAY 58.8 YLLW SAND 61.3
18866	6 14	Sep-83	599012 4920171	246.9	25.6	Fr	34.1	-1.8	14.6	114	150	24.4	2514 RC	WS CO	**MOE# 5718866** 0.0 YLLW SAND GRVL 14.6 GREY CLAY SAND GRVL 22.9 YLLW SAND GRVL 25.9 GREY CLAY BLDR 33.8 CSND 36.0
19094	9 13	Oct-83	594862 4917671	226.8	21.3	Fr	22.9	-0.9	NR	45	90	15.2	3135 CT	WS DO	**MOE# 5719094** 0.0 TPSL 0.3 SAND 12.8 CLAY SAND 21.3 SAND 23.8
19095	3 15	Feb-84	602212 4921221	233.8	36.3	Fr	36.3	-0.9	NR	27	120	36.0	2514 CT	WS DO	**MOE# 5719095** 0.0 BRWN SAND GRVL FILL 0.6 BRWN MUCK DKCL 2.1 YLLW SAND 4.6 GREY SILT CLAY SAND 36.3 GREY FSND SILT 37.2
19153	3 13	Feb-84	601362 4922621	280.1	50.3	Fr	50.9	-2.1	43.6	36	60	45.7	1467 CT	WS DO	**MOE# 5719153** 0.0 BRWN SAND STNS 10.1 GREY SAND CLAY 10.7 BRWN SAND 35.1 GREY SAND CLAY 43.3 GREY CLAY 47.5 GREY FSND SLTY 50.3 BRWN FSND 53.3 GREY CLAY SAND 53.3
19154	4 13	Apr-84	601012 4921921	236.8	18.3	Fr	19.2	-1.2	13.7	18	120	18.3	1467 CT	WS DO	**MOE# 5719154** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL 13.7 BRWN SAND LTCL 18.3 BRWN SAND CLAY DKCL 20.7 GREY CLAY 20.7
19245	4 14	May-83	602277 4921182	232.9	20.7	Fr	21.6	-0.9	1.8	27	60	15.2	3203 CT	WS DO	**MOE# 5719245** 0.0 FILL 0.6 BLCK CLAY SILT 4.6 GREY CLAY 6.4 BRWN SAND CLAY 8.8 GREY CLAY 20.1 GREY SILT 20.7 GREY SAND 22.6 GREY CLAY 22.6
19250	4 12	Jul-84	600956 4922666	252.7	17.7	-	18.3	-1.2	8.2	36	60	11.6	1467 CT	WS DO	**MOE# 5719250** 0.0 BRWN SAND 2.7 BRWN SAND CLAY 14.3 BRWN SAND DRY 17.7 BRWN SAND WBRG 19.8
19252	4 12	Jun-84	600672 4922411	244.8	24.7	Fr	24.7	-0.9	15.2	23	120	23.8	1467 CT	WS DO	**MOE# 5719252** 0.0 BRWN TPSL SAND 0.3 BRWN SAND STNS CMTD 11.6 BRWN SAND 19.5 GREY SAND GRVL CMTD 24.7 BRWN CSND 25.6 GREY CLAY GRVL 25.6
19253	5 11	May-84	599233 4921989	234.4	15.2	Fr	15.8	-1.8	10.4	23	120	12.8	1467 CT	WS DO	**MOE# 5719253** 0.0 BRWN SAND STNS 11.9 BRWN SAND 17.7 GREY SAND CLAY 18.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
19254	4 9	May-84	599377 4923686	238.7	12.2	Fr	13.7	-1.2	6.4	36	60	9.1	1467 CT	WS DO	**MOE# 5719254** 0.0 BRWN TPSL 0.3 BRWN SAND STNS 4.6 BRWN SAND 12.2 GREY FSND WBRG 14.9 GREY CLAY SAND 14.9
19255	5 16	May-84	600801 4919875	274.3	13.1	Fr	19.5	-1.8	13.7	23	120	19.5	1467 CT	WS DO	**MOE# 5719255** 0.0 GREY CLAY FILL 0.6 BRWN SAND 13.1 GREY FSND 21.6 GREY CLAY SAND 21.6
19279	2 23	Aug-84	602446 4923627	291.7	48.8	Fr	49.7	-0.9	32.3	14	120	48.2	3660 RC	WS DO	**MOE# 5719279** 0.0 BLCK TPSL 0.3 BRWN CLAY 12.2 GREY SAND CLAY 48.8 BRWN FSND MGRD 53.3
19339	7 8	Jun-83	595511 4922021	189.9			29.9	-1.5	FLW	14	1440		4816 RC	WS DO	**MOE# 5719339** 0.0 TPSL 0.3 SILT 2.7 CLAY 29.3 SILT 31.7 SILT CLAY 60.4 CLAY 61.9 BRWN SHLE 64.9 GREY SHLE 65.8
19547	4 11	Jun-84	600728 4923560	281.0	48.8	Fr	48.8	-0.9	39.6	45	120	46.9	4816 CT	WS DO	**MOE# 5719547** 0.0 TPSL 0.3 SAND GRVL CLAY 22.9 FSND CLAY 32.9 MSND CSND 39.6 FSND 49.7
19679	4 9	Jan-85	599462 4923583	239.9	14.3	Fr	14.6	-1.2	7.0	18	60	13.4	1467 -	WS DO	**MOE# 5719679** 0.0 BLCK TPSL 0.3 BRWN SAND CLAY 5.8 GREY CLAY 14.3 BRWN SAND CLAY 17.1
19716	3 12	Jan-85	601461 4922768	284.1	36.6	Fr	37.2	-0.9	25.6	68	120	33.5	2514 CT	WS DO	**MOE# 5719716** 0.0 YLLW SAND 23.8 GREY CLAY SILT 30.2 YLLW SAND 38.1
19815	8 8	Jun-84	594356 4921156	220.1	45.1	Fr	45.4	-0.9	24.7	91	60	36.9	2514 CT	WS DO	**MOE# 5719815** 0.0 TPSL SNDY 0.3 YLLW SAND 18.0 GREY FSND CLAY 21.0 GREY CLAY 26.5 GREY SAND CLAY HARD 45.1 YLLW MSND 46.3
19817	3 15	Sep-84	601595 4922811	282.5	19.8	Fr	21.3	-0.9	11.9	9	90	19.8	2514 RC	WS DO	**MOE# 5719817** 0.0 YLLW SAND 1.2 BRWN CLAY 13.7 YLLW SAND 22.3
19819	3 12	Jul-84	601352 4922750	274.9	41.1	Fr	41.1	-1.2	32.3	45	60	39.6	2514 CT	WS DO	**MOE# 5719819** 0.0 YLLW SAND 24.4 YLLW SAND SILT CLAY 29.6 GREY CLAY 36.0 GREY SILT HARD 41.1 YLLW MSND FSND 42.4
19820	5 9	Oct-84	599521 4923321	239.3	23.8	Fr	23.8	-0.9	14.9	45	60	23.2	2514 CT	WS DO	**MOE# 5719820** 0.0 YLLW SAND 24.7
19821	3 22	Jul-84	601659 4922769	278.3	30.5	Fr	31.1	-0.9	17.4	68	90	27.4	2514 RC	WS DO	**MOE# 5719821** 0.0 BRWN CLAY SAND 27.4 YLLW SAND 32.0
19912	4 11	Apr-85	600180 4922519	239.6	28.3	Fr	28.0	-0.9	16.5	36	60		4816 CT	WS DO	**MOE# 5719912** 0.0 OBDN 0.6 SAND SLTY CLAY 22.6 SILT 24.1 SAND CMTD 25.3 FSND SLTY 28.3 BRWN MSND 29.0 SAND SLTY 30.2

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
20001	5 14	Apr-85	600827 4921242	239.9	19.8	Fr	20.1	-0.9	8.2	23	120	16.8	1467 CT	WS DO	**MOE# 5720001** 0.0 BRWN SAND STNS 9.4 BRWN FSND 17.4 BRWN CLAY SAND 18.0 GREY CLAY SAND GRVL 19.8 GREY MSND MSND 21.0 GREY CLAY 21.0
20003	3 10	Jun-85	600531 4924039	281.0	44.5	Fr	45.4	-1.2	37.5	23	150	39.3	1467 CT	WS DO	**MOE# 5720003** 0.0 BLCK TPSL 0.3 BRWN SAND CLAY STNS 11.6 GREY CLAY SAND 19.5 BRWN CSND DRY 32.9 BRWN SAND CLAY 39.0 BRWN CLAY 43.0 GREY CLAY SAND 44.5 BRWN SAND 46.9
20127	1 16	Jul-85	604920 4921832	289.6	47.2	Fr	48.2	-1.2	39.9	45	120	42.7	3660 CT	WS DO	**MOE# 5720127 TAG#ASSMNT** 0.0 BRWN SAND GRVL 15.2 GREY CLAY SAND 20.4 BRWN SAND 43.6 BRWN FSND WBRG 47.2 YLLW MSND WBRG 49.4
20293	4 15	Jul-85	602113 4921430	236.5	19.8	Fr	20.4	-1.2	2.4	64	60	19.8	2514 CT	WS DO	**MOE# 5720293** 0.0 YLLW SAND 11.3 GREY CLAY 19.5 YLLW MSND SILT 21.6
20295	9 13	Nov-85	594765 4917969	222.8	14.9	Fr	14.9	-1.2	5.8	9	60	14.0	2514 CT	WS DO	**MOE# 5720295** 0.0 BRWN SAND GRVL BLDR 4.6 GREY CLAY 13.1 GREY SAND SILT 14.9 MSND 16.2
20388	4 12	Sep-84	601060 4922266	239.3	12.2	Fr	22.9	-0.9	9.1	36	60	13.7	3203 CT	WS DO	**MOE# 5720388** 0.0 PRDG 12.2 GREY SAND 23.8
20390	4 13	Oct-85	601015 4922225	234.4	12.5	Fr	20.4	-0.9	11.6	27	60	16.5	3203 CT	WS DO	**MOE# 5720390** 0.0 TPSL 0.6 BRWN SAND CLAY 11.0 BRWN SAND 12.5 GREY SAND 21.6 GREY SAND CLAY 21.6
20427	6 11	Nov-11	597084 4919440	227.7	9.4	Fr	25.9	-0.9	4.0		75	7.9	2514 RC	WS DO	**MOE# 5720427** 0.0 PRDG 9.1 GREY SAND SILT BLDR 25.0 WHTE MSND FSND 26.8
20428	8 13	Oct-85	596243 4918897	223.1	19.8	Fr	19.8	-1.2	6.4	23	180	16.2	1467 RC	WS DO	**MOE# 5720428** 0.0 MSND MGVL 4.3 CSND 8.5 CGVL 19.8 MSND 21.0
20516	2 18	Oct-85	604350 4922568	281.6					NR				3660 -	- -	**MOE# 5720516** 0.0 BLCK TPSL 0.3 BRWN SAND CLAY 4.9 GREY CLAY GRVL 18.3 GREY CLAY 59.7 GREY SILT CLAY 67.1 BRWN SAND CLAY 74.1
20986	4 13	Jun-86	595364 4918237	225.6	9.8	Fr	11.9	-1.2	1.5	18	150	11.6	1467 CT	WS DO	**MOE# 5720986** 0.0 BRWN SAND 4.3 GREY SAND CLAY 9.8 GREY FSND 13.1
21116	9 13	Aug-86	594832 4917991	224.0	15.5	Fr	15.5	-0.9	5.5	45	60	12.2	2514 CT	WS DO	**MOE# 5721116** 0.0 PRDG 5.5 GREY CLAY 15.2 MSND CGRD CMTD 16.5
21185	12 4	Oct-86	600709 4922306	239.6	18.3	Fr	19.2	-1.2	13.1	23		14.6	1467 CT	WS DO	**MOE# 5721185** 0.0 BRWN FILL 0.3 BRWN SAND GRVL STNS 14.0 GREY SAND GRVL CMTD 18.3 BRWN SAND 20.7 GREY GRVL CMTD 20.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
21364	4 16	Oct-85	600905 4922395	246.0	9.1	Fr	19.8	-0.9	9.1	32	60	16.5	3203 CT	WS DO	**MOE# 5721364 TAG#ASSMNT** 0.0 FILL 0.6 BRWN SAND CLAY 4.9 BRWN SAND 9.1 BRWN SAND 15.8 GREY SAND 21.0
21481	7 9	Nov-86	596193 4921713	200.3	13.7	Fr	14.3	-1.2	1.8	64	60	13.7	2514 CT	WS DO	**MOE# 5721481** 0.0 TPSL 0.3 BRWN SAND CLAY 0.9 BRWN CLAY 3.0 GREY CLAY SOFT 7.6 GREY SAND SILT 13.7 YLLW FSND MGRD 15.5
21883	10 17	May-87	595219 4916893	275.5			68.6	-0.9	NR				1583 RC	OW NU	**MOE# 5721883** 0.0 SAND GRVL 25.9 BRWN CLAY 26.8 SAND GRVL 30.8 GREY CLAY SILT 46.0 GREY CLAY 59.1 GREY FSND 73.2 GREY CLAY SILT 79.2
21997	4 13	Jul-87	600873 4922560	249.6	21.3	Fr	21.3	-0.9	10.1	23	120	10.1	3660 CT	WS DO	**MOE# 5721997** 0.0 BRWN SAND 21.3 GREY FSND WBRG 22.3
22000	10 14	Jul-87	594939 4917437	228.9	32.9	-	32.0	-0.9	16.8	27	120	30.5	1583 RC	OW MU	**MOE# 5722000** 0.0 CLAY SAND 1.5 SAND GRVL 3.7 BRWN FSND 7.0 BRWN SAND CLAY 8.2 GREY FSND 10.1 GREY SAND CLAY 14.3 GREY CLAY SAND 22.3 GRN SAND CLAY 29.3 GREY FSND CLAY 32.9
22278	4 17	Jul-85	601643 4922758	276.5	30.5	Fr	32.0	-1.2	17.4	45	90	23.5	3135 CT	WS DO	**MOE# 5722278** 0.0 SAND DRY PCKD 30.5 SAND WBRG 33.2
22282	4 10	Jul-87	599953 4922781	239.9	18.3	Fr	18.3	-2.1	10.7	14	150	18.3	3135 CT	WS DO	**MOE# 5722282** 0.0 SAND GRVL 4.6 FSND CLAY 18.3 SAND WBRG 21.3
22283	5 11	Jul-86	598811 4922066	226.8	17.7	Fr	18.0	-0.9	4.6	23	150	14.3	3135 CT	WS DO	**MOE# 5722283** 0.0 TPSL 0.3 SAND 3.4 SAND CLAY 17.7 SAND WBRG 18.9
22284	4 22	Jul-86	600717 4923434	282.2	12.2	Fr	12.8	-1.2	4.0	45	90	9.1	3135 CT	WS DO	**MOE# 5722284** 0.0 CLAY SAND 12.2 SAND 14.0
22291	4 17	Jul-85	602647 4920211	241.7	12.2	Fr	19.8	-1.2	12.2	45	90	16.5	3135 CT	WS DO	**MOE# 5722291** 0.0 SAND CLAY 12.2 SAND WBRG 21.0
22294	2 15	Mar-84	604963 4921449	284.1	51.8	Fr	52.7	-1.2	41.8	32	120	44.8	3135 CT	WS DO	**MOE# 5722294** 0.0 TPSL 0.3 SAND 9.1 SAND CLAY 51.8 SAND WBRG 53.9
22297	3 23	Apr-87	602417 4921327	236.5	27.4	Fr	29.0	-0.9	21.6	36	60	28.0	2514 CT	WS DO	**MOE# 5722297** 0.0 YLLW SAND 29.9 YLLW SAND CLAY 29.9
22298	5 16	Jul-87	601147 4919976	254.8	5.5	Fr	8.5	-0.9	0.9	36	90	7.6	2514 CT	WS DO	**MOE# 5722298** 0.0 TPSL 0.6 BRWN CLAY SAND 5.5 YLLW FSND MSND 9.4
22428	5 11	Sep-87	599106 4921890	232.6	14.9	Fr	17.4	-1.2	9.1	23	120	9.4	1467 CT	WS DO	**MOE# 5722428** 0.0 BRWN SAND 9.4 GREY SAND CLAY 14.9 BRWN FSND 18.9 BRWN SAND CLAY 18.9
22429	8 13	Aug-87	596461 4919115	224.9	14.6	Fr	15.5	-1.2	3.0	45	90	9.1	1467 CT	WS DO	**MOE# 5722429** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL 7.9 BRWN CLAY 9.1 GREY CLAY GRVL 14.6 BRWN CSND 16.8

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
22762	9 13	Oct-87	594632 4917997	211.2	12.2	Fr	13.4	-1.2	NR	18	210	12.8	1467 CT	WS DO	**MOE# 5722762** 0.0 BRWN GRVL 1.8 GREY SAND GRVL 9.4 GREY GRVL CLAY 14.6
22764	4 13	Oct-87	600618 4921721	240.8	18.9	Fr	20.4	-1.2	14.0	23	120	16.8	1467 CT	WS DO	**MOE# 5722764** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL 6.4 BRWN FSND 18.9 BRWN MSND 21.9 RED CLAY 21.9
22778	7 9	Dec-87	595827 4921636	192.9	18.3	Fr	18.9	-0.9	5.5	91	60	13.7	2513 CT	WS DO	**MOE# 5722778** 0.0 TPSL DKCL 0.3 BRWN CLAY 6.1 YLLW SAND SILT 12.2 GREY CLAY SAND SILT 18.3 YLLW SAND MGRD 19.8
23277	2 19	Mar-88	603957 4923389	289.9	48.5	Fr	52.1	-1.2	46.0	27	120	49.1	1467 CT	WS DO	**MOE# 5723277** 0.0 BRWN SAND 4.3 GREY CLAY SAND 17.4 GREY CLAY CGVL 25.0 GREY CLAY 30.8 GREY CLAY GRVL 48.5 BRWN MSND 53.3
23280	4 7	Apr-88	601149 4922791	261.5	28.3	Fr	29.3	-1.2	22.6	36	150	25.9	1467 CT	WS DO	**MOE# 5723280** 0.0 BRWN FILL 1.8 BRWN SAND GRVL STNS 7.9 GREY SAND 17.7 BRWN CLAY 19.5 GREY CLAY 26.5 GREY SAND CLAY 28.3 BRWN SAND 30.8
23282	8 13	Jan-88	597072 4919336	229.8	51.8	Fr	88.4	-3.0	11.3	68	180	20.7	2801 RC	OW NU	**MOE# 5723282** 0.0 CGVL FGRD 4.0 GREY CLAY SNDY 12.2 FSND GRVL 29.9 GREY CLAY GRVL 39.6 GREY CLAY SNDY GRVL 51.8 FSND CGRD 67.1 GREY CLAY SNDY FGVL 84.7 FGVL SAND CLAY 91.4 GREY CLAY SNDY GRVL 94.5 BRWN CLAY HARD 98.1
23283	8 13	Feb-88	596521 4918927	232.0			59.4	-1.5	11.9	114	240	13.1	2801 RC	OW NU	**MOE# 5723283** 0.0 SAND GRVL STNS 2.4 CLAY SNDY GRVL 6.4 GRVL MSND SNDY 10.4 SAND FGVL SNDY 12.5 FSND GRVL 19.8 FSND SLTY CLAY 22.9 CLAY SLTY GRVL 25.9 FSND SNDY CLAY 35.7 FSND SNDY CLAY 42.7 CLAY SLTY SAND 48.5 GREY CLAY SLTY HARD 56.4 FSND CLAY SNDY 77.7 GREY CLAY SLTY 81.4 GREY FSND MGRD CLAY 95.4 CLAY SLTY FSND 97.8
23284	8 13	Mar-88	597076 4919325	230.7	53.6	Fr	59.4	-6.1	11.0				2801 RC	WS MU	**MOE# 5723284** 0.0 TPSL 0.3 MGVL MSND 1.8 MSND MGVL 3.4 MSND FGVL CLAY 5.5 SILT 6.1 SILT 7.9 GREY CLAY 9.4 MSND MGVL 13.4 MSND 24.4 MSND FGVL 30.2 GREY CLAY 38.4 MSND 50.3 MSND 53.6 MSND FGVL CLAY 54.9 FSND 57.0 FSND 68.6

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
23285	8 14	Jan-88	596370 4918416	241.1			67.1	-1.5	19.2	64	180	21.3	2801 RC	OW NU	**MOE# 5723285 TAG#ASSMNT** 0.0 FSND FGVL BLDR 2.4 BRWN FSND SNDY CLAY 15.8 GREY CLAY SLTY SNDY 22.9 GREY CLAY SLTY FSND 27.4 GREY CLAY SLTY HARD 31.7 GREY CLAY SNDY FGVL 36.3 GREY CLAY SLTY HARD 36.9 GREY CLAY SNDY HARD 53.9 GREY CLAY SLTY HARD 60.7 GREY CLAY SNDY FGVL 66.8 GREY CLAY SNDY FGVL 86.9 GREY CLAY SLTY FGVL 90.5
23286	8 13	Feb-88	597095 4919324	229.8			59.4	-6.1	11.6	114	240	13.4	2801 RC	OW NU	**MOE# 5723286** 0.0 SAND GRVL STNS 2.4 BRWN CLAY SNDY 5.5 BRWN CLAY SLTY 6.1 GREY CLAY SLTY 9.4 FSND FGVL 12.5 FSND 30.5 GREY CLAY SLTY 39.9 FSND 41.1 GREY FSND CLAY PCKD 47.2 FSND VERY 53.6 FSND SNDY CLAY 59.4 FSND 66.4 GREY CLAY SNDY FGVL 73.5
23696	6 14	Jun-88	596886 4919181	232.9	37.5	Fr	36.6	-0.9	14.3	23	180	36.0	1583 RC	WS DO	**MOE# 5723696** 0.0 BRWN SAND 13.7 BRWN SAND GRVL 22.9 GREY SAND CLAY 38.1 FSND MSND 39.9 CLAY SILT 42.7
24011	6 14	Sep-88	599566 4920486	246.0	20.7	Fr	20.7	-1.8	9.1	36	120	14.0	1467 CT	WS DO	**MOE# 5724011** 0.0 BRWN SAND GRVL 9.4 BRWN FSND 21.0 BRWN MSND FSND 22.6 GREY SAND 22.6
24199	3 12	Oct-88	601200 4922972	275.8	53.3	Fr	54.3	-1.2	36.6	23	180		5022 RC	WS DO	**MOE# 5724199** 0.0 BRWN FSND FGVL 15.8 FGVL SAND 37.2 GREY CLAY SAND 51.8 FSND MSND 57.0
24202	5 14	Oct-88	601016 4920919	234.1	38.7	Fr	36.9	-1.8	3.7	136	135	33.5	1583 RC	WS CO	**MOE# 5724202** 0.0 BRWN SAND 18.3 CLAY 22.9 SAND CLAY 25.9 FSND 33.5 MSND 39.6 GREY FSND 42.7 CLAY 43.9
24354	6 15	Nov-88	599537 4919118	256.0	24.7	Fr	25.3	-1.2	14.6	36	120	19.5	1467 CT	WS DO	**MOE# 5724354** 0.0 BRWN TPSL 0.3 BRWN SAND CLAY GRVL 16.5 BRWN SAND DRY 24.7 BRWN MSND 26.5
24625	5 11	Dec-88	599682 4922266	239.9	54.9	Fr	51.2	-3.7	23.2	36	1440	40.5	3903 RC	WS MU	**MOE# 5724625** 0.0 BRWN SAND LOOS 1.2 BRWN FSND LOOS 15.8 BRWN MSND LOOS 25.9 BRWN FSND LOOS 30.5 BRWN FSND CLAY LYRD 32.9 BRWN FSND CLAY LYRD 41.5 BRWN CLAY STNS HARD 44.2 BRWN MSND STNS LYRD 55.8 GREY CLAY DNSE 56.4 GREY FSND GRVL CMTD 57.0 GREY SAND CLAY HARD 61.6
24656	5 16	Jan-89	601506 4920131	245.4	83.2	Fr	80.2	-3.0	5.5	609	1440	35.1	1583 RC	WS MU	**MOE# 5724656** 0.0 BRWN CLAY GRVL 6.7 GRVL CLAY 28.0 BRWN SAND 41.1 GREY CLAY SAND 70.1 BRWN MSND 75.6 BRWN SAND CLAY 78.6 BRWN MSND 83.5 CLAY SILT 87.2 GREY CLAY 92.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
24785	5 11	Feb-89	599887 4922236	241.1					NR				3903 RC	TH NU	**MOE# 5724785** 0.0 BRWN CSND PCKD 1.5 BRWN FSND CLAY GRVL 35.4 GREY CLAY SOFT 40.8 GREY CLAY FSND STNS 61.0 GREY FSND CLAY STNS 74.7 GREY CLAY DNSE 93.0 GREY CLAY STNS CMTD 103.9 GREY CLAY DNSE 107.9 GREY ROCK DNSE 110.0
24786	5 11	Feb-89	599887 4922246	241.1	27.7	Fr	24.7	-3.0	17.4	55	960	24.4	3903 RC	WS MU	**MOE# 5724786** 0.0 BRWN CSND PCKD 2.7 BRWN FSND CLAY LYRD 14.0 BRWN MSND FSND LYRD 15.2 BRWN CSND FSND LYRD 19.8 BRWN FSND LOOS 21.9 BRWN FSND CLAY LYRD 28.0 BRWN CLAY DNSE 29.9 GREY CLAY DNSE 31.1
24787	5 11	Feb-89	599762 4922321	239.9					NR				3903 RC	TH NU	**MOE# 5724787** 0.0 BRWN FSND VERY PCKD 9.4 BRWN FSND VERY CSND 14.6 BRWN CLAY SAND LYRD 21.6 GREY CLAY STNS HARD 25.9 GREY CLAY DNSE 27.7 GREY SAND CLAY SILT 38.4 GREY CLAY SILT LYRD 40.5
24802	5 15	Apr-89	601211 4920204	242.6	17.7	Fr	19.2	-1.2	4.0	45	480	9.1	3660 CT	WS DO	**MOE# 5724802** 0.0 BRWN GRVL FILL 1.5 GREY CLAY GRVL 8.5 GREY CLAY SOFT 17.7 GREY FSND WBRG 20.4
24900	8 13	May-89	597075 4919340	230.4	57.9	Fr	61.0	-6.1	13.1	909	240	32.6	2801 RC	WS MU	**MOE# 5724900** 0.0 MSND 1.8 MGVL MSND CLAY 6.1 GREY CLAY 10.4 GREY CLAY MGVL 14.3 MSND THIN MGVL 17.4 MSND 31.1 GREY CLAY 39.0 MSND 45.7 MSND MGVL CLAY 61.0 MSND 71.9 GREY CLAY 73.8
24990	6 21	Jun-01	596927 4919726	219.8	25.3 15.2	Fr Fr	23.2	-2.1	11.6	55	60	18.3	9999 RC	WS DO	**MOE# 5724990** 0.0 MSND 7.0 GREY CLAY 7.9 GREY CLAY MSND 15.2 MSND 25.3
24991	3 17	Aug-88	601609 4922695	270.7	39.6	Fr			29.0	55	90	30.5	3135 CT	WS DO	**MOE# 5724991** 0.0 SAND CLAY 7.6 SAND 32.3 CLAY 36.6 SAND CLAY 39.6 SAND 41.1
25264	5 16	Jul-89	601513 4920127	246.3	82.3	Fr	79.2	-4.3	17.7	600	1440	35.4	1583 RC	WS MU	**MOE# 5725264** 0.0 GRVL CLAY STNS 22.9 GREY CLAY SILT 47.2 GREY CLAY HARD 57.9 GREY CLAY SILT 66.4 SAND SILT 70.1 GREY FSND 73.8 GREY CLAY SAND SILT 78.6 GREY MSND 84.7 BRWN MSND 89.0 CLAY SAND TILL 93.0
25436	7 13	Aug-89	597554 4919759	227.1	19.5	Fr	17.7	-1.8	4.6	55	120		1583 CT	WS DO	**MOE# 5725436** 0.0 BRWN SAND CLAY 2.4 SAND CLAY HARD 5.5 GREY FSND CLAY 8.5 GREY CLAY 10.4 GREY FSND CLAY 11.6 GREY FSND 20.1
25572	3 12	Aug-89	601258 4922950	274.9	42.7	Fr	46.9	-1.2	35.7	27	60	44.2	3660 CT	WS DO	**MOE# 5725572** 0.0 BRWN SAND DRY 26.8 BRWN CLAY 29.0 BRWN SAND DRY 42.7 BRWN SAND WBRG 48.2

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
26046	7 13	Nov-89	597373 4919723	225.2	23.5	Fr	21.3	-1.8	5.5	68	240		1583 RC	WS -	**MOE# 5726046** 0.0 BRWN FSND 4.6 GREY CLAY SILT 9.8 BRWN FSND 25.0 SILT VERY FSND 29.0 GREY CLAY SILT 33.5
26101	6 15	Nov-89	600533 4919811	277.7	46.0	Fr	46.0	-1.8	41.5	27	240	44.2	1467 CT	WS DO	**MOE# 5726101** 0.0 BRWN SAND 21.0 BRWN SAND CLAY 28.0 BRWN CLAY SAND 30.8 GREY CLAY SAND 46.0 GREY SAND 47.9
26132	8 13	May-89	596206 4918876	221.9	36.6	Fr	36.6	-0.9	6.1	32	150	35.1	3135 CT	WS DO	**MOE# 5726132** 0.0 SAND GRVL DRY 15.2 CLAY SAND 36.6 SAND 37.5
26337	3 16	Feb-90	602564 4920896	230.1	67.1	Fr	67.1	-6.1	-2.7	182	180	36.0	2801 RC	OW NU	**MOE# 5726337** 0.0 FILL 1.5 BRWN CLAY SLTY SAND 2.7 GREY CLAY SLTY FSND 20.7 GREY FSND CLAY 28.0 FSND CLAY VERY 49.1 FSND FGVL CLAY 49.7 GREY CLAY HARD 56.1 GREY FSND CLAY 60.0 GREY CLAY SAND HARD 67.4 FSND CLAY PCKD 69.5 GREY FSND FGVL CLAY 73.8 GREY CLAY HARD 74.7
26424	8 13	Feb-90	596156 4918685	225.2	36.6	Fr	37.5	-1.5	-1.8	45	120	12.2	3660 CT	WS DO	**MOE# 5726424** 0.0 BRWN SAND FILL 1.5 BRWN CLAY GRVL 5.2 BRWN GRVL DRY 32.0 GREY GRVL CMTD 36.6 GREY FSND WBRG 39.6
26577	4 14	May-90	601052 4921091	236.8	50.6	Fr	50.6	-1.2	5.8	36	120	27.4	1467 CT	WS DO	**MOE# 5726577** 0.0 TPSL 0.3 BRWN SAND 9.4 BRWN SAND CLAY 19.5 GREY SAND SILT 29.6 GREY CLAY SAND 39.3 GREY CLAY 47.9 GREY CLAY SAND 50.6 GREY SAND CLAY 51.8
26850	7 10	Jun-90	597021 4921795	221.0	29.9	Fr	34.4	-1.8	14.6	68	180	30.2	5528 RC	WS DO	**MOE# 5726850** 0.0 TPSL 0.3 BRWN CLAY 4.9 GREY CLAY SAND GRVL 10.7 GREY CLAY 18.0 BRWN SAND FGVL 18.9 GREY CLAY 20.7 BRWN CSND 22.9 GREY CLAY 23.8 GREY SAND CMTD 29.9 BRWN MSND 37.2 GREY CLAY 38.4
26997	3 12	Jul-90	601571 4923167	290.5	54.9	Fr	55.5	-1.2	46.0	36	150	48.8	1467 CT	WS DO	**MOE# 5726997** 0.0 BRWN TPSL 0.3 BRWN SAND CLAY 9.1 BRWN SAND 49.1 BRWN CLAY 51.8 GREY SAND CLAY 54.9 GREY SAND 56.7 GREY CLAY 56.7
27481	9 13	Oct-90	594587 4918068	199.0	6.7	Fr	11.3	-0.9	13.1	32	60	7.6	3660 CT	WS DO	**MOE# 5727481** 0.0 BRWN SAND GRVL 6.7 BRWN MSND CSND WBRG 12.5
27742	4 23	Dec-90	600395 4922387	239.9	19.8	Fr	20.4	-1.2	9.1	36	120	13.4	1467 CT	WS DO	**MOE# 5727742** 0.0 BRWN GRVL CLAY SAND 10.4 GREY CLAY 19.8 BRWN SAND 21.6 GREY CLAY 21.6

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
27803	6 14	Jun-89	598736 4919910	239.9	36.9	Fr	36.6	-0.9	16.8	41	120	27.4	3203 CT	WS CO	**MOE# 5727803** 0.0 BRWN CLAY SAND 4.9 GREY CLAY SAND STNS 36.0 GREY SAND CLAY 36.9 GREY SAND WBRG 39.3
27804	6 15	Jul-89	599500 4919067	264.9					18.6	14	120	22.9	3203 CT	WS DO	**MOE# 5727804** 0.0 BRWN CLAY 4.9 GREY CLAY GRVL 18.9 GREY CLAY 22.3 GREY SAND SILT 26.8
27806	4 9	Jan-89	599342 4923731	238.4	12.8	Fr	15.5	-1.2	9.8	45	90	11.6	3203 CT	WS DO	**MOE# 5727806** 0.0 BRWN SAND FILL 0.9 BRWN SAND DRY 5.8 BRWN SAND CLAY 12.8 GREY SAND 17.7 GREY SAND CLAY 17.7
27807	6 16	Aug-89	599517 4918962	270.1	19.8	Fr	24.1	-1.8	19.8	32		21.3	3203 CT	WS DO	**MOE# 5727807** 0.0 TPSL 0.3 GREY GRVL CLAY 14.0 GREY SAND DRY 19.8 GREY SAND WBRG 26.2 GREY SAND 26.2
27906	4 13	Jan-91	600864 4922282	239.9	19.5	Fr	22.3	-1.2	11.3	36	120	13.1	1467 CT	WS DO	**MOE# 5727906** 0.0 BRWN TPSL 0.3 BRWN SAND 4.9 BRWN CLAY SAND 7.3 GREY CLAY 9.4 GREY SAND CLAY 19.5 BRWN SAND 23.5
27927	1 20	Nov-90	603983 4923273	289.6	56.4	Fr	60.0	-2.4	50.0	68	240	59.4	1851 RC	WS DO	**MOE# 5727927 TAG#ASSMNT** 0.0 BLCK TPSL 0.3 BRWN SAND CLAY 20.4 BRWN SAND 38.4 BRWN SAND SLTY 42.7 BRWN SAND CLAY 56.4 GREY SAND WBRG 62.5
28025	5 11	Apr-91	598919 4921951	229.8	46.0	Fr	45.1	-0.9	8.5	45	180	12.2	1413 RC	WS DO	**MOE# 5728025** 0.0 BRWN SAND LOOS 7.0 BRWN SAND GRVL LOOS 15.2 BRWN CLAY SAND SOFT 18.3 GREY CLAY DNSE 24.7 GREY CLAY SAND LYRD 33.5 GREY CLAY STNS STNY 43.0 BRWN GRVL SAND LOOS 46.0
28078	10 12	May-91	594658 4917845	219.8	6.1	-			6.1	45	60	13.7	4919 BR	WS DO	**MOE# 5728078** 0.0 BRWN TPSL 0.3 BRWN SAND CLAY PCKD 6.1 GREY CLAY HARD 15.8
28094	5 11	May-91	598947 4921943	229.8	47.9	Fr	46.9	-0.9	9.4	45	150	12.2	1413 RA	WS DO	**MOE# 5728094 TAG#ASSMNT** 0.0 BRWN FSND 7.0 BRWN CLAY STNS SOFT 9.4 BRWN GRVL SAND LOOS 11.9 BRWN CLAY SAND GRVL 16.8 BRWN CLAY SAND SOFT 23.8 GREY CLAY HARD 34.4 GREY CLAY SAND LYRD 36.9 GREY CLAY STNS HARD 44.2 BRWN SAND GRVL 47.9
28095	5 11	May-91	598875 4921942	228.6	45.7	Fr	43.9	-1.8	7.9	45	120	13.7	1413 RC	DW DO	**MOE# 5728095** 0.0 BRWN SAND LOOS 7.6 BRWN SAND GRVL LOOS 14.3 BRWN CLAY SAND SOFT 22.3 GREY CLAY STNS HARD 38.1 GREY SAND CLAY LYRD 40.5 GREY CLAY SAND HARD 42.7 GREY FSND 45.7
28180	4 12	Jun-91	600917 4922666	250.9	13.7	Fr	17.1	-1.2	8.5	45	60	13.7	3660 CT	WS DO	**MOE# 5728180** 0.0 BRWN SAND 0.9 BRWN CLAY 5.2 GREY CLAY HARD 7.0 BRWN SAND 13.7 BRWN MSND WBRG 18.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
28243	4 16	Mar-91	601784 4920238	239.3	68.3	Fr	68.6	-4.6	7.9	341	1440	16.5	5528 RC	WS MU	**MOE# 5728243 TAG#ABND TW** 0.0 BRWN SAND GRVL 5.2 BRWN CLAY SAND GRVL 7.6 BRWN SAND GRVL 18.0 GREY CLAY 19.5 BRWN FSND 32.3 GREY SILT CLAY 46.9 GREY SILT FSND 63.7 GREY FSND 67.7 GREY CLAY 68.3 GREY FSND 73.8 GREY CLAY SILT 78.0 GREY FSND 81.4 GREY CLAY 86.0
28273	6 16	Jul-91	599872 4919146	264.9	41.5	Fr	41.8	-1.2	30.8	36	180	35.4	1467 CT	WS DO	**MOE# 5728273** 0.0 CLAY SAND GRVL 7.0 GREY SAND CLAY 10.4 BRWN SAND 25.6 GREY CLAY SAND 27.7 GREY CLAY 41.5 BRWN SAND 43.9
28339	1 20	Jul-91	603999 4923237	289.9	57.9	Fr	61.0	-0.9	42.7	23	240	60.0	1851 CT	WS DO	**MOE# 5728339** 0.0 BRWN TPSL 0.3 BRWN GRVL 3.0 BRWN CLAY 6.4 BLUE CLAY 28.3 BLUE CLAY SOFT 33.5 RED SAND CGVL 49.1 RED SAND 50.6 GREY CLAY 55.5 GREY CLAY 57.9 GREY MSND WBRG 65.5
28343	3 10	Jul-91	601768 4924608	287.1	49.4	Fr	51.5	-1.8	39.0	68	120	44.2	1851 CT	WS DO	**MOE# 5728343 TAG#ASSMNT** 0.0 BRWN TPSL SAND 0.9 BRWN SAND GRVL 41.5 GREY CLAY SAND SLTY 49.4 BRWN SAND WBRG 53.3
28565	4 15	Oct-91	602274 4921279	235.0	22.9	Fr	23.8	-1.2	1.8	27	120		1456 CT	WS DO	**MOE# 5728565** 0.0 GREY SAND 13.1 GREY CLAY 21.0 CLAY SAND 22.9 MSND 25.0
28575	4 14	Oct-91	601052 4921134	236.8	59.4	Fr	59.7	-1.2	8.5	36	150	16.5	1467 CT	WS CO	**MOE# 5728575** 0.0 BRWN SAND 3.4 BRWN GRVL SAND 15.8 BRWN SAND 22.6 GREY CLAY SAND 40.5 GREY CLAY 59.4 GREY SAND 61.0 GREY CLAY 61.0
28671	4 16	Aug-91	601795 4920244	239.3	64.0	Fr	64.0	-4.6	8.2	364	1440	13.7	5528 RC	WS MU	**MOE# 5728671** 0.0 BRWN SAND GRVL 5.5 BRWN CLAY GRVL SAND 17.1 GREY CLAY 19.8 BRWN SAND 32.3 GREY SILT CLAY 47.2 GREY SILT 61.9 GREY MSND 67.1 GREY FSND 73.5 GREY CLAY 76.2
28687	1 23	Dec-91	603112 4924567	299.0	61.3	Fr	62.8	-1.2	52.4	45	210	59.4	1467 CT	WS DO	**MOE# 5728687** 0.0 TPSL 0.3 BRWN SAND GRVL 33.2 GREY SAND CLAY 41.5 BRWN SAND CLAY 51.5 GREY CLAY 59.1 GREY SILT 61.3 GREY SAND 64.0
28805	8 21	Oct-91	596100 4918440	232.0	30.8	Fr	28.7	-2.1	4.0	91	120	6.1	1456 CT	WS DO	**MOE# 5728805** 0.0 BRWN GRVL SAND 4.6 BRWN SAND 13.1 GREY CLAY 13.7 GREY SAND 24.4 GREY CLAY SAND 28.3 GREY SAND CLN 30.8
28933	5 14	Dec-91	600583 4921075	239.9	38.4	Fr	38.7	-1.2	8.5	36	210	27.4	1467 CT	WS DO	**MOE# 5728933** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL 12.5 BRWN CLAY SAND 20.7 GREY CLAY SAND 38.4 BRWN SAND 39.9 GREY CLAY GRVL 39.9

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
29157	4 12	Apr-92	600927 4922711	254.2	15.2	Fr	16.8	-0.9	10.4	45	60	13.7	3660 CT	WS DO	**MOE# 5729157** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL 1.8 BRWN CLAY SAND GRVL 4.6 GREY CLAY HARD 5.8 BRWN SAND 15.2 BRWN FSND WBRG MGRD 18.3
29252	4 14	May-92	601247 4920836	235.3	10.1	Fr	10.4	-1.8	1.5	45	120	9.1	1851 CT	WS DO	**MOE# 5729252** 0.0 BRWN FILL 0.6 BRWN TPSL 0.9 GREY SILT 5.8 RED CGVL 7.0 GREY SAND SLTY 10.1 GREY MSND WBRG 13.1
29277	3 5	May-92	601847 4921681	234.7	9.4	Fr	9.4	-1.8	3.7	68	90	9.4	2514 CT	WS DO	**MOE# 5729277** 0.0 TPSL 0.3 BRWN SAND 3.7 BRWN SAND CLAY 9.4 BRWN SAND 11.3 BRWN SAND CLAY 16.5
29457	5 2	Jul-92	599216 4921919	234.4	21.3	Fr	23.2	-1.2	11.6	55	60	19.8	3602 RA	WS DO	**MOE# 5729457** 0.0 BRWN SAND CLAY 18.3 GREY CLAY HARD 21.3 BRWN SAND CLN WBRG 24.4
29517	3 12	Aug-91	601491 4923291	288.3	51.5	Fr	54.6	-1.2	NR	77	210	55.8	2431 RC	WS DO	**MOE# 5729517** 0.0 BRWN SAND CLAY 4.3 BRWN CSND 11.3 BRWN CSND GRVL BLDR 25.6 BRWN FSND MSND 51.5 BRWN MSND 57.0 GREY FSND SLTY 61.0
29655	5 14	Oct-92	600383 4920871	237.4			11.0	-3.0	9.1				1839 BR	OW NU	**MOE# 5729655** 0.0 BRWN SAND LOOS 14.0 GREY SILT SAND STNS 14.9 GREY CLAY TILL 14.9
29656	5 14	Oct-92	600247 4920916	239.9			7.6	-1.5	5.5				1839 BR	OW NU	**MOE# 5729656** 0.0 BRWN SAND FGVL LOOS 5.5 GREY SILT SAND DNSE 9.1
29657	5 14	Oct-92	600367 4920916	235.9			20.7	-3.0	5.5				1839 -	- -	**MOE# 5729657** 0.0 BRWN SAND FGVL LOOS 5.5 GREY SAND SILT DNSE 22.9 GREY SILT CLAY SOFT 24.4
29658	5 14	Oct-92	600398 4920908	235.0			5.5	-1.5	4.6				1839 -	OW NU	**MOE# 5729658** 0.0 BLCK SAND GRVL 7.6
29659	5 14	Nov-92	600627 4921121	239.9					NR				1839 RC	OW NU	**MOE# 5729659** 0.0 BRWN SAND PCKD 7.0
29663	4 15	Oct-90	601301 4920741	234.7	36.3 10.4	Fr Mn			1.2	41	2160	18.3	1851 CT	WS DO	**MOE# 5729663** 0.0 BRWN FILL 0.6 BRWN TPSL 0.9 GREY SILT 5.8 RED GRVL 7.0 SAND 10.1 GREY MSND WBRG 13.1 GREY CLAY STKY 30.8 GREY CLAY CMTD 36.3 CGVL WBRG 38.7
30064	4 7	Jul-93	600266 4924231	274.9	42.1	Fr	42.4	-1.2	37.5	23	150	39.3	1467 CT	WS DO	**MOE# 5730064** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL 12.5 GREY SAND GRVL CLAY 20.7 BRWN SAND 29.6 GREY CLAY SAND 42.1 BRWN SAND 43.6

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
30128	5 16	Nov-92	601254 4920044	249.9	26.8 22.9	Fr Fr	30.5	-1.8	7.3	45	150	24.4	6386 CT	WS DO	**MOE# 5730128** 0.0 BRWN SAND SILT GRVL 18.6 GREY SILT SAND STNS 22.3 GREY HPAN ROCK SILT 22.9 BRWN SAND GRVL LOOS 24.4 GREY HPAN GRVL SILT 26.2 GREY HPAN SAND GRVL 26.8 GREY SAND SILT LYRD 29.9 BRWN SAND SILT LYRD 32.3
30133	4 14	Aug-93	600970 4921235	237.7	14.6	Fr	15.2	-1.2	7.9	45	120	11.3	1467 CT	WS DO	**MOE# 5730133** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL 12.8 BRWN SAND CLAY 14.6 RED SAND 16.5
30289	6 15	Sep-93	598832 4920041	242.9	45.7	Fr	45.7	-0.9	18.9	91	90	22.9	2514 RC	WS DO	**MOE# 5730289** 0.0 BRWN SAND GRVL 19.5 GREY SAND CLAY 36.6 BRWN SAND GRVL 46.6
30401	5 9	Oct-93	599279 4923652	234.1	14.6	Fr	15.2	-1.2	7.3	36	150	10.1	1467 CT	WS DO	**MOE# 5730401** 0.0 BRWN TPSL 0.3 BRWN SAND 8.8 GREY SAND CLAY 14.6 BRWN SAND 16.5
30402	7 13	Dec-93	597499 4919732	226.2	13.7	Fr	14.0	-2.4	4.3	36	150	8.5	1467 CT	WS DO	**MOE# 5730402** 0.0 BRWN SAND 3.0 GREY SAND CLAY 9.1 BRWN SAND 11.3 GREY SAND 13.7 BRWN FSND 16.5
30403	5 14	Nov-93	600395 4920930	235.9	15.8	Fr	17.1	-2.4	6.4	36	120	14.9	1467 CT	WS IN	**MOE# 5730403 TAG#ASSMNT** 0.0 BRWN SAND 7.3 GREY SAND CLAY GRVL 15.8 GREY FSND 19.5
30501	7 13	May-93	598172 4919885	233.8			31.4	-1.5	5.8				2801 RC	OW NU	**MOE# 5730501** 0.0 TPSL 0.6 BRWN CLAY SNDY 12.8 BRWN CLAY SNDY GRVL 15.8 SAND GRVL BLDR 23.2 BRWN SAND GRVL CLAY 25.0 SILT SNDS 33.8 SILT PCKD 35.1
30502	7 13	Jun-93	598112 4919636	241.7			62.5	-1.5	9.8				2801 RC	OW NU	**MOE# 5730502** 0.0 GRVL BLDR CSND 3.4 BLDR SNDS 6.4 BRWN CLAY SNDY 9.4 GREY CLAY HARD 13.1 GRVL SAND 31.7 SAND CLAY 36.6 GREY CLAY SNDY 37.2 GREY SAND 37.8 GREY CLAY SOFT 45.1 GREY FSND 58.5 FSND CGRD 68.9 GREY CLAY SNDY 71.9
30503	7 13	Jun-93	598132 4919616	244.8			62.5	-6.4	17.4	1137	1320	29.6	2801 RC	WS CO	**MOE# 5730503** 0.0 GRVL BLDR SAND 3.4 SAND STNS 6.4 BRWN SAND CLAY 9.1 GREY CLAY HARD 13.1 GRVL SAND 19.5 SAND FGVL 31.7 GREY SAND CLAY 36.6 GREY CLAY SOFT 45.1 FSND PCKD 58.5 GREY SAND 68.9 GREY CLAY SNDY 70.1
30504	7 13	May-93	598177 4919891	233.8			48.2	-9.4	14.0	682	20	27.7	2801 RC	WS IR	**MOE# 5730504** 0.0 TPSL 0.6 GRVL SAND BLDR 17.4 SAND GRVL BLDR 22.9 SAND GRVL CLAY 25.0 SAND GRVL 33.5 GREY SILT PCKD 40.8 GREY CLAY GRVL 45.7 SAND 56.4 GREY SAND PCKD 61.0 BRWN CLAY SAND 61.9 CLAY SAND HARD 66.4 CLAY SAND 67.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
30743	2 22	Jun-94	602831 4923518	291.4	57.9	Fr	59.4	-1.2	46.0	36	240	52.4	1467 CT	WS DO	**MOE# 5730743** 0.0 BRWN TPSL 0.3 BRWN SAND CLAY 4.9 BRWN SAND 18.9 GREY CLAY SAND 21.0 GREY SAND 34.7 BRWN SAND SILT 36.9 GREY SAND CLAY 57.9 GREY SAND 60.7
30971	3 12	Aug-94	601369 4922929	275.2	42.4	Fr	42.4	-1.2	33.2	23	180	36.9	1467 CT	WS DO	**MOE# 5730971** 0.0 BRWN SAND 14.6 GREY SAND 21.0 GREY SAND CLAY 24.7 GREY CLAY 37.5 GREY SAND CLAY 42.4 BRWN SAND 43.6 GREY CLAY SAND 43.6
31212	9 13	Dec-94	595171 4918227	224.6	29.9	Fr	30.2	-1.2	3.4	36	150	19.8	1467 CT	WS DO	**MOE# 5731212 TAG#ASSMNT** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL STNS 14.3 GREY SAND GRVL 22.3 GREY CLAY GRVL 29.9 BRWN SAND 31.4 GREY CLAY GRVL 31.4
31213	5 11	Oct-94	599144 4921991	233.5	14.3	Fr	15.2	-1.2	9.4	32	150	11.6	1467 CT	WS DO	**MOE# 5731213** 0.0 BRWN TPSL 0.3 BRWN SAND 3.4 GREY SAND 14.3 BRWN SAND 16.5 BRWN SAND GRVL 16.5
31373	3 11	Sep-94	601836 4924448	288.3	52.1	Fr	53.3	-1.2	12.2	36	120	50.3	1851 RC	WS DO	**MOE# 5731373** 0.0 RED GRVL 5.2 BRWN CLAY 8.5 BRWN GRVL CLAY 37.5 GREY CLAY STNS 39.6 BRWN CLAY 47.2 GREY CLAY 52.1 BRWN MSND WBRG 55.2 BRWN CLAY STNS 61.0
31939	10 13	Oct-95	594493 4917955	198.4	14.6	-	14.6	-1.2	FLW	27	120	7.9	1467 CT	WS DO	**MOE# 5731939** 0.0 BRWN FILL SAND 0.6 GREY CLAY SAND 14.6 GREY SAND 15.8 GREY CLAY 15.8
32299	5 12	Jun-95	599194 4921900	234.4	16.2	Fr	16.2	-1.2	10.4	27	120	16.2	2431 RC	WS DO	**MOE# 5732299** 0.0 BRWN FSND 17.4 GREY FSND SLTY 22.3 GREY SILT FSND CLAY 27.4
32472	6 16	Sep-96	599796 4919205	265.5	42.1	Fr	42.4	-1.2	26.2	73	120	32.0	1467 CT	WS DO	**MOE# 5732472** 0.0 BRWN TPSL 0.3 BRWN CLAY SAND 5.2 GREY SAND CLAY 41.1 GREY CLAY GRVL 42.1 BRWN CSND 43.6
32821	8 12	May-97	596564 4919431	222.8	44.2	-			NR				2576 RA	TH NU	**MOE# 5732821** 0.0 BRWN TPSL SILT 0.6 BRWN SAND GRVL 3.7 BRWN SAND 9.1 GREY SILT SAND 11.0 BRWN SAND FGVL 26.8 GREY GRVL SAND 31.4 GREY SAND 44.2 BRWN SAND WBRG 53.6
32988	8 9	Aug-97	595636 4921511	190.8	9.1	Fr	10.1	-0.9	NR	36	60		2514 CT	WS DO	**MOE# 5732988** 0.0 BLCK TPSL 0.3 BLCK FILL 1.5 GREY SILT CLAY SNDY 9.1 GREY SAND 11.0
33077	3 14	Sep-97	602514 4922061	255.7	25.3	Fr	25.6	-1.5	14.0	68	60	24.1	2513 CT	WS DO	**MOE# 5733077** 0.0 YLLW SAND 4.6 GREY CLAY SAND 15.2 GREY CLAY 18.9 GREY SILT SAND CMTD 25.3 YLLW FSND 27.1

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33158	5 13	Sep-97	600202 4920962	240.5	31.1	Fr	31.7	-0.9	8.8	55	60	21.3	3660 CT	WS DO	**MOE# 5733158** 0.0 BRWN SAND FILL 0.9 BRWN SAND GRVL 15.2 GREY SAND GRVL WBRG 18.3 GREY CLAY 31.1 GREY SAND MGRD WBRG 32.6
33191	2 16	Nov-97	604919 4921541	285.3	17.4	Fr	16.2	-1.2	12.2	32	120	15.2	4645 RC	WS DO	**MOE# 5733191** 0.0 BRWN SAND GRVL LOOS 1.2 BRWN CLAY SILT HARD 14.3 BRWN SAND GRVL LOOS 17.4 BRWN CLAY SAND HARD 54.9
33255	9 13	Nov-97	595254 4918256	224.6	51.2	Mn	51.2	-1.2	7.0	45	150	17.7	1467 CT	WS DO	**MOE# 5733255** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL 29.9 GREY CLAY FSND 51.2 GREY SAND 52.4 GREY CLAY 52.7
33452	4 16	May-98	601776 4920263	237.4	61.3	Fr	61.3	-10.1	2.1	727	4320	4.0	5528 RC	WS MU	**MOE# 5733452** 0.0 BRWN SAND 5.8 BRWN SAND GRVL CLAY 16.8 GREY CLAY 18.3 BRWN SILT SAND 25.9 GREY SILT CLAY 44.5 GREY CLAY SILT 46.6 GREY SILT 60.7 GREY FSND 72.2 GREY CLAY SAND LYRD 75.0
33549	2 17	Jan-98	604587 4922184	285.0	3.7	Fr			2.4	91	120	7.6	3413 BR	WS DO	**MOE# 5733549** 0.0 BRWN GRVL CGRD 3.7 GREY CLAY 8.5
33578	8 13	May-98	596036 4918673	220.1	38.4	Fr	39.9	-1.2	NR	23	1080	12.5	1467 CT	WS DO	**MOE# 5733578** 0.0 BRWN TPSL 0.3 BRWN SAND GRVL 12.8 GREY CLAY GRVL 38.4 GREY FSND 41.1
33595	7 9	Aug-98	596736 4922241	193.9	38.7	Fr	42.4	-1.2	NR	45	60	3.4	1467 CT	WS DO	**MOE# 5733595** 0.0 BRWN TPSL 0.3 RED SAND 0.9 GREY CLAY 34.7 GREY CLAY GRVL 36.9 GREY SILT 38.7 BRWN SAND 43.6 GREY CLAY 43.6
34001	8 13	Dec-98	595942 4918779	211.5	18.0	Fr	16.5	-1.5	1.8	68	150	4.9	7074 CT	WS DO	**MOE# 5734001** 0.0 GREY CLAY SAND 7.9 GREY CLAY CSND 16.5 BRWN SAND CLAY 18.0
34038	6 10	Nov-98	597151 4922019	222.8					NR				2513 -	AB NU	**MOE# 5734038** 0.0
34146	4 4	Apr-99	599392 4923657	238.7	10.1	Fr	13.7	-1.2	6.7	23	120	10.7	1467 CT	WS DO	**MOE# 5734146** 0.0 BRWN SAND 10.1 GREY SAND WBRG 14.9 GREY SAND CLAY 14.9
34300	4 13	May-99	600754 4921528	239.9	15.5	Fr	16.5	-1.2	12.2	23	60	13.7	1467 CT	WS DO	**MOE# 5734300** 0.0 BRWN TPSL 0.3 GREY SAND GRVL 15.5 BRWN SAND 17.7 GREY SAND CLAY 17.7
34379	5 9	Aug-99	598118 4923057	212.1	21.3	-	21.3	-1.5	FLW	18	180	18.3	5528 RC	OW MU	**MOE# 5734379** 0.0 BRWN SAND 2.1 BRWN CLAY SOFT 6.7 BRWN CLAY 14.6 BLDR 15.5 GREY CLAY GRVL 19.5 BRWN SAND 25.9 GREY SILT 28.0 GREY CLAY SILT 34.7 GREY CLAY HARD 41.1 GREY SILT 46.3 GREY CLAY 48.8 GREY FSND SILT 59.7 GREY CLAY SILT 64.0 GREY CLAY HARD 67.1

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
34380	5 10	Aug-99	598510 4922524	226.5					NR				5528 RC	AS MU	**MOE# 5734380** 0.0 BRWN SAND 3.7 BRWN CLAY 7.3 BRWN SAND 21.9 GREY CLAY SAND 28.3 GREY CLAY 29.3 GREY CLAY 33.5 GREY FSND SILT 41.1 GREY SILT 51.2 GREY CLAY 56.1 GREY SILT 71.9 GREY CLAY 81.7 GREY SILT CLAY 89.9 GREY SAND CLAY 91.4 GREY CLAY TILL 100.6
34381	5 10	Aug-99	598080 4923089	208.2					NR				5528 RC	AB MU	**MOE# 5734381** 0.0 BRWN SAND 1.5 BRWN CLAY SOFT 8.5 GREY CLAY SOFT 12.8 GREY CLAY GRVL 21.9 GRVL SAND STNS 24.4
34452	4 14	Jul-99	600968 4921207	238.0	16.5	Fr	15.5	-0.9	9.4	41		13.4	2514 CT	WS DO	**MOE# 5734452** 0.0 BLCK SAND GRVL TPSL 0.6 BRWN SAND GRVL 14.9 BRWN SAND 16.5
34824	5 14	Dec-99	600844 4921126	236.8	16.2	Fr	14.9	-1.2	8.5	36	180	14.3	2514 CT	WS DO	**MOE# 5734824** 0.0 BRWN GRVL SAND SNDY 12.2 BRWN SAND CLAY 14.9 BRWN MSND 16.2
35105	4 12	May-00	602494 4922159	239.0	20.1	Fr	17.4	-2.7	11.3	45	390	16.8	2514 CT	WS DO	**MOE# 5735105** 0.0 BRWN SAND CLAY 13.7 BRWN SAND 17.4 GREY FSND 20.1
35245	7 16	May-00	599460 4918471	281.9	23.8	Fr	32.9	-3.7	23.8	91	90	25.6	6409 CT	WS DO	**MOE# 5735245** 0.0 BLCK TPSL FILL 1.2 BRWN CLAY STNS 6.4 BRWN SAND LOOS DRY 23.8 BRWN SAND WBRG 36.6
35436	6 14	Jul-00	598666 4919887	239.9	25.0	Fr	23.2	-2.1	12.2	136	90	19.8	3602 RC	WS DO	**MOE# 5735436 TAG#ASSMNT** 0.0 BRWN SAND GRVL CLAY 7.6 BRWN CLAY HARD 7.9 BRWN SAND CLAY GRVL 12.2 BRWN CLAY HARD 13.7 BRWN CLAY SAND 15.2 BRWN SAND 18.3 BRWN SAND GRVL 19.8 BRWN CLAY 23.2 BRWN SAND WBRG 25.0
35502	4 12	Aug-00	602462 4922133	252.4	36.6	Fr	33.8	-2.7	11.9	68	360	32.3	2514 CT	WS DO	**MOE# 5735502** 0.0 BRWN SAND CLAY SAND 13.7 BRWN SAND 17.4 GREY SAND FSND 21.3 GREY SAND CLAY SAND 32.0 BRWN SAND FSND 36.6
35952	4 14	May-01	601434 4921874	237.4					NR				2801 RC	AQ MU	**MOE# 5735952** 0.0
36080	1 21	May-01	603956 4923346	290.5	53.6	Fr	53.9	-1.2	43.3	23	270	46.9	1467 CT	WS DO	**MOE# 5736080** 0.0 BLCK TPSL 0.3 BRWN SAND CLAY 14.3 GREY CLAY 20.1 GREY CLAY SAND 30.8 BRWN SAND CLAY LYRD 48.2 GREY CLAY 53.6 BRWN SAND 55.5 GREY CLAY SAND 55.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
36194	7 13	Jul-01	598309 4919758	239.9	36.9	Fr	28.7	-3.4	10.7	64	60	13.7	2801 RC	WS CO	**MOE# 5736194** 0.0 GRVL SAND BLDR 2.7 CLAY GRVL 7.3 CLAY SNDY GRVL 7.9 GRVL CLAY SOFT 9.4 GREY CLAY STNS 12.5 GRVL SAND BLDR 14.9 CLAY 16.5 SAND GRVL CLAY 22.9 SAND SNDY CLAY 26.8 SAND 29.0 SAND GRVL STKY 31.1 SAND PCKD 32.9 FSND GRVL 38.1 FSND FSND 40.5
36333	5 17	Jul-01	601034 4920744	237.1	25.3	Fr	21.9	-3.0	2.7	136	90	17.1	2513 CT	WS IR	**MOE# 5736333** 0.0 YLLW SAND 4.6 GREY SAND GRVL 13.1 GREY SAND SILT 14.0 GREY SAND 21.0 GREY FSND 25.3
36619	5 9	Jan-02	599363 4923509	236.8	27.4	-	25.6	-1.2	13.1	55	90	20.7	2576 CT	WS DO	**MOE# 5736619** 0.0 PRDR 19.8 GREY SAND 25.0 BRWN SAND 27.4
36620	4 9	Jan-02	599512 4923687	240.8	17.4	Fr	14.3	-1.2	7.6	36	90	11.9	2576 CT	WS DO	**MOE# 5736620** 0.0 BRWN SAND 6.7 GREY SAND 14.6 BRWN SAND 17.4
36644	5 17	Feb-02	601651 4919778	271.9	46.9	-	44.2	-2.4	36.6	55	180	41.1	2514 CT	WS DO	**MOE# 5736644** 0.0 BLCK TPSL 0.3 BRWN SAND MSND 20.1 GREY SAND CLAY 36.6 GREY SAND 46.9
36694	7 14	Mar-02	597809 4919103	280.4					NR				2801 -	AB NU	**MOE# 5736694** 0.0 SAND 4.6 SAND GRVL 10.7 BRWN CLAY 13.1 SAND GRVL 21.3 BRWN CLAY 21.9 SAND GRVL 39.9 GREY CLAY 43.9 CLAY GRVL 47.9 GREY SAND GRVL 68.9 GREY CLAY 75.3 SAND SILT 82.0 GREY CLAY GRVL 83.8 SAND SLTY 91.7 MSND 113.4 MSND 132.6 GREY CLAY STNS HARD 134.4
36988	9 13	Jun-02	595278 4918277	224.9	22.3	Fr	27.4	-1.2	13.4	41	60	19.8	7088 CT	WS DO	**MOE# 5736988** 0.0 BRWN SAND SILT 22.3 BRWN SAND 28.7 GREY SAND SILT 30.5
37087	5 9	Jun-02	599283 4923488	235.3	9.4	Fr	16.8	-1.2	7.0	23	120	12.5	1467 CT	WS DO	**MOE# 5737087** 0.0 BLCK TPSL 0.3 BRWN SAND STNS 2.1 BRWN SAND CLAY 9.4 BRWN SAND 18.0
37142	7 10	Aug-02	596970 4921744	218.8	35.4 32.9	Fr Fr	33.5	-0.9	NR	27	90		2576 RA	WS DO	**MOE# 5737142** 0.0 TPSL 0.3 BRWN SAND GRVL 5.5 GREY SILT GRVL 16.2 BRWN GRVL SAND WBRG 24.1 GREY SILT GRVL 27.1 GREY SILT CLAY GRVL 32.9 GREY SAND GRVL SILT 35.4
37146	4 12	Jul-02	602455 4922116	251.5	22.3 20.4	Fr Fr	19.8	-1.8	10.1	68	240	18.3	2514 CT	WS DO	**MOE# 5737146** 0.0 BRWN SAND GRVL FILL 0.9 BLCK SAND TPSL 1.2 BRWN SAND 9.1 GREY SAND CLAY SAND 18.3 BRWN SAND MSND 22.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
37231	14	Sep-02	598564 4919871	239.9	31.1 27.4	Fr Fr	29.0	-2.1	15.2	68	70	24.4	3602 RA	WS DO	**MOE# 5737231** 0.0 BRWN SAND GRVL STNS 7.9 BRWN SAND CLAY GRVL 15.5 BRWN SAND CLAY SNDY 27.4 BRWN SAND CLN WBRG 31.1
37242	5	Jun-02	600916 4923028	271.3	42.7	Fr	43.9	-2.4	30.5	55	150	39.6	1467 CT	WS DO	**MOE# 5737242** 0.0 BRWN TPSL 0.3 BRWN SAND 2.1 BRWN CLAY 7.9 BRWN SAND CMTD 42.7 BRWN SAND 45.4
37495	6 14	Dec-02	598542 4919846	239.9	28.7	Fr	29.0	-1.8	12.5	91	600		6300 RC	WS CO	**MOE# 5737495** 0.0 TPSL 0.6 BRWN SAND GRVL 2.4 BRWN SAND 10.4 BRWN CLAY 18.6 SAND 28.7 SAND CLN 31.1
37655	3 13	Feb-03	601652 4922230	243.5					NR				7144 -	AB -	**MOE# 5737655** 0.0 UNKN 2.1 UNKN 19.8 STNS 21.0
37801	9 13	Feb-03	595194 4918135	225.9	28.7	Fr	28.7	-1.2	8.5	32	90	27.4	5528 CT	WS DO	**MOE# 5737801** 0.0 BRWN GRVL STNS 9.1 GREY SAND SILT 13.1 GREY SAND CLAY SILT 27.4 GREY CLAY 28.3 GREY FSND 30.2
37827	9 13	Apr-03	594715 4917969	221.6	49.7	Fr	50.3	-1.2	4.9	36	120	14.0	1467 CT	WS DO	**MOE# 5737827** 0.0 TPSL 0.3 BRWN SAND GRVL 7.3 GREY SAND GRVL 17.4 GREY SILT 33.8 GREY CLAY HARD 46.9 GREY SAND 48.5 GREY CLAY 49.7 GREY SAND 51.2 GREY CLAY 51.5
37998	5 14	Jun-03	600496 4920946	235.0	21.6	Fr	20.1	-1.5	10.1	45	90	18.3	2514 CT	WS DO	**MOE# 5737998** 0.0 BRWN SAND GRVL 4.6 BRWN GRVL 6.7 BRWN SAND MSND 21.6
38195	9 13	Dec-02	596674 4918582	244.1			62.5	-7.6	23.8				2801 RC	OW NU	**MOE# 5738195** 0.0 SAND GRVL 5.5 SAND CLAY SILT 13.1 GREY CLAY 15.8 SAND CLAY LYRD 17.4 SAND 20.7 GREY CLAY SAND LYRD 24.1 GREY CLAY 25.6 FSND PCKD 43.0 GREY CLAY 44.2 SAND CLAY PCKD 46.9 GREY CLAY 54.3 SAND VERY PCKD 75.6 SAND VERY GRVL 77.7 SAND GRVL 80.5 GREY CLAY SNDY 89.9 GREY CLAY HARD 92.7
38227	8 13	Jul-03	596698 4918601	244.1			62.5	-10.1	24.7	1137	4320	39.3	2801 RC	WS MU	**MOE# 5738227** 0.0 SAND GRVL PCKD 4.3 SAND GRVL CMTD 7.0 SAND PCKD 12.8 GREY CLAY HARD 16.5 GREY SAND PCKD 20.7 GREY CLAY 25.9 SAND PCKD 43.0 GREY CLAY 44.5 SAND PCKD 46.6 GREY CLAY 54.9 SAND PCKD 75.6
38363	3 10	Sep-03	601099 4923536	284.7	53.3	Fr	53.3	-1.5	37.8	45	480	48.2	1851 CT	WS DO	**MOE# 5738363** 0.0 BRWN CLAY SAND 3.7 GREY CLAY SAND GRVL 40.5 BRWN SAND DRTY 46.6 GREY CLAY FSND SILT 53.3 GREY FSND WBRG 54.9

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
38422	4 11	Oct-03	599951 4922799	279.5	28.0	Fr	26.5	-1.5	11.6	5	120	26.5	2514 CT	WS DO	**MOE# 5738422** 0.0 BRWN FSND 20.7 GREY CLAY SAND SNDY 26.2 GREY FSND 28.0
38455	6 14	Dec-03	598714 4919899	239.9	36.0	Fr	34.7	-1.2	20.7	91	120	27.4	7074 CT	WS DO	**MOE# 5738455** 0.0 BRWN SAND GRVL 4.3 GREY CLAY 18.9 BRWN SAND GRVL 23.8 GREY CLAY SAND 35.1 BRWN CSND 36.0
38528	7 13	Jul-03	597694 4919729	230.1	4.6	Fr	60.7	-2.4	7.0	118	60	53.0	1663 RC	WS CO	**MOE# 5738528** 0.0 BRWN FSND GRVL 11.9 BRWN CLAY SNDY GRVL 13.7 BRWN SAND GRVL 20.7 BRWN CLAY 22.3 BRWN SAND CLAY 27.4 BLUE CLAY FSND 44.5 GREY MSND FSND 63.1
38845	8 16	May-04	596979 4917121	314.9	52.7	Fr	64.9	-2.1	53.6	9	60	185.0	7222 CT	WS DO	**MOE# 5738845 TAG#A003945** 0.0 BRWN SAND FGVL LOOS 67.1
38949	4 13	Jan-04	600870 4921370	239.9	10.7	Fr	6.1	-3.0	NR				6607 -	TH -	**MOE# 5738949 TAG#A007302** 0.0 BRWN SAND GRVL STNS 9.1
39023	6 14	Aug-04	598727 4919962	239.9	39.3	Fr	39.3	-1.2	16.8	32	120	36.6	1851 CT	WS IN	**MOE# 5739023 TAG#A003719** 0.0 BRWN GRVL SAND CLAY 10.7 GREY CLAY GRVL 20.1 BRWN GRVL CLAY 27.4 BRWN SAND DRTY 29.3 GREY CLAY STNS 38.1 GREY SAND SILT 39.3 BRWN SAND WBRG 40.5
39139	3 14	Aug-04	602438 4921985	256.9	27.1	Fr	26.2	-2.7	12.5			16.8	2514 CT	WS DO	**MOE# 5739139 TAG#A003188** 0.0 BRWN SAND GRVL SOFT 3.0 GREY CLAY SAND LYRD 24.4 BRWN SAND 29.0
39284	2 27	Oct-04	602485 4925381	281.0	53.0	Fr	51.8	-1.2	33.5	227	120	37.2	7074 RC	WS DO	**MOE# 5739284 TAG#A000683** 0.0 GREY CLAY SAND 8.2 BRWN SAND 36.6 GREY CLAY 50.3 BRWN SAND 53.0
39408	8 13	Oct-04	596021 4918582	217.6	17.1	Fr	17.4	-1.2	FLW	27	990	14.3	1467 CT	WS DO	**MOE# 5739408 TAG#A018286** 0.0 BRWN TPSL 0.3 BRWN CLAY STNS 4.3 GREY SAND CLAY GRVL 17.1 BRWN SAND 18.6
39425	8 14	Oct-04	596700 4918617	244.1	61.9	Fr	62.8	-9.8	23.5	1141	2520	39.6	2801 RC	WS MU	**MOE# 5739425 TAG#A011213** 0.0 SAND GRVL 6.4 FSND CLAY LYRD 20.7 SAND GRVL CLAY 25.6 FSND GRVL CLAY 44.2 CLAY LYRD SAND 56.7 FSND PCKD 76.8 FSND CLAY PCKD 78.6
39665	5 7	Jan-05	597678 4923800	199.9	26.8	Fr	26.5	-6.7	-0.9	9	60	61.0	2576 RA	WS -	**MOE# 5739665 TAG#A024711** 0.0 BRWN SAND 4.6 GREY CLAY SOFT 19.8 GREY SILT FSND 32.9 GREY CLAY 33.2
39677	4 12	Apr-05	601045 4923052	282.9	44.2	Fr	44.2	-2.4	31.1	45	60	39.9	7075 RC	WS DO	**MOE# 5739677 TAG#A020798** 0.0 TPSL 0.3 BRWN CSND 21.0 BRWN SAND CLAY LYRD 23.5 BRWN FSND 46.6
39696	9 15	Apr-05	596612 4917321	314.9					NR				2801 DG	AB -	**MOE# 5739696** 0.0 0.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
39881	4 14	Jun-05	600950 4921247	237.7					8.8	9	120	11.6	7074 CT	WS DO	**MOE# 5739881 TAG#A023948** 0.0 BRWN SAND MSND 7.9 GREY CLAY SAND 8.5 BRWN SAND CSND 19.2
39941	7 12	Jul-05	596907 4919777	222.8	25.6	Fr	24.4	-1.2	12.8	45	60	15.2	7075 RC	WS DO	**MOE# 5739941 TAG#A027101** 0.0 BLCK TPSL 0.3 BRWN FSND 8.8 GREY CLAY SILT HARD 21.9 BRWN SAND 25.6
40212	9 15	Sep-05	596506 4917729	294.7			53.3	-3.0	55.5				7075 RC	OW -	**MOE# 5740212 TAG#A030121** 0.0 TPSL 0.3 BRWN CSND CGVL STNS 15.8 BRWN CSND CGVL 56.4
40213	9 15	Sep-05	596236 4917630	245.7			59.7	-3.0	17.1				7075 RC	OW MU	**MOE# 5740213 TAG#A030101** 0.0 BRWN CSND CGVL STNS 14.6 BRWN CSND CGVL 62.8
40223		Sep-05	596737 4917299	314.9			6.7 21.9	-3.0 -3.0	24.1				7075 RC	OW MU	**MOE# 5740223 TAG#A030103** 0.0 TPSL 0.3 BRWN SAND LOOS 1.2 BRWN CSND CGVL 4.3 GREY CLAY TILL HARD 11.0 BRWN CSND CGVL 25.3
40325	7 8	Sep-05	596648 4922557	191.1	38.7	Un	43.0	-1.2	5.8	14	180	4.0	1467 CT	WS DO	**MOE# 5740325 TAG#A026875** 0.0 BRWN TPSL 0.3 GREY CLAY 38.7 GREY SAND 44.2 GREY CLAY 44.8
40481	4 12	Nov-05	601433 4922435	255.4	29.3	Fr	29.3	-1.2	15.5	27	300	27.4	1851 CT	WS DO	**MOE# 5740481 TAG#A024307** 0.0 GREY CLAY SAND 22.9 GREY CLAY DNSE 29.3 BRWN SAND WBRG 30.8 GREY SILT CLAY SAND 31.4
40551		Sep-05	600417 4920784	239.9			21.0	-3.0	NR				1737 RC	OW NU	**MOE# 5740551 TAG#A032270** 0.0 BLCK FILL 0.6 BRWN FSND 2.4 GREY CLAY SILT SOFT 5.2 GREY SAND GRVL CLAY 24.1
40552		Sep-05	600394 4920929	235.0					NR				1737 RC	OW NU	**MOE# 5740552 TAG#A032272** 0.0 BRWN FILL SAND GRVL 2.1 BRWN CSND 7.6 BRWN MSND 18.3
40553		Sep-05	600433 4920972	235.0			8.5	-3.0	NR				1737 RC	OW NU	**MOE# 5740553 TAG#A032271** 0.0 BRWN CGVL 2.4 BRWN MSND CLAY 11.6
40554		Sep-05	600433 4920972	235.0			24.1	-3.0	NR				1737 RC	OW NU	**MOE# 5740554 TAG#A032271** 0.0 BRWN CSND CGVL 2.4 BRWN MSND 11.3 GREY CLAY SILT SOFT 20.7 GREY MSND 27.4
40555		Sep-05	600343 4920903	239.0			3.0	-3.0	NR				1737 RC	OW NU	**MOE# 5740555 TAG#A032275** 0.0 BRWN GRVL SAND STNS 6.1
40556		Sep-05	600384 4920889	236.5					NR				1737 RC	OW NU	**MOE# 5740556 TAG#A032273** 0.0 BLCK FILL 1.8 BRWN CSND 5.8 BRWN CGVL 7.9 BRWN MSND 18.3
40561		Sep-05	600343 4920903	239.0					NR				1737 RC	OW NU	**MOE# 5740561 TAG#A032274** 0.0 BLCK FILL 1.5 BRWN CGVL CSND 8.2 BRWN MSND 18.3
40620		Dec-05	600360 4920936	237.1			9.1	-3.0	NR				6032 -	OW NU	**MOE# 5740620 TAG#A005465** 0.0 BRWN SAND 3.0 BRWN SAND 11.9

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40792	5 14	Apr-06	600762 4921225	239.9	18.0	Un	18.6	-0.9	9.8	59	60	11.6	2513 CT	WS DO	**MOE# 5740792 TAG#A015087** 0.0 YLLW SAND GRVL BLDR 3.4 GREY SAND GRVL BLDR 7.3 YLLW SAND GRVL 19.5
41263	5 12	Aug-06	599189 4921860	234.1	27.4	Fr	27.4	-1.5	9.1	45	60		2576 RA	WS DO	**MOE# 5741263 TAG#A048809** 0.0 BRWN SAND 21.6 GREY CLAY 27.4 GREY SAND 29.0 GREY SILT 29.6
41287		Aug-06	600356 4920911	237.7			2.7	-3.0	NR				6032 -	TH NU	**MOE# 5741287 TAG#A005219** 0.0 BLCK GRVL 0.3 BRWN SAND SILT 3.7 BRWN SAND GRVL 5.8
7035794		Sep-06	600865 4921358	239.9	10.7	Fr	9.1	-6.1	NR				6607 -	OW -	**MOE# 7035794 TAG#A046475** 0.0 BRWN SAND GRVL 1.5 BRWN CGVL SAND 4.6 BRWN FSND FGVL 9.1 GREY FSND 15.2
7035810		Sep-06	600865 4921358	239.9	10.7	Fr	9.1	-3.0	NR				6607 -	OW -	**MOE# 7035810 TAG#A046480** 0.0 BRWN SAND CGVL 1.5 BRWN SAND 6.1 GREY FSND 12.2
39205		Nov-06	600885 4921363	239.9	10.7	Fr	9.1	-3.0	NR				6607 -	OW -	**MOE# 7039205 TAG#A051199** 0.0 BRWN SAND CGVL 4.6 BRWN SAND FSND 9.1 GREY FSND 12.2
7040894		Nov-06	600325 4920974	240.5	10.1	Fr			NR				1129 RC	OW NU	**MOE# 7040894 TAG#A039909** 0.0 BRWN SAND SAND 12.2 BRWN SAND 21.3
41785	5 21	Feb-07	600004 4922834	241.1					NR				2514 -	AS NU	**MOE# 7041785 TAG#A048109** 0.0 67.1
7046407		Apr-07	600560 4921340	239.9	9.8	Un	14.9	-0.3	NR				6607 -	OW -	**MOE# 7046407 TAG#A048432** 0.0 BLCK FILL 4.6 BRWN SAND 6.1 SAND 9.8 SAND WBRG 15.2
7046408		May-07	600560 4921340	239.9	9.8	Un	9.1	-3.0	NR				6607 -	OW -	**MOE# 7046408 TAG#A048431** 0.0 BLCK FILL 4.6 BRWN SAND 6.1 BRWN SAND 9.8 BRWN SAND WBRG 12.2
7048679		Jul-07	595081 4916854	261.8					NR				6809 -	OW MO	**MOE# 7048679 TAG#A053003** 0.0 BRWN SAND GRVL 15.2 BRWN CSND GRVL WBRG 15.8 BRWN FSND SILT 24.1
51395		May-07	600343 4921203	239.9					NR				1129 OTH	OW -	**MOE# 7051395 TAG#A055379** 0.0 SAND GRVL 0.9 BRWN FSND MSND 11.9 BRWN SAND MSND 15.8
54010	3 11	Dec-07	600897 4923544	282.5	95.1	Fr	93.6	-2.4	47.9		60		5224 RA	WS DO	**MOE# 7054010 TAG#A059122** 0.0 BRWN CLAY SAND 2.4 BRWN SAND GRVL CLAY 13.7 BRWN SAND 54.9 GREY SILT SAND 93.9 GREY SAND 96.0
7100088		Nov-07	600320 4921195	240.2					NR				1129 -	OW MO	**MOE# 7100088 TAG#A060920** 0.0 BRWN SAND 12.2 GREY SAND WBRG 21.3

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2442	3 11	Jan-08	601084 4923476	285.0			41.8	-3.0	33.5				5528 RC	OW NU	**MOE# 7102442 TAG#A044231** 0.0 BRWN SAND 1.5 GREY CLAY 7.6 BRWN SAND MSND 18.9 GREY CLAY SAND TILL 22.9 GREY CLAY SILT 24.4 GREY CLAY SAND FSND 33.5 BRWN SAND MSND 57.9 BRWN SAND SILT 76.2 GREY CLAY SILT 83.5 GREY SAND CLAY SILT 85.3 GREY CLAY DNSE 90.2 GREY SILT CLAY 101.5 GREY SAND SILT FSND 108.2 BRWN SAND MSND 114.3 BRWN SAND SILT DRTY 135.6 GREY CLAY SILT TILL 146.3
2443	3 11	Jan-08	601084 4923476	285.0					NR				5528 RC	OW CO	**MOE# 7102443 TAG#A044231** 0.0 BRWN SAND 1.5 GREY CLAY 7.6 BRWN MSND CSND 18.9 GREY CLAY GRVL TILL 22.9 GREY CLAY SILT 24.4 GREY CLAY FSND 33.5 BRWN MSND 57.9 BRWN SAND SILT 76.2 GREY CLAY SILT 83.5 GREY SAND CLAY SILT 85.3 GREY CLAY DNSE 90.2 GREY SILT CLAY 101.5 GREY FSND SILT 108.2 BRWN MSND 114.3 BRWN SAND SILT DRTY 135.6 GREY CLAY SILT TILL 146.6
3469		Oct-07	600862 4921415	239.9	10.4	Fr			NR				6607 BR	WS TH	**MOE# 7103469 TAG#A065551** 0.0 BRWN SAND SILT FSND 17.4
6268	3 11	Jan-08	602204 4923681	290.8					NR				 RC	OW CO	**MOE# 7106268 TAG#A044221** 0.0 BRWN CLAY 3.0 BRWN SAND GRVL 9.1 BRWN FSND 39.6 BRWN SILT SAND CLAY 45.7 BRWN FSND 48.2 BRWN MSND 89.9 BRWN SILT CLAY SAND 103.6 BRWN FSND 112.8 BRWN MSND 117.3 BRWN SILT CLAY SAND 125.0 BRWN FSND 128.0 BRWN MSND 134.7 GREY CLAY DNSE 138.4 BRWN SILT SAND DRTY 141.7 BRWN SAND SILT STNS 144.2 BRWN MSND CSND 148.4 GREY CLAY STNS TILL 156.7
6274	3 11	Feb-08	602133 4923624	290.8			47.2	-0.9	40.5				5528 RC	OW NU	**MOE# 7106274 TAG#A044221** 0.0 BRWN CLAY 3.0 BRWN SAND GRVL 9.1 BRWN SAND FSND 39.6 BRWN SILT SAND LYRD 45.7 BRWN SAND FSND 48.8 BRWN SAND MSND 89.9 BRWN SILT CLAY SAND 103.6 BRWN SAND FSND 112.8 BRWN SAND MSND 117.3 BRWN SILT CLAY SAND 125.0 BRWN SAND FSND 128.0 BRWN SAND MSND 134.7
7108925	2 12	May-08	602228 4924119	289.6	64.3	Fr	63.1	-1.2	41.5	91	120	43.9	7074 RC	WS DO	**MOE# 7108925 TAG#A023980** 0.0 BRWN CLAY SAND 1.2 BRWN SAND MSND 25.6 GREY CLAY 35.1 GREY CLAY SILT 57.3 GREY SILT SAND FSND 61.9 BRWN SAND 64.3
7109716	5 15	Jun-08	600274 4919706	275.2	14.9	Fr	19.8	-1.5	NR				7190 RC	OW NU	**MOE# 7109716 TAG#A047918** 0.0 BRWN TPSL 0.6 BRWN SAND GRVL SILT 15.2 GREY SAND GRVL SILT 21.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
7110073		Jul-08	597670 4919755	229.5	12.2	Fr			6.1	68	60	7.6	7075 RA	WS -	**MOE# 7110073 TAG#A066540** 0.0 BRWN SAND LOOS 3.4 GREY CLAY SILT HARD 10.7 BRWN FSND LOOS 24.1
7111735	3 10	Aug-08	601830 4924191	286.8	110.9	Un	116.4 110.3	-9.1 -6.1	51.2	250	120	57.0	5528 RC	WS MU	**MOE# 7111735 TAG#A044266** 0.0 BRWN SAND GRVL 0.9 BRWN CLAY GRVL STNS 5.8 BRWN CLAY 10.7 BRWN SAND MGRD 25.9 BRWN SAND CLAY LYRD 33.5 BRWN SAND MGRD 35.1 BRWN SAND MGRD CGRD 57.9 BRWN SILT SAND DRTY 70.1 BRWN SAND FGRD 74.7 BRWN SILT SAND CLAY 89.0 GREY CLAY DNSE 92.4 GREY SILT CLAY 100.6 BRWN SAND FGRD 106.7 BRWN SAND MGRD LOOS 121.9 BRWN SAND MGRD PCKD 126.8
7111741	6 15	Aug-08	599944 4920087	279.8	71.0 123.1	Un Un	70.7 122.5	-3.0 -3.0	NR				5528 RC	OW MO	**MOE# 7111741 TAG#A044256** 0.0 BRWN SAND 15.2 BRWN CLAY 15.8 BRWN SAND 32.0 CLAY SLTY 62.5 FSND 76.2 CLAY SAND 85.3 GREY CLAY 95.4 BRWN FSND CLAY LYRD 101.2 BRWN FSND 108.8 BRWN SAND CLAY LYRD 112.8 GREY CLAY SILT 118.9 FSND 127.7 GREY CLAY 130.1
7111742	6 15	Aug-08	599958 4920092	279.8	29.0	Un	29.0	-3.0	NR				5528 RC	OW MO	**MOE# 7111742 TAG#A044260** 0.0 TPSL 0.6 BRWN SAND 15.2 BRWN CLAY 15.8 BRWN SAND 33.2 GREY CLAY 43.9
7112433	4 10	Aug-08	600834 4923410	282.5	45.1	Fr	45.1	-0.9	37.2	55	120	42.1	1851 CT	WS DO	**MOE# 7112433 TAG#A067196** 0.0 TPSL 0.6 BRWN CLAY SAND 3.0 GREY CLAY GRVL CMTD 37.8 BRWN SAND 42.1 BRWN CLAY SAND LYRD 45.1 BRWN SAND WBRG 46.0
7112434	4 10	Sep-08	600844 4923400	282.5					37.2				1851 -	- -	**MOE# 7112434 TAG#A067205** 0.0
7115223	3 13	Oct-08	602906 4922835	285.3	114.9	Un	114.3	-1.2	52.4	45	70	58.8	5528 RC	WS DO	**MOE# 7115223 TAG#A043145** 0.0 BRWN CLAY GRVL LYRD 25.9 BRWN SAND STNS 42.7 GREY CLAY SILT 46.6 BRWN SAND 54.9 BRWN SAND SILT CMTD 89.0 GREY CLAY DNSE 97.5 BRWN SAND SILT 131.7 GREY CLAY 134.1 BRWN SAND 144.8 GREY CLAY TILL 146.6
17922	6 16	Jul-08	600342 4918882	270.4	6.7 46.3 108.2 108.2 108.2 108.2 108.2	Fr Fr Fr Fr Fr Fr Fr	109.7 52.4	-3.0 -6.1	NR				7075 RA	TH TH	**MOE# 7117922 TAG#A066557** 0.0 BRWN SAND SLTY 19.8 GREY CLAY SLTY HARD 46.3 BRWN FSND 68.6 GREY CLAY SLTY HARD 82.3 GREY SAND SLTY 96.0 BRWN MSND 99.7 GREY CLAY HARD 102.4 GREY SILT 108.2 BRWN MSND 114.6 GREY CLAY HARD 119.5 SAND SLTY 121.0 CLAY HARD 126.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
17923	6 15	Jul-08	599491 4919785	265.5	47.5 16.2	Fr Fr	61.0 18.3	-3.0 -3.0	NR				7075 RA	TH MO	**MOE# 7117923 TAG#A066541** 0.0 BRWN SAND MSND LOOS 21.3 BRWN SAND SILT LOOS 31.4 GREY CLAY HARD 47.5 BRWN SAND MGRD LOOS 64.0 GREY CLAY SILT SOFT 71.6 GREY CLAY HARD 71.6
17924	6 16	Jul-08	600544 4919182	279.2	14.3 56.1	Fr Fr	61.0 35.1	-3.0 -3.0	NR				7075 RA	TH TH	**MOE# 7117924 TAG#A066556** 0.0 FSND MSND TILL 4.6 BRWN FSND 15.2 BRWN MSND FSND 41.1 FSND SLTY 45.1 GREY CLAY HARD 56.1 BRWN FSND 76.2 GREY FSND SLTY 81.4 GREY SILT CLAY HARD 83.8
17925	5 16	Aug-08	601054 4919322	282.5	17.7 58.8	Un Un	62.5 30.5	-3.0 -3.0	17.4				7075 RA	OW MO	**MOE# 7117925 TAG#A045940** 0.0 BRWN CLAY SAND HARD 12.2 GREY CLAY HARD 13.7 BRWN FSND LOOS 36.6 GREY SILT SAND LOOS 43.6 GREY CLAY SILT HARD 58.8 BRWN FSND LOOS 76.8 GREY SILT SAND LOOS 77.7
17926	6 16	Aug-08	600556 4919162	280.1	56.1	Fr	67.1	-7.6	42.7	273	60	49.4	7075 RA	OW -	**MOE# 7117926 TAG#A066565** 0.0 BRWN FSND LOOS 41.1 GREY FSND SILT LOOS 45.1 GREY CLAY HARD 56.1 BRWN FSND 74.7
7128851	3 20	Mar-08	603186 4923785	296.0			51.8 41.1	-6.1 -3.0	45.7				7075 RA	OW MU	**MOE# 7128851 TAG#A066563** 0.0 BLCK TPSL 0.3 BRWN SILT CLAY HARD 2.4 BRWN SAND GRVL LOOS 44.2 GREY SILT CLAY PCKD 50.3 BRWN MSND LOOS 79.2 GREY SILT CLAY PCKD 90.8
7128853	2 20	Mar-08	603280 4922834	290.5			64.0 47.2	-6.1 -3.0	42.4				7075 RA	OW MU	**MOE# 7128853 TAG#A066564** 0.0 BLCK TPSL 0.3 BRWN CLAY SAND 1.5 BRWN SAND GRVL LOOS 10.7 BRWN MSND LOOS 50.3 GREY CLAY SILT HARD 56.4 BRWN MSND LOOS 79.2 GREY CLAY SILT PCKD 93.0 GREY CLAY HARD 96.0
7128855	2 20	Mar-08	603865 4923251	290.5			55.8 29.0	-6.1 -3.0	43.0				7075 RC	OW MU	**MOE# 7128855 TAG#A066561** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL LOOS 4.6 BRWN CLAY SILT SOFT 6.1 GREY CLAY STNS HARD 29.0 BRWN SAND GRVL LOOS 41.1 BRWN SAND SILT LOOS 49.4 GREY CLAY SILT HARD 54.3 BRWN SAND MSND LOOS 79.6 GREY SILT CLAY PCKD 84.7
OW1		Mar-08	603995 4922853	290.5			69.8 15.5	-9.1 -3.0	44.2				7075 RC	OW MU	**MOE# 7128856 TAG#A045971** 0.0 BLCK TPSL 0.3 BRWN SAND GRVL LOOS 19.8 GREY CLAY TILL SILT 53.6 BRWN SAND MSND LOOS 83.5 SILT CLAY LYRD 90.8
7139215		Jan-09	595384 4918222	225.6	17.1 1.8	Fr Fr	28.7	-1.8	4.0	59	60	12.2	7222 CT	RP DO	**MOE# 7139215 TAG#A080750** 0.0 BRWN TPSL 0.3 BRWN SAND LOOS 5.5 BRWN SAND SILT PCKD 11.3 GREY CLAY SOFT 17.1 BRWN SAND SILT LOOS 18.3 GREY CLAY SOFT 21.3 BRWN SAND LOOS 30.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
7156883	4 10	Nov-10	600540 4923806	278.3	48.2	Fr			36.6	91	60	43.3	4645 RC	WS DO	**MOE# 7156883 TAG#A108089** 0.0 BLCK TPSL SOFT 0.3 BRWN CLAY SILT SOFT 9.1 BRWN SAND CLAY LYRD 15.2 BRWN SAND LOOS 29.0 BRWN CLAY SOFT 39.6 BRWN SAND LOOS 48.8
7167766		Oct-10	601291 4920584	235.0					NR				6607 BR	OW MO	**MOE# 7167766 TAG#A100962** 0.0 BRWN SAND SILT WBRG 4.6
89481	4 12	Aug-12	601018 4922506	251.8	23.2	Fr			9.4	23	60	16.5	1851 CT	WS DO	**MOE# 7189481 TAG#A118937** 0.0 BRWN SAND 4.6 GREY CLAY DNSE 19.8 GREY SAND SILT 22.3 GREY SAND WBRG FGRD 24.4
91815		Oct-12	599968 4922870	241.7	19.8	Fr			NR				3213 CT	WS DO	**MOE# 7191815 TAG#A136911** 0.0 SAND GRVL 10.7 SAND CMTD 15.2 FSND 20.1
L0053	5 11	Jun-89	599682 4922191	239.9			21.9 -3.0		16.5				9999 RC	OW PU	**MOE# DHL0053** 0.0 BRWN CSND 2.7 GREY FSND CLAY 14.0 MSND CSND 15.2 SAND CLAY FSND 19.8 FSND 21.9 FSND CLAY LYRD 28.0 BRWN CLAY FSND LYRD 29.9 BRWN CLAY 31.1
L0054	5 11	Jun-89	599620 4922191	239.9					NR				9999 RC	TH NU	**MOE# DHL0054** 0.0 BRWN CSND 1.5 BRWN FSND CLAY MGVL 35.4 BRWN CLAY 40.8 BRWN CLAY FSND PGVL 61.0 GREY FSND CLAY STNS 74.7 BRWN CLAY DNSE 93.0 BRWN CLAY PGVL CMTD 103.9 BRWN CLAY DNSE 107.9 GREY LMSN 110.0
L0055	5 11	Jun-88	599614 4922197	239.9			51.2 -3.7		23.2				9999 RC	WS PU	**MOE# DHL0055** 0.0 MSND 1.2 FSND 15.8 MSND CSND 25.9 FSND 30.5 FSND CLAY 31.4 FSND THIN CLAY 36.0 BRWN CLAY THIN FSND 41.5 FSND CLAY BLDR 49.4 CSND THIN CGVL 56.4 FSND SILT MGVL 57.0 FSND SILT 61.3
L0056	5 11	Jun-89	599512 4922255	239.9					NR				9999 RC	TH NU	**MOE# DHL0056** 0.0 BRWN FSND 9.4 BRWN FSND CSND 14.6 GREY CLAY MSND 15.5 GREY CLAY 18.3 GREY CLAY FSND 21.6 BRWN CLAY PGVL SOFT 25.9 BRWN CLAY HARD 27.7 GREY FSND SILT CLAY 38.4 BRWN CLAY SILT LYRD 40.5
L0057	7 13	Jan-91	598544 4919636	241.1			54.9 27.4	-6.1 -3.0	16.5				9999 RC	TH CO	**MOE# DHL0057** 0.0 FSND CLAY 1.2 MGVL MSND 2.7 GREY CLAY MSND MGVL 26.2 MSND 38.4 GREY CLAY MSND SILT 43.6 GREY CLAY 50.9 FSND MSND 61.6 GREY CLAY MSND 68.6 MSND CLAY FGVL 85.0 GREY CLAY 89.9 FSND CLAY MGVL 103.9 GREY CLAY MSND MGVL 107.0
L0063	5 13	Jan-89	599717 4921130	236.5			10.7 28.7	-1.5 -1.5	3.0				9999 CT	OW IN	**MOE# DHL0063** 0.0 SAND FGRD 25.0 SAND SILT 30.5

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
WELL4	3 4	Jun-90	601427 4921884	236.2			69.8	-6.1	4.9	1137	1440	20.4	9999 RC	WS MU	**MOE# DHL0194** 0.0 SAND GRVL CLAY 15.2 SILT SAND GRVL 24.1 GREY CLAY 30.5 GREY CLAY GRVL 34.7 SAND GRVL 36.6 CLAY GRVL SAND 49.4 GRVL SAND CLAY 54.3 GREY CLAY STNY HARD 60.4 SAND GRVL CLAY 64.3 CLAY GRVL HARD 68.9 FSND GRVL CLAY 77.7 CLAY SAND 78.9
PW1/89	5 13	Nov-89	600119 4921001	238.0			60.4	-0.9	NR				9999 RC	TH IN	**MOE# DHL0347** 0.0 BRWN SAND GRVL 10.7 GREY SAND SILT 15.2 GREY MSND FSND SILT 19.8 SAND SILT CGVL 24.4 BRWN CLAY SILT 27.4 BRWN FSND MSND 43.6 BRWN CLAY SILT 58.8 BRWN FSND 67.4
OW1/89	5 13	Nov-89	600115 4921006	238.0			61.3	-6.1	NR				9999 RC	OW IN	**MOE# DHL0348** 0.0 GREY SAND GVLY 10.7 GREY SAND SILT 15.2 GREY FSND MSND SILT 19.8 GREY SAND SILT GRVL 24.4 BRWN CLAY SILT 27.4 BRWN FSND MSND SLTY 43.6 CLAY SILT 58.8 BRWN SAND FGRD 71.6 BRWN SAND SILT FGRD 76.2
OW19	6 13	Jan-14	598604 4920119	236.5			93.9	-3.0	NR				9999 RC	TH PU	**MOE# DHL0421** 0.0 GRVL CGRD 12.2 GRVL SAND MGRD 15.8 BRWN GRVL SAND TILL 26.2 BRWN TILL SILT SAND 30.5 BRWN TILL SILT SAND 41.1 GREY CLAY HARD 47.2 BRWN FSND 58.8 GREY MSND FSND 64.9 GREY CLAY 71.6 BRWN FSND 82.3 GREY CLAY HARD 85.0 BRWN MSND LOOS 99.7 GREY CLAY 100.6
TW20	2 20	Jan-14	603253 4922816	289.9			60.4	-1.5	NR				9999 RC	TH PU	**MOE# DHL0422 TAG#A153125** 0.0 BRWN TILL STNY 3.0 GRVL 6.1 GREY CLAY 9.1 BRWN FSND 19.8 BRWN TILL SAND LYRD 27.4 BRWN MSND 47.2 GREY CLAY 53.9 BRWN FSND MSND 85.3 GREY SILT 93.6 GREY CLAY HARD 96.0 CLAY SAND SILT 105.2 GREY SILT 108.2 GREY FSND 115.2 BRWN FSND 119.8 BRWN SAND 125.6 BRWN MSND 133.8 GREY CLAY 137.2 BRWN MSND CSND 148.4 SAND SLTY 150.0 GREY SILT CLAY DKCL 152.4

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
TW22	6 13	Feb-14	598675 4920171	232.6			81.1	-8.8	NR				9999 RC	OW CO	**MOE# DHL0423** 0.0 CGVL 4.6 BRWN TILL 9.1 GREY GRVL TILL STNS 13.7 BRWN GRVL STNS SAND 15.2 GREY TILL 18.3 BRWN SAND GRVL 21.9 GREY TILL 30.5 GREY CLAY HARD 35.1 BRWN SAND 37.5 BRWN TILL 42.7 BRWN SAND HARD 45.1 STNS 45.4 BRWN SAND TILL LYRD 49.7 STNS 50.0 BRWN SAND TILL LYRD 53.9 BRWN FSND STNS TILL 60.0 BRWN FSND 66.1 GREY CLAY 70.1 GREY CLAY HARD 71.3 BRWN SAND 76.2 BRWN SAND TILL LYRD 79.9 BRWN CSND 80.8 STNY 81.4 GRVL HARD 84.4 BRWN CSND 95.4 BLGR CLAY 96.0
TW23	3 13	Feb-14	602250 4923166	290.2					NR				9999 RC	TH PU	**MOE# DHL0424** 0.0 BRWN SAND TILL 16.8 BRWN MSND CSND 38.7 CLAY 44.2 BRWN FSND MSND 70.1 BRWN FSND HARD 76.2 SAND TILL SLTY 92.0 GREY CLAY HARD 96.9 CLAY SILT LYRD 100.6 BRWN SAND SLTY 115.8 GREY CLAY 120.4 BRWN FSND SLTY 125.0 BRWN FSND 131.1 BRWN MSND 133.5 GREY CLAY 137.2
TW21	2 20	Jan-14	603827 4922777	289.9			116.1 113.1	-3.0 -16.8	NR				9999 RC	TH PU	**MOE# DHL0425** 0.0 BRWN SAND 2.1 BRWN SILT SAND TILL 4.6 GREY SILT TILL 9.1 BRWN SAND FGVL 15.2 SAND FGVL LYRD 32.0 GRVL 35.1 BRWN FSND 42.7 GREY CLAY HARD 47.9 BRWN MSND 67.1 BRWN FSND 91.4 GREY CLAY HARD 95.1 GREY SAND HARD 112.8 BRWN MSND FSND 121.9 BRWN FSND 123.4 BRWN MSND 129.5 MSND CSND HARD 134.1 SAND CLYY 135.6 GREY MSND CSND 141.7 GREY SAND TILL CLYY 150.9
OW24	2 20	Feb-14	603687 4922700	289.9			125.0	-6.1	49.4				9999 RC	TH PU	**MOE# DHL0426** 0.0 SILT 3.0 BRWN TILL 4.6 GREY SAND TILL 9.1 FGVL 10.4 GREY CLAY 14.6 BRWN SAND GRVL LYRD 19.8 GREY CLAY 21.9 BRWN SAND CLAY THIN 51.8 BRWN FSND 82.3 BRWN TILL FGRD HARD 91.4 GREY CLAY HARD 94.5 GREY SAND CLAY SOFT 106.7 BRWN FSND 125.0 BRWN FSND MSND 132.0 CLAY SAND HARD 134.1

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
TW25	2 20	Feb-14	603120 4922732	285.3					NR				9999 RC	TH PU	**MOE# DHL0427** 0.0 BRWN CLAY 1.2 GREY CLAY GRVL SNDY 6.4 BRWN FSND MSND 23.5 BRWN CLAY 24.7 GRN CLAY SAND LYRD 30.5 BRWN FSND MSND 47.9 BRWN FSND MSND CLAY 78.3 CLAY SILT SAND 80.2 GREY FSND CLAY THIN 83.8 SAND SILT CLAY 91.4 GREY CLAY HARD 95.1 CLAY SLTY 107.6 GREY MSND FSND 113.7 BRWN FSND MSND CLAY 116.7 GREY SAND CLAY SLTY 123.4 GREY FSND MSND 124.4 FSND SILT 125.9 BRWN FSND 127.4 BRWN FSND MSND 128.9 FSND MSND 130.5 GREY FSND 131.4 GREY CLAY HARD 132.0
TH26	6 16	Mar-14	600546 4919163	280.1					NR				9999 RC	TH CO	**MOE# DHL0428** 0.0 BRWN CLAY SNDY 1.5 GREY CLAY SNDY GVLY 5.8 CGVL SAND 8.8 SAND 23.5 BRWN FSND 43.0 GREY CLAY SAND LYRD 48.8 GREY CLAY SILT 56.1 BRWN FSND 66.8 GREY CLAY SILT 73.2 GREY SILT CLAY 81.1 GREY SILT CLAY 91.7 SAND SLTY 107.0 SAND SILT CLAY 116.7 GREY FSND 123.4 GREY SAND SILT CLAY 125.3 CLAY SAND HARD 129.2 GREY CLAY SAND HARD 135.0 GREY CLAY SAND STNS 141.1 CLAY STNY HARD 152.4
TW27	6 18	Mar-14	599535 4919778	265.5					NR				9999 RC	TH PU	**MOE# DHL0429** 0.0 BRWN SAND CLAY THIN 7.0 BRWN SAND GRVL THIN 21.6 GREY CLAY 23.2 BRWN SAND 29.3 GREY CLAY SAND LYRD 33.8 GREY CLAY 37.8 BRWN SAND 41.1 GREY CLAY SAND LYRD 51.8 SAND CLAY THIN 64.0 GREY CLAY SILT LYRD 68.9 GREY CLAY 73.5 SAND SLTY 75.3 GREY CLAY HARD 77.1 CLAY SLTY 79.9 GREY CLAY 82.3 SAND 90.8 BRWN FSND MSND 92.4 BRWN FSND 97.2 GREY CLAY 98.1 GREY SAND SLTY LYRD 102.1
TH28	2 18	Mar-14	603279 4922844	290.5			129.2	-3.0	NR				9999 RC	TH PU	**MOE# DHL0433** 0.0 BRWN TILL STNS 3.0 GRVL 5.5 GREY CLAY 9.1 BRWN FSND 19.8 BRWN MSND 47.9 GREY CLAY 54.9 BRWN SAND 85.3 SAND DRTY 93.6 CLAY HARD 96.0 CLAY SILT LYRD 108.2 GREY FSND 118.9 FSND CLAY LYRD 125.0 BRWN MSND 132.3 GREY CLAY 133.2

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
OW29	9 14	Apr-14	595623 4917663	239.0			51.8 94.5	-3.0 -3.0	21.9				9999 RC	OW PU	**MOE# DHL0434** 0.0 SAND SLTY 1.5 BRWN CSND 4.6 BRWN SAND CLAY TILL 10.7 BRWN CLAY 16.8 BRWN FSND 32.9 GREY CLAY 50.3 BRWN FSND 69.5 SAND SILT LYRD 71.6 BRWN FSND 83.8 GREY CLAY 89.0 BRWN QSND 93.0 BRWN SAND FGRD 99.1 BRWN MSND 104.2 GREY CLAY 106.7
TW30	2 14	Jun-14	603375 4923923	296.0			103.6	-2.4	54.3				9999 RC	OW CO	**MOE# DHL0435** 0.0 BRWN SILT TILL SAND 3.0 BRWN SILT TILL FGVL 10.7 BRWN SAND FGRD 16.8 BRWN FSND MSND HARD 95.1 GREY CLAY HARD 99.7 BRWN FSND 115.2 BRWN FSND MSND 118.9 SILT CLAY SAND 125.9 BRWN FSND 129.5 SILT CLAY HARD 133.2 GREY CLAY HARD 136.6 MSND FSND 137.2 BLDR 137.5 SAND HARD CMTD 143.3
TW31	3 17	Jun-14	603191 4923774	296.0					NR				9999 RC	TH PU	**MOE# DHL0436** 0.0 BRWN CLAY 3.0 CGVL 3.7 BRWN SAND GRVL CGRD 45.7 SILT SAND 46.0 MSND 48.2 GREY CLAY 51.8 MSND FSND 86.9 SAND SILT CLAY 96.6 GREY CLAY HARD 100.6 BRWN FSND 121.6 GREY CLAY 121.9
TW32	2 20	Jun-14	603887 4923245	290.5			115.8	-3.0	NR				9999 RC	OW PU	**MOE# DHL0437** 0.0 BRWN CLAY 3.0 BRWN TILL SNDY 4.6 GREY CLAY 7.6 BRWN TILL STNY 11.6 BRWN SAND 12.2 GREY CLAY HARD 15.8 BRWN SAND SILT 17.4 GREY CLAY HARD 27.4 BLDR 27.7 GREY CLAY 29.3 FGVL 29.9 BRWN SAND SILT LYRD 54.9 GREY CLAY 64.0 BRWN FSND 68.6 FSND MSND HARD 92.4 GREY CLAY HARD 96.0 SILT FSND 112.8 BRWN FSND 121.9 TILL HARD STNY 132.0 BRWN MSND 134.1 GREY CLAY STNS HARD 138.7
TH33	9 13	Jun-14	595943 4918594	221.0					-1.8				9999 RC	OW CO	**MOE# DHL0438** 0.0 CSND GRVL STNS 5.2 GREY CSND GRVL CLAY 17.1 GREY CLAY HARD 18.6 SAND GRVL CLAY 20.4 SAND CLAY THIN 35.1 SAND WBRG 36.6
TW34	6 18	Jul-14	595627 4917644	105.2			93.9	-9.1	21.6				9999 RC	TH PU	**MOE# DHL0440** 0.0 SAND DRTY 1.5 GRVL STNS 4.3 BRWN SAND TILL 10.7 BRWN CLAY 16.8 BRWN FSND VERY 32.9 GREY CLAY HARD 50.0 BRWN FSND 73.2 BRWN SAND CLAY LYRD 77.7 BRWN MSND 79.2 BRWN SAND SILT DRTY 84.4 GREY CLAY HARD 89.0 BRWN FSND 93.0 BRWN MSND 100.6 BRWN MSND HARD 100.9 BRWN SAND MGRD 104.2 GREY CLAY SILT 106.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR mbgl	FND Qu	SCR TOP mbgl	LEN m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
OW35	2 18	Jul-24	601782 4924244	285.3			118.9	-3.0	NR				9999 RC	TH PU	**MOE# DHL0441** 0.0 BRWN CLAY 5.5 BRWN SAND 6.1 GREY TILL 9.1 BRWN SAND 20.4 STNS GRVL TILL 22.9 BRWN SAND 35.1 GREY CLAY 41.1 BRWN SAND TILL CLAY 79.2 GREY CLAY SAND LYRD 83.8 GREY CLAY 91.4 FSND SILT 102.1 CLAY DRTY 109.7 BRWN FSND 123.7 GREY CLAY HARD 125.0
S0822		Jan-06	600624 4923215	285.0					NR				9999 RC	TH NU	**MOE# OGS0822** 0.0 SAND 1.5 SILT SAND TILL 4.0 SILT 4.9 UNKN 5.2 SAND 5.8 SILT SAND TILL 7.6 SAND 33.5 SILT 44.5 SAND 58.8
S0826		Jan-06	599320 4921063	238.0					NR				9999 RC	TH NU	**MOE# OGS0826** 0.0 SAND 32.9 CLAY 34.7 SAND 35.1 CLAY 38.1 SAND 39.3 CLAY 43.3 SAND 47.2 SILT SAND TILL 53.3 SAND 54.6 SILT SAND TILL 55.8 SAND 57.0 SILT SAND TILL 59.7 SILT 64.9 SAND 69.2
M0017	10 14	Jun-85	595266 4916774	275.5			23.5	-0.9	17.7				9999 RC	OW PU	**MOE# SIM0017** 0.0 BRWN SAND SILT TILL 11.0 BRWN SAND 25.6
M0018	10 14	May-87	595321 4916854	279.8			68.0	-1.8	54.9				9999 RC	OW PU	**MOE# SIM0018** 0.0 BRWN SAND SILT TILL 12.2 BRWN SAND 44.2 GREY SILT SAND 59.1 GREY SAND 72.8 GREY SILT CLAY 78.9

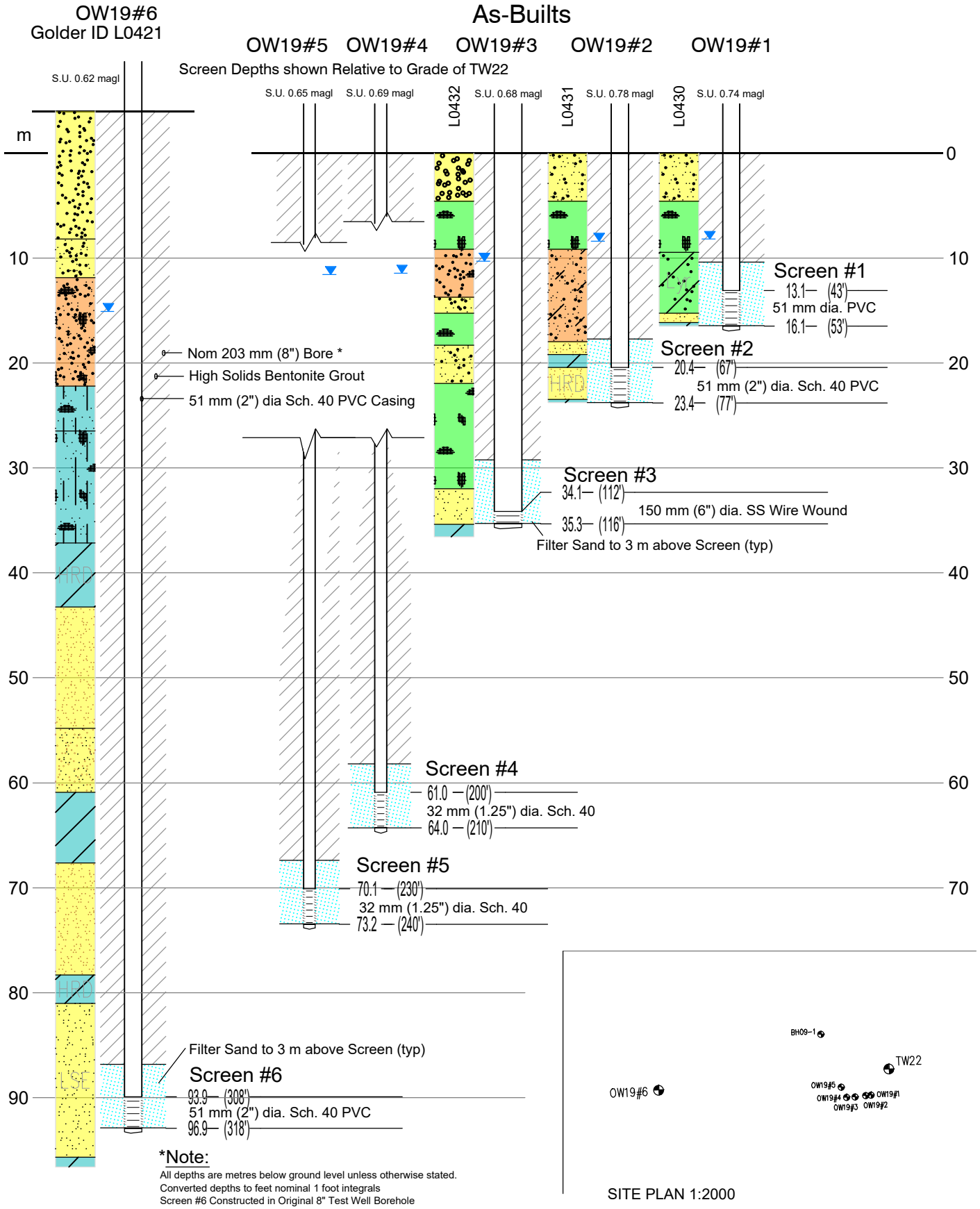
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Mn	Mineral	AQ	Abandoned Quality	DO	Domestic	IR	Irrigation	JT	Jetting
Sa	Salty	AS	Abandoned Supply	MU	Municipal	AL	Alteration	RC	Rotary Conventional
Su	Sulphur	AB	Abandonment Record	PU	Public	RP	Replacement	RA	Rotary Air
--	Unrecorded	TH	Test Hole or Observation	ST	Stock	-	Not Recorded	BR	Boring

Easting and Northings UTM NAD 83 Zone 17, Translated from Recorded UTM NAD, subject to Field Verified Location or Improved Location Accuracy.

Records Copyright Ministry of Environment Queen's Printer. Selected information tabulated to metric with changes and corrections subject to Driller's Records.

APPENDIX B

Site 1: Well Construction and Testing Snow Valley Road



Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

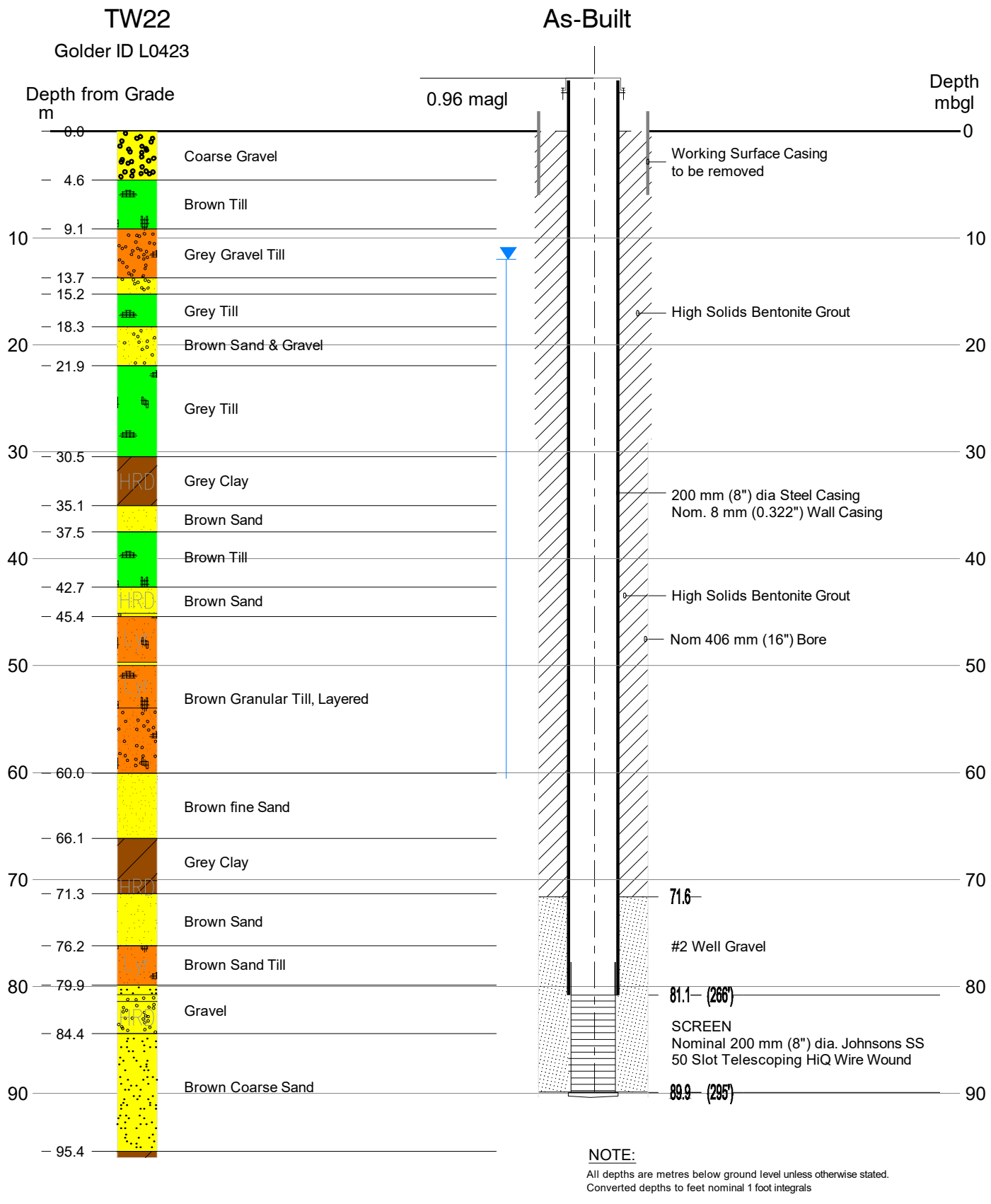
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FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **B-1**

PLOT DATE: October 28, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure B-1]



NOTE:
All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

PRODUCTION WELL TW22
AS-BUILT

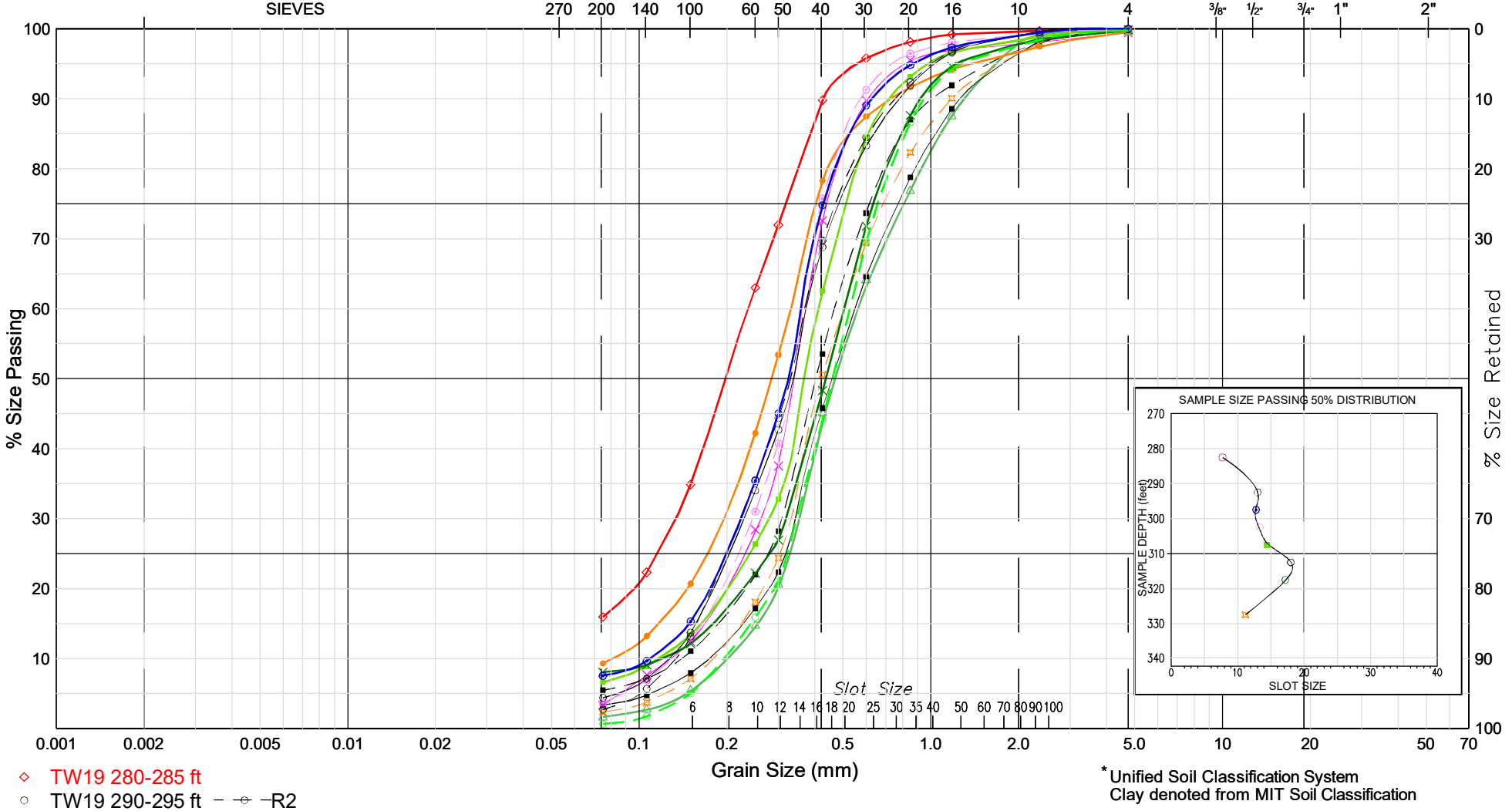
FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
B-2

PLOT DATE: July 8, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure B-2]

PLOT DATE: July 21, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE19.dwg



- TW19 280-285 ft
- TW19 290-295 ft – R2
- TW19 295-300 ft
- TW19 300-305 ft – R2
- TW19 305-310 ft
- TW19 310-315 ft – R2
- TW19 315-320 ft – R2
- TW19 320-325 ft
- TW19 325-330 ft – R2

*Unified Soil Classification System
Clay denoted from MIT Soil Classification

TITLE

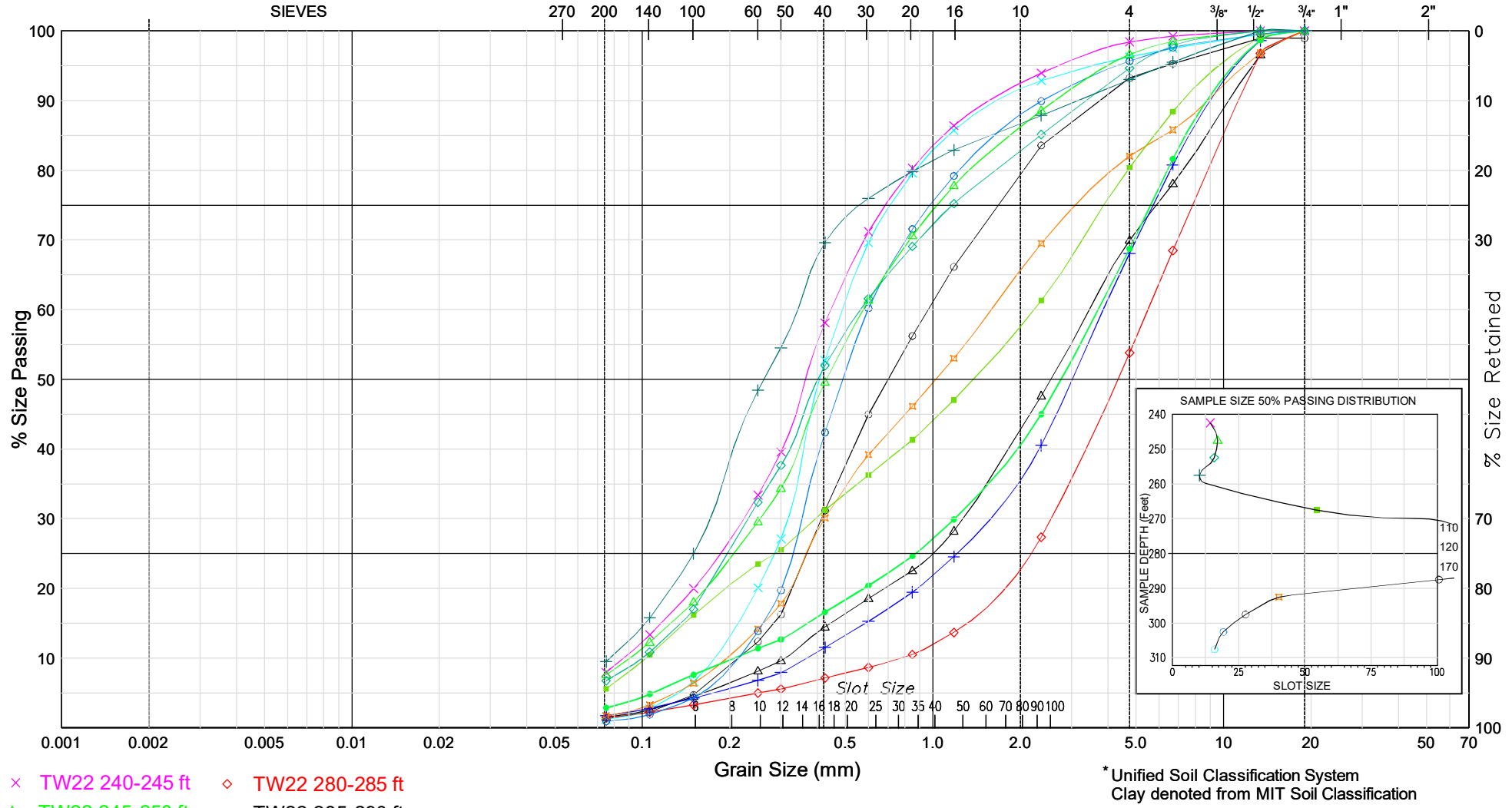
GRAIN SIZE CURVES
OW19#6

MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-01-27
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040BASVE19.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	B-3

PLOT DATE: July 21, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE22.dwg



× TW22 240-245 ft
△ TW22 245-250 ft
◇ TW22 250-255 ft
+ TW22 255-260 ft
▪ TW22 265-270 ft
• TW22 270-275 ft
+ TW22 275-280 ft
◇ TW22 280-285 ft
△ TW22 285-290 ft
⌑ TW22 290-295 ft
○ TW22 295-300 ft
○ TW22 300-305 ft
× TW22 305-310

*Unified Soil Classification System
Clay denoted from MIT Soil Classification

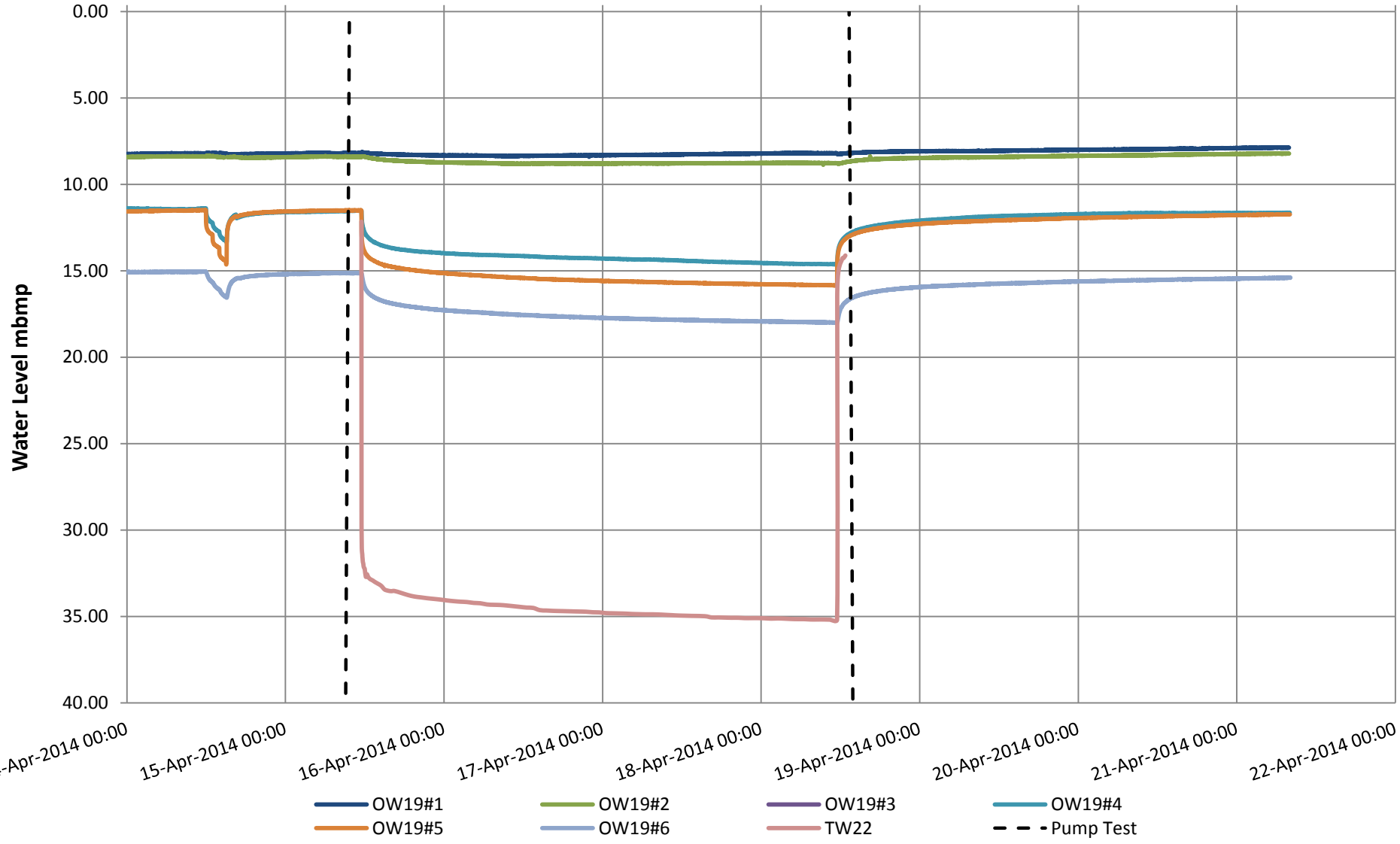
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GRAIN SIZE CURVES
TW22

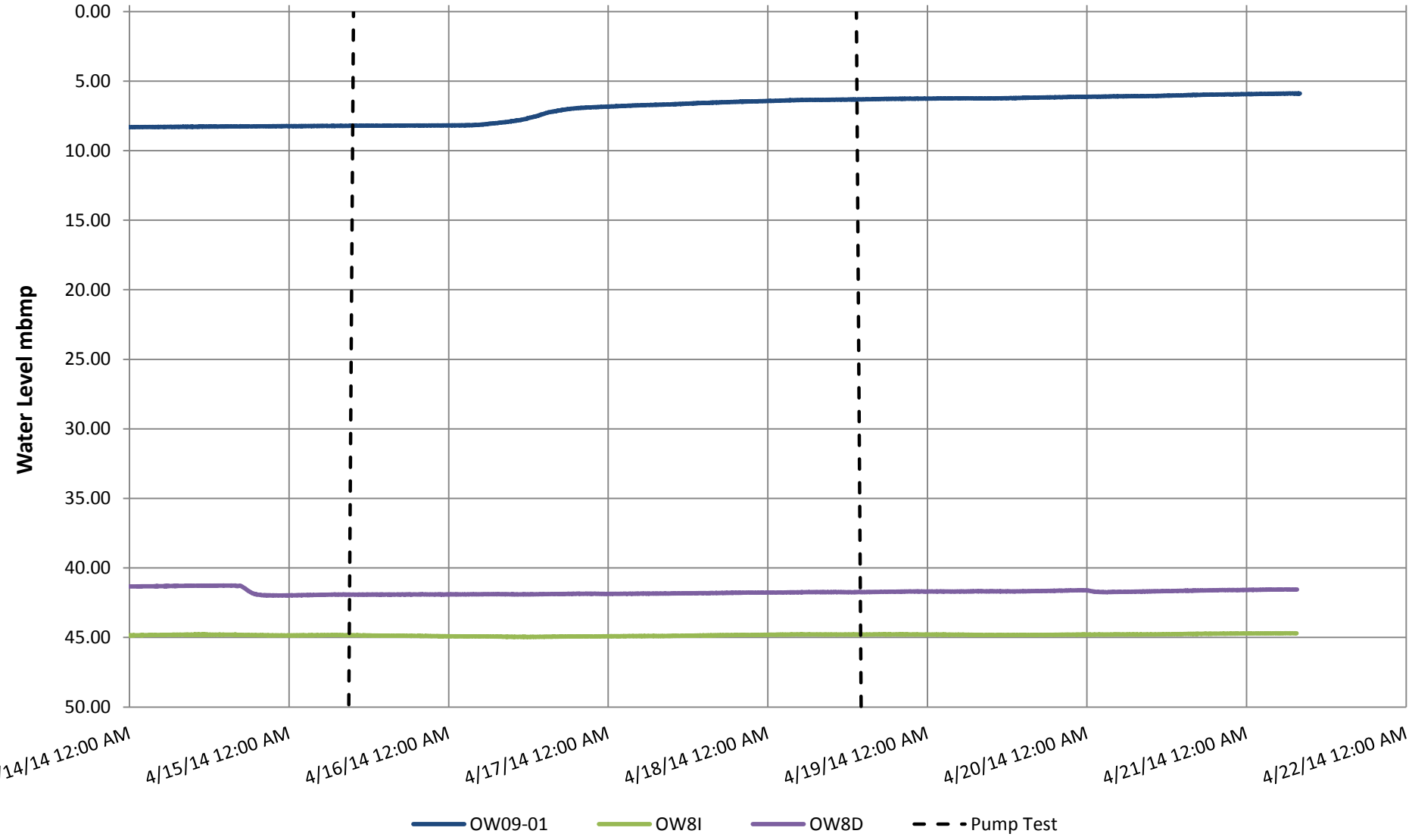
MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

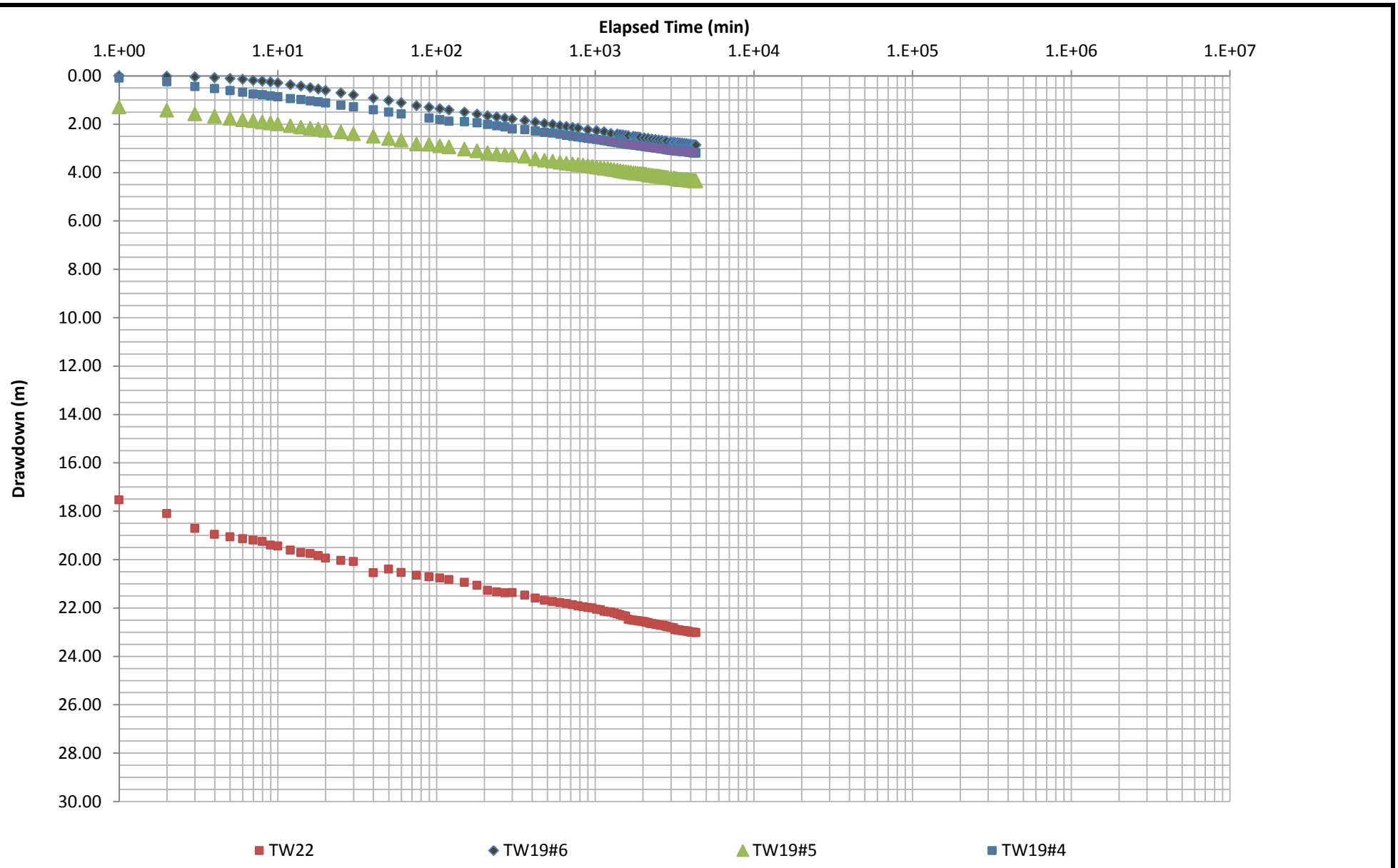
SCALE	AS SHOWN
DATE	2014-07-08
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040BASVE22.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	B-4



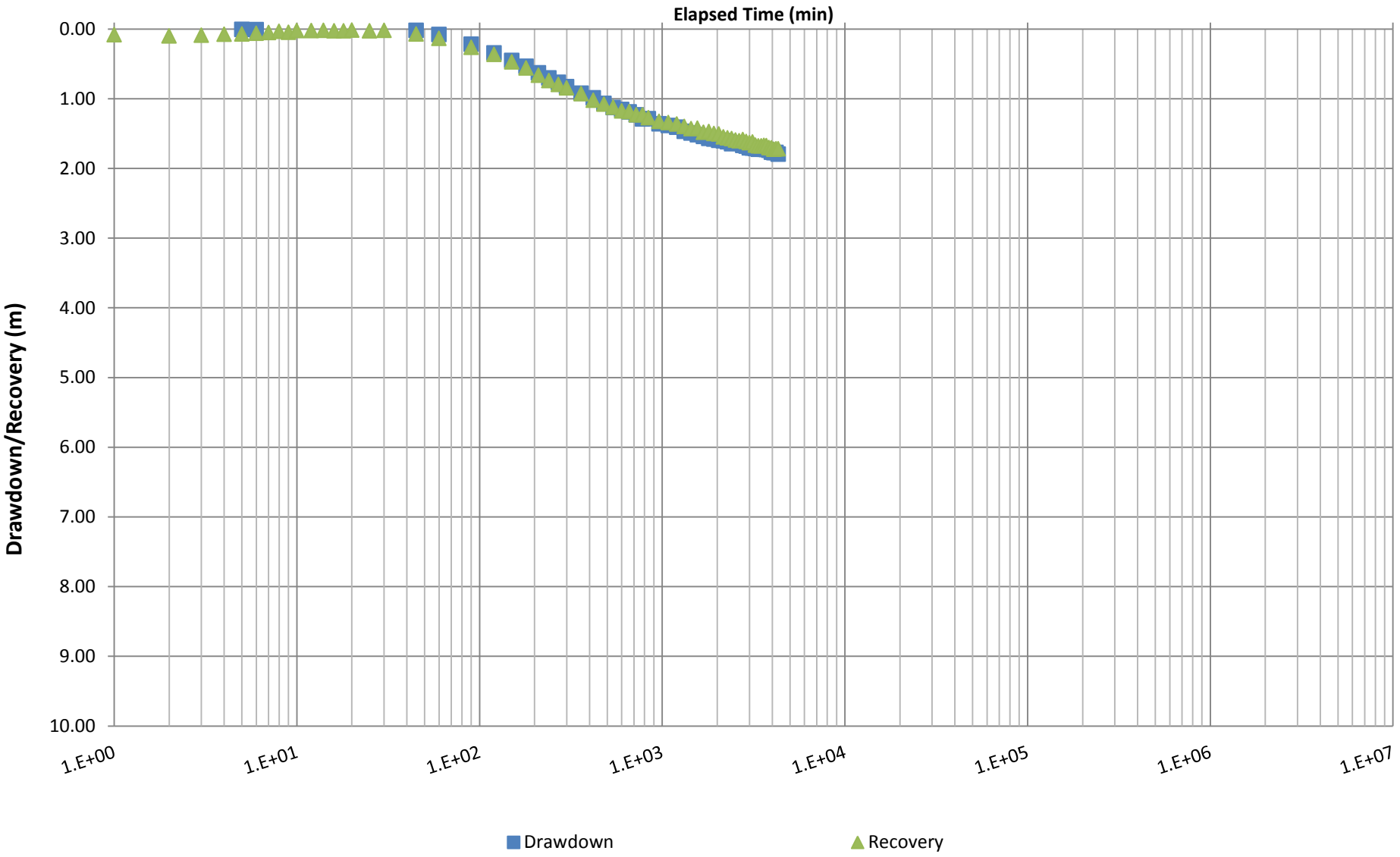
Test Date:	April 15, 2014	Golder Associates	SCALE:	NTS	**Testing of TW22** **Record of Observation Wells**
Pumping Rate:	36.5 L/s		DATE:	29-Oct-14	
			CAD:	JPR	
		FILE No. 1311700040TRANS	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW22
		PROJECT No. 13-1170-0040	REVIEW:		FIGURE No. B-5



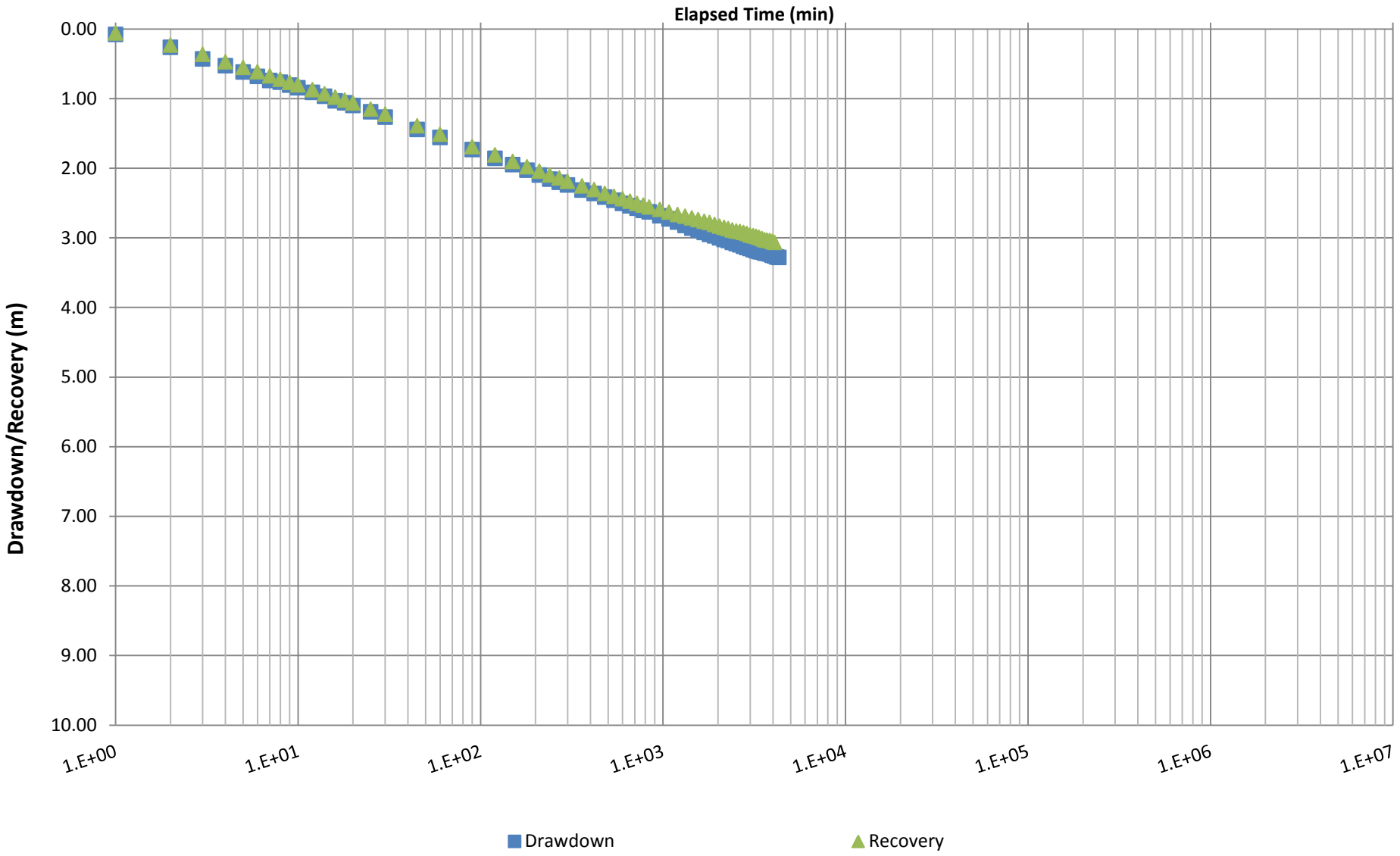
Test Date:	April 15, 2014	Golder Associates	SCALE:	NTS	**Testing of TW22** **Record of Observation Wells**
Pumping Rate:	36.5 L/s		DATE:	26-Sep-14	
			CAD:	ALB	
		FILE No. 1311700040TRANS	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW22
		PROJECT No. 13-1170-0040	REVIEW:		FIGURE No. B-6



Test Date:	15-April-2014	Golder Associates	SCALE:	NTS	Pumping Test Hydrograph Record of TW22 and Aquifer A3/A4 Observation Wells
Pumping Rates L/s:	36.5		DATE:	30-Oct-14	
			CAD:	ALB	
TW22 Static Level (mbmp):	12.16	FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW22
TW22 Pumping Level (mbmp):	35.19	PROJECT No. 1311700040	REVIEW:		FIGURE No. B-7



Test Date:	April 15, 2014	Golder Associates	SCALE:	NTS	**Pumping Test Hydrograph Record of OW19#3**
Pumping Rate:	36.5 L/s		DATE:	30-Oct-14	
Distance from TW22:	16.6 m		CAD:	ALB	
Static Water Level (mbmp):	10.30	FILE No. 1311700040TRANS	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW22
Pumping Water Level (mbmp):	12.09	PROJECT No. 13-1170-0040	REVIEW:		FIGURE No. B-8



Test Date:	April 15, 2014
Pumping Rate:	36.5 L/s
Distance from TW22:	19.1 m
Static Water Level (mbmp):	11.43
Pumping Water Level (mbmp):	14.71

Golder Associates

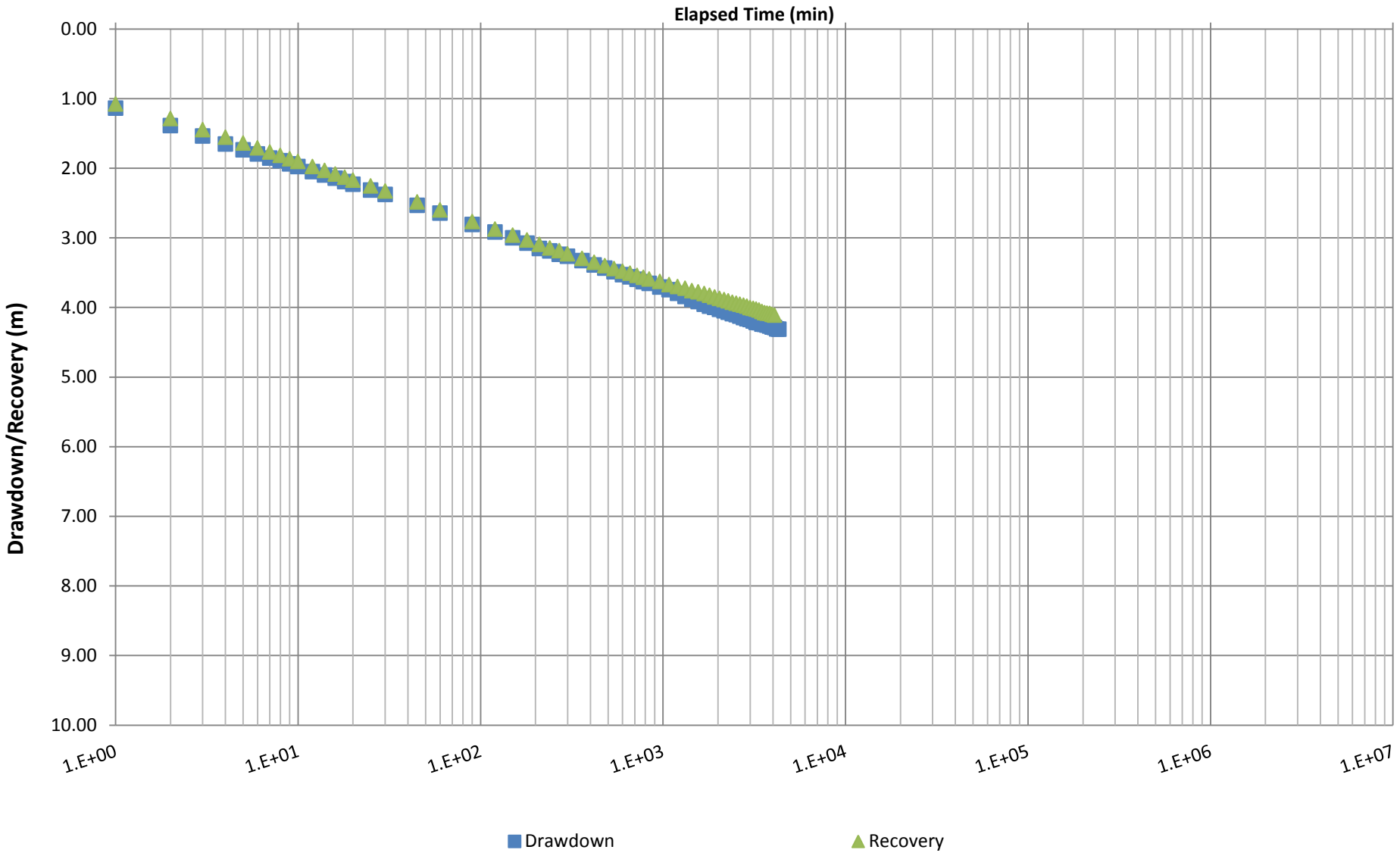
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	30-Oct-14
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of OW19#4

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW22

FIGURE No.
B-9



Test Date:	April 15, 2014
Pumping Rate:	36.5 L/s
Distance from TW22:	19.1 m
Static Water Level (mbmp):	11.53
Pumping Water Level (mbmp):	15.85

Golder Associates

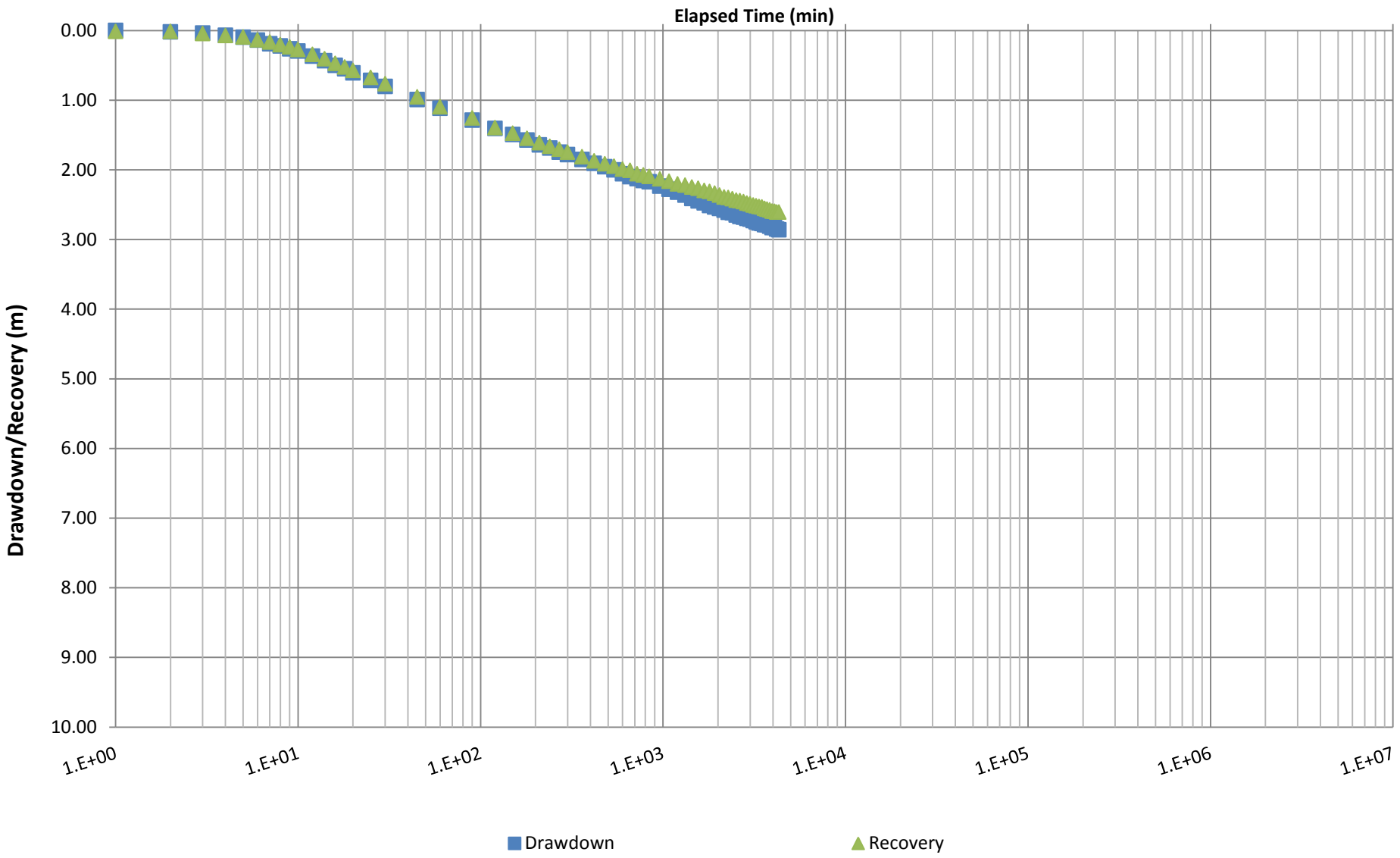
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	30-Oct-14
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of OW19#5

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW22

FIGURE No.
B-10



Test Date:	April 15, 2014
Pumping Rate:	36.5 L/s
Distance from TW22:	90 m
Static Water Level (mbmp):	15.14
Pumping Water Level (mbmp):	18.01

Golder Associates

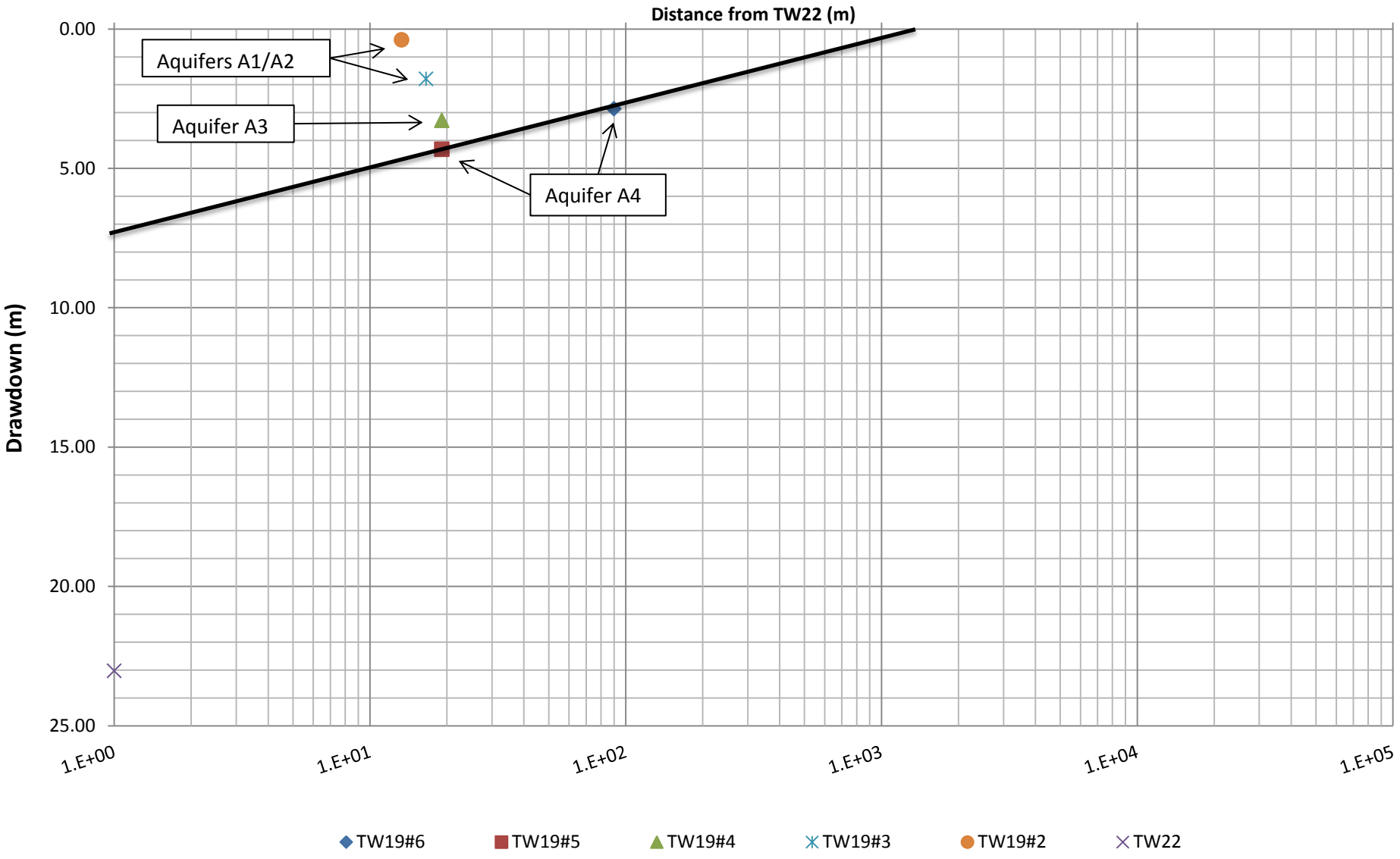
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	30-Oct-14
CAD:	ALB
CHECK:	
REVIEW:	

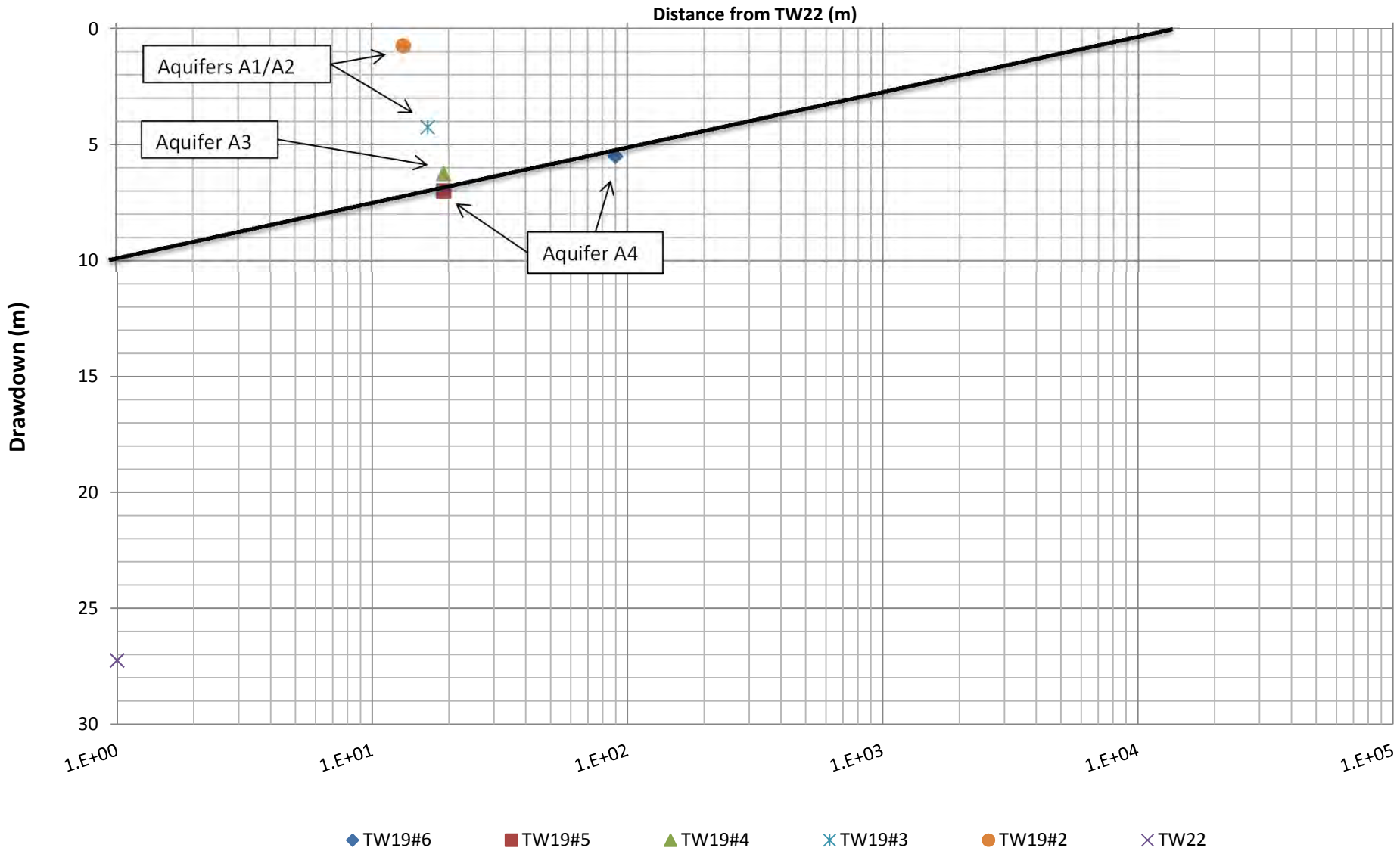
Pumping Test Hydrograph
Record of OW19#6

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW22

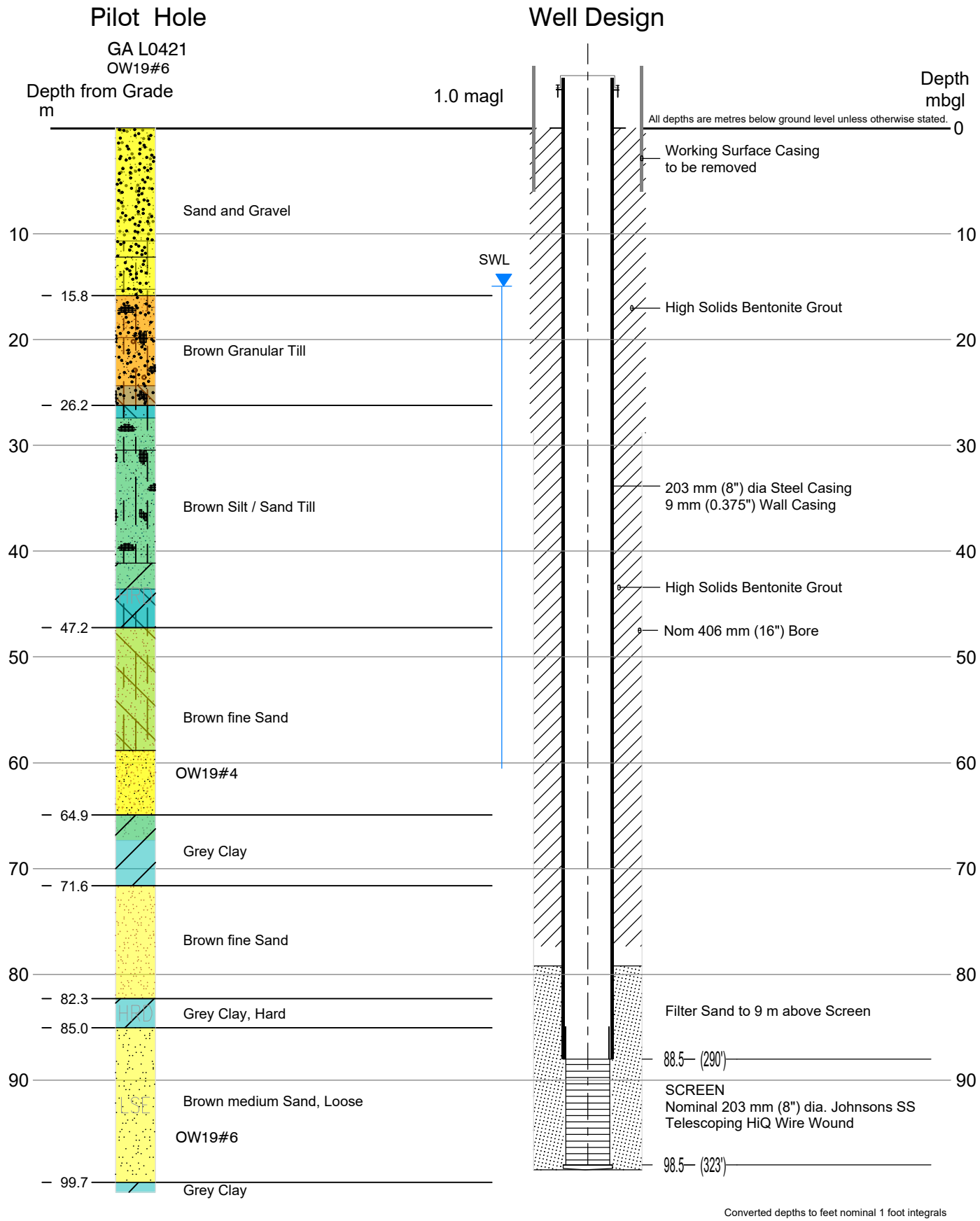
FIGURE No.
B-11



Test Date: April 15, 2014	Golder Associates	SCALE: NTS	**Test Data Drawdown vs Distance Interference From TW22**
Pumping Rate: 36.5 L/s		DATE: 28-Oct-14	
		CAD: ALB	
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW22 — FIGURE No. B-12
	PROJECT No. 13-1170-0040	REVIEW:	



Test Date: April 15, 2014	Golder Associates	SCALE: NTS	**20- Year Drawdown vs Distance Interference From TW22**	
Pumping Rate: 36.5 L/s		DATE: 20/May/15		
		CAD: ALB		
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY	FIGURE No.
	PROJECT No. 13-1170-0040	REVIEW:	CONSTRUCTION & TESTING of TW22	B-13



PLOT DATE: May 21, 2015
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure B-14]

Golder Associates
Barrie, Ontario, Canada

FILE No.	1311700040CBLOGS.dwg
PROJECT No.	13-1170-0040
REV.	
SCALE	AS SHOWN
DATE	2015-05-21
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

PROPOSED TEST WELL TW19 SITE

TOWNSHIP OF SPRINGWATER
MIDHURST WATER SUPPLY INVESTIGATIONS

FIGURE
B-14

Tabulated Levels for TW22

Pump On:	15-Apr-2014 11:30	Static Level:	12.16
Pump Off:	18-Apr-2014 11:30	Pumping Level:	35.19
Pumping Well:	**TW22**	Drawdown:	23.03
Distance from Pumping Well:	13.3 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	29.70	17.54	18-Apr-2014 11:30	0	35.19	0.00
15-Apr-2014 11:32	2	30.27	18.11	18-Apr-2014 11:31	1	16.50	18.69
15-Apr-2014 11:33	3	30.88	18.72	18-Apr-2014 11:32	2	16.13	19.06
15-Apr-2014 11:34	4	31.13	18.97	18-Apr-2014 11:33	3	15.85	19.34
15-Apr-2014 11:35	5	31.23	19.07	18-Apr-2014 11:34	4	15.69	19.50
15-Apr-2014 11:36	6	31.31	19.15	18-Apr-2014 11:35	5	15.55	19.64
15-Apr-2014 11:37	7	31.36	19.20	18-Apr-2014 11:36	6	15.44	19.75
15-Apr-2014 11:38	8	31.42	19.26	18-Apr-2014 11:37	7	15.34	19.85
15-Apr-2014 11:39	9	31.57	19.41	18-Apr-2014 11:38	8	15.26	19.93
15-Apr-2014 11:40	10	31.61	19.45	18-Apr-2014 11:39	9	15.20	19.99
15-Apr-2014 11:42	12	31.78	19.62	18-Apr-2014 11:40	10	15.15	20.04
15-Apr-2014 11:44	14	31.88	19.72	18-Apr-2014 11:42	12	15.03	20.16
15-Apr-2014 11:46	16	31.92	19.76	18-Apr-2014 11:44	14	14.96	20.23
15-Apr-2014 11:48	18	32.00	19.84	18-Apr-2014 11:46	16	14.85	20.34
15-Apr-2014 11:50	20	32.11	19.95	18-Apr-2014 11:48	18	14.81	20.38
15-Apr-2014 11:55	25	32.20	20.04	18-Apr-2014 11:50	20	14.77	20.42
15-Apr-2014 12:00	30	32.25	20.09	18-Apr-2014 11:55	25	14.65	20.54
15-Apr-2014 12:10	40	32.71	20.55	18-Apr-2014 12:00	30	14.56	20.63
15-Apr-2014 12:20	50	32.56	20.40	18-Apr-2014 12:10	40	14.42	20.77
15-Apr-2014 12:30	60	32.70	20.54	18-Apr-2014 12:20	50	14.27	20.92
15-Apr-2014 12:45	75	32.82	20.66	18-Apr-2014 12:30	60	14.26	20.93
15-Apr-2014 13:00	90	32.88	20.72	18-Apr-2014 12:45	75	14.12	21.07
15-Apr-2014 13:15	105	32.93	20.77				
15-Apr-2014 13:30	120	33.00	20.84				
15-Apr-2014 14:00	150	33.11	20.95				
15-Apr-2014 14:30	180	33.23	21.07				
15-Apr-2014 15:00	210	33.44	21.28				
15-Apr-2014 15:30	240	33.51	21.35				
15-Apr-2014 16:00	270	33.54	21.38				
15-Apr-2014 16:30	300	33.53	21.37				
15-Apr-2014 17:30	360	33.64	21.48				
15-Apr-2014 18:30	420	33.76	21.60				
15-Apr-2014 19:30	480	33.85	21.69				
15-Apr-2014 20:30	540	33.90	21.74				
15-Apr-2014 21:30	600	33.95	21.79				
15-Apr-2014 22:30	660	33.99	21.83				
15-Apr-2014 23:30	720	34.03	21.87				
16-Apr-2014 00:30	780	34.08	21.92				
16-Apr-2014 01:30	840	34.12	21.96				
16-Apr-2014 02:30	900	34.15	21.99				
16-Apr-2014 03:30	960	34.17	22.01				
16-Apr-2014 04:30	1020	34.22	22.06				
16-Apr-2014 05:30	1080	34.24	22.08				
16-Apr-2014 06:30	1140	34.31	22.15				
16-Apr-2014 07:30	1200	34.33	22.17				
16-Apr-2014 08:30	1260	34.34	22.18				
16-Apr-2014 09:30	1320	34.37	22.21				
16-Apr-2014 10:30	1380	34.41	22.25				
16-Apr-2014 11:30	1440	34.45	22.29				
16-Apr-2014 12:30	1500	34.49	22.33				
16-Apr-2014 13:30	1560	34.51	22.35				
16-Apr-2014 14:30	1620	34.64	22.48				
16-Apr-2014 15:30	1680	34.66	22.50				
16-Apr-2014 16:30	1740	34.68	22.52				
16-Apr-2014 17:30	1800	34.69	22.53				
16-Apr-2014 18:30	1860	34.70	22.54				
16-Apr-2014 19:30	1920	34.71	22.55				
16-Apr-2014 20:30	1980	34.72	22.56				
16-Apr-2014 21:30	2040	34.73	22.57				
16-Apr-2014 22:30	2100	34.76	22.60				
16-Apr-2014 23:30	2160	34.77	22.61				
17-Apr-2014 00:30	2220	34.81	22.65				
17-Apr-2014 01:30	2280	34.82	22.66				
17-Apr-2014 02:30	2340	34.83	22.67				
17-Apr-2014 03:30	2400	34.84	22.68				
17-Apr-2014 04:30	2460	34.86	22.70				
17-Apr-2014 05:30	2520	34.87	22.71				
17-Apr-2014 06:30	2580	34.88	22.72				
17-Apr-2014 07:30	2640	34.88	22.72				
17-Apr-2014 08:30	2700	34.89	22.73				

Tabulated Levels for TW22

Pump On:	15-Apr-2014 11:30	Static Level:	12.16
Pump Off:	18-Apr-2014 11:30	Pumping Level:	35.19
Pumping Well:	**TW22**	Drawdown:	23.03
Distance from Pumping Well:	13.3 m		

Date:Time dd-mmm-yyyy hh:mm	Elapsed (min)	WL m	DD m	Date:Time dd-mmm-yyyy hh:mm	Elapsed (min)	WL m	RC m
17-Apr-2014 09:30	2760	34.91	22.75				
17-Apr-2014 10:30	2820	34.93	22.77				
17-Apr-2014 11:30	2880	34.95	22.79				
17-Apr-2014 13:30	3000	34.97	22.81				
17-Apr-2014 15:30	3120	34.99	22.83				
17-Apr-2014 16:30	3180	35.06	22.90				
17-Apr-2014 17:30	3240	35.06	22.90				
17-Apr-2014 18:30	3300	35.07	22.91				
17-Apr-2014 19:30	3360	35.08	22.92				
17-Apr-2014 20:30	3420	35.08	22.92				
17-Apr-2014 21:30	3480	35.10	22.94				
17-Apr-2014 22:30	3540	35.10	22.94				
17-Apr-2014 23:30	3600	35.10	22.94				
18-Apr-2014 00:30	3660	35.11	22.95				
18-Apr-2014 01:30	3720	35.13	22.97				
18-Apr-2014 02:30	3780	35.12	22.96				
18-Apr-2014 03:30	3840	35.13	22.97				
18-Apr-2014 04:30	3900	35.15	22.99				
18-Apr-2014 05:30	3960	35.16	23.00				
18-Apr-2014 06:30	4020	35.16	23.00				
18-Apr-2014 07:30	4080	35.18	23.02				
18-Apr-2014 08:30	4140	35.18	23.02				
18-Apr-2014 09:30	4200	35.18	23.02				
18-Apr-2014 10:30	4260	35.19	23.03				
18-Apr-2014 11:30	4320	35.19	23.03				

Tabulated Levels for Ow19#1

Pump On:	15-Apr-2014 11:30	Static Level:	8.20
Pump Off:	18-Apr-2014 11:30	Pumping Level:	8.21
Pumping Well:	**TW22**	Drawdown:	0.00
Distance from Pumping Well:	13.3 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	8.17	-0.04	18-Apr-2014 11:31	1	8.22	-0.01
15-Apr-2014 11:32	2	8.14	-0.06	18-Apr-2014 11:32	2	8.22	-0.01
15-Apr-2014 11:33	3	8.14	-0.06	18-Apr-2014 11:33	3	8.26	-0.06
15-Apr-2014 11:34	4	8.15	-0.05	18-Apr-2014 11:34	4	8.27	-0.06
15-Apr-2014 11:35	5	8.14	-0.07	18-Apr-2014 11:35	5	8.27	-0.06
15-Apr-2014 11:36	6	8.15	-0.05	18-Apr-2014 11:36	6	8.26	-0.06
15-Apr-2014 11:37	7	8.15	-0.06	18-Apr-2014 11:37	7	8.26	-0.05
15-Apr-2014 11:38	8	8.14	-0.06	18-Apr-2014 11:38	8	8.26	-0.05
15-Apr-2014 11:39	9	8.16	-0.04	18-Apr-2014 11:39	9	8.26	-0.05
15-Apr-2014 11:40	10	8.16	-0.05	18-Apr-2014 11:40	10	8.26	-0.05
15-Apr-2014 11:42	12	8.15	-0.05	18-Apr-2014 11:42	12	8.26	-0.05
15-Apr-2014 11:44	14	8.16	-0.05	18-Apr-2014 11:44	14	8.25	-0.04
15-Apr-2014 11:46	16	8.16	-0.05	18-Apr-2014 11:46	16	8.25	-0.04
15-Apr-2014 11:48	18	8.16	-0.05	18-Apr-2014 11:48	18	8.24	-0.04
15-Apr-2014 11:50	20	8.16	-0.05	18-Apr-2014 11:50	20	8.24	-0.04
15-Apr-2014 11:55	25	8.17	-0.04	18-Apr-2014 11:55	25	8.25	-0.04
15-Apr-2014 12:00	30	8.17	-0.03	18-Apr-2014 12:00	30	8.24	-0.04
15-Apr-2014 12:15	45	8.18	-0.03	18-Apr-2014 12:15	45	8.23	-0.03
15-Apr-2014 12:30	60	8.18	-0.02	18-Apr-2014 12:30	60	8.22	-0.01
15-Apr-2014 13:00	90	8.22	0.02	18-Apr-2014 13:00	90	8.21	0.00
15-Apr-2014 13:30	120	8.21	0.01	18-Apr-2014 13:30	120	8.19	0.02
15-Apr-2014 14:00	150	8.23	0.03	18-Apr-2014 14:00	150	8.18	0.03
15-Apr-2014 14:30	180	8.24	0.04	18-Apr-2014 14:30	180	8.17	0.04
15-Apr-2014 15:00	210	8.25	0.04	18-Apr-2014 15:00	210	8.17	0.04
15-Apr-2014 15:30	240	8.28	0.07	18-Apr-2014 15:30	240	8.16	0.05
15-Apr-2014 16:00	270	8.27	0.07	18-Apr-2014 16:00	270	8.14	0.06
15-Apr-2014 16:30	300	8.27	0.06	18-Apr-2014 16:30	300	8.13	0.07
15-Apr-2014 17:30	360	8.29	0.09	18-Apr-2014 17:30	360	8.12	0.08
15-Apr-2014 18:30	420	8.29	0.08	18-Apr-2014 18:30	420	8.13	0.08
15-Apr-2014 19:30	480	8.30	0.10	18-Apr-2014 19:30	480	8.11	0.10
15-Apr-2014 20:30	540	8.31	0.11	18-Apr-2014 20:30	540	8.11	0.10
15-Apr-2014 21:30	600	8.32	0.12	18-Apr-2014 21:30	600	8.11	0.10
15-Apr-2014 22:30	660	8.33	0.13	18-Apr-2014 22:30	660	8.09	0.12
15-Apr-2014 23:30	720	8.33	0.12	18-Apr-2014 23:30	720	8.09	0.11
16-Apr-2014 00:30	780	8.33	0.12	19-Apr-2014 00:30	780	8.08	0.12
16-Apr-2014 01:30	840	8.33	0.13	19-Apr-2014 01:30	840	8.09	0.11
16-Apr-2014 03:30	960	8.33	0.12	19-Apr-2014 03:30	960	8.07	0.13
16-Apr-2014 05:30	1080	8.33	0.13	19-Apr-2014 05:30	1080	8.07	0.14
16-Apr-2014 07:30	1200	8.36	0.15	19-Apr-2014 07:30	1200	8.08	0.13
16-Apr-2014 09:30	1320	8.37	0.16	19-Apr-2014 09:30	1320	8.08	0.13
15-Apr-2014 11:30	1440	8.20	0.00	18-Apr-2014 11:30	1440	8.21	0.00
15-Apr-2014 13:30	1560	8.21	0.01	18-Apr-2014 13:30	1560	8.19	0.02
15-Apr-2014 15:30	1680	8.28	0.07	18-Apr-2014 15:30	1680	8.16	0.05
15-Apr-2014 17:30	1800	8.29	0.09	18-Apr-2014 17:30	1800	8.12	0.08
15-Apr-2014 19:30	1920	8.30	0.10	18-Apr-2014 19:30	1920	8.11	0.10
15-Apr-2014 21:30	2040	8.32	0.12	18-Apr-2014 21:30	2040	8.11	0.10
15-Apr-2014 23:30	2160	8.33	0.12	18-Apr-2014 23:30	2160	8.09	0.11
16-Apr-2014 01:30	2280	8.33	0.13	19-Apr-2014 01:30	2280	8.09	0.11
16-Apr-2014 03:30	2400	8.33	0.12	19-Apr-2014 03:30	2400	8.07	0.13
16-Apr-2014 05:30	2520	8.33	0.13	19-Apr-2014 05:30	2520	8.07	0.14
16-Apr-2014 07:30	2640	8.36	0.15	19-Apr-2014 07:30	2640	8.08	0.13
16-Apr-2014 09:30	2760	8.37	0.16	19-Apr-2014 09:30	2760	8.08	0.13
15-Apr-2014 11:30	2880	8.20	0.00	18-Apr-2014 11:30	2880	8.21	0.00
15-Apr-2014 13:30	3000	8.21	0.01	18-Apr-2014 13:30	3000	8.19	0.02
15-Apr-2014 15:30	3120	8.28	0.07	18-Apr-2014 15:30	3120	8.16	0.05
15-Apr-2014 17:30	3240	8.29	0.09	18-Apr-2014 17:30	3240	8.12	0.08
15-Apr-2014 19:30	3360	8.30	0.10	18-Apr-2014 19:30	3360	8.11	0.10
15-Apr-2014 21:30	3480	8.32	0.12	18-Apr-2014 21:30	3480	8.11	0.10
15-Apr-2014 23:30	3600	8.33	0.12	18-Apr-2014 23:30	3600	8.09	0.11
16-Apr-2014 01:30	3720	8.33	0.13	19-Apr-2014 01:30	3720	8.09	0.11
16-Apr-2014 03:30	3840	8.33	0.12	19-Apr-2014 03:30	3840	8.07	0.13
16-Apr-2014 05:30	3960	8.33	0.13	19-Apr-2014 05:30	3960	8.07	0.14
16-Apr-2014 07:30	4080	8.36	0.15	19-Apr-2014 07:30	4080	8.08	0.13
16-Apr-2014 09:30	4200	8.37	0.16	19-Apr-2014 09:30	4200	8.08	0.13
15-Apr-2014 11:30	4320	8.20	0.00	18-Apr-2014 11:30	4320	8.21	0.00

Tabulated Levels for Ow19#2

Pump On:	15-Apr-2014 11:30	Static Level:	8.41
Pump Off:	18-Apr-2014 11:30	Pumping Level:	8.8
Pumping Well:	**TW22**	Drawdown:	0.39
Distance from Pumping Well:	13.3 m	20yr DD:	0.75

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	8.42	0.01	18-Apr-2014 11:31	1	8.78	0.02
15-Apr-2014 11:32	2	8.40	-0.01	18-Apr-2014 11:32	2	8.78	0.02
15-Apr-2014 11:33	3	8.40	-0.01	18-Apr-2014 11:33	3	8.80	0.00
15-Apr-2014 11:34	4	8.39	-0.02	18-Apr-2014 11:34	4	8.80	0.00
15-Apr-2014 11:35	5	8.39	-0.02	18-Apr-2014 11:35	5	8.80	0.00
15-Apr-2014 11:36	6	8.38	-0.03	18-Apr-2014 11:36	6	8.80	0.00
15-Apr-2014 11:37	7	8.39	-0.02	18-Apr-2014 11:37	7	8.81	-0.01
15-Apr-2014 11:38	8	8.38	-0.03	18-Apr-2014 11:38	8	8.81	-0.01
15-Apr-2014 11:39	9	8.38	-0.03	18-Apr-2014 11:39	9	8.81	-0.01
15-Apr-2014 11:40	10	8.38	-0.03	18-Apr-2014 11:40	10	8.81	-0.01
15-Apr-2014 11:42	12	8.38	-0.03	18-Apr-2014 11:42	12	8.81	-0.01
15-Apr-2014 11:44	14	8.39	-0.02	18-Apr-2014 11:44	14	8.81	0.00
15-Apr-2014 11:46	16	8.39	-0.02	18-Apr-2014 11:46	16	8.81	-0.01
15-Apr-2014 11:48	18	8.39	-0.02	18-Apr-2014 11:48	18	8.81	-0.01
15-Apr-2014 11:50	20	8.40	-0.01	18-Apr-2014 11:50	20	8.80	0.00
15-Apr-2014 11:55	25	8.41	0.00	18-Apr-2014 11:55	25	8.79	0.01
15-Apr-2014 12:00	30	8.41	0.00	18-Apr-2014 12:00	30	8.79	0.01
15-Apr-2014 12:15	45	8.43	0.02	18-Apr-2014 12:15	45	8.77	0.03
15-Apr-2014 12:30	60	8.44	0.03	18-Apr-2014 12:30	60	8.74	0.06
15-Apr-2014 13:00	90	8.49	0.08	18-Apr-2014 13:00	90	8.70	0.10
15-Apr-2014 13:30	120	8.51	0.10	18-Apr-2014 13:30	120	8.67	0.13
15-Apr-2014 14:00	150	8.55	0.14	18-Apr-2014 14:00	150	8.66	0.14
15-Apr-2014 14:30	180	8.56	0.15	18-Apr-2014 14:30	180	8.63	0.18
15-Apr-2014 15:00	210	8.58	0.16	18-Apr-2014 15:00	210	8.60	0.20
15-Apr-2014 15:30	240	8.60	0.19	18-Apr-2014 15:30	240	8.59	0.22
15-Apr-2014 16:00	270	8.62	0.21	18-Apr-2014 16:00	270	8.58	0.22
15-Apr-2014 16:30	300	8.62	0.21	18-Apr-2014 16:30	300	8.38	0.42
15-Apr-2014 17:30	360	8.65	0.24	18-Apr-2014 17:30	360	8.54	0.26
15-Apr-2014 18:30	420	8.66	0.24	18-Apr-2014 18:30	420	8.52	0.28
15-Apr-2014 19:30	480	8.68	0.27	18-Apr-2014 19:30	480	8.50	0.30
15-Apr-2014 20:30	540	8.70	0.29	18-Apr-2014 20:30	540	8.49	0.31
15-Apr-2014 21:30	600	8.72	0.31	18-Apr-2014 21:30	600	8.49	0.31
15-Apr-2014 22:30	660	8.73	0.32	18-Apr-2014 22:30	660	8.49	0.31
15-Apr-2014 23:30	720	8.73	0.32	18-Apr-2014 23:30	720	8.48	0.32
16-Apr-2014 00:30	780	8.75	0.34	19-Apr-2014 00:30	780	8.47	0.33
16-Apr-2014 01:30	840	8.75	0.33	19-Apr-2014 01:30	840	8.46	0.34
16-Apr-2014 03:30	960	8.75	0.34	19-Apr-2014 03:30	960	8.46	0.34
16-Apr-2014 05:30	1080	8.76	0.35	19-Apr-2014 05:30	1080	8.44	0.36
16-Apr-2014 07:30	1200	8.78	0.37	19-Apr-2014 07:30	1200	8.44	0.36
16-Apr-2014 09:30	1320	8.80	0.39	19-Apr-2014 09:30	1320	8.44	0.36
15-Apr-2014 11:30	1440	8.41	0.00	18-Apr-2014 11:30	1440	8.78	0.03
15-Apr-2014 13:30	1560	8.51	0.10	18-Apr-2014 13:30	1560	8.67	0.13
15-Apr-2014 15:30	1680	8.60	0.19	18-Apr-2014 15:30	1680	8.59	0.22
15-Apr-2014 17:30	1800	8.65	0.24	18-Apr-2014 17:30	1800	8.54	0.26
15-Apr-2014 19:30	1920	8.68	0.27	18-Apr-2014 19:30	1920	8.50	0.30
15-Apr-2014 21:30	2040	8.72	0.31	18-Apr-2014 21:30	2040	8.49	0.31
15-Apr-2014 23:30	2160	8.73	0.32	18-Apr-2014 23:30	2160	8.48	0.32
16-Apr-2014 01:30	2280	8.75	0.33	19-Apr-2014 01:30	2280	8.46	0.34
16-Apr-2014 03:30	2400	8.75	0.34	19-Apr-2014 03:30	2400	8.46	0.34
16-Apr-2014 05:30	2520	8.76	0.35	19-Apr-2014 05:30	2520	8.44	0.36
16-Apr-2014 07:30	2640	8.78	0.37	19-Apr-2014 07:30	2640	8.44	0.36
16-Apr-2014 09:30	2760	8.80	0.39	19-Apr-2014 09:30	2760	8.44	0.36
15-Apr-2014 11:30	2880	8.41	0.00	18-Apr-2014 11:30	2880	8.78	0.03
15-Apr-2014 13:30	3000	8.51	0.10	18-Apr-2014 13:30	3000	8.67	0.13
15-Apr-2014 15:30	3120	8.60	0.19	18-Apr-2014 15:30	3120	8.59	0.22
15-Apr-2014 17:30	3240	8.65	0.24	18-Apr-2014 17:30	3240	8.54	0.26
15-Apr-2014 19:30	3360	8.68	0.27	18-Apr-2014 19:30	3360	8.50	0.30
15-Apr-2014 21:30	3480	8.72	0.31	18-Apr-2014 21:30	3480	8.49	0.31
15-Apr-2014 23:30	3600	8.73	0.32	18-Apr-2014 23:30	3600	8.48	0.32
16-Apr-2014 01:30	3720	8.75	0.33	19-Apr-2014 01:30	3720	8.46	0.34
16-Apr-2014 03:30	3840	8.75	0.34	19-Apr-2014 03:30	3840	8.46	0.34
16-Apr-2014 05:30	3960	8.76	0.35	19-Apr-2014 05:30	3960	8.44	0.36
16-Apr-2014 07:30	4080	8.78	0.37	19-Apr-2014 07:30	4080	8.44	0.36
16-Apr-2014 09:30	4200	8.80	0.39	19-Apr-2014 09:30	4200	8.44	0.36
15-Apr-2014 11:30	4320	8.41	0.00	18-Apr-2014 11:30	4320	8.78	0.03

Tabulated Levels for Ow19#3

Pump On:	15-Apr-2014 11:30	Static Level:	10.30
Pump Off:	18-Apr-2014 11:30	Pumping Level:	12.09
Pumping Well:	**TW22**	Drawdown:	1.79
Distance from Pumping Well:	16.6 m	20 yr DD:	4.25

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	10.27	-0.03	18-Apr-2014 11:31	1	12.01	0.08
15-Apr-2014 11:32	2	10.29	-0.01	18-Apr-2014 11:32	2	11.99	0.10
15-Apr-2014 11:33	3	10.27	-0.03	18-Apr-2014 11:33	3	12.00	0.09
15-Apr-2014 11:34	4	10.28	-0.02	18-Apr-2014 11:34	4	12.02	0.07
15-Apr-2014 11:35	5	10.30	0.01	18-Apr-2014 11:35	5	12.02	0.07
15-Apr-2014 11:36	6	10.31	0.01	18-Apr-2014 11:36	6	12.03	0.06
15-Apr-2014 11:37	7	10.29	0.00	18-Apr-2014 11:37	7	12.04	0.05
15-Apr-2014 11:38	8	10.28	-0.02	18-Apr-2014 11:38	8	12.05	0.04
15-Apr-2014 11:39	9	10.28	-0.02	18-Apr-2014 11:39	9	12.04	0.05
15-Apr-2014 11:40	10	10.27	-0.03	18-Apr-2014 11:40	10	12.07	0.02
15-Apr-2014 11:42	12	10.27	-0.03	18-Apr-2014 11:42	12	12.07	0.02
15-Apr-2014 11:44	14	10.28	-0.01	18-Apr-2014 11:44	14	12.07	0.02
15-Apr-2014 11:46	16	10.26	-0.04	18-Apr-2014 11:46	16	12.06	0.03
15-Apr-2014 11:48	18	10.29	-0.01	18-Apr-2014 11:48	18	12.06	0.03
15-Apr-2014 11:50	20	10.25	-0.04	18-Apr-2014 11:50	20	12.07	0.02
15-Apr-2014 11:55	25	10.28	-0.01	18-Apr-2014 11:55	25	12.06	0.03
15-Apr-2014 12:00	30	10.27	-0.03	18-Apr-2014 12:00	30	12.07	0.02
15-Apr-2014 12:15	45	10.32	0.02	18-Apr-2014 12:15	45	12.02	0.07
15-Apr-2014 12:30	60	10.38	0.08	18-Apr-2014 12:30	60	11.96	0.13
15-Apr-2014 13:00	90	10.52	0.22	18-Apr-2014 13:00	90	11.83	0.26
15-Apr-2014 13:30	120	10.64	0.34	18-Apr-2014 13:30	120	11.72	0.37
15-Apr-2014 14:00	150	10.75	0.45	18-Apr-2014 14:00	150	11.62	0.47
15-Apr-2014 14:30	180	10.84	0.54	18-Apr-2014 14:30	180	11.53	0.56
15-Apr-2014 15:00	210	10.93	0.63	18-Apr-2014 15:00	210	11.43	0.66
15-Apr-2014 15:30	240	11.00	0.70	18-Apr-2014 15:30	240	11.35	0.74
15-Apr-2014 16:00	270	11.06	0.77	18-Apr-2014 16:00	270	11.29	0.80
15-Apr-2014 16:30	300	11.13	0.83	18-Apr-2014 16:30	300	11.25	0.84
15-Apr-2014 17:30	360	11.22	0.92	18-Apr-2014 17:30	360	11.16	0.93
15-Apr-2014 18:30	420	11.29	0.99	18-Apr-2014 18:30	420	11.07	1.02
15-Apr-2014 19:30	480	11.37	1.07	18-Apr-2014 19:30	480	11.01	1.08
15-Apr-2014 20:30	540	11.42	1.13	18-Apr-2014 20:30	540	10.97	1.12
15-Apr-2014 21:30	600	11.45	1.15	18-Apr-2014 21:30	600	10.91	1.18
15-Apr-2014 22:30	660	11.49	1.19	18-Apr-2014 22:30	660	10.90	1.19
15-Apr-2014 23:30	720	11.53	1.23	18-Apr-2014 23:30	720	10.86	1.23
16-Apr-2014 00:30	780	11.59	1.29	19-Apr-2014 00:30	780	10.86	1.23
16-Apr-2014 01:30	840	11.59	1.29	19-Apr-2014 01:30	840	10.82	1.27
16-Apr-2014 03:30	960	11.66	1.36	19-Apr-2014 03:30	960	10.77	1.33
16-Apr-2014 05:30	1080	11.68	1.38	19-Apr-2014 05:30	1080	10.75	1.34
16-Apr-2014 07:30	1200	11.71	1.41	19-Apr-2014 07:30	1200	10.73	1.36
16-Apr-2014 09:30	1320	11.77	1.47	19-Apr-2014 09:30	1320	10.69	1.40
16-Apr-2014 11:30	1440	11.79	1.49	19-Apr-2014 11:30	1440	10.66	1.43
16-Apr-2014 13:30	1560	11.81	1.52	19-Apr-2014 13:30	1560	10.67	1.43
16-Apr-2014 15:30	1680	11.84	1.54	19-Apr-2014 15:30	1680	10.61	1.48
16-Apr-2014 17:30	1800	11.87	1.57	19-Apr-2014 17:30	1800	10.62	1.47
16-Apr-2014 19:30	1920	11.88	1.58	19-Apr-2014 19:30	1920	10.59	1.50
16-Apr-2014 21:30	2040	11.90	1.60	19-Apr-2014 21:30	2040	10.58	1.51
16-Apr-2014 23:30	2160	11.90	1.61	19-Apr-2014 23:30	2160	10.54	1.55
17-Apr-2014 01:30	2280	11.92	1.62	20-Apr-2014 01:30	2280	10.53	1.56
17-Apr-2014 03:30	2400	11.94	1.65	20-Apr-2014 03:30	2400	10.52	1.57
17-Apr-2014 05:30	2520	11.94	1.64	20-Apr-2014 05:30	2520	10.50	1.59
17-Apr-2014 07:30	2640	11.94	1.64	20-Apr-2014 07:30	2640	10.49	1.60
17-Apr-2014 09:30	2760	11.97	1.67	20-Apr-2014 09:30	2760	10.50	1.59
17-Apr-2014 11:30	2880	11.98	1.68	20-Apr-2014 11:30	2880	10.47	1.62
17-Apr-2014 13:30	3000	12.00	1.70	20-Apr-2014 13:30	3000	10.46	1.63
17-Apr-2014 15:30	3120	12.01	1.71	20-Apr-2014 15:30	3120	10.47	1.62
17-Apr-2014 17:30	3240	12.01	1.72	20-Apr-2014 17:30	3240	10.42	1.67
17-Apr-2014 19:30	3360	12.03	1.73	20-Apr-2014 19:30	3360	10.41	1.68
17-Apr-2014 21:30	3480	12.01	1.71	20-Apr-2014 21:30	3480	10.41	1.68
17-Apr-2014 23:30	3600	12.03	1.73	20-Apr-2014 23:30	3600	10.42	1.67
18-Apr-2014 01:30	3720	12.03	1.73	21-Apr-2014 01:30	3720	10.42	1.67
18-Apr-2014 03:30	3840	12.04	1.74	21-Apr-2014 03:30	3840	10.39	1.70
18-Apr-2014 05:30	3960	12.07	1.77	21-Apr-2014 05:30	3960	10.38	1.71
18-Apr-2014 07:30	4080	12.07	1.78	21-Apr-2014 07:30	4080	10.36	1.73
18-Apr-2014 09:30	4200	12.07	1.77	21-Apr-2014 09:30	4200	10.37	1.72
18-Apr-2014 11:30	4320	12.10	1.80	21-Apr-2014 11:30	4320	10.37	1.72

Tabulated Levels for Ow19#4

Pump On:	15-Apr-2014 11:30	Static Level:	11.43
Pump Off:	18-Apr-2014 11:30	Pumping Level:	14.71
Pumping Well:	**TW22**	Drawdown:	3.28
Distance from Pumping Well:	19.1 m	20 yr DD:	6.25

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	11.51	0.08	18-Apr-2014 11:31	1	14.65	0.06
15-Apr-2014 11:32	2	11.69	0.26	18-Apr-2014 11:32	2	14.48	0.23
15-Apr-2014 11:33	3	11.86	0.43	18-Apr-2014 11:33	3	14.34	0.37
15-Apr-2014 11:34	4	11.96	0.53	18-Apr-2014 11:34	4	14.24	0.47
15-Apr-2014 11:35	5	12.05	0.62	18-Apr-2014 11:35	5	14.16	0.55
15-Apr-2014 11:36	6	12.11	0.68	18-Apr-2014 11:36	6	14.09	0.62
15-Apr-2014 11:37	7	12.17	0.74	18-Apr-2014 11:37	7	14.03	0.68
15-Apr-2014 11:38	8	12.19	0.76	18-Apr-2014 11:38	8	13.99	0.72
15-Apr-2014 11:39	9	12.24	0.81	18-Apr-2014 11:39	9	13.94	0.77
15-Apr-2014 11:40	10	12.27	0.85	18-Apr-2014 11:40	10	13.91	0.80
15-Apr-2014 11:42	12	12.34	0.91	18-Apr-2014 11:42	12	13.84	0.87
15-Apr-2014 11:44	14	12.39	0.97	18-Apr-2014 11:44	14	13.78	0.93
15-Apr-2014 11:46	16	12.46	1.04	18-Apr-2014 11:46	16	13.73	0.98
15-Apr-2014 11:48	18	12.49	1.06	18-Apr-2014 11:48	18	13.69	1.02
15-Apr-2014 11:50	20	12.53	1.10	18-Apr-2014 11:50	20	13.65	1.07
15-Apr-2014 11:55	25	12.62	1.19	18-Apr-2014 11:55	25	13.56	1.15
15-Apr-2014 12:00	30	12.69	1.27	18-Apr-2014 12:00	30	13.48	1.23
15-Apr-2014 12:15	45	12.87	1.45	18-Apr-2014 12:15	45	13.32	1.39
15-Apr-2014 12:30	60	12.99	1.56	18-Apr-2014 12:30	60	13.20	1.52
15-Apr-2014 13:00	90	13.16	1.74	18-Apr-2014 13:00	90	13.02	1.69
15-Apr-2014 13:30	120	13.29	1.86	18-Apr-2014 13:30	120	12.90	1.81
15-Apr-2014 14:00	150	13.38	1.95	18-Apr-2014 14:00	150	12.81	1.90
15-Apr-2014 14:30	180	13.46	2.03	18-Apr-2014 14:30	180	12.73	1.98
15-Apr-2014 15:00	210	13.53	2.10	18-Apr-2014 15:00	210	12.67	2.05
15-Apr-2014 15:30	240	13.58	2.16	18-Apr-2014 15:30	240	12.61	2.10
15-Apr-2014 16:00	270	13.63	2.21	18-Apr-2014 16:00	270	12.57	2.14
15-Apr-2014 16:30	300	13.67	2.24	18-Apr-2014 16:30	300	12.52	2.19
15-Apr-2014 17:30	360	13.74	2.31	18-Apr-2014 17:30	360	12.46	2.26
15-Apr-2014 18:30	420	13.79	2.37	18-Apr-2014 18:30	420	12.40	2.31
15-Apr-2014 19:30	480	13.84	2.42	18-Apr-2014 19:30	480	12.35	2.37
15-Apr-2014 20:30	540	13.89	2.46	18-Apr-2014 20:30	540	12.31	2.41
15-Apr-2014 21:30	600	13.93	2.51	18-Apr-2014 21:30	600	12.27	2.44
15-Apr-2014 22:30	660	13.97	2.54	18-Apr-2014 22:30	660	12.23	2.48
15-Apr-2014 23:30	720	14.00	2.58	18-Apr-2014 23:30	720	12.21	2.51
16-Apr-2014 00:30	780	14.04	2.61	19-Apr-2014 00:30	780	12.18	2.53
16-Apr-2014 01:30	840	14.06	2.63	19-Apr-2014 01:30	840	12.15	2.56
16-Apr-2014 03:30	960	14.11	2.68	19-Apr-2014 03:30	960	12.12	2.59
16-Apr-2014 05:30	1080	14.16	2.73	19-Apr-2014 05:30	1080	12.08	2.63
16-Apr-2014 07:30	1200	14.20	2.77	19-Apr-2014 07:30	1200	12.05	2.67
16-Apr-2014 09:30	1320	14.25	2.82	19-Apr-2014 09:30	1320	12.02	2.69
16-Apr-2014 11:30	1440	14.29	2.86	19-Apr-2014 11:30	1440	12.00	2.72
16-Apr-2014 13:30	1560	14.32	2.89	19-Apr-2014 13:30	1560	11.97	2.74
16-Apr-2014 15:30	1680	14.35	2.92	19-Apr-2014 15:30	1680	11.95	2.76
16-Apr-2014 17:30	1800	14.38	2.95	19-Apr-2014 17:30	1800	11.93	2.78
16-Apr-2014 19:30	1920	14.40	2.97	19-Apr-2014 19:30	1920	11.90	2.81
16-Apr-2014 21:30	2040	14.43	3.00	19-Apr-2014 21:30	2040	11.88	2.83
16-Apr-2014 23:30	2160	14.45	3.02	19-Apr-2014 23:30	2160	11.86	2.85
17-Apr-2014 01:30	2280	14.47	3.04	20-Apr-2014 01:30	2280	11.84	2.87
17-Apr-2014 03:30	2400	14.49	3.07	20-Apr-2014 03:30	2400	11.82	2.89
17-Apr-2014 05:30	2520	14.51	3.08	20-Apr-2014 05:30	2520	11.81	2.90
17-Apr-2014 07:30	2640	14.53	3.10	20-Apr-2014 07:30	2640	11.80	2.91
17-Apr-2014 09:30	2760	14.55	3.12	20-Apr-2014 09:30	2760	11.79	2.92
17-Apr-2014 11:30	2880	14.57	3.14	20-Apr-2014 11:30	2880	11.77	2.94
17-Apr-2014 13:30	3000	14.58	3.15	20-Apr-2014 13:30	3000	11.75	2.96
17-Apr-2014 15:30	3120	14.60	3.17	20-Apr-2014 15:30	3120	11.74	2.97
17-Apr-2014 17:30	3240	14.61	3.18	20-Apr-2014 17:30	3240	11.73	2.98
17-Apr-2014 19:30	3360	14.63	3.20	20-Apr-2014 19:30	3360	11.72	3.00
17-Apr-2014 21:30	3480	14.64	3.21	20-Apr-2014 21:30	3480	11.70	3.01
17-Apr-2014 23:30	3600	14.65	3.22	20-Apr-2014 23:30	3600	11.68	3.03
18-Apr-2014 01:30	3720	14.65	3.22	21-Apr-2014 01:30	3720	11.67	3.04
18-Apr-2014 03:30	3840	14.66	3.23	21-Apr-2014 03:30	3840	11.67	3.04
18-Apr-2014 05:30	3960	14.68	3.25	21-Apr-2014 05:30	3960	11.66	3.05
18-Apr-2014 07:30	4080	14.69	3.26	21-Apr-2014 07:30	4080	11.64	3.07
18-Apr-2014 09:30	4200	14.70	3.28				
18-Apr-2014 11:30	4320	14.71	3.28				

Tabulated Levels for Ow19#5

Pump On:	15-Apr-2014 11:30	Static Level:	11.53
Pump Off:	18-Apr-2014 11:30	Pumping Level:	15.85
Pumping Well:	**TW22**	Drawdown:	4.32
Distance from Pumping Well:	19.1 m	20 yr DD:	7

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	12.67	1.14	18-Apr-2014 11:31	1	14.77	1.08
15-Apr-2014 11:32	2	12.92	1.39	18-Apr-2014 11:32	2	14.56	1.29
15-Apr-2014 11:33	3	13.07	1.54	18-Apr-2014 11:33	3	14.40	1.45
15-Apr-2014 11:34	4	13.18	1.65	18-Apr-2014 11:34	4	14.29	1.56
15-Apr-2014 11:35	5	13.27	1.74	18-Apr-2014 11:35	5	14.21	1.64
15-Apr-2014 11:36	6	13.33	1.80	18-Apr-2014 11:36	6	14.14	1.71
15-Apr-2014 11:37	7	13.39	1.86	18-Apr-2014 11:37	7	14.08	1.77
15-Apr-2014 11:38	8	13.42	1.89	18-Apr-2014 11:38	8	14.03	1.82
15-Apr-2014 11:39	9	13.47	1.94	18-Apr-2014 11:39	9	13.99	1.87
15-Apr-2014 11:40	10	13.51	1.98	18-Apr-2014 11:40	10	13.95	1.91
15-Apr-2014 11:42	12	13.58	2.05	18-Apr-2014 11:42	12	13.87	1.98
15-Apr-2014 11:44	14	13.63	2.10	18-Apr-2014 11:44	14	13.82	2.03
15-Apr-2014 11:46	16	13.68	2.15	18-Apr-2014 11:46	16	13.76	2.09
15-Apr-2014 11:48	18	13.72	2.19	18-Apr-2014 11:48	18	13.72	2.13
15-Apr-2014 11:50	20	13.76	2.23	18-Apr-2014 11:50	20	13.68	2.17
15-Apr-2014 11:55	25	13.85	2.32	18-Apr-2014 11:55	25	13.60	2.26
15-Apr-2014 12:00	30	13.91	2.38	18-Apr-2014 12:00	30	13.52	2.33
15-Apr-2014 12:15	45	14.06	2.53	18-Apr-2014 12:15	45	13.36	2.49
15-Apr-2014 12:30	60	14.18	2.65	18-Apr-2014 12:30	60	13.25	2.60
15-Apr-2014 13:00	90	14.34	2.81	18-Apr-2014 13:00	90	13.08	2.77
15-Apr-2014 13:30	120	14.45	2.92	18-Apr-2014 13:30	120	12.98	2.88
15-Apr-2014 14:00	150	14.53	3.00	18-Apr-2014 14:00	150	12.89	2.96
15-Apr-2014 14:30	180	14.61	3.08	18-Apr-2014 14:30	180	12.82	3.03
15-Apr-2014 15:00	210	14.68	3.15	18-Apr-2014 15:00	210	12.75	3.10
15-Apr-2014 15:30	240	14.72	3.19	18-Apr-2014 15:30	240	12.70	3.15
15-Apr-2014 16:00	270	14.77	3.24	18-Apr-2014 16:00	270	12.66	3.19
15-Apr-2014 16:30	300	14.80	3.27	18-Apr-2014 16:30	300	12.62	3.23
15-Apr-2014 17:30	360	14.86	3.33	18-Apr-2014 17:30	360	12.55	3.30
15-Apr-2014 18:30	420	14.92	3.39	18-Apr-2014 18:30	420	12.50	3.35
15-Apr-2014 19:30	480	14.97	3.44	18-Apr-2014 19:30	480	12.45	3.40
15-Apr-2014 20:30	540	15.02	3.49	18-Apr-2014 20:30	540	12.41	3.44
15-Apr-2014 21:30	600	15.06	3.53	18-Apr-2014 21:30	600	12.37	3.48
15-Apr-2014 22:30	660	15.09	3.56	18-Apr-2014 22:30	660	12.34	3.51
15-Apr-2014 23:30	720	15.13	3.60	18-Apr-2014 23:30	720	12.31	3.54
16-Apr-2014 00:30	780	15.16	3.63	19-Apr-2014 00:30	780	12.28	3.57
16-Apr-2014 01:30	840	15.19	3.66	19-Apr-2014 01:30	840	12.26	3.59
16-Apr-2014 03:30	960	15.24	3.71	19-Apr-2014 03:30	960	12.22	3.63
16-Apr-2014 05:30	1080	15.28	3.75	19-Apr-2014 05:30	1080	12.18	3.67
16-Apr-2014 07:30	1200	15.33	3.80	19-Apr-2014 07:30	1200	12.15	3.70
16-Apr-2014 09:30	1320	15.37	3.84	19-Apr-2014 09:30	1320	12.13	3.73
16-Apr-2014 11:30	1440	15.41	3.88	19-Apr-2014 11:30	1440	12.09	3.76
16-Apr-2014 13:30	1560	15.45	3.92	19-Apr-2014 13:30	1560	12.07	3.78
16-Apr-2014 15:30	1680	15.49	3.96	19-Apr-2014 15:30	1680	12.05	3.80
16-Apr-2014 17:30	1800	15.51	3.98	19-Apr-2014 17:30	1800	12.03	3.83
16-Apr-2014 19:30	1920	15.53	4.00	19-Apr-2014 19:30	1920	12.00	3.85
16-Apr-2014 21:30	2040	15.56	4.03	19-Apr-2014 21:30	2040	11.98	3.87
16-Apr-2014 23:30	2160	15.58	4.05	19-Apr-2014 23:30	2160	11.96	3.89
17-Apr-2014 01:30	2280	15.60	4.07	20-Apr-2014 01:30	2280	11.94	3.91
17-Apr-2014 03:30	2400	15.62	4.09	20-Apr-2014 03:30	2400	11.92	3.93
17-Apr-2014 05:30	2520	15.64	4.11	20-Apr-2014 05:30	2520	11.91	3.94
17-Apr-2014 07:30	2640	15.65	4.12	20-Apr-2014 07:30	2640	11.89	3.96
17-Apr-2014 09:30	2760	15.68	4.15	20-Apr-2014 09:30	2760	11.88	3.97
17-Apr-2014 11:30	2880	15.69	4.16	20-Apr-2014 11:30	2880	11.87	3.98
17-Apr-2014 13:30	3000	15.70	4.17	20-Apr-2014 13:30	3000	11.85	4.00
17-Apr-2014 15:30	3120	15.73	4.20	20-Apr-2014 15:30	3120	11.84	4.01
17-Apr-2014 17:30	3240	15.75	4.22	20-Apr-2014 17:30	3240	11.83	4.02
17-Apr-2014 19:30	3360	15.75	4.22	20-Apr-2014 19:30	3360	11.81	4.04
17-Apr-2014 21:30	3480	15.77	4.24	20-Apr-2014 21:30	3480	11.79	4.06
17-Apr-2014 23:30	3600	15.78	4.25	20-Apr-2014 23:30	3600	11.77	4.08
18-Apr-2014 01:30	3720	15.78	4.25	21-Apr-2014 01:30	3720	11.77	4.08
18-Apr-2014 03:30	3840	15.80	4.27	21-Apr-2014 03:30	3840	11.76	4.09
18-Apr-2014 05:30	3960	15.81	4.28	21-Apr-2014 05:30	3960	11.75	4.10
18-Apr-2014 07:30	4080	15.82	4.29	21-Apr-2014 07:30	4080	11.74	4.11
18-Apr-2014 09:30	4200	15.84	4.31				
18-Apr-2014 11:30	4320	15.84	4.31				

Tabulated Levels for Ow19#6

Pump On:	15-Apr-2014 11:30	Static Level:	15.14
Pump Off:	18-Apr-2014 11:30	Pumping Level:	18.01
Pumping Well:	**TW22**	Drawdown:	2.87
Distance from Pumping Well:	90 m	20 yr DD:	5.5

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	15.14	0.00	18-Apr-2014 11:31	1	18.00	0.02
15-Apr-2014 11:32	2	15.17	0.02	18-Apr-2014 11:32	2	18.00	0.01
15-Apr-2014 11:33	3	15.18	0.04	18-Apr-2014 11:33	3	17.97	0.04
15-Apr-2014 11:34	4	15.21	0.07	18-Apr-2014 11:34	4	17.94	0.07
15-Apr-2014 11:35	5	15.24	0.10	18-Apr-2014 11:35	5	17.92	0.09
15-Apr-2014 11:36	6	15.28	0.14	18-Apr-2014 11:36	6	17.88	0.13
15-Apr-2014 11:37	7	15.33	0.19	18-Apr-2014 11:37	7	17.85	0.16
15-Apr-2014 11:38	8	15.37	0.22	18-Apr-2014 11:38	8	17.81	0.21
15-Apr-2014 11:39	9	15.41	0.27	18-Apr-2014 11:39	9	17.78	0.23
15-Apr-2014 11:40	10	15.44	0.30	18-Apr-2014 11:40	10	17.74	0.28
15-Apr-2014 11:42	12	15.51	0.37	18-Apr-2014 11:42	12	17.67	0.34
15-Apr-2014 11:44	14	15.58	0.44	18-Apr-2014 11:44	14	17.60	0.41
15-Apr-2014 11:46	16	15.64	0.50	18-Apr-2014 11:46	16	17.54	0.47
15-Apr-2014 11:48	18	15.69	0.55	18-Apr-2014 11:48	18	17.49	0.52
15-Apr-2014 11:50	20	15.75	0.61	18-Apr-2014 11:50	20	17.44	0.57
15-Apr-2014 11:55	25	15.86	0.72	18-Apr-2014 11:55	25	17.34	0.67
15-Apr-2014 12:00	30	15.95	0.81	18-Apr-2014 12:00	30	17.25	0.77
15-Apr-2014 12:15	45	16.14	0.99	18-Apr-2014 12:15	45	17.06	0.95
15-Apr-2014 12:30	60	16.26	1.12	18-Apr-2014 12:30	60	16.91	1.10
15-Apr-2014 13:00	90	16.43	1.29	18-Apr-2014 13:00	90	16.75	1.26
15-Apr-2014 13:30	120	16.55	1.41	18-Apr-2014 13:30	120	16.61	1.40
15-Apr-2014 14:00	150	16.64	1.49	18-Apr-2014 14:00	150	16.53	1.48
15-Apr-2014 14:30	180	16.72	1.57	18-Apr-2014 14:30	180	16.46	1.55
15-Apr-2014 15:00	210	16.79	1.64	18-Apr-2014 15:00	210	16.40	1.61
15-Apr-2014 15:30	240	16.83	1.69	18-Apr-2014 15:30	240	16.35	1.67
15-Apr-2014 16:00	270	16.89	1.75	18-Apr-2014 16:00	270	16.31	1.71
15-Apr-2014 16:30	300	16.93	1.78	18-Apr-2014 16:30	300	16.26	1.75
15-Apr-2014 17:30	360	16.99	1.85	18-Apr-2014 17:30	360	16.20	1.82
15-Apr-2014 18:30	420	17.05	1.91	18-Apr-2014 18:30	420	16.14	1.87
15-Apr-2014 19:30	480	17.10	1.96	18-Apr-2014 19:30	480	16.10	1.91
15-Apr-2014 20:30	540	17.15	2.00	18-Apr-2014 20:30	540	16.06	1.95
15-Apr-2014 21:30	600	17.20	2.06	18-Apr-2014 21:30	600	16.02	1.99
15-Apr-2014 22:30	660	17.24	2.10	18-Apr-2014 22:30	660	16.00	2.01
15-Apr-2014 23:30	720	17.27	2.13	18-Apr-2014 23:30	720	15.95	2.06
16-Apr-2014 00:30	780	17.30	2.16	19-Apr-2014 00:30	780	15.94	2.07
16-Apr-2014 01:30	840	17.31	2.17	19-Apr-2014 01:30	840	15.92	2.09
16-Apr-2014 03:30	960	17.38	2.23	19-Apr-2014 03:30	960	15.88	2.13
16-Apr-2014 05:30	1080	17.42	2.28	19-Apr-2014 05:30	1080	15.84	2.17
16-Apr-2014 07:30	1200	17.46	2.32	19-Apr-2014 07:30	1200	15.81	2.20
16-Apr-2014 09:30	1320	17.51	2.36	19-Apr-2014 09:30	1320	15.79	2.22
16-Apr-2014 11:30	1440	17.56	2.41	19-Apr-2014 11:30	1440	15.76	2.25
16-Apr-2014 13:30	1560	17.59	2.45	19-Apr-2014 13:30	1560	15.74	2.27
16-Apr-2014 15:30	1680	17.62	2.48	19-Apr-2014 15:30	1680	15.71	2.30
16-Apr-2014 17:30	1800	17.66	2.51	19-Apr-2014 17:30	1800	15.70	2.31
16-Apr-2014 19:30	1920	17.68	2.53	19-Apr-2014 19:30	1920	15.67	2.34
16-Apr-2014 21:30	2040	17.70	2.56	19-Apr-2014 21:30	2040	15.65	2.36
16-Apr-2014 23:30	2160	17.72	2.58	19-Apr-2014 23:30	2160	15.62	2.39
17-Apr-2014 01:30	2280	17.75	2.61	20-Apr-2014 01:30	2280	15.61	2.40
17-Apr-2014 03:30	2400	17.76	2.62	20-Apr-2014 03:30	2400	15.59	2.42
17-Apr-2014 05:30	2520	17.79	2.65	20-Apr-2014 05:30	2520	15.57	2.44
17-Apr-2014 07:30	2640	17.81	2.67	20-Apr-2014 07:30	2640	15.57	2.44
17-Apr-2014 09:30	2760	17.82	2.68	20-Apr-2014 09:30	2760	15.55	2.46
17-Apr-2014 11:30	2880	17.84	2.70	20-Apr-2014 11:30	2880	15.53	2.48
17-Apr-2014 13:30	3000	17.85	2.71	20-Apr-2014 13:30	3000	15.52	2.49
17-Apr-2014 15:30	3120	17.87	2.73	20-Apr-2014 15:30	3120	15.50	2.51
17-Apr-2014 17:30	3240	17.89	2.75	20-Apr-2014 17:30	3240	15.49	2.52
17-Apr-2014 19:30	3360	17.91	2.76	20-Apr-2014 19:30	3360	15.48	2.53
17-Apr-2014 21:30	3480	17.91	2.77	20-Apr-2014 21:30	3480	15.47	2.54
17-Apr-2014 23:30	3600	17.93	2.79	20-Apr-2014 23:30	3600	15.45	2.56
18-Apr-2014 01:30	3720	17.93	2.79	21-Apr-2014 01:30	3720	15.44	2.57
18-Apr-2014 03:30	3840	17.95	2.81	21-Apr-2014 03:30	3840	15.44	2.58
18-Apr-2014 05:30	3960	17.97	2.83	21-Apr-2014 05:30	3960	15.42	2.59
18-Apr-2014 07:30	4080	17.97	2.83	21-Apr-2014 07:30	4080	15.41	2.60
18-Apr-2014 09:30	4200	18.00	2.85	21-Apr-2014 09:30	4200	15.40	2.61
18-Apr-2014 11:30	4320	18.01	2.86	21-Apr-2014 11:30	4320	15.40	2.61

Tabulated Levels for Ow09-01

Pump On:	15-Apr-2014 11:30	Static Level:	8.21
Pump Off:	18-Apr-2014 11:30	Pumping Level:	6.33
Pumping Well:	**TW22**	Drawdown:	-1.88
Distance from Pumping Well:	m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	8.20	0.00	18-Apr-2014 11:31	1	6.33	0.00
15-Apr-2014 11:32	2	8.20	-0.01	18-Apr-2014 11:32	2	6.33	0.00
15-Apr-2014 11:33	3	8.21	0.00	18-Apr-2014 11:33	3	6.33	0.00
15-Apr-2014 11:34	4	8.21	0.00	18-Apr-2014 11:34	4	6.33	0.00
15-Apr-2014 11:35	5	8.20	0.00	18-Apr-2014 11:35	5	6.33	0.00
15-Apr-2014 11:36	6	8.20	0.00	18-Apr-2014 11:36	6	6.33	0.00
15-Apr-2014 11:37	7	8.20	0.00	18-Apr-2014 11:37	7	6.33	0.00
15-Apr-2014 11:38	8	8.20	0.00	18-Apr-2014 11:38	8	6.33	0.00
15-Apr-2014 11:39	9	8.20	0.00	18-Apr-2014 11:39	9	6.33	0.00
15-Apr-2014 11:40	10	8.20	0.00	18-Apr-2014 11:40	10	6.33	0.00
15-Apr-2014 11:42	12	8.21	0.00	18-Apr-2014 11:42	12	6.33	0.00
15-Apr-2014 11:44	14	8.21	0.01	18-Apr-2014 11:44	14	6.32	0.00
15-Apr-2014 11:46	16	8.21	0.00	18-Apr-2014 11:46	16	6.33	0.00
15-Apr-2014 11:48	18	8.21	0.00	18-Apr-2014 11:48	18	6.33	0.00
15-Apr-2014 11:50	20	8.20	0.00	18-Apr-2014 11:50	20	6.33	0.00
15-Apr-2014 11:55	25	8.21	0.00	18-Apr-2014 11:55	25	6.33	0.00
15-Apr-2014 12:00	30	8.21	0.00	18-Apr-2014 12:00	30	6.33	0.00
15-Apr-2014 12:15	45	8.20	0.00	18-Apr-2014 12:15	45	6.33	0.00
15-Apr-2014 12:30	60	8.20	0.00	18-Apr-2014 12:30	60	6.32	0.01
15-Apr-2014 13:00	90	8.21	0.00	18-Apr-2014 13:00	90	6.32	0.01
15-Apr-2014 13:30	120	8.20	0.00	18-Apr-2014 13:30	120	6.32	0.01
15-Apr-2014 14:00	150	8.20	0.00	18-Apr-2014 14:00	150	6.31	0.02
15-Apr-2014 14:30	180	8.20	-0.01	18-Apr-2014 14:30	180	6.31	0.02
15-Apr-2014 15:00	210	8.20	-0.01	18-Apr-2014 15:00	210	6.31	0.02
15-Apr-2014 15:30	240	8.20	0.00	18-Apr-2014 15:30	240	6.30	0.03
15-Apr-2014 16:00	270	8.20	0.00	18-Apr-2014 16:00	270	6.30	0.03
15-Apr-2014 16:30	300	8.20	-0.01	18-Apr-2014 16:30	300	6.29	0.04
15-Apr-2014 17:30	360	8.20	-0.01	18-Apr-2014 17:30	360	6.28	0.05
15-Apr-2014 18:30	420	8.19	-0.02	18-Apr-2014 18:30	420	6.28	0.05
15-Apr-2014 19:30	480	8.19	-0.02	18-Apr-2014 19:30	480	6.27	0.06
15-Apr-2014 20:30	540	8.19	-0.01	18-Apr-2014 20:30	540	6.27	0.06
15-Apr-2014 21:30	600	8.19	-0.02	18-Apr-2014 21:30	600	6.27	0.06
15-Apr-2014 22:30	660	8.19	-0.02	18-Apr-2014 22:30	660	6.26	0.06
15-Apr-2014 23:30	720	8.19	-0.02	18-Apr-2014 23:30	720	6.26	0.07
16-Apr-2014 00:30	780	8.18	-0.02	19-Apr-2014 00:30	780	6.26	0.07
16-Apr-2014 01:30	840	8.18	-0.03	19-Apr-2014 01:30	840	6.25	0.08
16-Apr-2014 03:30	960	8.17	-0.04	19-Apr-2014 03:30	960	6.25	0.08
16-Apr-2014 05:30	1080	8.10	-0.11	19-Apr-2014 05:30	1080	6.24	0.09
16-Apr-2014 07:30	1200	8.00	-0.21	19-Apr-2014 07:30	1200	6.24	0.09
16-Apr-2014 09:30	1320	7.89	-0.32	19-Apr-2014 09:30	1320	6.24	0.09
16-Apr-2014 11:30	1440	7.73	-0.47	19-Apr-2014 11:30	1440	6.23	0.10
16-Apr-2014 13:30	1560	7.48	-0.73	19-Apr-2014 13:30	1560	6.22	0.11
16-Apr-2014 15:30	1680	7.20	-1.00	19-Apr-2014 15:30	1680	6.20	0.13
16-Apr-2014 17:30	1800	7.05	-1.16	19-Apr-2014 17:30	1800	6.18	0.15
16-Apr-2014 19:30	1920	6.93	-1.27	19-Apr-2014 19:30	1920	6.16	0.17
16-Apr-2014 21:30	2040	6.88	-1.32	19-Apr-2014 21:30	2040	6.14	0.19
16-Apr-2014 23:30	2160	6.84	-1.36	19-Apr-2014 23:30	2160	6.13	0.20
17-Apr-2014 01:30	2280	6.80	-1.41	20-Apr-2014 01:30	2280	6.12	0.21
17-Apr-2014 03:30	2400	6.76	-1.45	20-Apr-2014 03:30	2400	6.10	0.23
17-Apr-2014 05:30	2520	6.73	-1.48	20-Apr-2014 05:30	2520	6.09	0.24
17-Apr-2014 07:30	2640	6.70	-1.51	20-Apr-2014 07:30	2640	6.09	0.24
17-Apr-2014 09:30	2760	6.67	-1.54	20-Apr-2014 09:30	2760	6.07	0.26
17-Apr-2014 11:30	2880	6.63	-1.57	20-Apr-2014 11:30	2880	6.06	0.27
17-Apr-2014 13:30	3000	6.58	-1.62	20-Apr-2014 13:30	3000	6.03	0.30
17-Apr-2014 15:30	3120	6.55	-1.66	20-Apr-2014 15:30	3120	6.00	0.33
17-Apr-2014 17:30	3240	6.52	-1.69	20-Apr-2014 17:30	3240	5.98	0.35
17-Apr-2014 19:30	3360	6.49	-1.72	20-Apr-2014 19:30	3360	5.97	0.36
17-Apr-2014 21:30	3480	6.47	-1.74	20-Apr-2014 21:30	3480	5.95	0.38
17-Apr-2014 23:30	3600	6.43	-1.77	20-Apr-2014 23:30	3600	5.94	0.39
18-Apr-2014 01:30	3720	6.41	-1.80	21-Apr-2014 01:30	3720	5.93	0.40
18-Apr-2014 03:30	3840	6.38	-1.83	21-Apr-2014 03:30	3840	5.91	0.41
18-Apr-2014 05:30	3960	6.36	-1.85	21-Apr-2014 05:30	3960	5.90	0.43
18-Apr-2014 07:30	4080	6.35	-1.86	21-Apr-2014 07:30	4080	5.89	0.44
18-Apr-2014 09:30	4200	6.34	-1.86				
18-Apr-2014 11:30	4320	6.33	-1.88				

Tabulated Levels for Ow8I

Pump On:	15-Apr-2014 11:30	Static Level:	44.85
Pump Off:	18-Apr-2014 11:30	Pumping Level:	44.79
Pumping Well:	**TW22**	Drawdown:	-0.06
Distance from Pumping Well:	1250 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	44.85	0.00	18-Apr-2014 11:31	1	44.79	0.00
15-Apr-2014 11:32	2	44.85	0.00	18-Apr-2014 11:32	2	44.79	0.00
15-Apr-2014 11:33	3	44.85	0.00	18-Apr-2014 11:33	3	44.79	0.00
15-Apr-2014 11:34	4	44.85	0.01	18-Apr-2014 11:34	4	44.79	0.00
15-Apr-2014 11:35	5	44.85	0.00	18-Apr-2014 11:35	5	44.79	0.00
15-Apr-2014 11:36	6	44.85	0.00	18-Apr-2014 11:36	6	44.79	0.00
15-Apr-2014 11:37	7	44.85	0.00	18-Apr-2014 11:37	7	44.79	0.00
15-Apr-2014 11:38	8	44.85	0.00	18-Apr-2014 11:38	8	44.79	0.00
15-Apr-2014 11:39	9	44.85	0.01	18-Apr-2014 11:39	9	44.79	0.00
15-Apr-2014 11:40	10	44.86	0.01	18-Apr-2014 11:40	10	44.79	0.00
15-Apr-2014 11:42	12	44.86	0.01	18-Apr-2014 11:42	12	44.79	0.00
15-Apr-2014 11:44	14	44.86	0.01	18-Apr-2014 11:44	14	44.79	0.00
15-Apr-2014 11:46	16	44.85	0.01	18-Apr-2014 11:46	16	44.79	0.00
15-Apr-2014 11:48	18	44.86	0.01	18-Apr-2014 11:48	18	44.79	0.00
15-Apr-2014 11:50	20	44.86	0.01	18-Apr-2014 11:50	20	44.79	0.00
15-Apr-2014 11:55	25	44.86	0.01	18-Apr-2014 11:55	25	44.79	0.00
15-Apr-2014 12:00	30	44.85	0.00	18-Apr-2014 12:00	30	44.79	0.00
15-Apr-2014 12:15	45	44.86	0.01	18-Apr-2014 12:15	45	44.79	0.00
15-Apr-2014 12:30	60	44.85	0.01	18-Apr-2014 12:30	60	44.79	0.00
15-Apr-2014 13:00	90	44.86	0.01	18-Apr-2014 13:00	90	44.79	0.00
15-Apr-2014 13:30	120	44.86	0.01	18-Apr-2014 13:30	120	44.79	0.00
15-Apr-2014 14:00	150	44.86	0.02	18-Apr-2014 14:00	150	44.79	0.00
15-Apr-2014 14:30	180	44.86	0.01	18-Apr-2014 14:30	180	44.79	0.00
15-Apr-2014 15:00	210	44.87	0.02	18-Apr-2014 15:00	210	44.78	0.01
15-Apr-2014 15:30	240	44.88	0.03	18-Apr-2014 15:30	240	44.79	0.00
15-Apr-2014 16:00	270	44.88	0.03	18-Apr-2014 16:00	270	44.78	0.01
15-Apr-2014 16:30	300	44.88	0.03	18-Apr-2014 16:30	300	44.78	0.01
15-Apr-2014 17:30	360	44.88	0.03	18-Apr-2014 17:30	360	44.78	0.01
15-Apr-2014 18:30	420	44.88	0.03	18-Apr-2014 18:30	420	44.78	0.01
15-Apr-2014 19:30	480	44.88	0.03	18-Apr-2014 19:30	480	44.78	0.01
15-Apr-2014 20:30	540	44.89	0.04	18-Apr-2014 20:30	540	44.78	0.01
15-Apr-2014 21:30	600	44.90	0.05	18-Apr-2014 21:30	600	44.78	0.01
15-Apr-2014 22:30	660	44.91	0.06	18-Apr-2014 22:30	660	44.79	0.00
15-Apr-2014 23:30	720	44.91	0.06	18-Apr-2014 23:30	720	44.79	0.00
16-Apr-2014 00:30	780	44.92	0.07	19-Apr-2014 00:30	780	44.79	0.00
16-Apr-2014 01:30	840	44.91	0.07	19-Apr-2014 01:30	840	44.79	0.00
16-Apr-2014 03:30	960	44.92	0.07	19-Apr-2014 03:30	960	44.80	-0.01
16-Apr-2014 05:30	1080	44.92	0.07	19-Apr-2014 05:30	1080	44.80	-0.01
16-Apr-2014 07:30	1200	44.94	0.09	19-Apr-2014 07:30	1200	44.81	-0.02
16-Apr-2014 09:30	1320	44.95	0.10	19-Apr-2014 09:30	1320	44.82	-0.03
16-Apr-2014 11:30	1440	44.96	0.11	19-Apr-2014 11:30	1440	44.82	-0.03
16-Apr-2014 13:30	1560	44.95	0.10	19-Apr-2014 13:30	1560	44.83	-0.04
16-Apr-2014 15:30	1680	44.94	0.09	19-Apr-2014 15:30	1680	44.82	-0.03
16-Apr-2014 17:30	1800	44.93	0.09	19-Apr-2014 17:30	1800	44.81	-0.02
16-Apr-2014 19:30	1920	44.92	0.07	19-Apr-2014 19:30	1920	44.80	-0.01
16-Apr-2014 21:30	2040	44.92	0.07	19-Apr-2014 21:30	2040	44.80	-0.01
16-Apr-2014 23:30	2160	44.92	0.07	19-Apr-2014 23:30	2160	44.79	0.00
17-Apr-2014 01:30	2280	44.91	0.06	20-Apr-2014 01:30	2280	44.79	0.00
17-Apr-2014 03:30	2400	44.90	0.05	20-Apr-2014 03:30	2400	44.78	0.01
17-Apr-2014 05:30	2520	44.89	0.04	20-Apr-2014 05:30	2520	44.78	0.01
17-Apr-2014 07:30	2640	44.89	0.04	20-Apr-2014 07:30	2640	44.78	0.01
17-Apr-2014 09:30	2760	44.89	0.04	20-Apr-2014 09:30	2760	44.77	0.02
17-Apr-2014 11:30	2880	44.88	0.03	20-Apr-2014 11:30	2880	44.77	0.02
17-Apr-2014 13:30	3000	44.86	0.01	20-Apr-2014 13:30	3000	44.76	0.03
17-Apr-2014 15:30	3120	44.85	0.00	20-Apr-2014 15:30	3120	44.74	0.05
17-Apr-2014 17:30	3240	44.83	-0.02	20-Apr-2014 17:30	3240	44.74	0.05
17-Apr-2014 19:30	3360	44.82	-0.03	20-Apr-2014 19:30	3360	44.73	0.06
17-Apr-2014 21:30	3480	44.82	-0.03	20-Apr-2014 21:30	3480	44.72	0.07
17-Apr-2014 23:30	3600	44.81	-0.04	20-Apr-2014 23:30	3600	44.71	0.08
18-Apr-2014 01:30	3720	44.80	-0.05	21-Apr-2014 01:30	3720	44.71	0.08
18-Apr-2014 03:30	3840	44.79	-0.06	21-Apr-2014 03:30	3840	44.70	0.09
18-Apr-2014 05:30	3960	44.78	-0.07	21-Apr-2014 05:30	3960	44.70	0.09
18-Apr-2014 07:30	4080	44.78	-0.07	21-Apr-2014 07:30	4080	44.70	0.09
18-Apr-2014 09:30	4200	44.79	-0.06				
18-Apr-2014 11:30	4320	44.79	-0.06				

Tabulated Levels for Ow8D

Pump On:	15-Apr-2014 11:30	Static Level:	41.92
Pump Off:	18-Apr-2014 11:30	Pumping Level:	41.74
Pumping Well:	**TW22**	Drawdown:	-0.18
Distance from Pumping Well:	1250 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	41.92	0.00	18-Apr-2014 11:31	1	41.74	0.00
15-Apr-2014 11:32	2	41.91	0.00	18-Apr-2014 11:32	2	41.74	0.00
15-Apr-2014 11:33	3	41.92	0.00	18-Apr-2014 11:33	3	41.74	0.00
15-Apr-2014 11:34	4	41.92	0.00	18-Apr-2014 11:34	4	41.74	0.00
15-Apr-2014 11:35	5	41.91	0.00	18-Apr-2014 11:35	5	41.74	0.00
15-Apr-2014 11:36	6	41.91	0.00	18-Apr-2014 11:36	6	41.74	0.00
15-Apr-2014 11:37	7	41.91	0.00	18-Apr-2014 11:37	7	41.74	0.00
15-Apr-2014 11:38	8	41.92	0.00	18-Apr-2014 11:38	8	41.74	0.00
15-Apr-2014 11:39	9	41.92	0.00	18-Apr-2014 11:39	9	41.74	0.00
15-Apr-2014 11:40	10	41.92	0.00	18-Apr-2014 11:40	10	41.74	0.00
15-Apr-2014 11:42	12	41.92	0.00	18-Apr-2014 11:42	12	41.74	0.00
15-Apr-2014 11:44	14	41.92	0.00	18-Apr-2014 11:44	14	41.74	0.00
15-Apr-2014 11:46	16	41.91	0.00	18-Apr-2014 11:46	16	41.74	0.00
15-Apr-2014 11:48	18	41.91	0.00	18-Apr-2014 11:48	18	41.74	0.00
15-Apr-2014 11:50	20	41.91	0.00	18-Apr-2014 11:50	20	41.74	0.00
15-Apr-2014 11:55	25	41.91	0.00	18-Apr-2014 11:55	25	41.75	0.00
15-Apr-2014 12:00	30	41.91	-0.01	18-Apr-2014 12:00	30	41.74	0.00
15-Apr-2014 12:15	45	41.91	-0.01	18-Apr-2014 12:15	45	41.75	0.00
15-Apr-2014 12:30	60	41.91	-0.01	18-Apr-2014 12:30	60	41.74	0.00
15-Apr-2014 13:00	90	41.92	0.00	18-Apr-2014 13:00	90	41.74	0.00
15-Apr-2014 13:30	120	41.91	-0.01	18-Apr-2014 13:30	120	41.74	0.00
15-Apr-2014 14:00	150	41.91	-0.01	18-Apr-2014 14:00	150	41.74	0.00
15-Apr-2014 14:30	180	41.92	0.00	18-Apr-2014 14:30	180	41.74	0.00
15-Apr-2014 15:00	210	41.91	0.00	18-Apr-2014 15:00	210	41.73	0.01
15-Apr-2014 15:30	240	41.91	0.00	18-Apr-2014 15:30	240	41.73	0.01
15-Apr-2014 16:00	270	41.91	-0.01	18-Apr-2014 16:00	270	41.73	0.01
15-Apr-2014 16:30	300	41.91	-0.01	18-Apr-2014 16:30	300	41.72	0.02
15-Apr-2014 17:30	360	41.91	-0.01	18-Apr-2014 17:30	360	41.72	0.02
15-Apr-2014 18:30	420	41.91	-0.01	18-Apr-2014 18:30	420	41.72	0.03
15-Apr-2014 19:30	480	41.90	-0.02	18-Apr-2014 19:30	480	41.71	0.04
15-Apr-2014 20:30	540	41.90	-0.02	18-Apr-2014 20:30	540	41.70	0.04
15-Apr-2014 21:30	600	41.90	-0.01	18-Apr-2014 21:30	600	41.70	0.05
15-Apr-2014 22:30	660	41.91	-0.01	18-Apr-2014 22:30	660	41.70	0.05
15-Apr-2014 23:30	720	41.91	-0.01	18-Apr-2014 23:30	720	41.70	0.04
16-Apr-2014 00:30	780	41.90	-0.02	19-Apr-2014 00:30	780	41.70	0.05
16-Apr-2014 01:30	840	41.90	-0.02	19-Apr-2014 01:30	840	41.69	0.05
16-Apr-2014 03:30	960	41.89	-0.02	19-Apr-2014 03:30	960	41.70	0.04
16-Apr-2014 05:30	1080	41.89	-0.03	19-Apr-2014 05:30	1080	41.69	0.05
16-Apr-2014 07:30	1200	41.89	-0.03	19-Apr-2014 07:30	1200	41.68	0.06
16-Apr-2014 09:30	1320	41.90	-0.02	19-Apr-2014 09:30	1320	41.68	0.06
16-Apr-2014 11:30	1440	41.90	-0.02	19-Apr-2014 11:30	1440	41.69	0.05
16-Apr-2014 13:30	1560	41.90	-0.02	19-Apr-2014 13:30	1560	41.69	0.06
16-Apr-2014 15:30	1680	41.87	-0.04	19-Apr-2014 15:30	1680	41.67	0.07
16-Apr-2014 17:30	1800	41.87	-0.05	19-Apr-2014 17:30	1800	41.66	0.08
16-Apr-2014 19:30	1920	41.86	-0.06	19-Apr-2014 19:30	1920	41.64	0.10
16-Apr-2014 21:30	2040	41.85	-0.06	19-Apr-2014 21:30	2040	41.62	0.12
16-Apr-2014 23:30	2160	41.87	-0.05	19-Apr-2014 23:30	2160	41.61	0.14
17-Apr-2014 01:30	2280	41.86	-0.06	20-Apr-2014 01:30	2280	41.72	0.02
17-Apr-2014 03:30	2400	41.85	-0.06	20-Apr-2014 03:30	2400	41.73	0.01
17-Apr-2014 05:30	2520	41.84	-0.07	20-Apr-2014 05:30	2520	41.72	0.03
17-Apr-2014 07:30	2640	41.84	-0.08	20-Apr-2014 07:30	2640	41.70	0.04
17-Apr-2014 09:30	2760	41.84	-0.08	20-Apr-2014 09:30	2760	41.68	0.06
17-Apr-2014 11:30	2880	41.83	-0.09	20-Apr-2014 11:30	2880	41.67	0.07
17-Apr-2014 13:30	3000	41.82	-0.10	20-Apr-2014 13:30	3000	41.65	0.09
17-Apr-2014 15:30	3120	41.81	-0.11	20-Apr-2014 15:30	3120	41.63	0.11
17-Apr-2014 17:30	3240	41.79	-0.13	20-Apr-2014 17:30	3240	41.62	0.12
17-Apr-2014 19:30	3360	41.78	-0.14	20-Apr-2014 19:30	3360	41.60	0.14
17-Apr-2014 21:30	3480	41.78	-0.14	20-Apr-2014 21:30	3480	41.58	0.16
17-Apr-2014 23:30	3600	41.77	-0.14	20-Apr-2014 23:30	3600	41.59	0.16
18-Apr-2014 01:30	3720	41.76	-0.15	21-Apr-2014 01:30	3720	41.57	0.17
18-Apr-2014 03:30	3840	41.76	-0.16	21-Apr-2014 03:30	3840	41.56	0.18
18-Apr-2014 05:30	3960	41.75	-0.17	21-Apr-2014 05:30	3960	41.55	0.19
18-Apr-2014 07:30	4080	41.74	-0.18	21-Apr-2014 07:30	4080	41.55	0.19
18-Apr-2014 09:30	4200	41.74	-0.17				
18-Apr-2014 11:30	4320	41.74	-0.18				

Tabulated Levels for Ow10D

Pump On:	15-Apr-2014 11:30	Static Level:	36.87
Pump Off:	18-Apr-2014 11:30	Pumping Level:	39.16
Pumping Well:	**TW22**	Drawdown:	2.29
Distance from Pumping Well:	2050 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
15-Apr-2014 11:31	1	36.86	-0.01	18-Apr-2014 11:31	1	39.16	0.00
15-Apr-2014 11:32	2	36.85	-0.02	18-Apr-2014 11:32	2	39.16	0.00
15-Apr-2014 11:33	3	36.84	-0.03	18-Apr-2014 11:33	3	39.16	0.00
15-Apr-2014 11:34	4	36.83	-0.04	18-Apr-2014 11:34	4	39.16	0.00
15-Apr-2014 11:35	5	36.82	-0.05	18-Apr-2014 11:35	5	39.16	0.00
15-Apr-2014 11:36	6	36.81	-0.06	18-Apr-2014 11:36	6	39.16	0.00
15-Apr-2014 11:37	7	36.80	-0.07	18-Apr-2014 11:37	7	39.16	0.00
15-Apr-2014 11:38	8	36.79	-0.08	18-Apr-2014 11:38	8	39.16	0.00
15-Apr-2014 11:39	9	36.79	-0.08	18-Apr-2014 11:39	9	39.16	0.00
15-Apr-2014 11:40	10	36.77	-0.10	18-Apr-2014 11:40	10	39.16	0.00
15-Apr-2014 11:42	12	36.76	-0.11	18-Apr-2014 11:42	12	39.16	0.00
15-Apr-2014 11:44	14	36.74	-0.13	18-Apr-2014 11:44	14	39.15	0.01
15-Apr-2014 11:46	16	36.72	-0.15	18-Apr-2014 11:46	16	39.16	0.00
15-Apr-2014 11:48	18	36.70	-0.17	18-Apr-2014 11:48	18	39.16	0.00
15-Apr-2014 11:50	20	36.68	-0.19	18-Apr-2014 11:50	20	39.16	0.00
15-Apr-2014 11:55	25	36.64	-0.23	18-Apr-2014 11:55	25	39.16	0.00
15-Apr-2014 12:00	30	36.60	-0.27	18-Apr-2014 12:00	30	39.16	0.00
15-Apr-2014 12:15	45	36.47	-0.40	18-Apr-2014 12:15	45	39.16	0.00
15-Apr-2014 12:30	60	36.36	-0.51	18-Apr-2014 12:30	60	39.16	0.00
15-Apr-2014 13:00	90	36.17	-0.70	18-Apr-2014 13:00	90	39.16	0.00
15-Apr-2014 13:30	120	36.31	-0.56	18-Apr-2014 13:30	120	39.16	0.00
15-Apr-2014 14:00	150	36.59	-0.28	18-Apr-2014 14:00	150	39.16	0.00
15-Apr-2014 14:30	180	37.91	1.04	18-Apr-2014 14:30	180	39.16	0.00
15-Apr-2014 15:00	210	39.16	2.29	18-Apr-2014 15:00	210	39.16	0.00
15-Apr-2014 15:30	240	39.16	2.29	18-Apr-2014 15:30	240	39.16	0.00
15-Apr-2014 16:00	270	39.16	2.29	18-Apr-2014 16:00	270	39.16	0.00
15-Apr-2014 16:30	300	39.16	2.29	18-Apr-2014 16:30	300	39.16	0.00
15-Apr-2014 17:30	360	38.31	1.44	18-Apr-2014 17:30	360	39.16	0.00
15-Apr-2014 18:30	420	37.40	0.53	18-Apr-2014 18:30	420	39.16	0.00
15-Apr-2014 19:30	480	37.06	0.19	18-Apr-2014 19:30	480	39.16	0.00
15-Apr-2014 20:30	540	36.86	-0.01	18-Apr-2014 20:30	540	39.16	0.00
15-Apr-2014 21:30	600	38.11	1.24	18-Apr-2014 21:30	600	39.16	0.00
15-Apr-2014 22:30	660	39.16	2.29	18-Apr-2014 22:30	660	39.16	0.00
15-Apr-2014 23:30	720	39.15	2.28	18-Apr-2014 23:30	720	39.16	0.00
16-Apr-2014 00:30	780	39.16	2.29	19-Apr-2014 00:30	780	39.16	0.00
16-Apr-2014 01:30	840	39.15	2.28	19-Apr-2014 01:30	840	39.15	0.01
16-Apr-2014 03:30	960	39.16	2.29	19-Apr-2014 03:30	960	39.16	0.00
16-Apr-2014 05:30	1080	38.92	2.05	19-Apr-2014 05:30	1080	39.16	0.00
16-Apr-2014 07:30	1200	37.50	0.63	19-Apr-2014 07:30	1200	39.15	0.01
16-Apr-2014 09:30	1320	37.13	0.26	19-Apr-2014 09:30	1320	39.16	0.00
16-Apr-2014 11:30	1440	36.91	0.04	19-Apr-2014 11:30	1440	39.16	0.00
16-Apr-2014 13:30	1560	36.79	-0.08	19-Apr-2014 13:30	1560	39.16	0.00
16-Apr-2014 15:30	1680	36.66	-0.21	19-Apr-2014 15:30	1680	39.16	0.00
16-Apr-2014 17:30	1800	36.62	-0.25	19-Apr-2014 17:30	1800	39.16	0.00
16-Apr-2014 19:30	1920	36.59	-0.28	19-Apr-2014 19:30	1920	39.16	0.00
16-Apr-2014 21:30	2040	36.44	-0.43	19-Apr-2014 21:30	2040	39.16	0.00
16-Apr-2014 23:30	2160	36.22	-0.65	19-Apr-2014 23:30	2160	39.16	0.00
17-Apr-2014 01:30	2280	36.05	-0.82	20-Apr-2014 01:30	2280	39.16	0.00
17-Apr-2014 03:30	2400	36.45	-0.42	20-Apr-2014 03:30	2400	39.15	0.01
17-Apr-2014 05:30	2520	39.15	2.28	20-Apr-2014 05:30	2520	39.15	0.01
17-Apr-2014 07:30	2640	39.15	2.28	20-Apr-2014 07:30	2640	39.16	0.00
17-Apr-2014 09:30	2760	39.15	2.28	20-Apr-2014 09:30	2760	39.16	0.00
17-Apr-2014 11:30	2880	39.15	2.28	20-Apr-2014 11:30	2880	39.16	0.00
17-Apr-2014 13:30	3000	39.16	2.29	20-Apr-2014 13:30	3000	39.16	0.00
17-Apr-2014 15:30	3120	39.15	2.29	20-Apr-2014 15:30	3120	39.16	0.00
17-Apr-2014 17:30	3240	39.15	2.28	20-Apr-2014 17:30	3240	39.16	0.00
17-Apr-2014 19:30	3360	39.16	2.29	20-Apr-2014 19:30	3360	39.16	0.00
17-Apr-2014 21:30	3480	39.16	2.29	20-Apr-2014 21:30	3480	39.16	0.00
17-Apr-2014 23:30	3600	39.16	2.29	20-Apr-2014 23:30	3600	39.16	0.00
18-Apr-2014 01:30	3720	39.16	2.29	21-Apr-2014 01:30	3720	39.16	0.00
18-Apr-2014 03:30	3840	39.16	2.29	21-Apr-2014 03:30	3840	39.16	0.00
18-Apr-2014 05:30	3960	39.16	2.29	21-Apr-2014 05:30	3960	39.16	0.00
18-Apr-2014 07:30	4080	39.15	2.29				
18-Apr-2014 09:30	4200	39.16	2.29				
18-Apr-2014 11:30	4320	39.16	2.29				

Table B-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G32925 **REPORT No. B14-07939**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 08-May-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-07939-1			
			Date Collected		16-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Total Coliform	cfu/100mL	1	MOE E3407	17-Apr-14/O	0			
E coli	cfu/100mL	1	MOE E3407	17-Apr-14/O	0			
Background	cfu/100mL	1	MOE E3407	17-Apr-14/O	0			
Hardness (as CaCO3)	mg/L	1	SM 3120	22-Apr-14/O	311			
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	21-Apr-14/O	238			
pH @25°C	pH Units		SM 4500H	21-Apr-14/O	7.90			
Colour	TCU	2	SM 2120C	21-Apr-14/O	3			
Turbidity	NTU	0.1	SM 2130	22-Apr-14/O	0.4			
Fluoride	mg/L	0.1	SM4110C	17-Apr-14/O	0.1			
Chloride	mg/L	0.5	SM4110C	17-Apr-14/O	30.2			
Nitrite (N)	mg/L	0.1	SM4110C	17-Apr-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	17-Apr-14/O	7.7			
Nitrate + Nitrite (N)	mg/L	0.1	SM4110C	17-Apr-14/O	7.7			
Sulphate	mg/L	1	SM4110C	17-Apr-14/O	22			
Total Cyanide	mg/L	0.005	SM 4500CN	22-Apr-14/K	< 0.005			
Calcium	mg/L	0.02	SM 3120	22-Apr-14/O	85.9			
Magnesium	mg/L	0.01	SM 3120	22-Apr-14/O	23.4			
Sodium	mg/L	0.2	SM 3120	22-Apr-14/O	9.9			
Potassium	mg/L	0.1	SM 3120	22-Apr-14/O	1.6			
Aluminum	mg/L	0.01	SM 3120	22-Apr-14/O	0.02			
Antimony	mg/L	0.0001	EPA 200.8	22-Apr-14/O	< 0.0001			
Arsenic	mg/L	0.0001	EPA 200.8	22-Apr-14/O	0.0002			
Barium	mg/L	0.001	SM 3120	22-Apr-14/O	0.045			
Boron	mg/L	0.005	SM 3120	22-Apr-14/O	0.007			
Cadmium	mg/L	0.00002	EPA 200.8	22-Apr-14/O	< 0.00002			
Chromium	mg/L	0.002	SM 3120	22-Apr-14/O	< 0.002			



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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Table B-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
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Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 08-May-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-07939-1			
			Date Collected		16-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Copper	mg/L	0.002	SM 3120	22-Apr-14/O	< 0.002			
Iron	mg/L	0.005	SM 3120	22-Apr-14/O	< 0.005			
Lead	mg/L	0.00002	EPA 200.8	22-Apr-14/O	< 0.00002			
Manganese	mg/L	0.001	SM 3120	22-Apr-14/O	< 0.001			
Mercury	mg/L	0.00002	SM 3112 B	22-Apr-14/O	< 0.00002			
Selenium	mg/L	0.001	EPA 200.8	22-Apr-14/O	< 0.001			
Uranium	mg/L	0.00005	EPA 200.8	22-Apr-14/O	0.00138			
Zinc	mg/L	0.005	SM 3120	22-Apr-14/O	< 0.005			
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	22-Apr-14/O	< 0.01			
Total Kjeldahl Nitrogen	mg/L	0.05	MOEE 3367	25-Apr-14/O	< 0.05			
Organic Nitrogen	mg/L	0.05	MOEE 3367	28-Apr-14/O	< 0.05			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	17-Apr-14/O	1.7			
Sulphide	mg/L	0.01	SM4500-S2	21-Apr-14/K	< 0.01			
Methane	L/m3	0.006	NA	23-Apr-14	< 0.006 [2]			
Benzene	µg/L	0.5	EPA 8260	17-Apr-14/O	< 0.5			
Carbon Tetrachloride	µg/L	0.2	EPA 8260	17-Apr-14/O	< 0.2			
Dichlorobenzene,1,2-	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Dichlorobenzene,1,4-	µg/L	0.2	EPA 8260	17-Apr-14/O	< 0.2			
Dichloroethane,1,2-	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Dichloroethene, 1,1-	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Dichloromethane (Methylene Chloride)	µg/L	0.3	EPA 8260	17-Apr-14/O	< 0.3			
Ethylbenzene	µg/L	0.5	EPA 8260	17-Apr-14/O	< 0.5			
Monochlorobenzene (Chlorobenzene)	µg/L	0.2	EPA 8260	17-Apr-14/O	< 0.2			
Tetrachloroethylene	µg/L	0.2	EPA 8260	17-Apr-14/O	< 0.2			
Toluene	µg/L	0.5	EPA 8260	17-Apr-14/O	< 0.5			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
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Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 08-May-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-07939-1			
			Date Collected		16-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Trichloroethylene	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Vinyl Chloride	µg/L	0.2	EPA 8260	17-Apr-14/O	< 0.2			
Xylene, m,p-	µg/L	0.4	EPA 8260	17-Apr-14/O	< 0.4			
Xylene, o-	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Xylene, m,p,o-	µg/L	0.4	EPA 8260	17-Apr-14/O	< 0.4			
Bromoform	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Bromodichloromethane	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Dibromochloromethane	µg/L	0.1	EPA 8260	17-Apr-14/O	< 0.1			
Chloroform	µg/L	0.3	EPA 8260	17-Apr-14/O	< 0.3			
Total Trihalomethanes	µg/L	0.3	EPA 8260	17-Apr-14/O	< 0.3			
Alachlor	µg/L	0.3	EPA 8270	24-Apr-14/K	< 0.3			
Aldicarb	µg/L	3	EPA 8270	24-Apr-14/K	< 3			
Aldrin + Dieldrin	µg/L	0.02	EPA 8080	22-Apr-14/K	< 0.02			
Atrazine + Metabolites	µg/L	0.5	Calc.	24-Apr-14/K	< 0.5			
Azinphos-methyl	µg/L	1	EPA 8270	24-Apr-14/K	< 1			
Bendiocarb	µg/L	3	EPA 8270	24-Apr-14/K	< 3			
Benzo(a)pyrene	µg/L	0.005	EPA 8270	24-Apr-14/K	< 0.005			
Bromoxynil	µg/L	0.3	EPA 8270	24-Apr-14/K	< 0.3			
Carbaryl	µg/L	3	EPA 8270	24-Apr-14/K	< 3			
Carbofuran	µg/L	1	EPA 8270	24-Apr-14/K	< 1			
Chlordane (Total)	µg/L	0.04	EPA 8080	22-Apr-14/K	< 0.04			
Chlorpyrifos	µg/L	0.5	EPA 8270	24-Apr-14/K	< 0.5			
Cyanazine	µg/L	0.5	EPA 8270	24-Apr-14/K	< 0.5			
DDT + Metabolites	µg/L	0.01	EPA 8080	22-Apr-14/K	< 0.01			
Diazinon	µg/L	1	EPA 8270	24-Apr-14/K	< 1			
Dicamba	µg/L	5	EPA 8270	24-Apr-14/K	< 5			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
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Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 08-May-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-07939-1			
			Date Collected		16-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Dichlorophenol, 2,4-	µg/L	0.1	EPA 8270	24-Apr-14/K	< 0.1			
Dichlorophenoxy acetic acid, 2,4- (2,4-D)	µg/L	5	EPA 8270	24-Apr-14/K	< 5			
Diclofop-methyl	µg/L	0.5	EPA 8270	24-Apr-14/K	< 0.5			
Dimethoate	µg/L	1	EPA 8270	24-Apr-14/K	< 1			
Dinoseb	µg/L	0.5	EPA 8270	24-Apr-14/K	< 0.5			
Dioxin & Furan (TEQ)	ppq	1	E.C. 1/RM/19	01-May-14	< 1 [3]			
Diquat	µg/L	5	EPA 549.1	23-Apr-14/K	< 5			
Diuron	µg/L	5	EPA 8270	24-Apr-14/K	< 5			
Lindane (Hexachlorocyclohexane, Gamma)	µg/L	0.1	EPA 8080	22-Apr-14/K	< 0.1			
Glyphosate	µg/L	25	EPA 547	23-Apr-14/K	< 25			
Heptachlor + Heptachlor Epoxide	µg/L	0.1	EPA 8080	22-Apr-14/K	< 0.1			
Malathion	µg/L	5	EPA 8270	24-Apr-14/K	< 5			
Methoxychlor	µg/L	0.1	EPA 8080	22-Apr-14/K	< 0.1			
Metolachlor	µg/L	3	EPA 8270	24-Apr-14/K	< 3			
Metribuzin	µg/L	3	EPA 8270	24-Apr-14/K	< 3			
Microcystin DM	ppb	0.1	NA	24-Apr-14	< 0.1 [1]			
N-Nitrosodimethylamine	µg/L	0.0008	E3209A/SM 6410B	25-Apr-14	< 0.0008 [2]			
NTA	mg/L	0.03	J. Chrom A 690	23-Apr-14	< 0.03 [2]			
Paraquat	µg/L	1	EPA 549.1	23-Apr-14/K	< 1			
Parathion	µg/L	3	EPA 8270	24-Apr-14/K	< 3			
Pentachlorophenol	µg/L	0.1	EPA 8270	24-Apr-14/K	< 0.1			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
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2378 Holly Lane
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Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 08-May-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-07939-1			
			Date Collected		16-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Phorate	µg/L	0.3	EPA 8270	24-Apr-14/K	< 0.3			
Picloram	µg/L	5	EPA 8270	24-Apr-14/K	< 5			
Poly-Chlorinated Biphenyls (PCB's)	µg/L	0.05	EPA 8080	22-Apr-14/K	< 0.05			
Prometryne	µg/L	0.1	EPA 8270	24-Apr-14/K	< 0.1			
Simazine	µg/L	0.5	EPA 8270	24-Apr-14/K	< 0.5			
Temephos	µg/L	10	EPA 8270	24-Apr-14/K	< 10			
Terbufos	µg/L	0.3	EPA 8270	24-Apr-14/K	< 0.3			
Tetrachlorophenol, 2,3,4,6-	µg/L	0.1	EPA 8270	24-Apr-14/K	< 0.1			
Triallate	µg/L	10	EPA 8270	24-Apr-14/K	< 10			
Trichlorophenol 2,4,6-	µg/L	0.1	EPA 8270	24-Apr-14/K	< 0.1			
Trichlorophenoxy acetic acid, 2,4,5-	µg/L	10	EPA 8270	24-Apr-14/K	< 10			
Trifluralin	µg/L	0.5	EPA 8270	24-Apr-14/K	< 0.5			
Anion Sum	meq/L		Calc.	23-Apr-14/O	6.63			
Cation Sum	meq/L		Calc.	23-Apr-14/O	6.68			
% Difference	%		Calc.	23-Apr-14/O	0.382			
Ion Ratio	AS/CS		Calc.	23-Apr-14/O	0.992			
Sodium Adsorption Ratio	-		Calc.	23-Apr-14/O	0.245			
TDS(ion sum calc.)	mg/L		Calc.	23-Apr-14/O	350			
Conductivity (calc.)	µmho/cm		Calc.	23-Apr-14/O	637			
Langelier Index(25°C)	S.I.		Calc.	23-Apr-14/O	0.758			

1 subcontracted to COAL Inc.
2 Subcontracted to SGS Lakefield
3 Subcontracted to Wellington Labs

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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Table B-2: Water Quality Results

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Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 30-Apr-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22 (1 hr)			
			Sample I.D.		B14-07940-1			
			Date Collected		15-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	22-Apr-14/O	313			
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	17-Apr-14/O	233			
Conductivity @25°C	µmho/cm	1	SM 2510B	17-Apr-14/O	649			
pH @25°C	pH Units		SM 4500H	17-Apr-14/O	8.11			
Colour	TCU	2	SM 2120C	21-Apr-14/O	2			
Turbidity	NTU	0.1	SM 2130	22-Apr-14/O	2.5			
Calcium	mg/L	0.02	SM 3120	22-Apr-14/O	86.1			
Magnesium	mg/L	0.01	SM 3120	22-Apr-14/O	23.8			
Sodium	mg/L	0.2	SM 3120	22-Apr-14/O	11.8			
Potassium	mg/L	0.1	SM 3120	22-Apr-14/O	2.3			
Copper	mg/L	0.002	SM 3120	22-Apr-14/O	0.003			
Iron	mg/L	0.005	SM 3120	22-Apr-14/O	0.013			
Manganese	mg/L	0.001	SM 3120	22-Apr-14/O	0.003			
Silica	mg/L	0.02	SM 3120	22-Apr-14/O	14.2			
Zinc	mg/L	0.005	SM 3120	22-Apr-14/O	< 0.005			
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	22-Apr-14/O	< 0.01			
Total Kjeldahl Nitrogen	mg/L	0.05	MOEE 3367	25-Apr-14/O	< 0.05			
Organic Nitrogen	mg/L	0.05	MOEE 3367	25-Apr-14/O	< 0.05			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	17-Apr-14/O	1.8			
Sulphide	mg/L	0.01	SM4500-S2	21-Apr-14/K	< 0.01			
Phenolics	mg/L	0.001	MOEE 3179	17-Apr-14/O	< 0.001			
Tannins and Lignins	mg/L	0.1	N/A	28-Apr-14	< 0.1 [1]			
Anion Sum	meq/L		Calc.	22-Apr-14/O	6.77			
Cation Sum	meq/L		Calc.	22-Apr-14/O	6.83			
% Difference	%		Calc.	22-Apr-14/O	0.481			
Ion Ratio	AS/CS		Calc.	22-Apr-14/O	0.990			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 17-Apr-14
DATE REPORTED: 30-Apr-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Snow Valley
P.O. NUMBER: 13-1170-0040
WATERWORKS NO.

			Client I.D.		TW22 (1 hr)			
			Sample I.D.		B14-07940-1			
			Date Collected		15-Apr-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Sodium Adsorption Ratio	-		Calc.	22-Apr-14/O	0.291			
TDS(ion sum calc.)	mg/L		Calc.	22-Apr-14/O	360			
Conductivity (calc.)	µmho/cm		Calc.	22-Apr-14/O	655			
TDS(calc.)/EC(actual)	-		Calc.	22-Apr-14/O	0.554			
EC(calc.)/EC(actual)	-		Calc.	22-Apr-14/O	1.01			
Langelier Index(25°C)	S.I.		Calc.	22-Apr-14/O	0.961			
Fluoride	mg/L	0.1	SM4110C	17-Apr-14/O	0.1			
Nitrite (N)	mg/L	0.1	SM4110C	17-Apr-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	17-Apr-14/O	7.9			
Bromide	mg/L	0.4	SM4110C	17-Apr-14/O	< 0.4			
Chloride	mg/L	0.5	SM4110C	17-Apr-14/O	37.8			
Sulphate	mg/L	1	SM4110C	17-Apr-14/O	22			

1 . subcontracted to Paracel Labs



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Table B-2: Water Quality Results

CENTRAL ONTARIO ANALYTICAL LABORATORY INC.

4260 Burnside Line, R.R. #4
Orillia, ON L3V 6H4
Tel: (705) 326-8285 Fax: (705) 326-9316
www.coalab.ca

Final Certificate of Microbiological Analysis of Drinking Water

Date & Time Received:	Temp. Rec'd. (°C):	Receiver:	Date & Time Incubated:	2014-04-15 15:00
2014-04-15 14:12	8.3	MH	HPC & FS Date & Time Incubated:	

Date Sampled: 2014-04-15

Collected By: K. Easton

Name of Facility: Golder Associates

Drinking Water System (DWS) #

Submitted By: K. Easton

Twp/Town	
Systems Health Unit	SMDHU
Regulation	319/08
Total # of pages sent	1
# of samples sent	1
# of samples received	1

Report To: **Golder Associates Ltd.**

Address: 121 Commerce Park Drive, Unit L, Barrie, ON. L4N 8X1

Telephone: 705 722-4492 Ext: Fax: 705-722-3786

Email Address: patricia_chapple@golder.com

"Live Person" After Hours Contact Name and Tel. No:

Conditions/ Comments Project #: 13-1170-0040 Also send to: John - easton@golder.com Alicia - beynon@golder.com Thanks!

Time Sampled	Sample Identifier	Identification of Collection Site	Water Type	Temp. Of Sample (°C/°F)	Treatment Information				Laboratory Number	Total Coliform		E. coli		Background		HPC		
					U.V.	Other	Total Cl_2 (mg/L)	Free Cl_2 (mg/L)		>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/1 ml	
12:00	1	TW22-Well	D						005752		0		0		0			

All samples will be considered DISTRIBUTION samples unless otherwise indicated.

All times are transcribed in the 24-hour clock for upload to the Ministry of the Environment (MOE) and/or Ministry of Health and Long Term Care (MoHLTC).

Analysis performed by qualified analysts. Results relate only to the aliquot submitted. Samples have been analyzed as received. COAL is accredited by SCC and licensed by MOE in these specific microbiological parameters and the following inorganic and physical parameters: pH, turbidity, and alkalinity.

COAL accepts no responsibility for parameters selected, misidentification of samples or incorrect quantity, this is the responsibility of the submitting agency.

For collection and handling procedures visit www.coalab.ca/watersamples.html

Raw = R
Distribution = D
Point of Entry = E

F.S. & Faecal Strep. = Faecal Streptococcus HPC = Heterotrophic Plate Count HPM = Heavy Particulate Matter N/R = Not Received F.S. and HPC require 48 hours of incubation Raw Water Comsumed = RWC

Analysis Date & Time: 2014-04-16 13:30 Enumerated By: GD Audited By: LC Methodology: M/F CFU/100ml

Analysis Date & Time: Enumerated By: Audited By: HPC Methodology: SP CFU/1ml; FS Methodology: M/F CFU/100ml

Transcribed By: HM Authorized & Rechecked By: TJ/JT Copy Released By: CAB, LC

Lab No. Submitting Agency @ Health Unit @ Spills Action Centre (SAC) @ AWQI # By: Date:

Test Methodology and Detection Limit

Total Coliform (Treated)	COAL Endo	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Total Coliform (Untreated)	COAL DC	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
E. coli	COAL DC	Detection Limit	0 - 60	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL Endo	Detection Limit	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL DC	Detection Limit	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
HPC	COAL HPC	Detection Limit	10 - 2.00 x 10^3	Indicates Deterioration:	>500	Performed by Spread Plate	SP CFU/1 ml
Faecal Streptococcus	COAL FS	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml

Approved for use by TJ prior to use.

Table B-2: Water Quality Results

CENTRAL ONTARIO ANALYTICAL LABORATORY INC.

4260 Burnside Line, R.R. #4
Orillia, ON L3V 6H4
Tel: (705) 326-8285 Fax: (705) 326-9316
www.coalab.ca

Final Certificate of Microbiological Analysis of Drinking Water

Date & Time Received:	Temp. Rec'd. (°C):	Receiver:	Date & Time Incubated:	2014-04-16 15:00
2014-04-16 14:40	13.7	AB	HPC & FS Date & Time Incubated:	

Date Sampled: 2014-04-16

Collected By: Alicia Beynon

Name of Facility: Golder Associates

Drinking Water System (DWS) #

Submitted By: Kevin Easton

Twp/Town	
Systems Health Unit	SMDHU
Regulation	319/08
Total # of pages sent	1
# of samples sent	1
# of samples received	1

Report To: **Golder Associates Ltd.**

Address: 121 Commerce Park Drive, Unit L, Barrie, ON. L4N 8X1

Telephone: 705 722-4492 Ext: Fax: 705-722-3786

Email Address: patricia_chapple@golder.com

"Live Person" After Hours Contact Name and Tel. No:

Conditions/ Comments Project #: 13-1170-0040 Please send to: John_easton@golder.com ; Alicia_beynon@golder.com

Time Sampled	Sample Identifier	Identification of Collection Site	Water Type	Temp. Of Sample (°C/°F)	Treatment Information				Laboratory Number	Total Coliform		E. coli		Background		HPC		
					U.V.	Other	Total Cl_2 (mg/L)	Free Cl_2 (mg/L)		>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/1 ml	
08:00		TW22	D						005901		0		0		0			

All samples will be considered DISTRIBUTION samples unless otherwise indicated.

All times are transcribed in the 24-hour clock for upload to the Ministry of the Environment (MOE) and/or Ministry of Health and Long Term Care (MoHLTC).

Analysis performed by qualified analysts. Results relate only to the aliquot submitted. Samples have been analyzed as received. COAL is accredited by SCC and licensed by MOE in these specific microbiological parameters and the following inorganic and physical parameters: pH, turbidity, and alkalinity.

COAL accepts no responsibility for parameters selected, misidentification of samples or incorrect quantity, this is the responsibility of the submitting agency.

For collection and handling procedures visit www.coalab.ca/watersamples.html

Raw = R
Distribution = D
Point of Entry = E

F.S. & Faecal Strep. = Faecal Streptococcus HPC = Heterotrophic Plate Count HPM = Heavy Particulate Matter N/R = Not Received F.S. and HPC require 48 hours of incubation Raw Water Comsumed = RWC

Analysis Date & Time: 2014-04-17 13:30 Enumerated By: LC Audited By: AV Methodology: M/F CFU/100ml

Analysis Date & Time: Enumerated By: Audited By: HPC Methodology: SP CFU/1ml; FS Methodology: M/F CFU/100ml

Transcribed By: HM Authorized & Rechecked By: TJ/JT Copy Released By: AB, AV, HM

Lab No. Submitting Agency @ Health Unit @ Spills Action Centre (SAC) @ AWQI # By: Date:

Test Methodology and Detection Limit

Total Coliform (Treated)	COAL Endo	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Total Coliform (Untreated)	COAL DC	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
E. coli	COAL DC	Detection Limit	0 - 60	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL Endo	Detection Limit	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL DC	Detection Limit	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
HPC	COAL HPC	Detection Limit	10 - 2.00 x 10^3	Indicates Deterioration:	>500	Performed by Spread Plate	SP CFU/1 ml
Faecal Streptococcus	COAL FS	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml

Approved for use by TJ prior to use.

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G42871 **REPORT No. B14-26213**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 08-Oct-14
DATE REPORTED: 17-Oct-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1311700040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-26213-1			
			Date Collected		07-Oct-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	09-Oct-14/O	331			
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	09-Oct-14/O	231			
Conductivity @25°C	µmho/cm	1	SM 2510B	09-Oct-14/O	660			
pH @25°C	pH Units		SM 4500H	09-Oct-14/O	8.11			
Fluoride	mg/L	0.1	SM4110C	10-Oct-14/O	< 0.1			
Chloride	mg/L	0.5	SM4110C	10-Oct-14/O	50.3			
Nitrite (N)	mg/L	0.1	SM4110C	10-Oct-14/O	< 0.1			
Nitrate (N)								
Sulphate	mg/L	1	SM4110C	10-Oct-14/O	23			
Calcium	mg/L	0.02	SM 3120	09-Oct-14/O	90.9			
Magnesium	mg/L	0.01	SM 3120	09-Oct-14/O	25.3			
Sodium	mg/L	0.2	SM 3120	09-Oct-14/O	16.5			
Potassium	mg/L	0.1	SM 3120	09-Oct-14/O	1.9			
Iron	mg/L	0.005	SM 3120	09-Oct-14/O	0.027			
Manganese	mg/L	0.001	SM 3120	09-Oct-14/O	0.002			
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	17-Oct-14/O	< 0.01			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	14-Oct-14/O	1.7			
Tannins and Lignins	mg/L	0.1	N/A	14-Oct-14	< 0.1 [1]			
Anion Sum	meq/L		Calc.	17-Oct-14/O	7.05			
Cation Sum	meq/L		Calc.	17-Oct-14/O	7.38			
% Difference	%		Calc.	17-Oct-14/O	2.32			
Ion Ratio	AS/CS		Calc.	17-Oct-14/O	0.955			
Sodium Adsorption Ratio	-		Calc.	17-Oct-14/O	0.395			
TDS(ion sum calc.)	mg/L		Calc.	17-Oct-14/O	380			
Conductivity (calc.)	µmho/cm		Calc.	17-Oct-14/O	700			
TDS(calc.)/EC(actual)	-		Calc.	17-Oct-14/O	0.576			
EC(calc.)/EC(actual)	-		Calc.	17-Oct-14/O	1.06			

Table B-2: Water Quality Results

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

CADUCEON™
ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G42871 **REPORT No. B14-26213**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 08-Oct-14
DATE REPORTED: 17-Oct-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1311700040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW22			
			Sample I.D.		B14-26213-1			
			Date Collected		07-Oct-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Langelier Index(25°C)	S.I.		Calc.	17-Oct-14/O	0.979			

1 subcontracted to Paracel Labs

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Table B-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: ---

REPORT No. B14-26214

Report To:

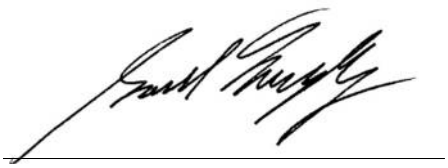
Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 08-Oct-14
DATE REPORTED: 27-Oct-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1311700040
P.O. NUMBER: THM Formation
WATERWORKS NO.

	Parameter		Chloroform	Bromodichloromethane	Dibromochloromethane	Bromoform	Total Trihalomethanes
	Units		µg/L	µg/L	µg/L	µg/L	µg/L
	M.D.L.		0.3	0.1	0.1	0.1	0.3
	Reference Method		EPA 8260	EPA 8260	EPA 8260	EPA 8260	EPA 8260
	Date Analyzed/Site		23-Oct-14/O	23-Oct-14/O	23-Oct-14/O	23-Oct-14/O	23-Oct-14/O
Client I.D.	Sample I.D.	Date Collected					
TW22 No Cl added	B14-26214-1	07-Oct-14	< 0.3	< 0.1	< 0.1	< 0.1	< 0.3
TW22 2.0 mg/L	B14-26214-2	07-Oct-14	7.4	4.4	2.5	< 0.1	14.4
TW22 4.0 mg/L	B14-26214-3	07-Oct-14	11.4	5.1	2.4	< 0.1	18.9
TW22 6.0 mg/L	B14-26214-4	07-Oct-14	12.8	5.1	2.2	< 0.1	20.1
TW22 8.0 mg/L	B14-26214-5	07-Oct-14	17.1	6.0	2.3	< 0.1	25.3
TW22 10 mg/L	B14-26214-6	07-Oct-14	17.3	5.7	2.0	< 0.1	25.1
TW22 12.0 mg/L	B14-26214-7	07-Oct-14	18.1	5.6	1.9	< 0.1	25.6
TW22 14.0 mg/L	B14-26214-8	07-Oct-14	19.6	5.8	1.9	< 0.1	27.3
TW22 4.0 mg/L DUP	B14-26214-9	07-Oct-14	11.7	5.4	2.5	< 0.1	19.6
BLK Organuc Free	B14-26214-10	07-Oct-14	1.1	< 0.1	< 0.1	< 0.1	1.1
Organic Free - 2.0 mg/L	B14-26214-11	07-Oct-14	5.5	0.4	< 0.1	< 0.1	5.8
Organic Free - 4.0 mg/L	B14-26214-12	07-Oct-14	2.1	0.3	< 0.1	< 0.1	2.4
Organic Free - 6.0 mg/L	B14-26214-13	07-Oct-14	3.4	0.3	< 0.1	< 0.1	3.7
Organic Free - 8.0 mg/L	B14-26214-14	07-Oct-14	3.7	0.3	< 0.1	< 0.1	4.1
Organic Free - 10.0 mg/L	B14-26214-15	07-Oct-14	4.7	0.3	< 0.1	< 0.1	5.0
Organic Free - 12.0 mg/L	B14-26214-16	07-Oct-14	4.0	0.3	< 0.1	< 0.1	4.3
Organic Free - 14.0 mg/L	B14-26214-17	07-Oct-14	5.4	0.3	< 0.1	< 0.1	5.7
Organic Free - 4.0 mg/mL DUP	B14-26214-18	07-Oct-14	2.9	0.3	< 0.1	< 0.1	3.2



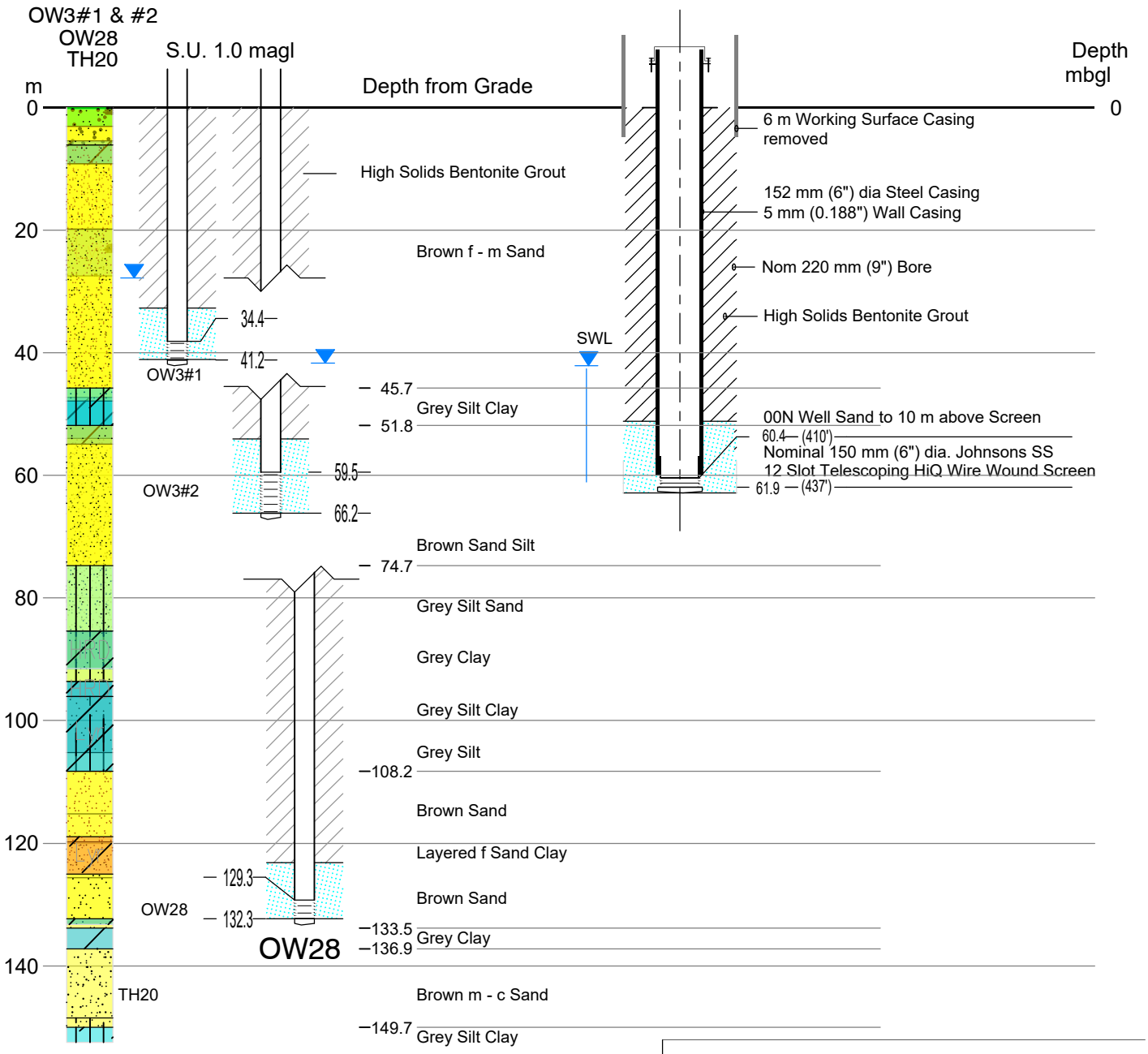
Gord Murphy
Lab Supervisor

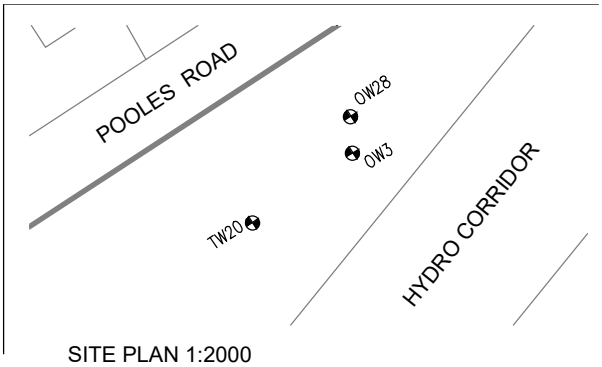
M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

APPENDIX C

Site 2: Well Construction and Testing Pooles Road





SITE PLAN 1:2000

Notes:

All depths are metres below ground level unless otherwise stated.

Converted depths to feet nominal 1 foot integrals

OW's at distance from Pilot Hole of TW20 are truncated above grade at elevation of Test Well, with depths relative approximate to Site Grade of TW20

Observation Well Screens 51 mm (2") dia. Sch. 40 PVC

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-14
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

AS-BUILT WELL TW20

FILE No. 1311700040CBLOGS.dwg

PROJECT No. 13-1170-0040 REV.

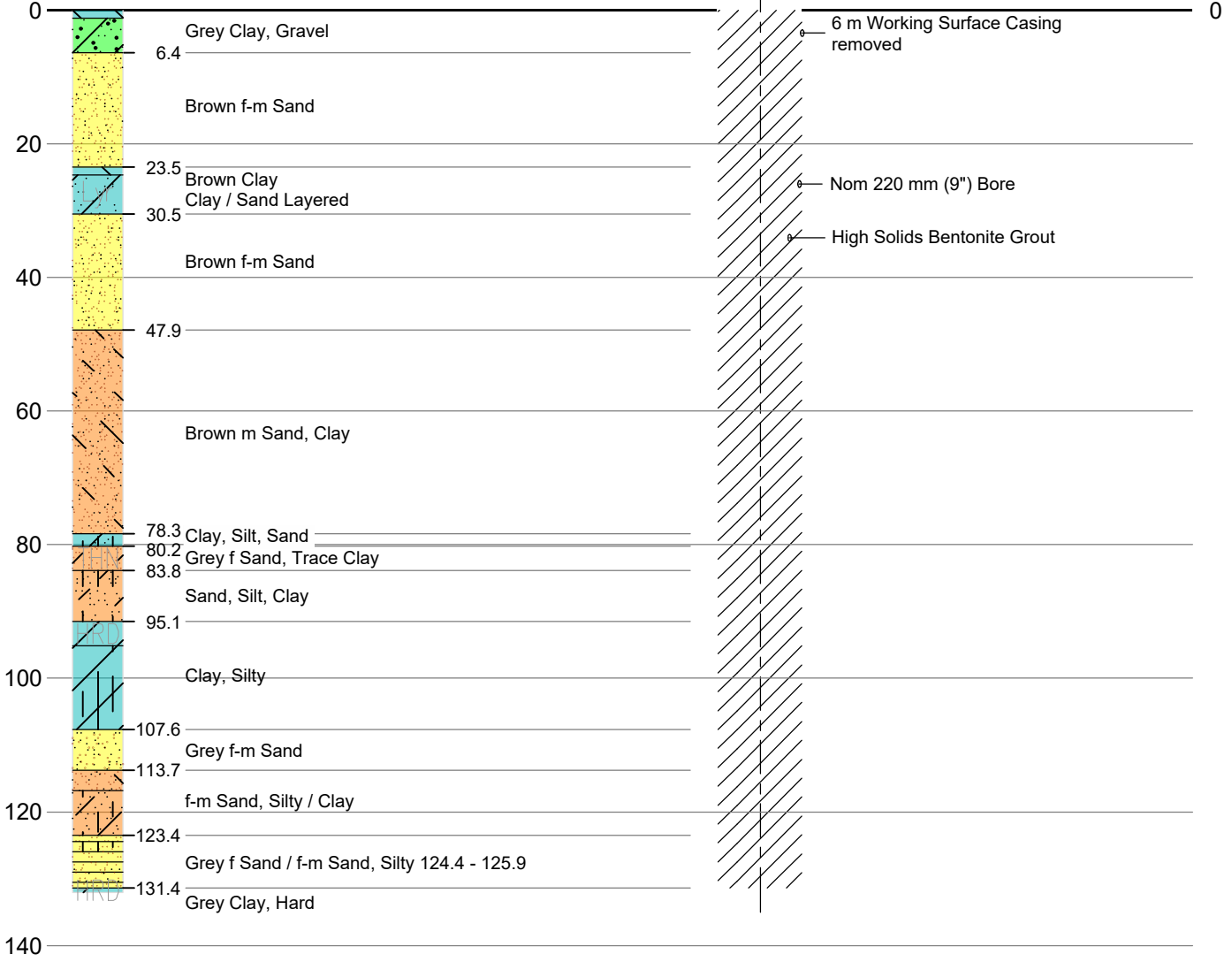
MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **C-1**

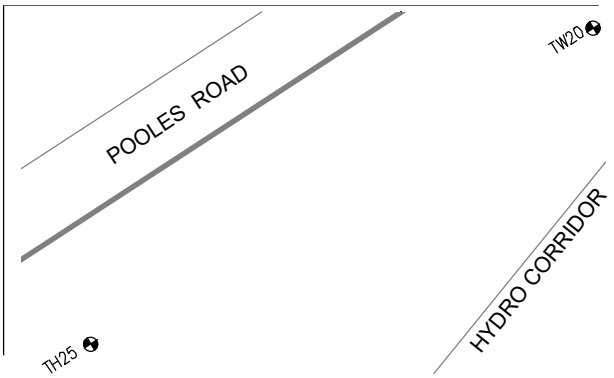
PLOT DATE: August 7, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB-\1311700040CBLOGS.dwg: [Figure C-1]

Log

TH25
Abandonment



SITE PLAN 1:2000



Notes:

All depths are metres below ground level unless otherwise stated.

Converted depths to feet nominal 1 foot integrals

Initiated construction of 51 mm PVC, Screen damaged, pulled, and hole abandoned

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-14
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

ABANDONMENT WELL TH25

FILE No. 1311700040CBLOGS.dwg

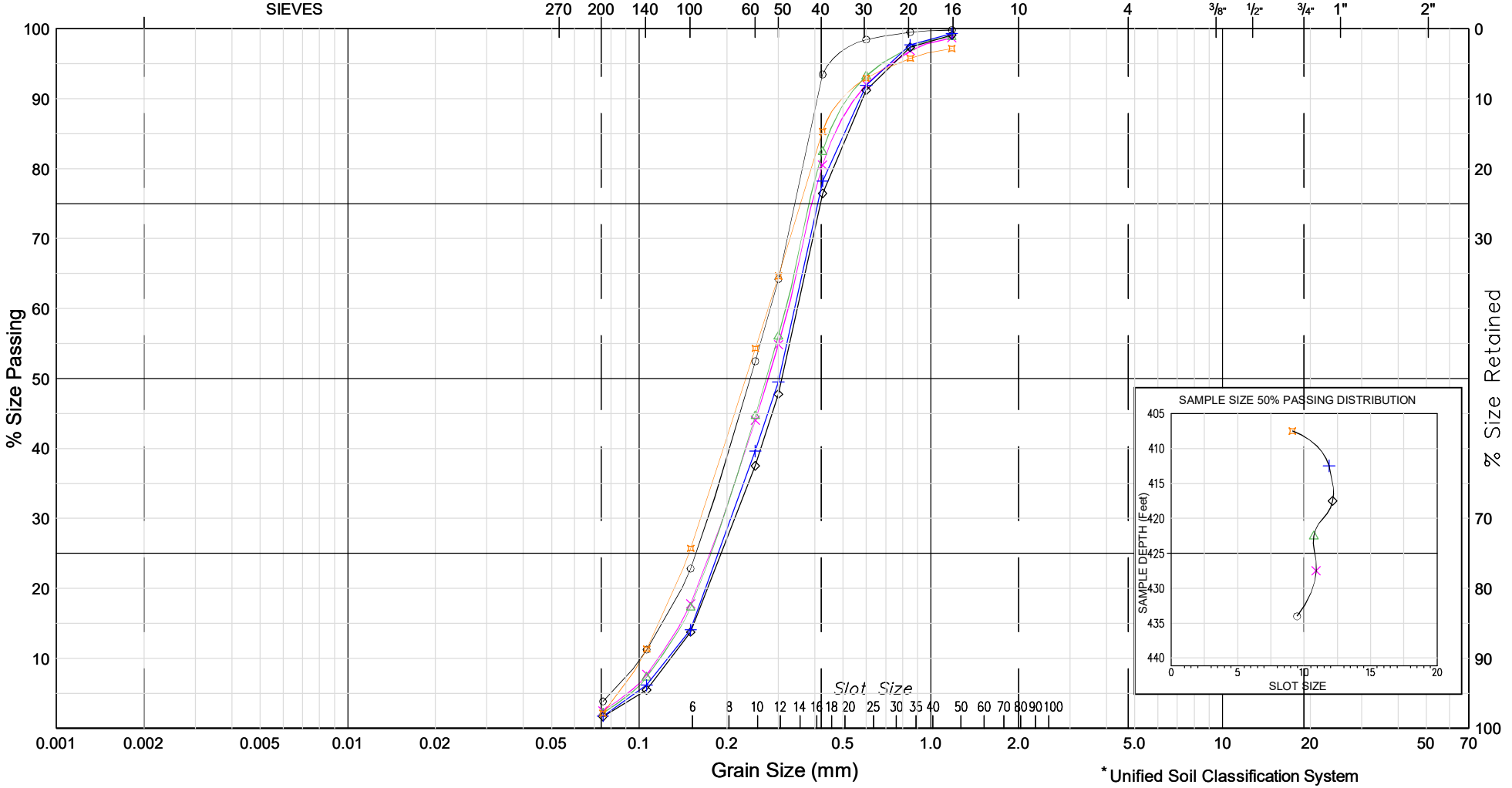
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **C-2**

PLOT DATE: August 7, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB-\1311700040CBLOGS.dwg: [Figure C-2]

PLOT DATE: October 1, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE20A.dwg



TW20A 405–410 ft
TW20A 410–415 ft
TW20A 415–420 ft
TW20A 420–425 ft
TW20A 425–430 ft
TW20A 430–438 ft

*Unified Soil Classification System
Clay denoted from MIT Soil Classification

TITLE

GRAIN SIZE ANALYSIS
TW20
WASHED SAMPLES

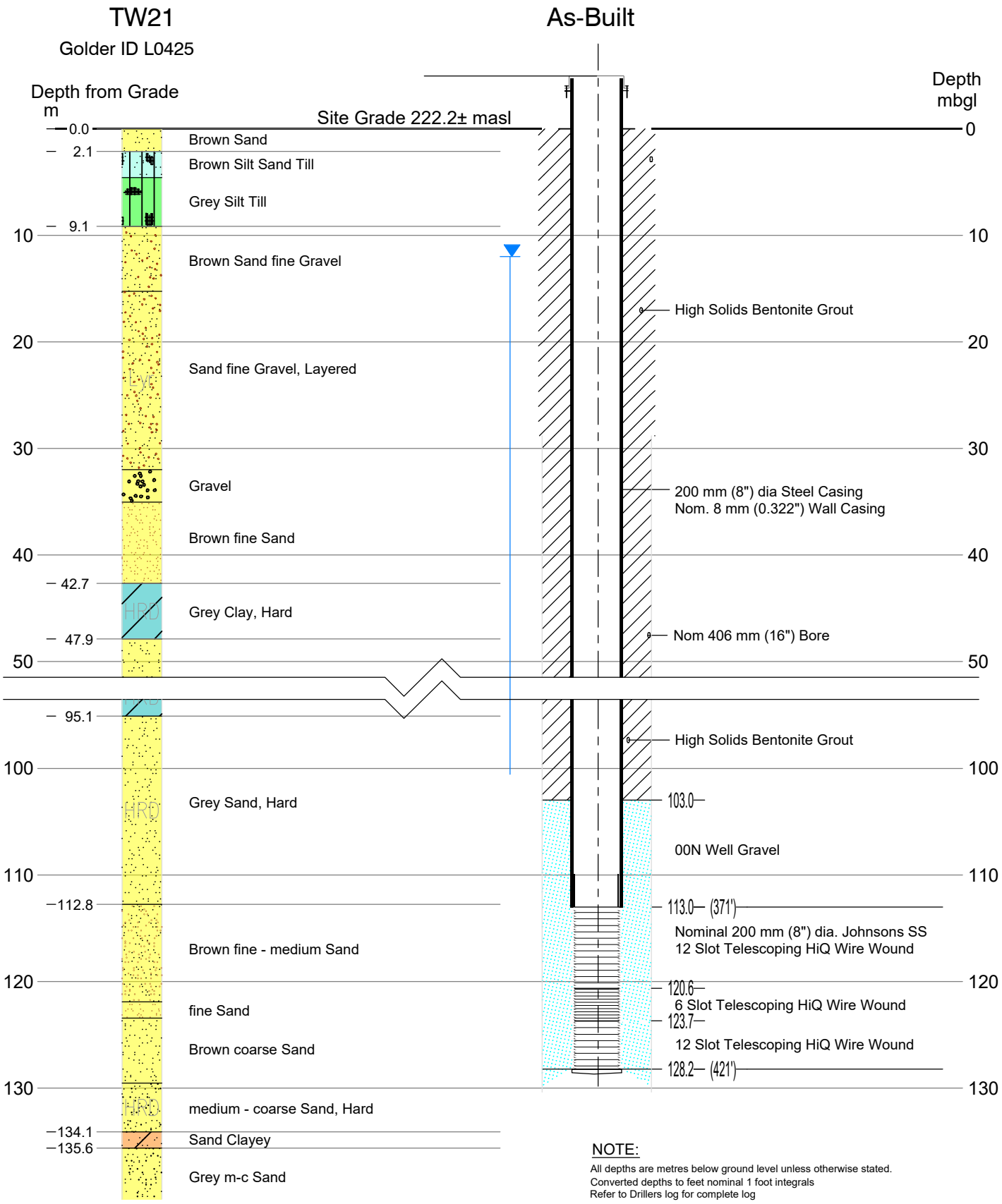
MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-02-24
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040BASVE20A.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	C-3

APPENDIX D

Site 3: Well Construction and Testing Old Second Road



NOTE:
All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

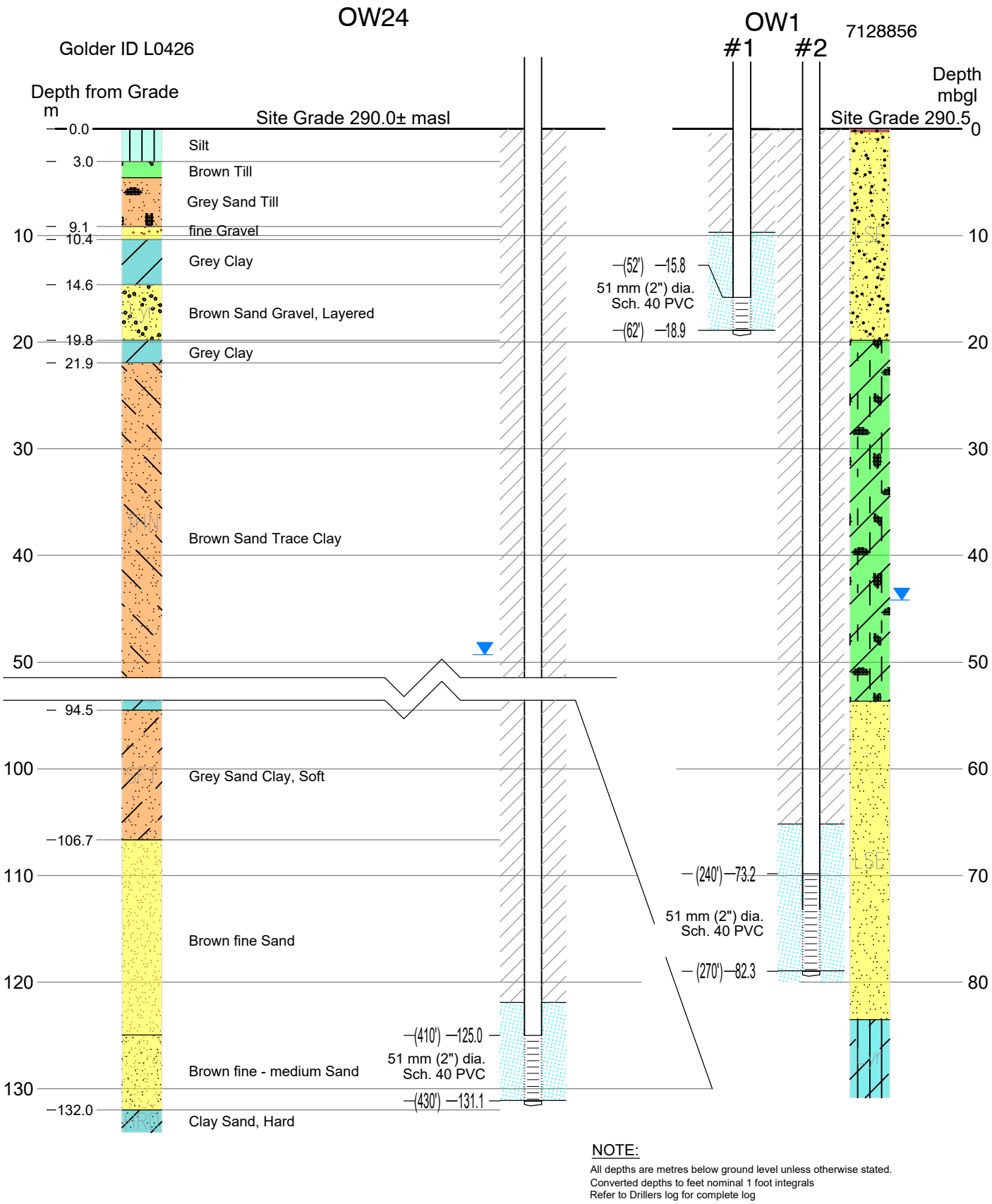
TITLE

PRODUCTION WELL TW21
AS-BUILT

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
D-1

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure D-1]



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-09-26
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

OBSERVATION WELL OW24
AS-BUILT

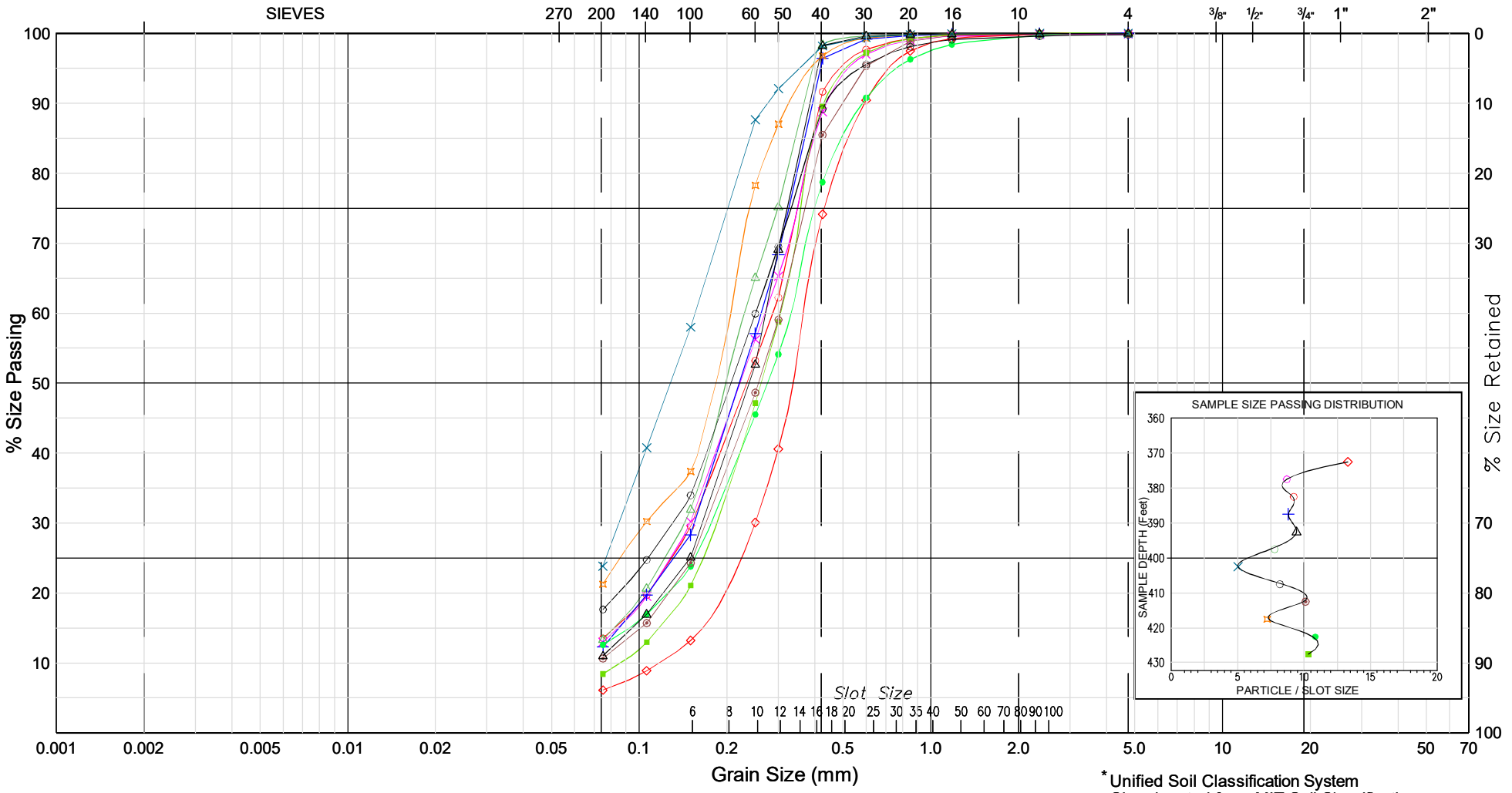
FILE No. 1311700040CBLOGS.dwg		
PROJECT No. 13-1170-0040	REV.	

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
D-2

PLOT DATE: September 26, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure D-2]

PLOT DATE: July 21, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE21.dwg



*Unified Soil Classification System
Clay denoted from MIT Soil Classification

- TW21 370-375 ft
- TW21 375-380 ft
- TW21 380-385 ft
- TW21 385-390 ft
- TW21 390-395 ft
- TW21 395-400 ft
- TW21 420-425 ft
- TW21 425-430 ft
- TW21 410-415 ft
- TW21 400-405 ft
- TW21 405-410 ft
- TW21 415-420 ft

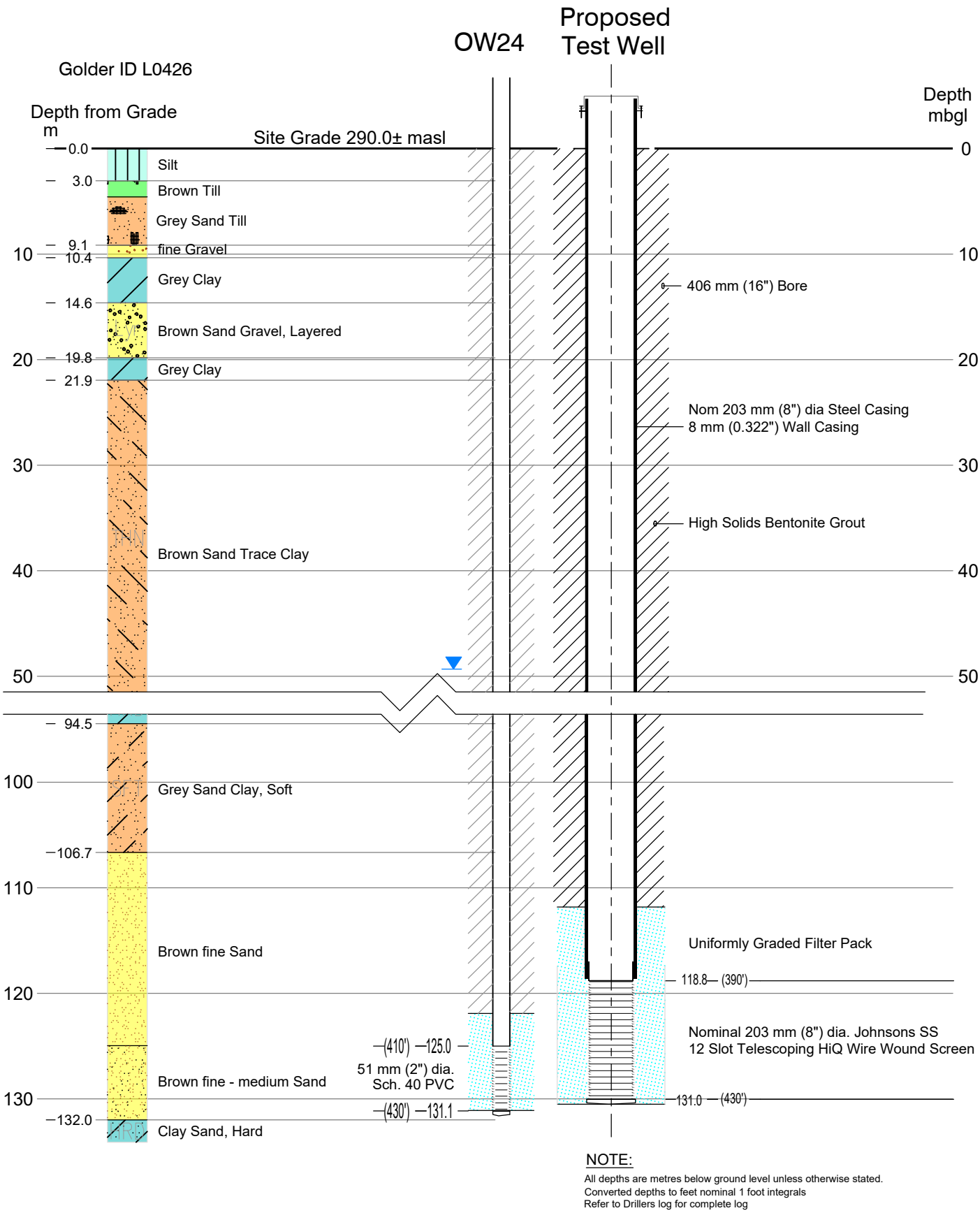
TITLE

GRAIN SIZE ANALYSIS TW21

MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-21
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040BASVE21.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	D-3



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-10-30
DESIGN	
CAD	JPR
CHECK	JAE
REVIEW	

FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

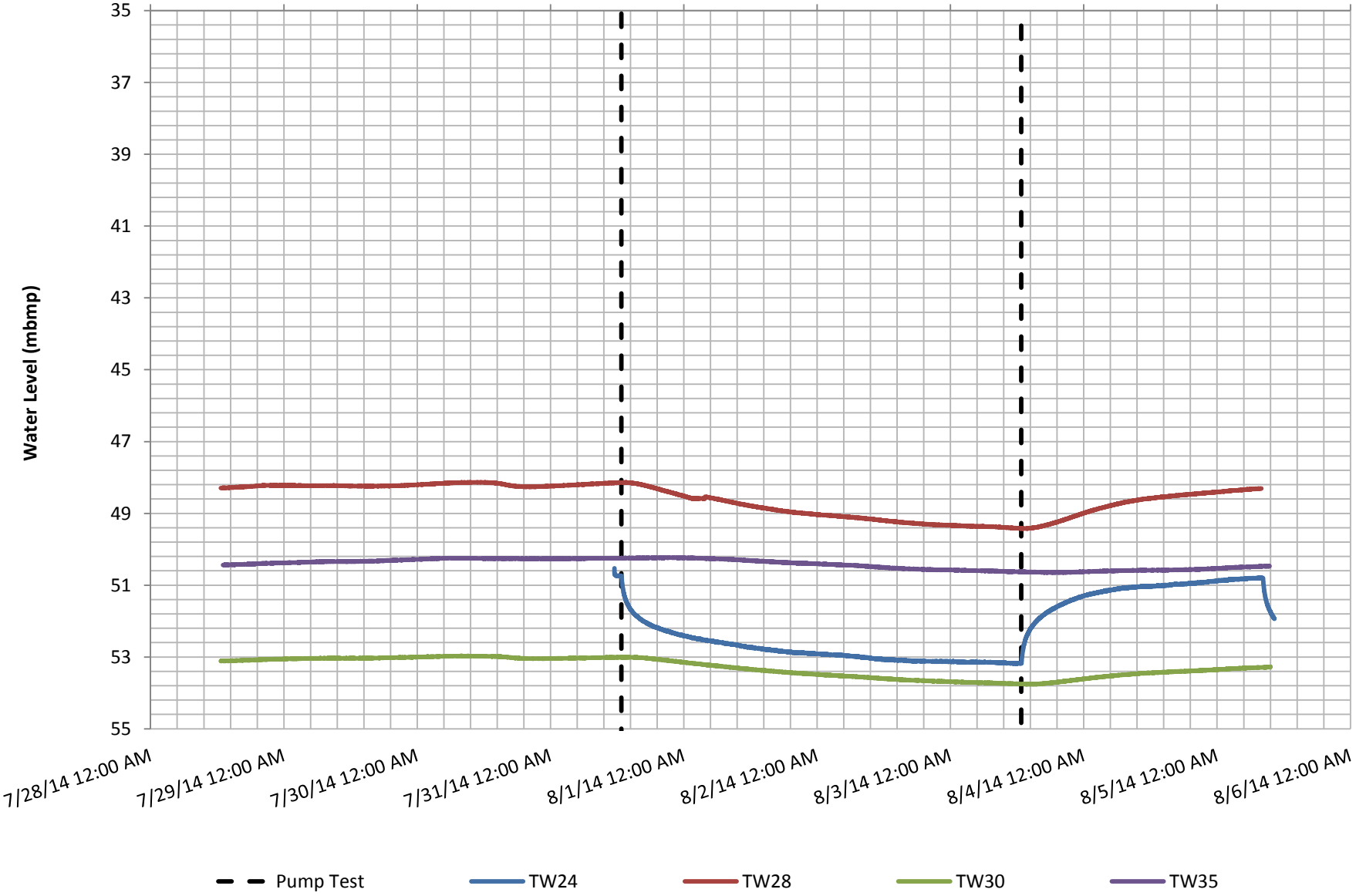
TITLE

TEST WELL OW24 SITE PROPOSED CONSTRUCTION

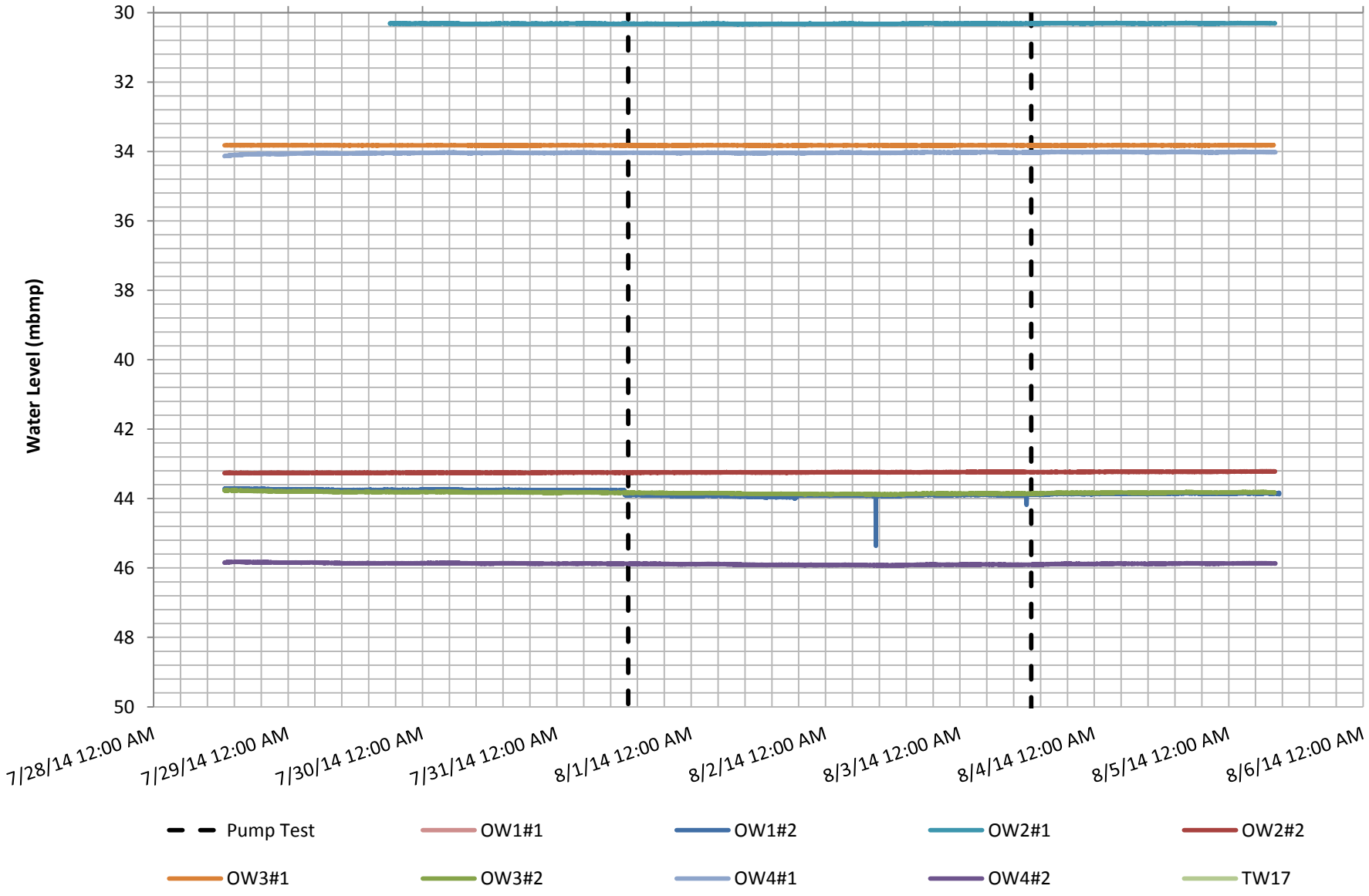
MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **D-4**

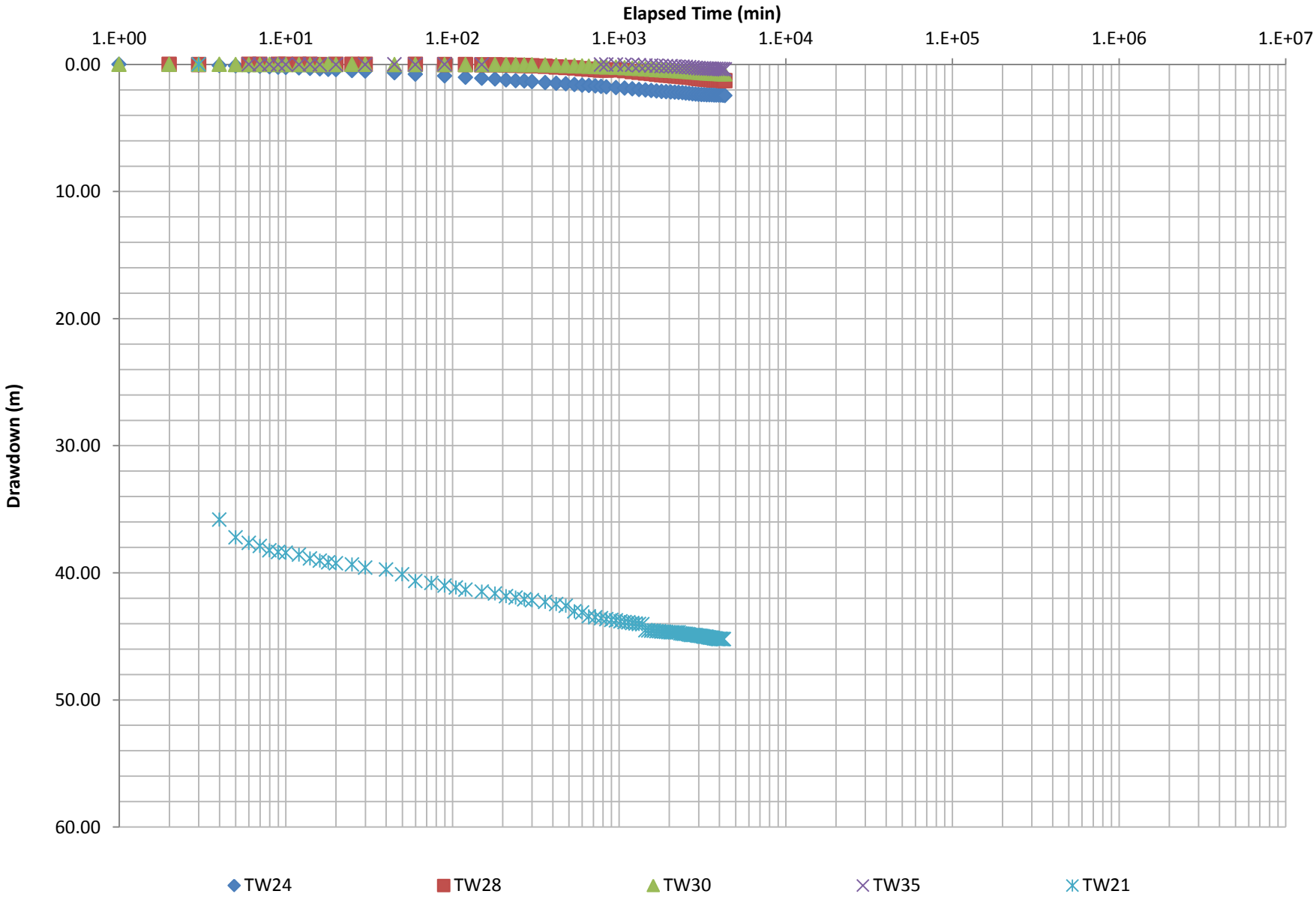
PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure D-4]



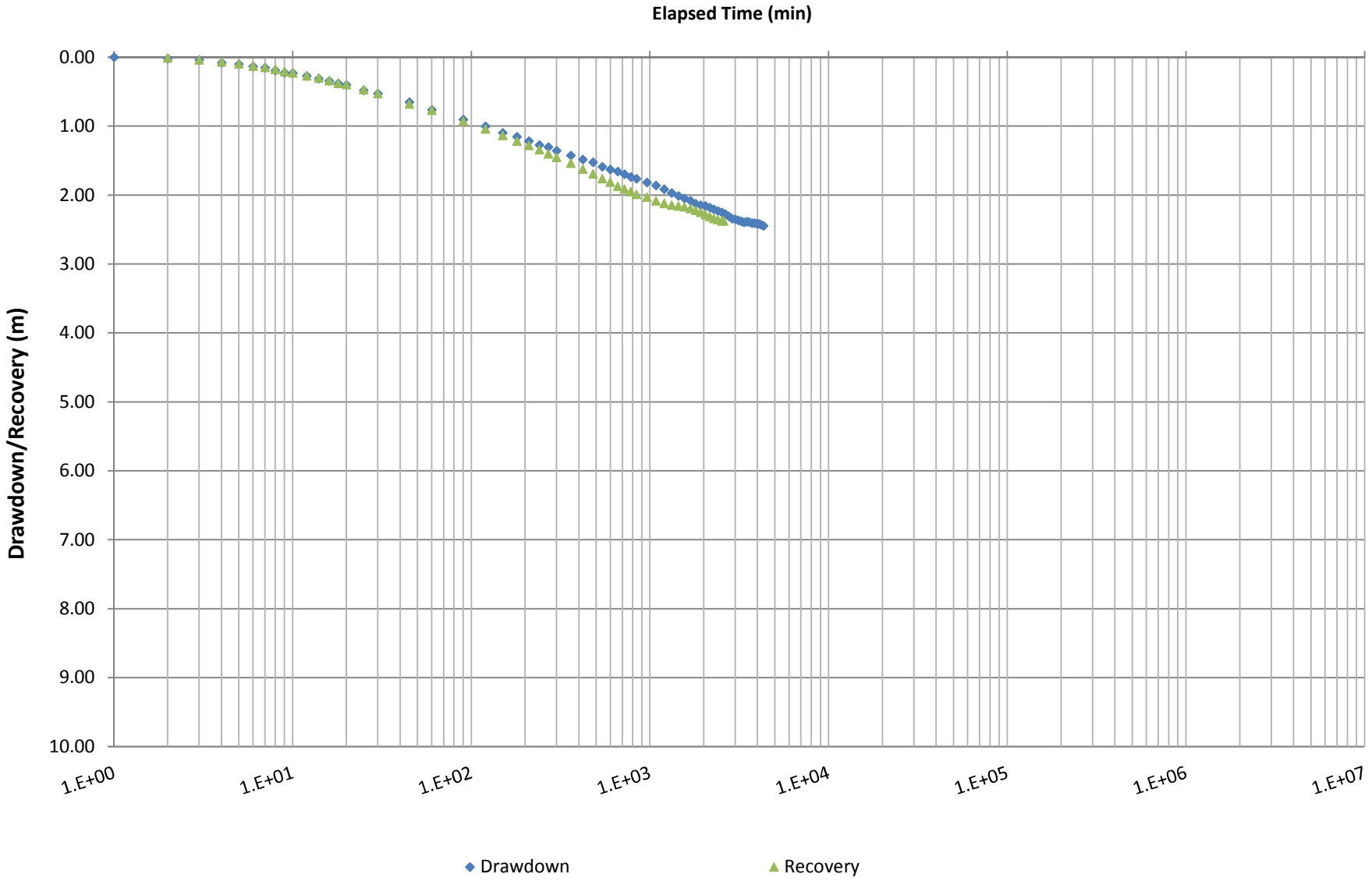
Test Date:	31-Jul-2014	Golder Associates	SCALE:	NTS	**Testing of TW21** **Record of Observation Wells**
Pumping Rates L/s:	27.8		DATE:	29-Oct-14	
			CAD:	ALB	
		FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW21
		PROJECT No. 1311700040	REVIEW:		FIGURE No. D-5



Test Date:	31-Jul-2014	Golder Associates	SCALE:	NTS	**Testing of TW21** **Record of Observation Wells**
Pumping Rates L/s:	27.8		DATE:	29-Oct-14	
			CAD:	ALB	
		FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW21
		PROJECT No. 1311700040	REVIEW:		FIGURE No. D-6



Test Date:	31-Jul-2014	Golder Associates	SCALE:	NTS	**Pumping Test Hydrograph Record of TW21 and Aquifer A3 Observation Wells**
Pumping Rates L/s:	27.8		DATE:	30-Oct-14	
TW21 Static Level (mbmp):	49.08		CAD:	ALB	
TW21 Pumping Level (mbmp):	94.31	FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW21
		PROJECT No. 1311700040	REVIEW:		FIGURE No. D-7



Test Date:	31-Jul-2014
Pumping Rate:	27.8 L/s
Distance from TW21 (m):	155.6
Static Water Level (mbmp):	50.74
Pumping Water Level (mbmp):	53.18

Golder Associates

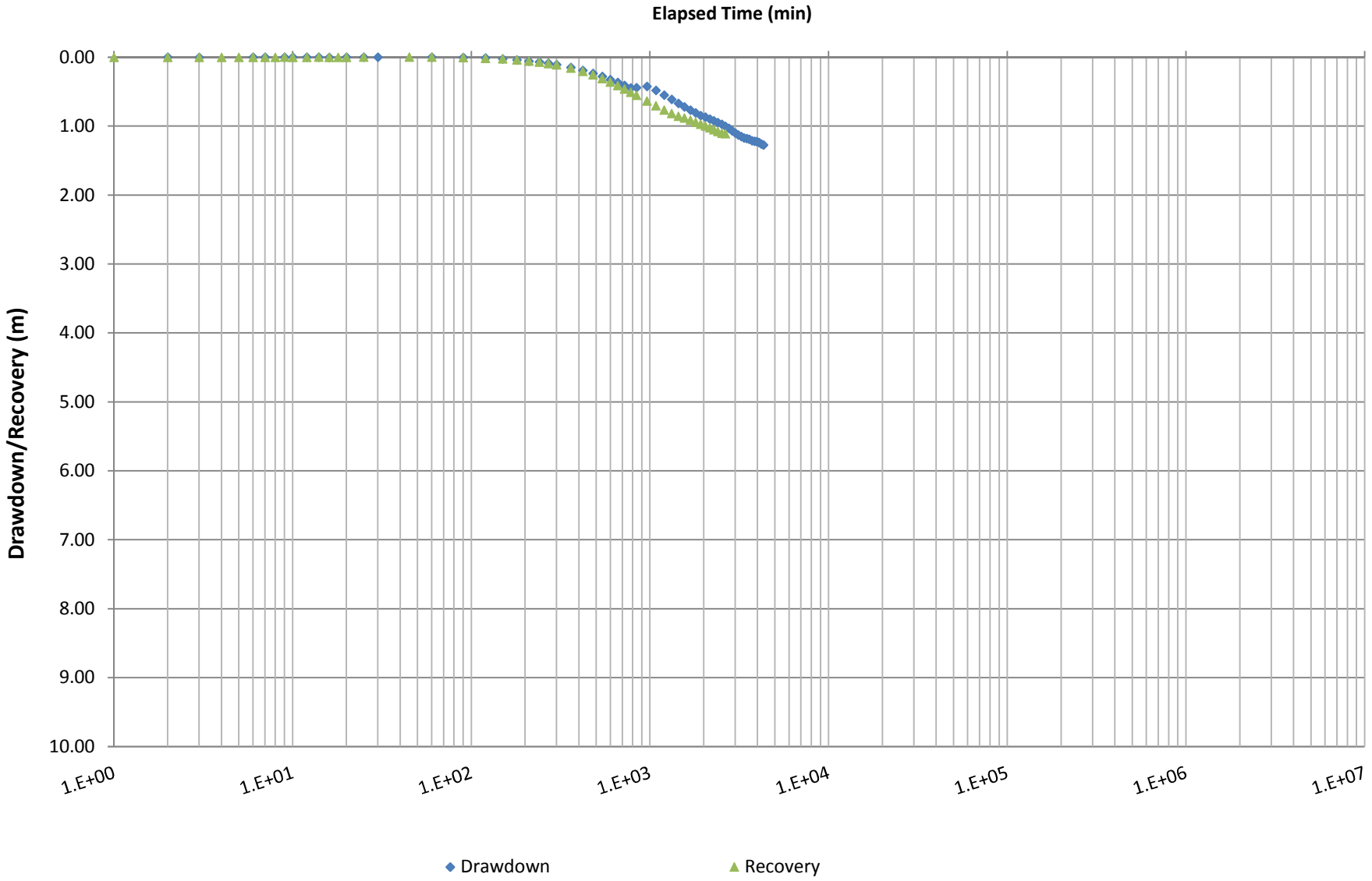
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	9/Mar/16
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of OW24

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW21

FIGURE No.
D-8



Test Date:	31-Jul-2014
Pumping Rate:	27.8 L/s
Distance from TW21 (m):	530
Static Water Level (mbmp):	48.14
Pumping Water Level (mbmp):	49.42

Golder Associates

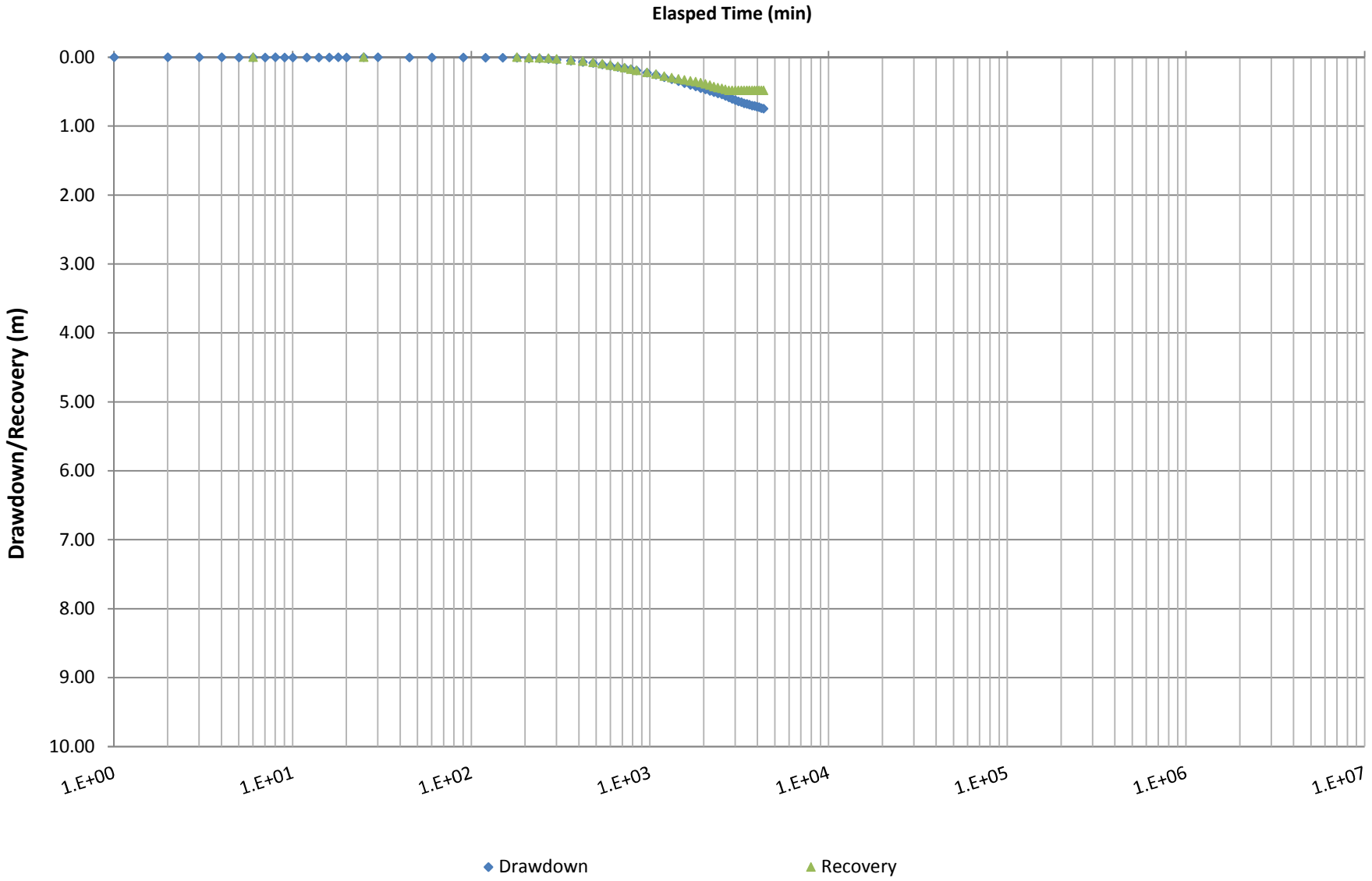
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	9/Mar/16
CAD:	ALB
CHECK:	
REVIEW:	

PUMP TEST HYDROGRAPH
OBSERVATION WELL OW28

MIDHURST WATER SUPPLY
TESTING AND CONSTRUCTION

FIGURE No.
D-9



Test Date:	31-Jul-2014
Pumping Rate:	27.8 L/s
Distance from TW21 (m):	1250
Static Water Level (mbmp):	53.01
Pumping Water Level (mbmp):	53.75

Golder Associates

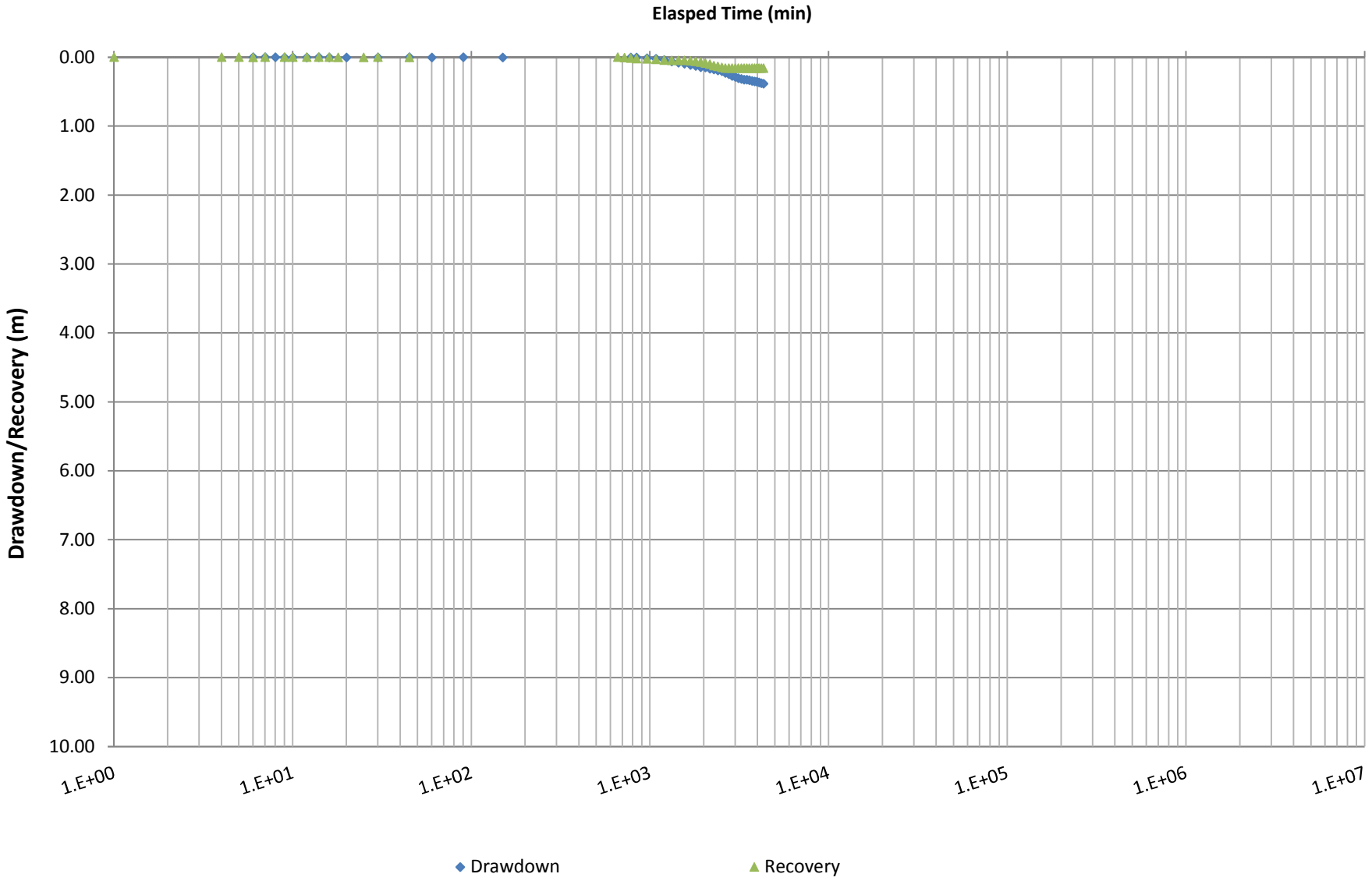
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	9/Mar/16
CAD:	ALB
CHECK:	
REVIEW:	

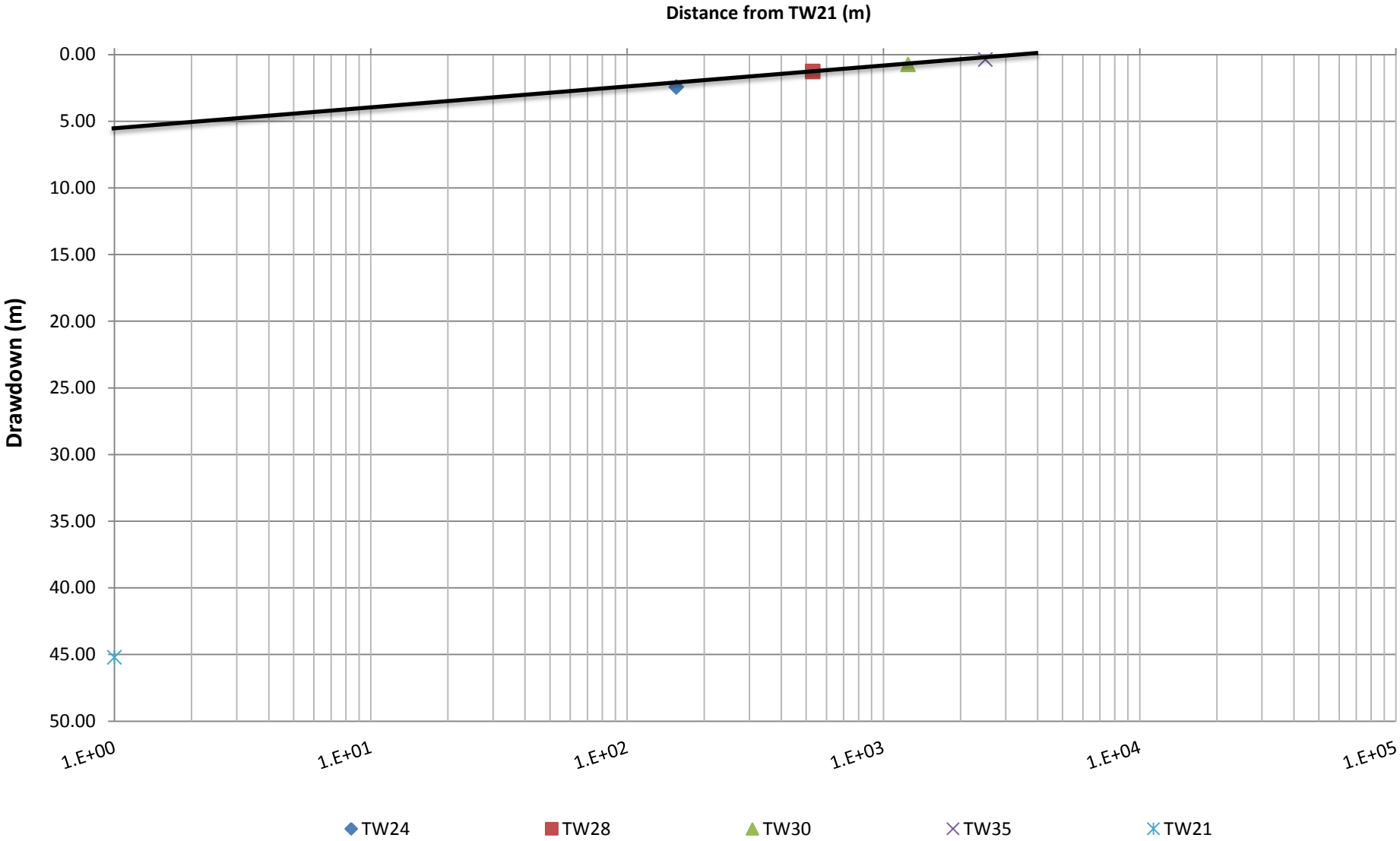
Pumping Test Hydrograph
Record of OW30

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW21

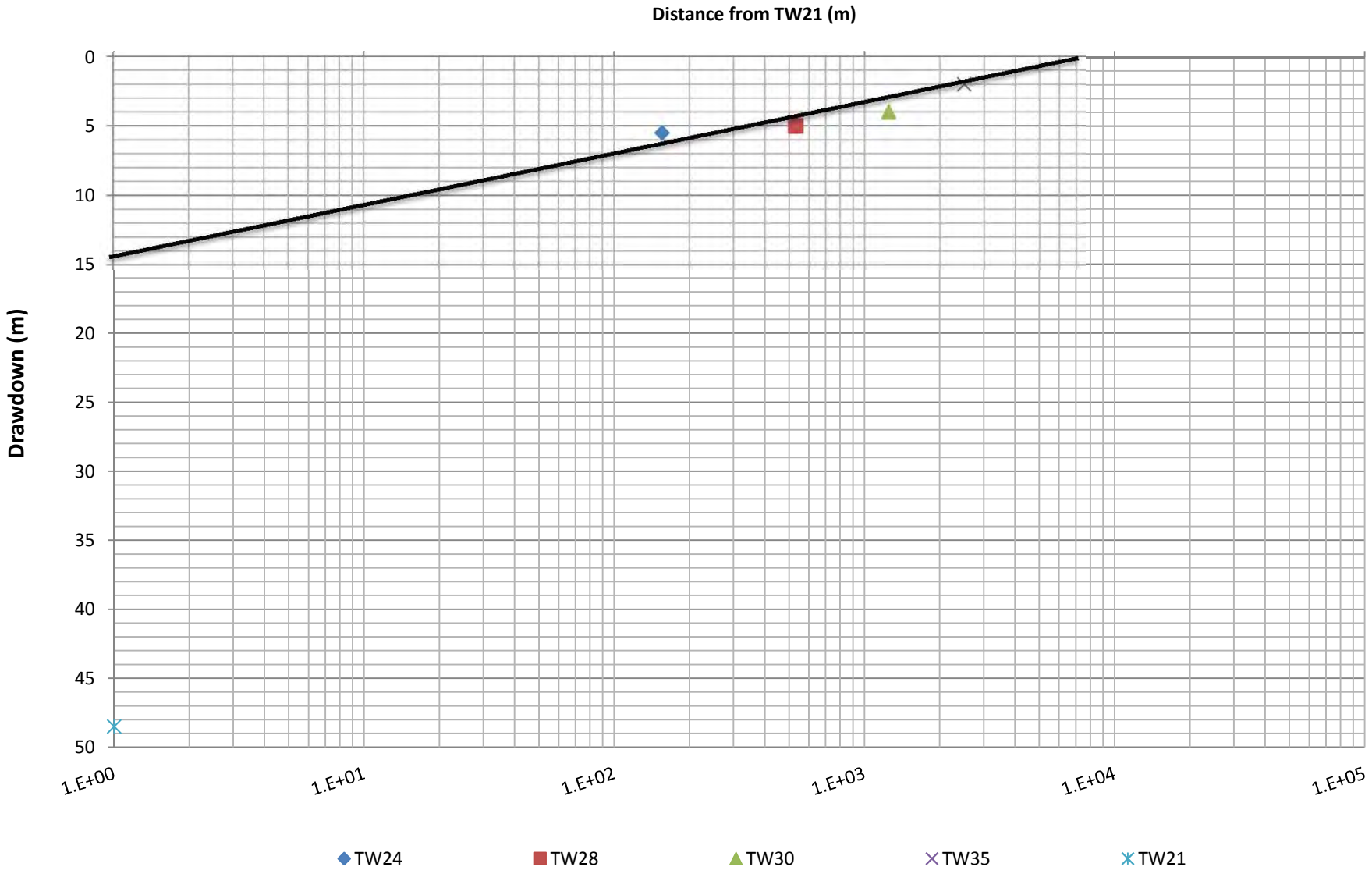
FIGURE No.
D-10



Test Date:	31-Jul-2014	Golder Associates	SCALE:	NTS	**Pumping Test Hydrograph Record of OW35**
Pumping Rate:	27.8 L/s		DATE:	9/Mar/16	
Distance from TW21 (m):	2500		CAD:	ALB	
Static Water Level (mbmp):	50.25	FILE No. 1311700040TRANS	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW21
Pumping Water Level (mbmp):	50.63	PROJECT No. 13-1170-0040	REVIEW:		FIGURE No. D-11



Test Date: July 22, 2014	Golder Associates	SCALE: NTS	Test Data Drawdown vs Distance Interference From TW21	
Pumping Rate: 27.8 L/s		DATE: 29-Oct-14		
		CAD: ALB		
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY	FIGURE No.
	PROJECT No. 13-1170-0040	REVIEW:	CONSTRUCTION & TESTIONG of TW21	D-12



Test Date:	July 22, 2014	Golder Associates		SCALE: NTS	20-Year Drawdown vs Distance Interference From TW21
Pumping Rate:	27.8 L/s			DATE: 9/Mar/16	
				CAD: ALB	
		FILE No. 1311700040TRANS		CHECK:	MIDHURST WATER SUPPLY CONSTRUCTION & TESTIONG of TW21
		PROJECT No. 13-1170-0040		REVIEW:	FIGURE No. D-13

Tabulated Levels for TW21

	Pump On:	22-Jul-2014 12:45		Static Level:	49.08
	Pump Off:	24-Jul-2014 12:45		Pumping Level:	94.31
	Pumping Well:	**TW21**		Drawdown:	45.23
	Distance from Pumping Well:	0 m		20 yr DD:	48.5
Date:Time	Elapsed	WL	DD		
dd-mmm-yyyy hh:mm	(min)	m	m		
31-07-2014 12:45	3	49.08	0.00		
24-07-2014 12:48	4	84.89	35.81		
24-07-2014 12:49	5	86.3	37.22		
24-07-2014 12:50	6	86.72	37.64		
24-07-2014 12:51	7	86.98	37.90		
24-07-2014 12:52	8	87.32	38.24		
24-07-2014 12:53	9	87.44	38.36		
24-07-2014 12:54	10	87.5	38.42		
24-07-2014 12:55	12	87.66	38.58		
24-07-2014 12:57	14	87.95	38.87		
24-07-2014 12:59	16	88.12	39.04		
24-07-2014 13:01	18	88.26	39.18		
24-07-2014 13:03	20	88.34	39.26		
24-07-2014 13:05	25	88.43	39.35		
24-07-2014 13:10	30	88.68	39.60		
24-07-2014 13:15	40	88.83	39.75		
24-07-2014 13:25	50	89.2	40.12		
24-07-2014 13:35	60	89.73	40.65		
24-07-2014 13:45	75	89.89	40.81		
24-07-2014 14:00	90	90.09	41.01		
24-07-2014 14:15	105	90.25	41.17		
24-07-2014 14:30	120	90.42	41.34		
24-07-2014 14:45	150	90.56	41.48		
24-07-2014 15:15	180	90.71	41.63		
24-07-2014 15:45	210	90.92	41.84		
24-07-2014 16:15	240	91.03	41.95		
24-07-2014 16:45	270	91.17	42.09		
24-07-2014 17:15	300	91.24	42.16		
24-07-2014 17:45	360	91.37	42.29		
24-07-2014 18:45	420	91.54	42.46		
24-07-2014 19:45	480	91.68	42.60		
24-07-2014 20:45	540	92.11	43.03		
24-07-2014 21:45	600	92.21	43.13		
24-07-2014 22:45	660	92.51	43.43		
24-07-2014 23:45	720	92.59	43.51		
25-07-2014 0:45	780	92.66	43.58		
25-07-2014 1:45	840	92.74	43.66		
25-07-2014 2:45	900	92.79	43.71		
25-07-2014 3:45	960	92.83	43.75		
25-07-2014 4:45	1020	92.9	43.82		
25-07-2014 5:45	1080	92.97	43.89		
25-07-2014 6:45	1140	92.98	43.90		
25-07-2014 7:45	1200	93.03	43.95		
25-07-2014 8:45	1260	93.07	43.99		
25-07-2014 9:45	1320	93.12	44.04		
25-07-2014 10:45	1380	93.14	44.06		
25-07-2014 11:45	1440	93.61	44.53		
25-07-2014 12:45	1500	93.63	44.55		
25-07-2014 13:45	1560	93.65	44.57		
25-07-2014 14:45	1620	93.65	44.57		
25-07-2014 15:45	1680	93.68	44.60		
25-07-2014 16:45	1740	93.68	44.60		
25-07-2014 17:45	1800	93.71	44.63		
25-07-2014 18:45	1860	93.72	44.64		
25-07-2014 19:45	1920	93.74	44.66		
25-07-2014 20:45	1980	93.76	44.68		
25-07-2014 21:45	2040	93.77	44.69		
25-07-2014 22:45	2100	93.78	44.70		
25-07-2014 23:45	2160	93.77	44.69		
26-07-2014 0:45	2220	93.78	44.70		
26-07-2014 1:45	2280	93.78	44.70		
26-07-2014 2:45	2340	93.84	44.76		
26-07-2014 3:45	2400	93.87	44.79		
26-07-2014 4:45	2460	93.88	44.80		
26-07-2014 5:45	2520	93.89	44.81		
26-07-2014 6:45	2580	93.91	44.83		
26-07-2014 7:45	2640	93.95	44.87		
26-07-2014 8:45	2700	93.98	44.90		
26-07-2014 9:45	2760	93.98	44.90		
26-07-2014 10:45	2820	93.99	44.91		
26-07-2014 11:45	2880	93.99	44.91		

Tabulated Levels for TW21

	Pump On:	22-Jul-2014 12:45		Static Level:	49.08
	Pump Off:	24-Jul-2014 12:45		Pumping Level:	94.31
	Pumping Well:	**TW21**		Drawdown:	45.23
	Distance from Pumping Well:	0 m		20 yr DD:	48.5

Date:Time	Elapsed	WL	DD
dd-mmm-yyyy hh:mm	(min)	m	m
26-07-2014 12:45	2940	94.02	44.94
26-07-2014 13:45	3000	94.04	44.96
26-07-2014 14:45	3060	94.04	44.96
26-07-2014 15:45	3120	94.05	44.97
26-07-2014 16:45	3180	94.08	45.00
26-07-2014 17:45	3240	94.12	45.04
26-07-2014 18:45	3300	94.12	45.04
26-07-2014 19:45	3360	94.11	45.03
26-07-2014 20:45	3420	94.16	45.08
26-07-2014 21:45	3480	94.17	45.09
26-07-2014 22:45	3540	94.18	45.10
26-07-2014 23:45	3600	94.19	45.11
27-07-2014 0:45	3660	94.2	45.12
27-07-2014 1:45	3720	94.25	45.17
27-07-2014 2:45	3780	94.25	45.17
27-07-2014 3:45	3840	94.26	45.18
27-07-2014 4:45	3900	94.28	45.20
27-07-2014 5:45	3960	94.3	45.22
27-07-2014 6:45	4020	94.29	45.21
27-07-2014 7:45	4080	94.29	45.21
27-07-2014 8:45	4140	94.3	45.22
27-07-2014 9:45	4200	94.3	45.22
27-07-2014 10:45	4260	94.3	45.22
27-07-2014 11:45	4320	94.31	45.23

Tabulated Levels forTW24

Pump On:	31-Jul-2014 12:45			Static Level:	50.74		
Pump Off:	03-Aug-2014 12:45			Pumping Level:	53.18		
Pumping Well:	**TW21**			Drawdown:	2.45		
Distance from Pumping Well:	155.6 m			20 yr DD:	5.5		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	50.74	0.00	03-Aug-2014 12:46	1	53.18	0.00
31-Jul-2014 12:47	2	50.76	0.02	03-Aug-2014 12:47	2	53.17	0.01
31-Jul-2014 12:48	3	50.78	0.04	03-Aug-2014 12:48	3	53.14	0.04
31-Jul-2014 12:49	4	50.82	0.08	03-Aug-2014 12:49	4	53.11	0.07
31-Jul-2014 12:50	5	50.84	0.10	03-Aug-2014 12:50	5	53.08	0.10
31-Jul-2014 12:51	6	50.87	0.13	03-Aug-2014 12:51	6	53.05	0.13
31-Jul-2014 12:52	7	50.89	0.15	03-Aug-2014 12:52	7	53.03	0.15
31-Jul-2014 12:53	8	50.93	0.19	03-Aug-2014 12:53	8	53.00	0.18
31-Jul-2014 12:54	9	50.96	0.22	03-Aug-2014 12:54	9	52.97	0.21
31-Jul-2014 12:55	10	50.97	0.23	03-Aug-2014 12:55	10	52.95	0.23
31-Jul-2014 12:57	12	51.01	0.27	03-Aug-2014 12:57	12	52.91	0.27
31-Jul-2014 12:59	14	51.05	0.31	03-Aug-2014 12:59	14	52.88	0.30
31-Jul-2014 13:01	16	51.08	0.34	03-Aug-2014 13:01	16	52.84	0.34
31-Jul-2014 13:03	18	51.12	0.38	03-Aug-2014 13:03	18	52.80	0.38
31-Jul-2014 13:05	20	51.14	0.40	03-Aug-2014 13:05	20	52.78	0.40
31-Jul-2014 13:10	25	51.22	0.48	03-Aug-2014 13:10	25	52.71	0.47
31-Jul-2014 13:15	30	51.27	0.53	03-Aug-2014 13:15	30	52.65	0.53
31-Jul-2014 13:30	45	51.39	0.65	03-Aug-2014 13:30	45	52.50	0.68
31-Jul-2014 13:45	60	51.50	0.76	03-Aug-2014 13:45	60	52.41	0.77
31-Jul-2014 14:15	90	51.64	0.90	03-Aug-2014 14:15	90	52.25	0.93
31-Jul-2014 14:45	120	51.74	1.00	03-Aug-2014 14:45	120	52.14	1.04
31-Jul-2014 15:15	150	51.83	1.10	03-Aug-2014 15:15	150	52.05	1.14
31-Jul-2014 15:45	180	51.89	1.15	03-Aug-2014 15:45	180	51.96	1.22
31-Jul-2014 16:15	210	51.95	1.22	03-Aug-2014 16:15	210	51.90	1.28
31-Jul-2014 16:45	240	52.01	1.27	03-Aug-2014 16:45	240	51.84	1.34
31-Jul-2014 17:15	270	52.04	1.30	03-Aug-2014 17:15	270	51.78	1.40
31-Jul-2014 17:45	300	52.09	1.36	03-Aug-2014 17:45	300	51.73	1.46
31-Jul-2014 18:45	360	52.16	1.43	03-Aug-2014 18:45	360	51.64	1.54
31-Jul-2014 19:45	420	52.22	1.48	03-Aug-2014 19:45	420	51.56	1.62
31-Jul-2014 20:45	480	52.26	1.52	03-Aug-2014 20:45	480	51.49	1.70
31-Jul-2014 21:45	540	52.32	1.59	03-Aug-2014 21:45	540	51.42	1.76
31-Jul-2014 22:45	600	52.37	1.63	03-Aug-2014 22:45	600	51.37	1.81
31-Jul-2014 23:45	660	52.39	1.66	03-Aug-2014 23:45	660	51.31	1.87
01-Aug-2014 00:45	720	52.43	1.70	04-Aug-2014 00:45	720	51.27	1.92
01-Aug-2014 01:45	780	52.47	1.74	04-Aug-2014 01:45	780	51.23	1.95
01-Aug-2014 02:45	840	52.50	1.76	04-Aug-2014 02:45	840	51.19	1.99
01-Aug-2014 04:45	960	52.55	1.82	04-Aug-2014 04:45	960	51.15	2.03
01-Aug-2014 06:45	1080	52.60	1.86	04-Aug-2014 06:45	1080	51.10	2.09
01-Aug-2014 08:45	1200	52.65	1.92	04-Aug-2014 08:45	1200	51.06	2.12
01-Aug-2014 10:45	1320	52.70	1.97	04-Aug-2014 10:45	1320	51.03	2.15
01-Aug-2014 12:45	1440	52.75	2.01	04-Aug-2014 12:45	1440	51.02	2.16
01-Aug-2014 14:45	1560	52.79	2.05	04-Aug-2014 14:45	1560	51.01	2.17
01-Aug-2014 16:45	1680	52.82	2.08	04-Aug-2014 16:45	1680	50.98	2.20
01-Aug-2014 18:45	1800	52.86	2.12	04-Aug-2014 18:45	1800	50.96	2.22
01-Aug-2014 20:45	1920	52.88	2.15	04-Aug-2014 20:45	1920	50.93	2.25
01-Aug-2014 22:45	2040	52.89	2.16	04-Aug-2014 22:45	2040	50.90	2.28
02-Aug-2014 00:45	2160	52.92	2.18	05-Aug-2014 00:45	2160	50.87	2.31
02-Aug-2014 02:45	2280	52.94	2.21	05-Aug-2014 02:45	2280	50.84	2.34
02-Aug-2014 04:45	2400	52.96	2.23	05-Aug-2014 04:45	2400	50.82	2.36
02-Aug-2014 06:45	2520	52.99	2.25	05-Aug-2014 06:45	2520	50.80	2.38
02-Aug-2014 08:45	2640	53.01	2.28	05-Aug-2014 07:45	2580	50.81	2.37
02-Aug-2014 10:45	2760	53.04	2.31				
02-Aug-2014 12:45	2880	53.08	2.34				
02-Aug-2014 14:45	3000	53.09	2.35				
02-Aug-2014 16:45	3120	53.10	2.37				
02-Aug-2014 18:45	3240	53.12	2.38				
02-Aug-2014 20:45	3360	53.13	2.40				
02-Aug-2014 22:45	3480	53.12	2.38				
03-Aug-2014 00:45	3600	53.13	2.39				
03-Aug-2014 02:45	3720	53.14	2.41				
03-Aug-2014 04:45	3840	53.14	2.41				
03-Aug-2014 06:45	3960	53.15	2.41				
03-Aug-2014 08:45	4080	53.15	2.42				
03-Aug-2014 10:45	4200	53.17	2.43				
03-Aug-2014 12:45	4320	53.18	2.45				

Tabulated Levels for OW1#1

Pump On:	31-Jul-2014 12:45		Static Level:	7.64	
Pump Off:	03-Aug-2014 12:45		Pumping Level:	7.69	
Pumping Well:	**TW21**		Drawdown:	0.05	
Distance from Pumping Well:	200 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	7.64	0.00	03-Aug-2014 12:46	1	7.69	0.00
31-Jul-2014 12:47	2	7.64	0.00	03-Aug-2014 12:47	2	7.69	0.00
31-Jul-2014 12:48	3	7.64	0.00	03-Aug-2014 12:48	3	7.69	0.00
31-Jul-2014 12:49	4	7.64	0.00	03-Aug-2014 12:49	4	7.69	0.00
31-Jul-2014 12:50	5	7.64	0.00	03-Aug-2014 12:50	5	7.69	0.00
31-Jul-2014 12:51	6	7.64	0.00	03-Aug-2014 12:51	6	7.68	0.00
31-Jul-2014 12:52	7	7.64	0.00	03-Aug-2014 12:52	7	7.69	0.00
31-Jul-2014 12:53	8	7.64	0.00	03-Aug-2014 12:53	8	7.69	0.00
31-Jul-2014 12:54	9	7.64	0.00	03-Aug-2014 12:54	9	7.69	0.00
31-Jul-2014 12:55	10	7.64	0.00	03-Aug-2014 12:55	10	7.69	0.00
31-Jul-2014 12:57	12	7.64	0.00	03-Aug-2014 12:57	12	7.68	0.00
31-Jul-2014 12:59	14	7.64	0.00	03-Aug-2014 12:59	14	7.68	0.00
31-Jul-2014 13:01	16	7.64	0.00	03-Aug-2014 13:01	16	7.68	0.00
31-Jul-2014 13:03	18	7.64	0.00	03-Aug-2014 13:03	18	7.68	0.00
31-Jul-2014 13:05	20	7.64	0.00	03-Aug-2014 13:05	20	7.69	0.00
31-Jul-2014 13:10	25	7.64	0.00	03-Aug-2014 13:10	25	7.68	0.00
31-Jul-2014 13:15	30	7.64	0.00	03-Aug-2014 13:15	30	7.68	0.00
31-Jul-2014 13:30	45	7.64	0.00	03-Aug-2014 13:30	45	7.68	0.00
31-Jul-2014 13:45	60	7.64	0.00	03-Aug-2014 13:45	60	7.68	0.00
31-Jul-2014 14:15	90	7.64	0.00	03-Aug-2014 14:15	90	7.68	0.00
31-Jul-2014 14:45	120	7.64	0.00	03-Aug-2014 14:45	120	7.68	0.00
31-Jul-2014 15:15	150	7.64	0.00	03-Aug-2014 15:15	150	7.68	0.01
31-Jul-2014 15:45	180	7.64	0.00	03-Aug-2014 15:45	180	7.68	0.01
31-Jul-2014 16:15	210	7.65	0.01	03-Aug-2014 16:15	210	7.67	0.01
31-Jul-2014 16:45	240	7.64	0.00	03-Aug-2014 16:45	240	7.67	0.01
31-Jul-2014 17:15	270	7.64	0.00	03-Aug-2014 17:15	270	7.67	0.01
31-Jul-2014 17:45	300	7.65	0.01	03-Aug-2014 17:45	300	7.67	0.02
31-Jul-2014 18:45	360	7.65	0.01	03-Aug-2014 18:45	360	7.67	0.02
31-Jul-2014 19:45	420	7.65	0.01	03-Aug-2014 19:45	420	7.67	0.01
31-Jul-2014 20:45	480	7.65	0.01	03-Aug-2014 20:45	480	7.67	0.02
31-Jul-2014 21:45	540	7.66	0.02	03-Aug-2014 21:45	540	7.67	0.01
31-Jul-2014 22:45	600	7.66	0.02	03-Aug-2014 22:45	600	7.67	0.01
31-Jul-2014 23:45	660	7.66	0.02	03-Aug-2014 23:45	660	7.67	0.01
01-Aug-2014 00:45	720	7.65	0.02	04-Aug-2014 00:45	720	7.67	0.02
01-Aug-2014 01:45	780	7.66	0.02	04-Aug-2014 01:45	780	7.66	0.02
01-Aug-2014 02:45	840	7.65	0.01	04-Aug-2014 02:45	840	7.67	0.02
01-Aug-2014 04:45	960	7.65	0.01	04-Aug-2014 04:45	960	7.66	0.02
01-Aug-2014 06:45	1080	7.66	0.02	04-Aug-2014 06:45	1080	7.67	0.02
01-Aug-2014 08:45	1200	7.67	0.03	04-Aug-2014 08:45	1200	7.67	0.02
01-Aug-2014 10:45	1320	7.68	0.04	04-Aug-2014 10:45	1320	7.67	0.02
01-Aug-2014 12:45	1440	7.68	0.04	04-Aug-2014 12:45	1440	7.67	0.02
01-Aug-2014 14:45	1560	7.68	0.04	04-Aug-2014 14:45	1560	7.66	0.02
01-Aug-2014 16:45	1680	7.68	0.04	04-Aug-2014 16:45	1680	7.66	0.03
01-Aug-2014 18:45	1800	7.68	0.04	04-Aug-2014 18:45	1800	7.66	0.02
01-Aug-2014 20:45	1920	7.68	0.04	04-Aug-2014 20:45	1920	7.66	0.02
01-Aug-2014 22:45	2040	7.69	0.05	04-Aug-2014 22:45	2040	7.66	0.02
02-Aug-2014 00:45	2160	7.69	0.05	05-Aug-2014 00:45	2160	7.66	0.02
02-Aug-2014 02:45	2280	7.68	0.05	05-Aug-2014 02:45	2280	7.66	0.03
02-Aug-2014 04:45	2400	7.69	0.05	05-Aug-2014 04:45	2400	7.66	0.03
02-Aug-2014 06:45	2520	7.69	0.05	05-Aug-2014 06:45	2520	7.66	0.03
02-Aug-2014 08:45	2640	7.70	0.06	05-Aug-2014 07:45	2580	7.66	0.02
02-Aug-2014 10:45	2760	7.70	0.06				
02-Aug-2014 12:45	2880	7.70	0.06				
02-Aug-2014 14:45	3000	7.69	0.05				
02-Aug-2014 16:45	3120	7.69	0.05				
02-Aug-2014 18:45	3240	7.68	0.04				
02-Aug-2014 20:45	3360	7.68	0.05				
02-Aug-2014 22:45	3480	7.68	0.04				
03-Aug-2014 00:45	3600	7.68	0.04				
03-Aug-2014 02:45	3720	7.68	0.05				
03-Aug-2014 04:45	3840	7.68	0.04				
03-Aug-2014 06:45	3960	7.68	0.04				
03-Aug-2014 08:45	4080	7.69	0.05				
03-Aug-2014 10:45	4200	7.69	0.05				
03-Aug-2014 12:45	4320	7.69	0.05				

Tabulated Levels for OW1#2

Pump On:	31-Jul-2014 12:45		Static Level:	43.90	
Pump Off:	03-Aug-2014 12:45		Pumping Level:	43.88	
Pumping Well:	**TW21**		Drawdown:	-0.02	
Distance from Pumping Well:	200 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	43.90	0.00	03-Aug-2014 12:46	1	43.88	0.00
31-Jul-2014 12:47	2	43.90	0.00	03-Aug-2014 12:47	2	43.89	-0.01
31-Jul-2014 12:48	3	43.90	-0.01	03-Aug-2014 12:48	3	43.88	0.00
31-Jul-2014 12:49	4	43.90	-0.01	03-Aug-2014 12:49	4	43.89	0.00
31-Jul-2014 12:50	5	43.89	-0.01	03-Aug-2014 12:50	5	43.88	0.00
31-Jul-2014 12:51	6	43.89	-0.01	03-Aug-2014 12:51	6	43.88	0.00
31-Jul-2014 12:52	7	43.89	-0.01	03-Aug-2014 12:52	7	43.88	0.00
31-Jul-2014 12:53	8	43.89	-0.01	03-Aug-2014 12:53	8	43.89	-0.01
31-Jul-2014 12:54	9	43.90	0.00	03-Aug-2014 12:54	9	43.89	-0.01
31-Jul-2014 12:55	10	43.89	-0.01	03-Aug-2014 12:55	10	43.89	0.00
31-Jul-2014 12:57	12	43.89	-0.01	03-Aug-2014 12:57	12	43.89	-0.01
31-Jul-2014 12:59	14	43.90	-0.01	03-Aug-2014 12:59	14	43.89	-0.01
31-Jul-2014 13:01	16	43.90	-0.01	03-Aug-2014 13:01	16	43.88	0.00
31-Jul-2014 13:03	18	43.88	-0.02	03-Aug-2014 13:03	18	43.88	0.00
31-Jul-2014 13:05	20	43.90	-0.01	03-Aug-2014 13:05	20	43.89	-0.01
31-Jul-2014 13:10	25	43.90	-0.01	03-Aug-2014 13:10	25	43.89	-0.01
31-Jul-2014 13:15	30	43.89	-0.01	03-Aug-2014 13:15	30	43.89	-0.01
31-Jul-2014 13:30	45	43.89	-0.01	03-Aug-2014 13:30	45	43.88	0.00
31-Jul-2014 13:45	60	43.90	0.00	03-Aug-2014 13:45	60	43.88	0.00
31-Jul-2014 14:15	90	43.90	0.00	03-Aug-2014 14:15	90	43.88	0.00
31-Jul-2014 14:45	120	43.89	-0.01	03-Aug-2014 14:45	120	43.88	0.00
31-Jul-2014 15:15	150	43.90	0.00	03-Aug-2014 15:15	150	43.88	0.00
31-Jul-2014 15:45	180	43.89	-0.01	03-Aug-2014 15:45	180	43.88	0.01
31-Jul-2014 16:15	210	43.90	-0.01	03-Aug-2014 16:15	210	43.87	0.01
31-Jul-2014 16:45	240	43.90	0.00	03-Aug-2014 16:45	240	43.87	0.02
31-Jul-2014 17:15	270	43.89	-0.01	03-Aug-2014 17:15	270	43.87	0.01
31-Jul-2014 17:45	300	43.89	-0.01	03-Aug-2014 17:45	300	43.87	0.01
31-Jul-2014 18:45	360	43.91	0.01	03-Aug-2014 18:45	360	43.86	0.02
31-Jul-2014 19:45	420	43.91	0.01	03-Aug-2014 19:45	420	43.85	0.03
31-Jul-2014 20:45	480	43.92	0.02	03-Aug-2014 20:45	480	43.87	0.01
31-Jul-2014 21:45	540	43.92	0.02	03-Aug-2014 21:45	540	43.87	0.01
31-Jul-2014 22:45	600	43.93	0.02	03-Aug-2014 22:45	600	43.87	0.01
31-Jul-2014 23:45	660	43.93	0.02	03-Aug-2014 23:45	660	43.87	0.02
01-Aug-2014 00:45	720	43.92	0.02	04-Aug-2014 00:45	720	43.86	0.02
01-Aug-2014 01:45	780	43.92	0.02	04-Aug-2014 01:45	780	43.86	0.02
01-Aug-2014 02:45	840	43.90	0.00	04-Aug-2014 02:45	840	43.86	0.02
01-Aug-2014 04:45	960	43.91	0.01	04-Aug-2014 04:45	960	43.85	0.03
01-Aug-2014 06:45	1080	43.93	0.03	04-Aug-2014 06:45	1080	43.87	0.02
01-Aug-2014 08:45	1200	43.94	0.04	04-Aug-2014 08:45	1200	43.85	0.03
01-Aug-2014 10:45	1320	43.93	0.03	04-Aug-2014 10:45	1320	43.86	0.02
01-Aug-2014 12:45	1440	43.95	0.05	04-Aug-2014 12:45	1440	43.86	0.02
01-Aug-2014 14:45	1560	43.96	0.05	04-Aug-2014 14:45	1560	43.85	0.03
01-Aug-2014 16:45	1680	43.96	0.05	04-Aug-2014 16:45	1680	43.85	0.03
01-Aug-2014 18:45	1800	43.96	0.06	04-Aug-2014 18:45	1800	43.85	0.03
01-Aug-2014 20:45	1920	43.90	0.00	04-Aug-2014 20:45	1920	43.85	0.03
01-Aug-2014 22:45	2040	43.91	0.00	04-Aug-2014 22:45	2040	43.85	0.03
02-Aug-2014 00:45	2160	43.91	0.00	05-Aug-2014 00:45	2160	43.85	0.03
02-Aug-2014 02:45	2280	43.91	0.00	05-Aug-2014 02:45	2280	43.84	0.04
02-Aug-2014 04:45	2400	43.90	0.00	05-Aug-2014 04:45	2400	43.85	0.03
02-Aug-2014 06:45	2520	43.91	0.00	05-Aug-2014 06:45	2520	43.85	0.03
02-Aug-2014 08:45	2640	43.92	0.01	05-Aug-2014 07:45	2580	43.85	0.03
02-Aug-2014 10:45	2760	43.91	0.00				
02-Aug-2014 12:45	2880	43.92	0.02				
02-Aug-2014 14:45	3000	43.91	0.00				
02-Aug-2014 16:45	3120	43.90	0.00				
02-Aug-2014 18:45	3240	43.90	0.00				
02-Aug-2014 20:45	3360	43.90	-0.01				
02-Aug-2014 22:45	3480	43.89	-0.01				
03-Aug-2014 00:45	3600	43.90	0.00				
03-Aug-2014 02:45	3720	43.90	-0.01				
03-Aug-2014 04:45	3840	43.89	-0.01				
03-Aug-2014 06:45	3960	43.89	-0.01				
03-Aug-2014 08:45	4080	43.91	0.01				
03-Aug-2014 10:45	4200	43.91	0.00				
03-Aug-2014 12:45	4320	43.88	-0.02				

Tabulated Levels for OW2#1

Pump On:	31-Jul-2014 12:45		Static Level:	30.32	
Pump Off:	03-Aug-2014 12:45		Pumping Level:	30.31	
Pumping Well:	**TW21**		Drawdown:	-0.01	
Distance from Pumping Well:	490 m		20 yr DD:	5	

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	30.32	0.00	03-Aug-2014 12:46	1	30.31	0.00
31-Jul-2014 12:47	2	30.32	0.00	03-Aug-2014 12:47	2	30.31	0.00
31-Jul-2014 12:48	3	30.32	0.00	03-Aug-2014 12:48	3	30.31	0.00
31-Jul-2014 12:49	4	30.32	0.00	03-Aug-2014 12:49	4	30.31	0.00
31-Jul-2014 12:50	5	30.32	0.00	03-Aug-2014 12:50	5	30.31	0.00
31-Jul-2014 12:51	6	30.32	0.00	03-Aug-2014 12:51	6	30.32	0.00
31-Jul-2014 12:52	7	30.32	0.00	03-Aug-2014 12:52	7	30.31	0.00
31-Jul-2014 12:53	8	30.32	0.00	03-Aug-2014 12:53	8	30.31	0.00
31-Jul-2014 12:54	9	30.32	0.00	03-Aug-2014 12:54	9	30.31	0.00
31-Jul-2014 12:55	10	30.33	0.01	03-Aug-2014 12:55	10	30.31	0.00
31-Jul-2014 12:57	12	30.32	0.00	03-Aug-2014 12:57	12	30.31	0.00
31-Jul-2014 12:59	14	30.32	0.00	03-Aug-2014 12:59	14	30.31	0.00
31-Jul-2014 13:01	16	30.33	0.00	03-Aug-2014 13:01	16	30.31	0.00
31-Jul-2014 13:03	18	30.32	0.00	03-Aug-2014 13:03	18	30.31	0.00
31-Jul-2014 13:05	20	30.32	0.00	03-Aug-2014 13:05	20	30.31	0.00
31-Jul-2014 13:10	25	30.32	0.00	03-Aug-2014 13:10	25	30.31	0.00
31-Jul-2014 13:15	30	30.32	0.00	03-Aug-2014 13:15	30	30.31	0.00
31-Jul-2014 13:30	45	30.32	0.00	03-Aug-2014 13:30	45	30.31	0.00
31-Jul-2014 13:45	60	30.32	0.00	03-Aug-2014 13:45	60	30.31	0.00
31-Jul-2014 14:15	90	30.32	0.00	03-Aug-2014 14:15	90	30.31	0.00
31-Jul-2014 14:45	120	30.32	0.00	03-Aug-2014 14:45	120	30.31	0.00
31-Jul-2014 15:15	150	30.33	0.00	03-Aug-2014 15:15	150	30.31	0.01
31-Jul-2014 15:45	180	30.32	0.00	03-Aug-2014 15:45	180	30.31	0.01
31-Jul-2014 16:15	210	30.32	0.00	03-Aug-2014 16:15	210	30.30	0.01
31-Jul-2014 16:45	240	30.32	0.00	03-Aug-2014 16:45	240	30.30	0.01
31-Jul-2014 17:15	270	30.32	0.00	03-Aug-2014 17:15	270	30.31	0.01
31-Jul-2014 17:45	300	30.32	0.00	03-Aug-2014 17:45	300	30.31	0.01
31-Jul-2014 18:45	360	30.32	0.00	03-Aug-2014 18:45	360	30.30	0.01
31-Jul-2014 19:45	420	30.33	0.01	03-Aug-2014 19:45	420	30.31	0.01
31-Jul-2014 20:45	480	30.32	0.00	03-Aug-2014 20:45	480	30.31	0.01
31-Jul-2014 21:45	540	30.33	0.01	03-Aug-2014 21:45	540	30.31	0.00
31-Jul-2014 22:45	600	30.33	0.01	03-Aug-2014 22:45	600	30.31	0.01
31-Jul-2014 23:45	660	30.33	0.01	03-Aug-2014 23:45	660	30.32	0.00
01-Aug-2014 00:45	720	30.33	0.00	04-Aug-2014 00:45	720	30.31	0.00
01-Aug-2014 01:45	780	30.32	0.00	04-Aug-2014 01:45	780	30.31	0.01
01-Aug-2014 02:45	840	30.32	0.00	04-Aug-2014 02:45	840	30.31	0.01
01-Aug-2014 04:45	960	30.32	0.00	04-Aug-2014 04:45	960	30.31	0.00
01-Aug-2014 06:45	1080	30.32	0.00	04-Aug-2014 06:45	1080	30.32	0.00
01-Aug-2014 08:45	1200	30.33	0.01	04-Aug-2014 08:45	1200	30.31	0.01
01-Aug-2014 10:45	1320	30.33	0.01	04-Aug-2014 10:45	1320	30.31	0.00
01-Aug-2014 12:45	1440	30.33	0.01	04-Aug-2014 12:45	1440	30.31	0.01
01-Aug-2014 14:45	1560	30.33	0.01	04-Aug-2014 14:45	1560	30.31	0.00
01-Aug-2014 16:45	1680	30.33	0.01	04-Aug-2014 16:45	1680	30.30	0.01
01-Aug-2014 18:45	1800	30.33	0.00	04-Aug-2014 18:45	1800	30.31	0.00
01-Aug-2014 20:45	1920	30.33	0.01	04-Aug-2014 20:45	1920	30.31	0.00
01-Aug-2014 22:45	2040	30.33	0.00	04-Aug-2014 22:45	2040	30.31	0.00
02-Aug-2014 00:45	2160	30.33	0.01	05-Aug-2014 00:45	2160	30.31	0.00
02-Aug-2014 02:45	2280	30.32	0.00	05-Aug-2014 02:45	2280	30.30	0.01
02-Aug-2014 04:45	2400	30.32	0.00	05-Aug-2014 04:45	2400	30.30	0.01
02-Aug-2014 06:45	2520	30.32	0.00	05-Aug-2014 06:45	2520	30.31	0.01
02-Aug-2014 08:45	2640	30.33	0.00	05-Aug-2014 08:45	2640	30.31	0.00
02-Aug-2014 10:45	2760	30.33	0.01				
02-Aug-2014 12:45	2880	30.33	0.01				
02-Aug-2014 14:45	3000	30.32	0.00				
02-Aug-2014 16:45	3120	30.31	-0.01				
02-Aug-2014 18:45	3240	30.31	-0.01				
02-Aug-2014 20:45	3360	30.32	0.00				
02-Aug-2014 22:45	3480	30.32	-0.01				
03-Aug-2014 00:45	3600	30.31	-0.01				
03-Aug-2014 02:45	3720	30.32	0.00				
03-Aug-2014 04:45	3840	30.31	-0.01				
03-Aug-2014 06:45	3960	30.32	-0.01				
03-Aug-2014 08:45	4080	30.32	0.00				
03-Aug-2014 10:45	4200	30.32	0.00				
03-Aug-2014 12:45	4320	30.31	-0.01				

Tabulated Levels for OW2#2

Pump On:	31-Jul-2014 12:45			Static Level:	43.25		
Pump Off:	03-Aug-2014 12:45			Pumping Level:	43.24		
Pumping Well:	**TW21**			Drawdown:	-0.01		
Distance from Pumping Well:	490 m			20 yr DD:	5		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	43.25	0.00	03-Aug-2014 12:46	1	43.24	0.00
31-Jul-2014 12:47	2	43.25	0.00	03-Aug-2014 12:47	2	43.24	0.00
31-Jul-2014 12:48	3	43.25	0.00	03-Aug-2014 12:48	3	43.24	0.00
31-Jul-2014 12:49	4	43.25	0.00	03-Aug-2014 12:49	4	43.24	0.00
31-Jul-2014 12:50	5	43.25	0.00	03-Aug-2014 12:50	5	43.24	0.00
31-Jul-2014 12:51	6	43.26	0.00	03-Aug-2014 12:51	6	43.24	0.00
31-Jul-2014 12:52	7	43.25	0.00	03-Aug-2014 12:52	7	43.24	0.00
31-Jul-2014 12:53	8	43.25	0.00	03-Aug-2014 12:53	8	43.24	0.00
31-Jul-2014 12:54	9	43.26	0.01	03-Aug-2014 12:54	9	43.24	0.00
31-Jul-2014 12:55	10	43.25	0.00	03-Aug-2014 12:55	10	43.24	0.00
31-Jul-2014 12:57	12	43.25	0.00	03-Aug-2014 12:57	12	43.24	0.00
31-Jul-2014 12:59	14	43.25	0.00	03-Aug-2014 12:59	14	43.24	0.00
31-Jul-2014 13:01	16	43.26	0.00	03-Aug-2014 13:01	16	43.24	0.00
31-Jul-2014 13:03	18	43.25	0.00	03-Aug-2014 13:03	18	43.24	0.00
31-Jul-2014 13:05	20	43.25	0.00	03-Aug-2014 13:05	20	43.24	0.00
31-Jul-2014 13:10	25	43.25	0.00	03-Aug-2014 13:10	25	43.24	0.00
31-Jul-2014 13:15	30	43.25	0.00	03-Aug-2014 13:15	30	43.24	0.00
31-Jul-2014 13:30	45	43.26	0.00	03-Aug-2014 13:30	45	43.24	0.00
31-Jul-2014 13:45	60	43.25	0.00	03-Aug-2014 13:45	60	43.24	0.00
31-Jul-2014 14:15	90	43.25	0.00	03-Aug-2014 14:15	90	43.24	0.00
31-Jul-2014 14:45	120	43.25	0.00	03-Aug-2014 14:45	120	43.24	0.00
31-Jul-2014 15:15	150	43.25	0.00	03-Aug-2014 15:15	150	43.24	0.00
31-Jul-2014 15:45	180	43.25	0.00	03-Aug-2014 15:45	180	43.24	0.00
31-Jul-2014 16:15	210	43.25	0.00	03-Aug-2014 16:15	210	43.24	0.00
31-Jul-2014 16:45	240	43.25	0.00	03-Aug-2014 16:45	240	43.24	0.00
31-Jul-2014 17:15	270	43.25	0.00	03-Aug-2014 17:15	270	43.23	0.00
31-Jul-2014 17:45	300	43.25	0.00	03-Aug-2014 17:45	300	43.24	0.00
31-Jul-2014 18:45	360	43.25	0.00	03-Aug-2014 18:45	360	43.23	0.00
31-Jul-2014 19:45	420	43.25	0.00	03-Aug-2014 19:45	420	43.24	0.00
31-Jul-2014 20:45	480	43.25	0.00	03-Aug-2014 20:45	480	43.24	0.00
31-Jul-2014 21:45	540	43.25	0.00	03-Aug-2014 21:45	540	43.23	0.00
31-Jul-2014 22:45	600	43.25	0.00	03-Aug-2014 22:45	600	43.23	0.00
31-Jul-2014 23:45	660	43.25	0.00	03-Aug-2014 23:45	660	43.23	0.01
01-Aug-2014 00:45	720	43.25	-0.01	04-Aug-2014 00:45	720	43.23	0.01
01-Aug-2014 01:45	780	43.25	0.00	04-Aug-2014 01:45	780	43.23	0.01
01-Aug-2014 02:45	840	43.25	0.00	04-Aug-2014 02:45	840	43.23	0.01
01-Aug-2014 04:45	960	43.24	-0.01	04-Aug-2014 04:45	960	43.23	0.01
01-Aug-2014 06:45	1080	43.24	-0.01	04-Aug-2014 06:45	1080	43.23	0.01
01-Aug-2014 08:45	1200	43.25	-0.01	04-Aug-2014 08:45	1200	43.23	0.01
01-Aug-2014 10:45	1320	43.25	0.00	04-Aug-2014 10:45	1320	43.23	0.01
01-Aug-2014 12:45	1440	43.25	0.00	04-Aug-2014 12:45	1440	43.23	0.01
01-Aug-2014 14:45	1560	43.25	0.00	04-Aug-2014 14:45	1560	43.23	0.01
01-Aug-2014 16:45	1680	43.25	0.00	04-Aug-2014 16:45	1680	43.23	0.01
01-Aug-2014 18:45	1800	43.25	-0.01	04-Aug-2014 18:45	1800	43.23	0.01
01-Aug-2014 20:45	1920	43.25	0.00	04-Aug-2014 20:45	1920	43.23	0.01
01-Aug-2014 22:45	2040	43.24	-0.01	04-Aug-2014 22:45	2040	43.23	0.01
02-Aug-2014 00:45	2160	43.24	-0.01	05-Aug-2014 00:45	2160	43.22	0.01
02-Aug-2014 02:45	2280	43.24	-0.01	05-Aug-2014 02:45	2280	43.22	0.01
02-Aug-2014 04:45	2400	43.24	-0.01	05-Aug-2014 04:45	2400	43.22	0.02
02-Aug-2014 06:45	2520	43.24	-0.01	05-Aug-2014 06:45	2520	43.22	0.02
02-Aug-2014 08:45	2640	43.24	-0.01	05-Aug-2014 08:45	2640	43.22	0.02
02-Aug-2014 10:45	2760	43.24	-0.01				
02-Aug-2014 12:45	2880	43.24	-0.01				
02-Aug-2014 14:45	3000	43.24	-0.01				
02-Aug-2014 16:45	3120	43.25	-0.01				
02-Aug-2014 18:45	3240	43.24	-0.01				
02-Aug-2014 20:45	3360	43.24	-0.01				
02-Aug-2014 22:45	3480	43.24	-0.01				
03-Aug-2014 00:45	3600	43.24	-0.01				
03-Aug-2014 02:45	3720	43.24	-0.01				
03-Aug-2014 04:45	3840	43.23	-0.02				
03-Aug-2014 06:45	3960	43.23	-0.02				
03-Aug-2014 08:45	4080	43.23	-0.02				
03-Aug-2014 10:45	4200	43.24	-0.02				
03-Aug-2014 12:45	4320	43.24	-0.01				

Tabulated Levels for TW28

Pump On:	31-Jul-2014 12:45			Static Level:	48.14		
Pump Off:	03-Aug-2014 12:45			Pumping Level:	49.42		
Pumping Well:	**TW21**			Drawdown:	1.28		
Distance from Pumping Well:	530 m			20 yr DD:	5		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	48.14	0.00	03-Aug-2014 12:46	1	49.42	0.00
31-Jul-2014 12:47	2	48.14	0.00	03-Aug-2014 12:47	2	49.42	0.00
31-Jul-2014 12:48	3	48.15	0.00	03-Aug-2014 12:48	3	49.42	0.00
31-Jul-2014 12:49	4	48.14	0.00	03-Aug-2014 12:49	4	49.42	0.00
31-Jul-2014 12:50	5	48.14	0.00	03-Aug-2014 12:50	5	49.42	0.00
31-Jul-2014 12:51	6	48.14	0.00	03-Aug-2014 12:51	6	49.42	0.00
31-Jul-2014 12:52	7	48.14	0.00	03-Aug-2014 12:52	7	49.42	0.00
31-Jul-2014 12:53	8	48.14	0.00	03-Aug-2014 12:53	8	49.42	0.00
31-Jul-2014 12:54	9	48.14	0.00	03-Aug-2014 12:54	9	49.42	0.00
31-Jul-2014 12:55	10	48.14	0.00	03-Aug-2014 12:55	10	49.42	0.00
31-Jul-2014 12:57	12	48.14	0.00	03-Aug-2014 12:57	12	49.42	0.00
31-Jul-2014 12:59	14	48.14	0.00	03-Aug-2014 12:59	14	49.42	0.00
31-Jul-2014 13:01	16	48.15	0.00	03-Aug-2014 13:01	16	49.42	0.00
31-Jul-2014 13:03	18	48.14	0.00	03-Aug-2014 13:03	18	49.42	0.00
31-Jul-2014 13:05	20	48.14	0.00	03-Aug-2014 13:05	20	49.42	0.00
31-Jul-2014 13:10	25	48.14	0.00	03-Aug-2014 13:10	25	49.42	0.00
31-Jul-2014 13:15	30	48.14	0.00	03-Aug-2014 13:15	30	49.42	0.00
31-Jul-2014 13:30	45	48.14	0.00	03-Aug-2014 13:30	45	49.42	0.00
31-Jul-2014 13:45	60	48.14	0.00	03-Aug-2014 13:45	60	49.42	0.00
31-Jul-2014 14:15	90	48.15	0.00	03-Aug-2014 14:15	90	49.41	0.01
31-Jul-2014 14:45	120	48.15	0.01	03-Aug-2014 14:45	120	49.40	0.02
31-Jul-2014 15:15	150	48.17	0.02	03-Aug-2014 15:15	150	49.39	0.03
31-Jul-2014 15:45	180	48.18	0.04	03-Aug-2014 15:45	180	49.38	0.04
31-Jul-2014 16:15	210	48.20	0.06	03-Aug-2014 16:15	210	49.36	0.06
31-Jul-2014 16:45	240	48.21	0.07	03-Aug-2014 16:45	240	49.35	0.07
31-Jul-2014 17:15	270	48.23	0.09	03-Aug-2014 17:15	270	49.33	0.09
31-Jul-2014 17:45	300	48.25	0.11	03-Aug-2014 17:45	300	49.31	0.11
31-Jul-2014 18:45	360	48.29	0.15	03-Aug-2014 18:45	360	49.26	0.16
31-Jul-2014 19:45	420	48.34	0.19	03-Aug-2014 19:45	420	49.21	0.21
31-Jul-2014 20:45	480	48.38	0.23	03-Aug-2014 20:45	480	49.16	0.26
31-Jul-2014 21:45	540	48.42	0.28	03-Aug-2014 21:45	540	49.11	0.31
31-Jul-2014 22:45	600	48.47	0.32	03-Aug-2014 22:45	600	49.06	0.36
31-Jul-2014 23:45	660	48.51	0.37	03-Aug-2014 23:45	660	49.01	0.41
01-Aug-2014 00:45	720	48.55	0.41	04-Aug-2014 00:45	720	48.96	0.46
01-Aug-2014 01:45	780	48.59	0.45	04-Aug-2014 01:45	780	48.91	0.51
01-Aug-2014 02:45	840	48.59	0.44	04-Aug-2014 02:45	840	48.87	0.55
01-Aug-2014 04:45	960	48.57	0.42	04-Aug-2014 04:45	960	48.78	0.64
01-Aug-2014 06:45	1080	48.62	0.48	04-Aug-2014 06:45	1080	48.71	0.71
01-Aug-2014 08:45	1200	48.69	0.55	04-Aug-2014 08:45	1200	48.65	0.77
01-Aug-2014 10:45	1320	48.76	0.61	04-Aug-2014 10:45	1320	48.60	0.82
01-Aug-2014 12:45	1440	48.81	0.67	04-Aug-2014 12:45	1440	48.56	0.86
01-Aug-2014 14:45	1560	48.86	0.72	04-Aug-2014 14:45	1560	48.54	0.88
01-Aug-2014 16:45	1680	48.91	0.77	04-Aug-2014 16:45	1680	48.50	0.92
01-Aug-2014 18:45	1800	48.95	0.81	04-Aug-2014 18:45	1800	48.48	0.94
01-Aug-2014 20:45	1920	48.99	0.84	04-Aug-2014 20:45	1920	48.45	0.97
01-Aug-2014 22:45	2040	49.01	0.87	04-Aug-2014 22:45	2040	48.42	1.00
02-Aug-2014 00:45	2160	49.04	0.90	05-Aug-2014 00:45	2160	48.40	1.03
02-Aug-2014 02:45	2280	49.07	0.92	05-Aug-2014 02:45	2280	48.37	1.05
02-Aug-2014 04:45	2400	49.09	0.95	05-Aug-2014 04:45	2400	48.34	1.08
02-Aug-2014 06:45	2520	49.12	0.97	05-Aug-2014 06:45	2520	48.32	1.10
02-Aug-2014 08:45	2640	49.15	1.00	05-Aug-2014 08:45	2640	48.31	1.11
02-Aug-2014 10:45	2760	49.18	1.03				
02-Aug-2014 12:45	2880	49.21	1.07				
02-Aug-2014 14:45	3000	49.24	1.10				
02-Aug-2014 16:45	3120	49.27	1.13				
02-Aug-2014 18:45	3240	49.29	1.15				
02-Aug-2014 20:45	3360	49.32	1.17				
02-Aug-2014 22:45	3480	49.32	1.18				
03-Aug-2014 00:45	3600	49.34	1.19				
03-Aug-2014 02:45	3720	49.36	1.21				
03-Aug-2014 04:45	3840	49.36	1.22				
03-Aug-2014 06:45	3960	49.37	1.22				
03-Aug-2014 08:45	4080	49.38	1.24				
03-Aug-2014 10:45	4200	49.40	1.26				
03-Aug-2014 12:45	4320	49.42	1.27				

Tabulated Levels for OW3#1

Pump On:	31-Jul-2014 12:45		Static Level:	33.83	
Pump Off:	03-Aug-2014 12:45		Pumping Level:	33.83	
Pumping Well:	**TW21**		Drawdown:	0.00	
Distance from Pumping Well:	550 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	33.83	0.00	03-Aug-2014 12:46	1	33.83	0.00
31-Jul-2014 12:47	2	33.82	0.00	03-Aug-2014 12:47	2	33.83	0.00
31-Jul-2014 12:48	3	33.82	0.00	03-Aug-2014 12:48	3	33.83	0.00
31-Jul-2014 12:49	4	33.83	0.00	03-Aug-2014 12:49	4	33.83	0.00
31-Jul-2014 12:50	5	33.83	0.00	03-Aug-2014 12:50	5	33.83	0.00
31-Jul-2014 12:51	6	33.83	0.00	03-Aug-2014 12:51	6	33.83	0.00
31-Jul-2014 12:52	7	33.83	0.00	03-Aug-2014 12:52	7	33.83	0.00
31-Jul-2014 12:53	8	33.83	0.00	03-Aug-2014 12:53	8	33.83	0.00
31-Jul-2014 12:54	9	33.83	0.00	03-Aug-2014 12:54	9	33.83	0.00
31-Jul-2014 12:55	10	33.83	0.00	03-Aug-2014 12:55	10	33.83	0.00
31-Jul-2014 12:57	12	33.83	0.00	03-Aug-2014 12:57	12	33.83	0.00
31-Jul-2014 12:59	14	33.83	0.00	03-Aug-2014 12:59	14	33.83	0.00
31-Jul-2014 13:01	16	33.83	0.00	03-Aug-2014 13:01	16	33.83	0.00
31-Jul-2014 13:03	18	33.82	0.00	03-Aug-2014 13:03	18	33.83	0.00
31-Jul-2014 13:05	20	33.83	0.00	03-Aug-2014 13:05	20	33.83	0.00
31-Jul-2014 13:10	25	33.83	0.00	03-Aug-2014 13:10	25	33.83	0.00
31-Jul-2014 13:15	30	33.83	0.00	03-Aug-2014 13:15	30	33.83	0.00
31-Jul-2014 13:30	45	33.83	0.00	03-Aug-2014 13:30	45	33.83	0.00
31-Jul-2014 13:45	60	33.83	0.00	03-Aug-2014 13:45	60	33.83	0.00
31-Jul-2014 14:15	90	33.83	0.00	03-Aug-2014 14:15	90	33.83	0.00
31-Jul-2014 14:45	120	33.83	0.00	03-Aug-2014 14:45	120	33.83	0.00
31-Jul-2014 15:15	150	33.83	0.00	03-Aug-2014 15:15	150	33.83	0.00
31-Jul-2014 15:45	180	33.83	0.00	03-Aug-2014 15:45	180	33.83	0.00
31-Jul-2014 16:15	210	33.83	0.00	03-Aug-2014 16:15	210	33.83	0.00
31-Jul-2014 16:45	240	33.83	0.00	03-Aug-2014 16:45	240	33.83	0.00
31-Jul-2014 17:15	270	33.83	0.00	03-Aug-2014 17:15	270	33.83	0.00
31-Jul-2014 17:45	300	33.83	0.00	03-Aug-2014 17:45	300	33.83	0.00
31-Jul-2014 18:45	360	33.83	0.00	03-Aug-2014 18:45	360	33.82	0.00
31-Jul-2014 19:45	420	33.83	0.00	03-Aug-2014 19:45	420	33.83	0.00
31-Jul-2014 20:45	480	33.83	0.00	03-Aug-2014 20:45	480	33.83	0.00
31-Jul-2014 21:45	540	33.83	0.00	03-Aug-2014 21:45	540	33.83	0.00
31-Jul-2014 22:45	600	33.83	0.00	03-Aug-2014 22:45	600	33.83	0.00
31-Jul-2014 23:45	660	33.83	0.00	03-Aug-2014 23:45	660	33.82	0.00
01-Aug-2014 00:45	720	33.82	0.00	04-Aug-2014 00:45	720	33.83	0.00
01-Aug-2014 01:45	780	33.83	0.00	04-Aug-2014 01:45	780	33.82	0.01
01-Aug-2014 02:45	840	33.82	0.00	04-Aug-2014 02:45	840	33.82	0.00
01-Aug-2014 04:45	960	33.82	0.00	04-Aug-2014 04:45	960	33.82	0.01
01-Aug-2014 06:45	1080	33.82	-0.01	04-Aug-2014 06:45	1080	33.82	0.01
01-Aug-2014 08:45	1200	33.83	0.00	04-Aug-2014 08:45	1200	33.82	0.01
01-Aug-2014 10:45	1320	33.83	0.00	04-Aug-2014 10:45	1320	33.82	0.01
01-Aug-2014 12:45	1440	33.83	0.01	04-Aug-2014 12:45	1440	33.82	0.00
01-Aug-2014 14:45	1560	33.83	0.01	04-Aug-2014 14:45	1560	33.83	0.00
01-Aug-2014 16:45	1680	33.83	0.01	04-Aug-2014 16:45	1680	33.83	0.00
01-Aug-2014 18:45	1800	33.83	0.00	04-Aug-2014 18:45	1800	33.83	0.00
01-Aug-2014 20:45	1920	33.83	0.00	04-Aug-2014 20:45	1920	33.83	0.00
01-Aug-2014 22:45	2040	33.82	0.00	04-Aug-2014 22:45	2040	33.82	0.01
02-Aug-2014 00:45	2160	33.82	0.00	05-Aug-2014 00:45	2160	33.82	0.01
02-Aug-2014 02:45	2280	33.83	0.00	05-Aug-2014 02:45	2280	33.82	0.01
02-Aug-2014 04:45	2400	33.82	0.00	05-Aug-2014 04:45	2400	33.82	0.01
02-Aug-2014 06:45	2520	33.82	0.00	05-Aug-2014 06:45	2520	33.82	0.01
02-Aug-2014 08:45	2640	33.83	0.00	05-Aug-2014 08:45	2640	33.82	0.01
02-Aug-2014 10:45	2760	33.83	0.00				
02-Aug-2014 12:45	2880	33.83	0.00				
02-Aug-2014 14:45	3000	33.83	0.00				
02-Aug-2014 16:45	3120	33.83	0.00				
02-Aug-2014 18:45	3240	33.83	0.00				
02-Aug-2014 20:45	3360	33.83	0.01				
02-Aug-2014 22:45	3480	33.82	0.00				
03-Aug-2014 00:45	3600	33.82	0.00				
03-Aug-2014 02:45	3720	33.83	0.00				
03-Aug-2014 04:45	3840	33.83	0.00				
03-Aug-2014 06:45	3960	33.82	0.00				
03-Aug-2014 08:45	4080	33.82	0.00				
03-Aug-2014 10:45	4200	33.83	0.00				
03-Aug-2014 12:45	4320	33.83	0.00				

Tabulated Levels for OW3#2

Pump On:	31-Jul-2014 12:45		Static Level:	43.83	
Pump Off:	03-Aug-2014 12:45		Pumping Level:	43.86	
Pumping Well:	**TW21**		Drawdown:	0.02	
Distance from Pumping Well:	550 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	43.83	0.00	03-Aug-2014 12:46	1	43.85	0.00
31-Jul-2014 12:47	2	43.83	0.00	03-Aug-2014 12:47	2	43.86	0.00
31-Jul-2014 12:48	3	43.83	0.00	03-Aug-2014 12:48	3	43.86	0.00
31-Jul-2014 12:49	4	43.83	0.00	03-Aug-2014 12:49	4	43.86	0.00
31-Jul-2014 12:50	5	43.83	0.00	03-Aug-2014 12:50	5	43.86	0.00
31-Jul-2014 12:51	6	43.83	0.00	03-Aug-2014 12:51	6	43.85	0.00
31-Jul-2014 12:52	7	43.83	0.00	03-Aug-2014 12:52	7	43.86	0.00
31-Jul-2014 12:53	8	43.83	0.00	03-Aug-2014 12:53	8	43.86	0.00
31-Jul-2014 12:54	9	43.83	0.00	03-Aug-2014 12:54	9	43.85	0.00
31-Jul-2014 12:55	10	43.83	0.00	03-Aug-2014 12:55	10	43.86	0.00
31-Jul-2014 12:57	12	43.83	0.00	03-Aug-2014 12:57	12	43.85	0.00
31-Jul-2014 12:59	14	43.83	0.00	03-Aug-2014 12:59	14	43.85	0.00
31-Jul-2014 13:01	16	43.84	0.01	03-Aug-2014 13:01	16	43.86	0.00
31-Jul-2014 13:03	18	43.83	0.00	03-Aug-2014 13:03	18	43.85	0.00
31-Jul-2014 13:05	20	43.83	0.00	03-Aug-2014 13:05	20	43.85	0.00
31-Jul-2014 13:10	25	43.83	0.00	03-Aug-2014 13:10	25	43.85	0.00
31-Jul-2014 13:15	30	43.83	0.00	03-Aug-2014 13:15	30	43.85	0.00
31-Jul-2014 13:30	45	43.83	0.00	03-Aug-2014 13:30	45	43.85	0.00
31-Jul-2014 13:45	60	43.83	0.00	03-Aug-2014 13:45	60	43.85	0.00
31-Jul-2014 14:15	90	43.83	0.00	03-Aug-2014 14:15	90	43.86	0.00
31-Jul-2014 14:45	120	43.83	0.00	03-Aug-2014 14:45	120	43.85	0.00
31-Jul-2014 15:15	150	43.84	0.00	03-Aug-2014 15:15	150	43.85	0.01
31-Jul-2014 15:45	180	43.83	0.00	03-Aug-2014 15:45	180	43.85	0.01
31-Jul-2014 16:15	210	43.84	0.01	03-Aug-2014 16:15	210	43.84	0.01
31-Jul-2014 16:45	240	43.83	0.00	03-Aug-2014 16:45	240	43.84	0.02
31-Jul-2014 17:15	270	43.83	0.00	03-Aug-2014 17:15	270	43.84	0.02
31-Jul-2014 17:45	300	43.84	0.00	03-Aug-2014 17:45	300	43.84	0.02
31-Jul-2014 18:45	360	43.84	0.00	03-Aug-2014 18:45	360	43.83	0.02
31-Jul-2014 19:45	420	43.84	0.01	03-Aug-2014 19:45	420	43.84	0.02
31-Jul-2014 20:45	480	43.84	0.01	03-Aug-2014 20:45	480	43.84	0.02
31-Jul-2014 21:45	540	43.85	0.01	03-Aug-2014 21:45	540	43.84	0.02
31-Jul-2014 22:45	600	43.85	0.02	03-Aug-2014 22:45	600	43.84	0.02
31-Jul-2014 23:45	660	43.84	0.01	03-Aug-2014 23:45	660	43.84	0.02
01-Aug-2014 00:45	720	43.84	0.01	04-Aug-2014 00:45	720	43.83	0.02
01-Aug-2014 01:45	780	43.85	0.02	04-Aug-2014 01:45	780	43.83	0.02
01-Aug-2014 02:45	840	43.84	0.01	04-Aug-2014 02:45	840	43.83	0.02
01-Aug-2014 04:45	960	43.84	0.01	04-Aug-2014 04:45	960	43.83	0.03
01-Aug-2014 06:45	1080	43.85	0.01	04-Aug-2014 06:45	1080	43.83	0.02
01-Aug-2014 08:45	1200	43.86	0.03	04-Aug-2014 08:45	1200	43.83	0.03
01-Aug-2014 10:45	1320	43.87	0.03	04-Aug-2014 10:45	1320	43.83	0.03
01-Aug-2014 12:45	1440	43.87	0.04	04-Aug-2014 12:45	1440	43.83	0.03
01-Aug-2014 14:45	1560	43.87	0.03	04-Aug-2014 14:45	1560	43.83	0.03
01-Aug-2014 16:45	1680	43.87	0.04	04-Aug-2014 16:45	1680	43.82	0.04
01-Aug-2014 18:45	1800	43.87	0.04	04-Aug-2014 18:45	1800	43.82	0.03
01-Aug-2014 20:45	1920	43.87	0.04	04-Aug-2014 20:45	1920	43.83	0.03
01-Aug-2014 22:45	2040	43.87	0.04	04-Aug-2014 22:45	2040	43.83	0.03
02-Aug-2014 00:45	2160	43.87	0.04	05-Aug-2014 00:45	2160	43.82	0.03
02-Aug-2014 02:45	2280	43.87	0.04	05-Aug-2014 02:45	2280	43.82	0.04
02-Aug-2014 04:45	2400	43.87	0.04	05-Aug-2014 04:45	2400	43.82	0.04
02-Aug-2014 06:45	2520	43.87	0.04	05-Aug-2014 06:45	2520	43.82	0.04
02-Aug-2014 08:45	2640	43.88	0.05	05-Aug-2014 08:45	2640	43.83	0.03
02-Aug-2014 10:45	2760	43.88	0.05				
02-Aug-2014 12:45	2880	43.88	0.05				
02-Aug-2014 14:45	3000	43.87	0.04				
02-Aug-2014 16:45	3120	43.87	0.03				
02-Aug-2014 18:45	3240	43.86	0.03				
02-Aug-2014 20:45	3360	43.86	0.03				
02-Aug-2014 22:45	3480	43.86	0.03				
03-Aug-2014 00:45	3600	43.86	0.02				
03-Aug-2014 02:45	3720	43.86	0.03				
03-Aug-2014 04:45	3840	43.85	0.02				
03-Aug-2014 06:45	3960	43.85	0.02				
03-Aug-2014 08:45	4080	43.86	0.03				
03-Aug-2014 10:45	4200	43.86	0.03				
03-Aug-2014 12:45	4320	43.86	0.02				

Tabulated Levels for TW30

Pump On:	31-Jul-2014 12:45			Static Level:	53.01		
Pump Off:	03-Aug-2014 12:45			Pumping Level:	53.75		
Pumping Well:	**TW21**			Drawdown:	0.74		
Distance from Pumping Well:	1250 m			20 yr DD:	4		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	53.01	0.00	03-Aug-2014 12:46	1	53.75	0.00
31-Jul-2014 12:47	2	53.01	0.00	03-Aug-2014 12:47	2	53.75	0.00
31-Jul-2014 12:48	3	53.01	0.00	03-Aug-2014 12:48	3	53.75	0.00
31-Jul-2014 12:49	4	53.01	0.00	03-Aug-2014 12:49	4	53.75	0.00
31-Jul-2014 12:50	5	53.01	0.00	03-Aug-2014 12:50	5	53.75	0.00
31-Jul-2014 12:51	6	53.01	0.00	03-Aug-2014 12:51	6	53.75	0.00
31-Jul-2014 12:52	7	53.01	0.00	03-Aug-2014 12:52	7	53.75	0.00
31-Jul-2014 12:53	8	53.01	0.00	03-Aug-2014 12:53	8	53.75	0.00
31-Jul-2014 12:54	9	53.01	0.00	03-Aug-2014 12:54	9	53.75	0.00
31-Jul-2014 12:55	10	53.01	0.00	03-Aug-2014 12:55	10	53.75	0.00
31-Jul-2014 12:57	12	53.01	0.00	03-Aug-2014 12:57	12	53.75	0.00
31-Jul-2014 12:59	14	53.01	0.00	03-Aug-2014 12:59	14	53.75	0.00
31-Jul-2014 13:01	16	53.01	0.00	03-Aug-2014 13:01	16	53.75	0.00
31-Jul-2014 13:03	18	53.01	0.00	03-Aug-2014 13:03	18	53.75	0.00
31-Jul-2014 13:05	20	53.01	0.00	03-Aug-2014 13:05	20	53.75	0.00
31-Jul-2014 13:10	25	53.01	0.00	03-Aug-2014 13:10	25	53.75	0.00
31-Jul-2014 13:15	30	53.01	0.00	03-Aug-2014 13:15	30	53.75	0.00
31-Jul-2014 13:30	45	53.01	0.01	03-Aug-2014 13:30	45	53.75	0.00
31-Jul-2014 13:45	60	53.01	0.00	03-Aug-2014 13:45	60	53.75	0.00
31-Jul-2014 14:15	90	53.01	0.00	03-Aug-2014 14:15	90	53.76	-0.01
31-Jul-2014 14:45	120	53.01	0.01	03-Aug-2014 14:45	120	53.76	-0.01
31-Jul-2014 15:15	150	53.01	0.01	03-Aug-2014 15:15	150	53.76	-0.01
31-Jul-2014 15:45	180	53.01	0.01	03-Aug-2014 15:45	180	53.75	0.00
31-Jul-2014 16:15	210	53.02	0.02	03-Aug-2014 16:15	210	53.74	0.01
31-Jul-2014 16:45	240	53.02	0.02	03-Aug-2014 16:45	240	53.74	0.01
31-Jul-2014 17:15	270	53.03	0.03	03-Aug-2014 17:15	270	53.73	0.02
31-Jul-2014 17:45	300	53.04	0.04	03-Aug-2014 17:45	300	53.73	0.02
31-Jul-2014 18:45	360	53.06	0.05	03-Aug-2014 18:45	360	53.71	0.04
31-Jul-2014 19:45	420	53.07	0.07	03-Aug-2014 19:45	420	53.69	0.06
31-Jul-2014 20:45	480	53.09	0.08	03-Aug-2014 20:45	480	53.68	0.07
31-Jul-2014 21:45	540	53.11	0.11	03-Aug-2014 21:45	540	53.66	0.09
31-Jul-2014 22:45	600	53.13	0.12	03-Aug-2014 22:45	600	53.64	0.11
31-Jul-2014 23:45	660	53.15	0.14	03-Aug-2014 23:45	660	53.62	0.13
01-Aug-2014 00:45	720	53.16	0.16	04-Aug-2014 00:45	720	53.60	0.15
01-Aug-2014 01:45	780	53.18	0.18	04-Aug-2014 01:45	780	53.58	0.17
01-Aug-2014 02:45	840	53.20	0.19	04-Aug-2014 02:45	840	53.56	0.19
01-Aug-2014 04:45	960	53.23	0.22	04-Aug-2014 04:45	960	53.53	0.22
01-Aug-2014 06:45	1080	53.26	0.25	04-Aug-2014 06:45	1080	53.50	0.25
01-Aug-2014 08:45	1200	53.29	0.29	04-Aug-2014 08:45	1200	53.48	0.27
01-Aug-2014 10:45	1320	53.32	0.32	04-Aug-2014 10:45	1320	53.45	0.30
01-Aug-2014 12:45	1440	53.35	0.35	04-Aug-2014 12:45	1440	53.44	0.31
01-Aug-2014 14:45	1560	53.38	0.38	04-Aug-2014 14:45	1560	53.42	0.33
01-Aug-2014 16:45	1680	53.41	0.40	04-Aug-2014 16:45	1680	53.41	0.34
01-Aug-2014 18:45	1800	53.43	0.42	04-Aug-2014 18:45	1800	53.39	0.36
01-Aug-2014 20:45	1920	53.45	0.45	04-Aug-2014 20:45	1920	53.38	0.37
01-Aug-2014 22:45	2040	53.47	0.47	04-Aug-2014 22:45	2040	53.36	0.39
02-Aug-2014 00:45	2160	53.50	0.49	05-Aug-2014 00:45	2160	53.35	0.41
02-Aug-2014 02:45	2280	53.51	0.51	05-Aug-2014 02:45	2280	53.32	0.43
02-Aug-2014 04:45	2400	53.53	0.52	05-Aug-2014 04:45	2400	53.31	0.44
02-Aug-2014 06:45	2520	53.55	0.54	05-Aug-2014 06:45	2520	53.30	0.45
02-Aug-2014 08:45	2640	53.57	0.56	05-Aug-2014 08:45	2640	53.29	0.46
02-Aug-2014 10:45	2760	53.59	0.58	05-Aug-2014 10:45	2760	53.27	0.48
02-Aug-2014 12:45	2880	53.61	0.61	05-Aug-2014 12:45	2880	53.27	0.48
02-Aug-2014 14:45	3000	53.63	0.62	05-Aug-2014 14:45	3000	53.27	0.48
02-Aug-2014 16:45	3120	53.65	0.64	05-Aug-2014 16:45	3120	53.27	0.48
02-Aug-2014 18:45	3240	53.66	0.65	05-Aug-2014 18:45	3240	53.27	0.48
02-Aug-2014 20:45	3360	53.67	0.67	05-Aug-2014 20:45	3360	53.27	0.48
02-Aug-2014 22:45	3480	53.68	0.68	05-Aug-2014 22:45	3480	53.27	0.48
03-Aug-2014 00:45	3600	53.69	0.69	06-Aug-2014 00:45	3600	53.27	0.48
03-Aug-2014 02:45	3720	53.71	0.70	06-Aug-2014 02:45	3720	53.27	0.48
03-Aug-2014 04:45	3840	53.71	0.71	06-Aug-2014 04:45	3840	53.27	0.48
03-Aug-2014 06:45	3960	53.72	0.72	06-Aug-2014 06:45	3960	53.27	0.48
03-Aug-2014 08:45	4080	53.73	0.72	06-Aug-2014 08:45	4080	53.27	0.48
03-Aug-2014 10:45	4200	53.74	0.74	06-Aug-2014 10:45	4200	53.27	0.48
03-Aug-2014 12:45	4320	53.75	0.74	06-Aug-2014 12:45	4320	53.27	0.48

Tabulated Levels for OW4#1

Pump On:	31-Jul-2014 12:45			Static Level:	34.04		
Pump Off:	03-Aug-2014 12:45			Pumping Level:	34.03		
Pumping Well:	**TW21**			Drawdown:	-0.01		
Distance from Pumping Well:	1250 m			20 yr DD:	4		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	34.03	0.00	03-Aug-2014 12:46	1	34.03	0.00
31-Jul-2014 12:47	2	34.04	0.00	03-Aug-2014 12:47	2	34.03	0.00
31-Jul-2014 12:48	3	34.04	0.00	03-Aug-2014 12:48	3	34.03	0.00
31-Jul-2014 12:49	4	34.04	0.00	03-Aug-2014 12:49	4	34.03	0.00
31-Jul-2014 12:50	5	34.04	0.00	03-Aug-2014 12:50	5	34.03	0.00
31-Jul-2014 12:51	6	34.04	0.00	03-Aug-2014 12:51	6	34.02	0.00
31-Jul-2014 12:52	7	34.04	0.00	03-Aug-2014 12:52	7	34.03	0.00
31-Jul-2014 12:53	8	34.04	0.00	03-Aug-2014 12:53	8	34.03	0.00
31-Jul-2014 12:54	9	34.04	0.00	03-Aug-2014 12:54	9	34.03	0.00
31-Jul-2014 12:55	10	34.04	0.00	03-Aug-2014 12:55	10	34.03	0.00
31-Jul-2014 12:57	12	34.04	0.00	03-Aug-2014 12:57	12	34.03	0.00
31-Jul-2014 12:59	14	34.04	0.00	03-Aug-2014 12:59	14	34.03	0.00
31-Jul-2014 13:01	16	34.04	0.00	03-Aug-2014 13:01	16	34.02	0.00
31-Jul-2014 13:03	18	34.04	0.00	03-Aug-2014 13:03	18	34.03	0.00
31-Jul-2014 13:05	20	34.04	0.00	03-Aug-2014 13:05	20	34.03	0.00
31-Jul-2014 13:10	25	34.04	0.00	03-Aug-2014 13:10	25	34.03	0.00
31-Jul-2014 13:15	30	34.04	0.00	03-Aug-2014 13:15	30	34.03	0.00
31-Jul-2014 13:30	45	34.04	0.00	03-Aug-2014 13:30	45	34.02	0.00
31-Jul-2014 13:45	60	34.04	0.00	03-Aug-2014 13:45	60	34.03	0.00
31-Jul-2014 14:15	90	34.04	0.00	03-Aug-2014 14:15	90	34.03	0.00
31-Jul-2014 14:45	120	34.04	0.00	03-Aug-2014 14:45	120	34.02	0.00
31-Jul-2014 15:15	150	34.04	0.00	03-Aug-2014 15:15	150	34.02	0.00
31-Jul-2014 15:45	180	34.04	0.00	03-Aug-2014 15:45	180	34.02	0.01
31-Jul-2014 16:15	210	34.04	0.00	03-Aug-2014 16:15	210	34.02	0.01
31-Jul-2014 16:45	240	34.04	0.00	03-Aug-2014 16:45	240	34.02	0.01
31-Jul-2014 17:15	270	34.04	0.00	03-Aug-2014 17:15	270	34.02	0.01
31-Jul-2014 17:45	300	34.04	0.00	03-Aug-2014 17:45	300	34.02	0.01
31-Jul-2014 18:45	360	34.04	0.00	03-Aug-2014 18:45	360	34.01	0.01
31-Jul-2014 19:45	420	34.04	0.01	03-Aug-2014 19:45	420	34.02	0.01
31-Jul-2014 20:45	480	34.04	0.00	03-Aug-2014 20:45	480	34.02	0.00
31-Jul-2014 21:45	540	34.05	0.01	03-Aug-2014 21:45	540	34.03	0.00
31-Jul-2014 22:45	600	34.05	0.01	03-Aug-2014 22:45	600	34.02	0.01
31-Jul-2014 23:45	660	34.04	0.01	03-Aug-2014 23:45	660	34.02	0.01
01-Aug-2014 00:45	720	34.04	0.01	04-Aug-2014 00:45	720	34.02	0.01
01-Aug-2014 01:45	780	34.04	0.01	04-Aug-2014 01:45	780	34.01	0.02
01-Aug-2014 02:45	840	34.04	0.00	04-Aug-2014 02:45	840	34.02	0.01
01-Aug-2014 04:45	960	34.04	0.00	04-Aug-2014 04:45	960	34.01	0.02
01-Aug-2014 06:45	1080	34.04	0.00	04-Aug-2014 06:45	1080	34.02	0.00
01-Aug-2014 08:45	1200	34.05	0.02	04-Aug-2014 08:45	1200	34.02	0.01
01-Aug-2014 10:45	1320	34.05	0.01	04-Aug-2014 10:45	1320	34.02	0.01
01-Aug-2014 12:45	1440	34.05	0.01	04-Aug-2014 12:45	1440	34.02	0.01
01-Aug-2014 14:45	1560	34.05	0.01	04-Aug-2014 14:45	1560	34.02	0.01
01-Aug-2014 16:45	1680	34.04	0.01	04-Aug-2014 16:45	1680	34.01	0.01
01-Aug-2014 18:45	1800	34.05	0.01	04-Aug-2014 18:45	1800	34.02	0.00
01-Aug-2014 20:45	1920	34.05	0.01	04-Aug-2014 20:45	1920	34.03	0.00
01-Aug-2014 22:45	2040	34.04	0.01	04-Aug-2014 22:45	2040	34.02	0.00
02-Aug-2014 00:45	2160	34.05	0.01	05-Aug-2014 00:45	2160	34.02	0.01
02-Aug-2014 02:45	2280	34.04	0.00	05-Aug-2014 02:45	2280	34.01	0.02
02-Aug-2014 04:45	2400	34.03	0.00	05-Aug-2014 04:45	2400	34.02	0.01
02-Aug-2014 06:45	2520	34.03	0.00	05-Aug-2014 06:45	2520	34.02	0.01
02-Aug-2014 08:45	2640	34.04	0.00	05-Aug-2014 08:45	2640	34.02	0.01
02-Aug-2014 10:45	2760	34.04	0.00	05-Aug-2014 10:45	2760	34.02	0.01
02-Aug-2014 12:45	2880	34.04	0.00	05-Aug-2014 12:45	2880	34.02	0.01
02-Aug-2014 14:45	3000	34.03	0.00	05-Aug-2014 14:45	3000	34.02	0.01
02-Aug-2014 16:45	3120	34.03	-0.01	05-Aug-2014 16:45	3120	34.02	0.01
02-Aug-2014 18:45	3240	34.03	-0.01	05-Aug-2014 18:45	3240	34.02	0.01
02-Aug-2014 20:45	3360	34.03	-0.01	05-Aug-2014 20:45	3360	34.02	0.01
02-Aug-2014 22:45	3480	34.03	-0.01	05-Aug-2014 22:45	3480	34.02	0.01
03-Aug-2014 00:45	3600	34.03	-0.01	06-Aug-2014 00:45	3600	34.02	0.01
03-Aug-2014 02:45	3720	34.03	-0.01	06-Aug-2014 02:45	3720	34.02	0.01
03-Aug-2014 04:45	3840	34.02	-0.02	06-Aug-2014 04:45	3840	34.02	0.01
03-Aug-2014 06:45	3960	34.03	-0.01	06-Aug-2014 06:45	3960	34.02	0.01
03-Aug-2014 08:45	4080	34.03	-0.01	06-Aug-2014 08:45	4080	34.02	0.01
03-Aug-2014 10:45	4200	34.03	-0.01	06-Aug-2014 10:45	4200	34.02	0.01
03-Aug-2014 12:45	4320	34.03	-0.01	06-Aug-2014 12:45	4320	34.02	0.01

Tabulated Levels for OW4#2

Pump On:	31-Jul-2014 12:45			Static Level:	45.88		
Pump Off:	03-Aug-2014 12:45			Pumping Level:	45.90		
Pumping Well:	**TW21**			Drawdown:	0.02		
Distance from Pumping Well:	1250 m			20 yr DD:	4		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	45.88	0.00	03-Aug-2014 12:46	1	45.90	0.00
31-Jul-2014 12:47	2	45.88	0.00	03-Aug-2014 12:47	2	45.90	0.00
31-Jul-2014 12:48	3	45.88	0.00	03-Aug-2014 12:48	3	45.90	0.00
31-Jul-2014 12:49	4	45.88	0.00	03-Aug-2014 12:49	4	45.90	0.00
31-Jul-2014 12:50	5	45.88	0.00	03-Aug-2014 12:50	5	45.90	0.00
31-Jul-2014 12:51	6	45.88	0.00	03-Aug-2014 12:51	6	45.90	0.00
31-Jul-2014 12:52	7	45.88	0.00	03-Aug-2014 12:52	7	45.90	0.00
31-Jul-2014 12:53	8	45.88	0.00	03-Aug-2014 12:53	8	45.90	0.00
31-Jul-2014 12:54	9	45.88	0.00	03-Aug-2014 12:54	9	45.90	0.00
31-Jul-2014 12:55	10	45.88	0.00	03-Aug-2014 12:55	10	45.90	0.00
31-Jul-2014 12:57	12	45.88	0.00	03-Aug-2014 12:57	12	45.90	0.00
31-Jul-2014 12:59	14	45.88	0.00	03-Aug-2014 12:59	14	45.90	0.00
31-Jul-2014 13:01	16	45.88	0.01	03-Aug-2014 13:01	16	45.90	0.00
31-Jul-2014 13:03	18	45.88	0.00	03-Aug-2014 13:03	18	45.90	0.00
31-Jul-2014 13:05	20	45.88	0.00	03-Aug-2014 13:05	20	45.90	0.00
31-Jul-2014 13:10	25	45.88	0.00	03-Aug-2014 13:10	25	45.90	0.00
31-Jul-2014 13:15	30	45.88	0.00	03-Aug-2014 13:15	30	45.90	0.00
31-Jul-2014 13:30	45	45.88	0.00	03-Aug-2014 13:30	45	45.90	0.00
31-Jul-2014 13:45	60	45.88	0.00	03-Aug-2014 13:45	60	45.90	0.00
31-Jul-2014 14:15	90	45.88	0.00	03-Aug-2014 14:15	90	45.90	0.00
31-Jul-2014 14:45	120	45.88	0.00	03-Aug-2014 14:45	120	45.90	0.00
31-Jul-2014 15:15	150	45.88	0.00	03-Aug-2014 15:15	150	45.90	0.00
31-Jul-2014 15:45	180	45.88	0.00	03-Aug-2014 15:45	180	45.89	0.01
31-Jul-2014 16:15	210	45.88	0.01	03-Aug-2014 16:15	210	45.89	0.01
31-Jul-2014 16:45	240	45.88	0.00	03-Aug-2014 16:45	240	45.89	0.01
31-Jul-2014 17:15	270	45.88	0.00	03-Aug-2014 17:15	270	45.89	0.02
31-Jul-2014 17:45	300	45.88	0.00	03-Aug-2014 17:45	300	45.89	0.01
31-Jul-2014 18:45	360	45.88	0.00	03-Aug-2014 18:45	360	45.88	0.02
31-Jul-2014 19:45	420	45.89	0.01	03-Aug-2014 19:45	420	45.88	0.02
31-Jul-2014 20:45	480	45.89	0.01	03-Aug-2014 20:45	480	45.89	0.02
31-Jul-2014 21:45	540	45.90	0.02	03-Aug-2014 21:45	540	45.89	0.01
31-Jul-2014 22:45	600	45.90	0.02	03-Aug-2014 22:45	600	45.89	0.02
31-Jul-2014 23:45	660	45.90	0.02	03-Aug-2014 23:45	660	45.89	0.02
01-Aug-2014 00:45	720	45.89	0.01	04-Aug-2014 00:45	720	45.88	0.02
01-Aug-2014 01:45	780	45.89	0.01	04-Aug-2014 01:45	780	45.88	0.02
01-Aug-2014 02:45	840	45.89	0.01	04-Aug-2014 02:45	840	45.88	0.02
01-Aug-2014 04:45	960	45.89	0.01	04-Aug-2014 04:45	960	45.88	0.03
01-Aug-2014 06:45	1080	45.89	0.01	04-Aug-2014 06:45	1080	45.88	0.02
01-Aug-2014 08:45	1200	45.91	0.03	04-Aug-2014 08:45	1200	45.88	0.03
01-Aug-2014 10:45	1320	45.91	0.03	04-Aug-2014 10:45	1320	45.88	0.02
01-Aug-2014 12:45	1440	45.91	0.03	04-Aug-2014 12:45	1440	45.88	0.02
01-Aug-2014 14:45	1560	45.91	0.03	04-Aug-2014 14:45	1560	45.88	0.03
01-Aug-2014 16:45	1680	45.91	0.03	04-Aug-2014 16:45	1680	45.87	0.04
01-Aug-2014 18:45	1800	45.91	0.03	04-Aug-2014 18:45	1800	45.87	0.03
01-Aug-2014 20:45	1920	45.92	0.04	04-Aug-2014 20:45	1920	45.87	0.03
01-Aug-2014 22:45	2040	45.92	0.04	04-Aug-2014 22:45	2040	45.87	0.03
02-Aug-2014 00:45	2160	45.92	0.04	05-Aug-2014 00:45	2160	45.87	0.03
02-Aug-2014 02:45	2280	45.91	0.03	05-Aug-2014 02:45	2280	45.86	0.04
02-Aug-2014 04:45	2400	45.91	0.03	05-Aug-2014 04:45	2400	45.87	0.03
02-Aug-2014 06:45	2520	45.91	0.03	05-Aug-2014 06:45	2520	45.86	0.04
02-Aug-2014 08:45	2640	45.92	0.04	05-Aug-2014 08:45	2640	45.87	0.03
02-Aug-2014 10:45	2760	45.92	0.04	05-Aug-2014 10:45	2760	45.87	0.03
02-Aug-2014 12:45	2880	45.93	0.05	05-Aug-2014 12:45	2880	45.87	0.03
02-Aug-2014 14:45	3000	45.92	0.04	05-Aug-2014 14:45	3000	45.87	0.03
02-Aug-2014 16:45	3120	45.91	0.03	05-Aug-2014 16:45	3120	45.87	0.03
02-Aug-2014 18:45	3240	45.90	0.02	05-Aug-2014 18:45	3240	45.87	0.03
02-Aug-2014 20:45	3360	45.91	0.03	05-Aug-2014 20:45	3360	45.87	0.03
02-Aug-2014 22:45	3480	45.90	0.03	05-Aug-2014 22:45	3480	45.87	0.03
03-Aug-2014 00:45	3600	45.90	0.02	06-Aug-2014 00:45	3600	45.87	0.03
03-Aug-2014 02:45	3720	45.91	0.03	06-Aug-2014 02:45	3720	45.87	0.03
03-Aug-2014 04:45	3840	45.90	0.02	06-Aug-2014 04:45	3840	45.87	0.03
03-Aug-2014 06:45	3960	45.90	0.02	06-Aug-2014 06:45	3960	45.87	0.03
03-Aug-2014 08:45	4080	45.91	0.03	06-Aug-2014 08:45	4080	45.87	0.03
03-Aug-2014 10:45	4200	45.91	0.03	06-Aug-2014 10:45	4200	45.87	0.03
03-Aug-2014 12:45	4320	45.90	0.02	06-Aug-2014 12:45	4320	45.87	0.03

Tabulated Levels for TW35

	Pump On:	31-Jul-2014 12:45			Static Level:	50.25	
	Pump Off:	03-Aug-2014 12:45			Pumping Level:	50.63	
	Pumping Well:	**TW21**			Drawdown	0.38	
	Distance from Pumping Well:	2500 m			20 yr DD:	2	
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	50.25	0.00	03-Aug-2014 12:46	1	50.63	0.00
31-Jul-2014 12:47	2	50.25	0.00	03-Aug-2014 12:47	2	50.63	0.00
31-Jul-2014 12:48	3	50.24	0.00	03-Aug-2014 12:48	3	50.63	0.00
31-Jul-2014 12:49	4	50.25	0.00	03-Aug-2014 12:49	4	50.63	0.00
31-Jul-2014 12:50	5	50.25	0.00	03-Aug-2014 12:50	5	50.63	0.00
31-Jul-2014 12:51	6	50.25	0.00	03-Aug-2014 12:51	6	50.63	0.00
31-Jul-2014 12:52	7	50.25	0.00	03-Aug-2014 12:52	7	50.63	0.00
31-Jul-2014 12:53	8	50.25	0.00	03-Aug-2014 12:53	8	50.63	0.00
31-Jul-2014 12:54	9	50.25	0.00	03-Aug-2014 12:54	9	50.63	0.00
31-Jul-2014 12:55	10	50.25	0.00	03-Aug-2014 12:55	10	50.63	0.00
31-Jul-2014 12:57	12	50.25	0.00	03-Aug-2014 12:57	12	50.63	0.00
31-Jul-2014 12:59	14	50.25	0.00	03-Aug-2014 12:59	14	50.63	0.00
31-Jul-2014 13:01	16	50.25	0.00	03-Aug-2014 13:01	16	50.63	0.00
31-Jul-2014 13:03	18	50.25	0.00	03-Aug-2014 13:03	18	50.63	0.00
31-Jul-2014 13:05	20	50.25	0.00	03-Aug-2014 13:05	20	50.63	0.00
31-Jul-2014 13:10	25	50.25	0.00	03-Aug-2014 13:10	25	50.63	0.00
31-Jul-2014 13:15	30	50.25	0.00	03-Aug-2014 13:15	30	50.63	0.00
31-Jul-2014 13:30	45	50.25	0.00	03-Aug-2014 13:30	45	50.63	0.00
31-Jul-2014 13:45	60	50.25	0.00	03-Aug-2014 13:45	60	50.63	0.00
31-Jul-2014 14:15	90	50.25	0.00	03-Aug-2014 14:15	90	50.64	-0.01
31-Jul-2014 14:45	120	50.24	0.00	03-Aug-2014 14:45	120	50.64	-0.01
31-Jul-2014 15:15	150	50.25	0.00	03-Aug-2014 15:15	150	50.64	-0.01
31-Jul-2014 15:45	180	50.24	0.00	03-Aug-2014 15:45	180	50.64	-0.01
31-Jul-2014 16:15	210	50.25	0.00	03-Aug-2014 16:15	210	50.64	-0.01
31-Jul-2014 16:45	240	50.24	0.00	03-Aug-2014 16:45	240	50.64	-0.01
31-Jul-2014 17:15	270	50.24	0.00	03-Aug-2014 17:15	270	50.64	-0.01
31-Jul-2014 17:45	300	50.24	-0.01	03-Aug-2014 17:45	300	50.64	-0.01
31-Jul-2014 18:45	360	50.24	-0.01	03-Aug-2014 18:45	360	50.64	-0.01
31-Jul-2014 19:45	420	50.24	-0.01	03-Aug-2014 19:45	420	50.65	-0.02
31-Jul-2014 20:45	480	50.23	-0.01	03-Aug-2014 20:45	480	50.64	-0.01
31-Jul-2014 21:45	540	50.23	-0.01	03-Aug-2014 21:45	540	50.64	-0.01
31-Jul-2014 22:45	600	50.24	-0.01	03-Aug-2014 22:45	600	50.63	0.00
31-Jul-2014 23:45	660	50.24	-0.01	03-Aug-2014 23:45	660	50.63	0.00
01-Aug-2014 00:45	720	50.24	0.00	04-Aug-2014 00:45	720	50.62	0.01
01-Aug-2014 01:45	780	50.25	0.00	04-Aug-2014 01:45	780	50.62	0.02
01-Aug-2014 02:45	840	50.25	0.00	04-Aug-2014 02:45	840	50.61	0.02
01-Aug-2014 04:45	960	50.26	0.01	04-Aug-2014 04:45	960	50.60	0.03
01-Aug-2014 06:45	1080	50.27	0.02	04-Aug-2014 06:45	1080	50.60	0.03
01-Aug-2014 08:45	1200	50.29	0.04	04-Aug-2014 08:45	1200	50.59	0.04
01-Aug-2014 10:45	1320	50.31	0.06	04-Aug-2014 10:45	1320	50.58	0.05
01-Aug-2014 12:45	1440	50.33	0.08	04-Aug-2014 12:45	1440	50.58	0.05
01-Aug-2014 14:45	1560	50.34	0.09	04-Aug-2014 14:45	1560	50.58	0.05
01-Aug-2014 16:45	1680	50.36	0.11	04-Aug-2014 16:45	1680	50.58	0.05
01-Aug-2014 18:45	1800	50.37	0.13	04-Aug-2014 18:45	1800	50.57	0.06
01-Aug-2014 20:45	1920	50.39	0.14	04-Aug-2014 20:45	1920	50.56	0.07
01-Aug-2014 22:45	2040	50.40	0.15	04-Aug-2014 22:45	2040	50.54	0.09
02-Aug-2014 00:45	2160	50.41	0.16	05-Aug-2014 00:45	2160	50.53	0.10
02-Aug-2014 02:45	2280	50.42	0.18	05-Aug-2014 02:45	2280	50.51	0.12
02-Aug-2014 04:45	2400	50.44	0.19	05-Aug-2014 04:45	2400	50.50	0.14
02-Aug-2014 06:45	2520	50.45	0.20	05-Aug-2014 06:45	2520	50.48	0.15
02-Aug-2014 08:45	2640	50.47	0.23	05-Aug-2014 08:45	2640	50.47	0.16
02-Aug-2014 10:45	2760	50.49	0.25	05-Aug-2014 10:45	2760	50.47	0.16
02-Aug-2014 12:45	2880	50.52	0.27	05-Aug-2014 12:45	2880	50.47	0.16
02-Aug-2014 14:45	3000	50.53	0.29	05-Aug-2014 14:45	3000	50.47	0.16
02-Aug-2014 16:45	3120	50.55	0.30	05-Aug-2014 16:45	3120	50.47	0.16
02-Aug-2014 18:45	3240	50.56	0.31	05-Aug-2014 18:45	3240	50.47	0.16
02-Aug-2014 20:45	3360	50.57	0.33	05-Aug-2014 20:45	3360	50.47	0.16
02-Aug-2014 22:45	3480	50.57	0.33	05-Aug-2014 22:45	3480	50.47	0.16
03-Aug-2014 00:45	3600	50.58	0.33	06-Aug-2014 00:45	3600	50.47	0.16
03-Aug-2014 02:45	3720	50.59	0.34	06-Aug-2014 02:45	3720	50.47	0.16
03-Aug-2014 04:45	3840	50.60	0.35	06-Aug-2014 04:45	3840	50.47	0.16
03-Aug-2014 06:45	3960	50.60	0.35	06-Aug-2014 06:45	3960	50.47	0.16
03-Aug-2014 08:45	4080	50.61	0.36	06-Aug-2014 08:45	4080	50.47	0.16
03-Aug-2014 10:45	4200	50.62	0.38	06-Aug-2014 10:45	4200	50.47	0.16
03-Aug-2014 12:45	4320	50.63	0.38	06-Aug-2014 12:45	4320	50.47	0.16

Tabulated Levels for TW17

Pump On:	31-Jul-2014 12:45		Static Level:	4.76	
Pump Off:	03-Aug-2014 12:45		Pumping Level:	4.80	
Pumping Well:	**TW21**		Drawdown	0.04	
Distance from Pumping Well:	4800 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
31-Jul-2014 12:46	1	4.76	0.00	03-Aug-2014 12:46	1	4.80	0.00
31-Jul-2014 12:47	2	4.75	0.00	03-Aug-2014 12:47	2	4.80	0.00
31-Jul-2014 12:48	3	4.76	0.00	03-Aug-2014 12:48	3	4.80	0.00
31-Jul-2014 12:49	4	4.76	0.00	03-Aug-2014 12:49	4	4.80	0.00
31-Jul-2014 12:50	5	4.76	0.00	03-Aug-2014 12:50	5	4.80	0.00
31-Jul-2014 12:51	6	4.76	0.00	03-Aug-2014 12:51	6	4.80	0.00
31-Jul-2014 12:52	7	4.76	0.00	03-Aug-2014 12:52	7	4.80	0.00
31-Jul-2014 12:53	8	4.76	0.00	03-Aug-2014 12:53	8	4.80	0.00
31-Jul-2014 12:54	9	4.76	0.00	03-Aug-2014 12:54	9	4.80	0.00
31-Jul-2014 12:55	10	4.76	0.00	03-Aug-2014 12:55	10	4.80	0.00
31-Jul-2014 12:57	12	4.76	0.00	03-Aug-2014 12:57	12	4.80	0.00
31-Jul-2014 12:59	14	4.76	0.00	03-Aug-2014 12:59	14	4.80	0.00
31-Jul-2014 13:01	16	4.76	0.00	03-Aug-2014 13:01	16	4.80	0.00
31-Jul-2014 13:03	18	4.76	0.00	03-Aug-2014 13:03	18	4.80	0.00
31-Jul-2014 13:05	20	4.76	0.00	03-Aug-2014 13:05	20	4.80	0.00
31-Jul-2014 13:10	25	4.76	0.00	03-Aug-2014 13:10	25	4.80	0.00
31-Jul-2014 13:15	30	4.76	0.00	03-Aug-2014 13:15	30	4.80	0.00
31-Jul-2014 13:30	45	4.76	0.00	03-Aug-2014 13:30	45	4.80	0.00
31-Jul-2014 13:45	60	4.76	0.00	03-Aug-2014 13:45	60	4.80	0.00
31-Jul-2014 14:15	90	4.76	0.00	03-Aug-2014 14:15	90	4.80	0.00
31-Jul-2014 14:45	120	4.76	0.00	03-Aug-2014 14:45	120	4.80	0.00
31-Jul-2014 15:15	150	4.76	0.00	03-Aug-2014 15:15	150	4.80	0.00
31-Jul-2014 15:45	180	4.76	0.00	03-Aug-2014 15:45	180	4.80	0.00
31-Jul-2014 16:15	210	4.76	0.01	03-Aug-2014 16:15	210	4.80	0.00
31-Jul-2014 16:45	240	4.76	0.00	03-Aug-2014 16:45	240	4.80	0.00
31-Jul-2014 17:15	270	4.76	0.00	03-Aug-2014 17:15	270	4.80	0.00
31-Jul-2014 17:45	300	4.76	0.01	03-Aug-2014 17:45	300	4.80	0.00
31-Jul-2014 18:45	360	4.76	0.01	03-Aug-2014 18:45	360	4.80	0.00
31-Jul-2014 19:45	420	4.77	0.01	03-Aug-2014 19:45	420	4.80	0.00
31-Jul-2014 20:45	480	4.77	0.01	03-Aug-2014 20:45	480	4.80	0.00
31-Jul-2014 21:45	540	4.77	0.02	03-Aug-2014 21:45	540	4.80	0.00
31-Jul-2014 22:45	600	4.78	0.02	03-Aug-2014 22:45	600	4.80	0.00
31-Jul-2014 23:45	660	4.77	0.02	03-Aug-2014 23:45	660	4.80	0.00
01-Aug-2014 00:45	720	4.77	0.02	04-Aug-2014 00:45	720	4.80	0.00
01-Aug-2014 01:45	780	4.77	0.02	04-Aug-2014 01:45	780	4.80	0.00
01-Aug-2014 02:45	840	4.77	0.01	04-Aug-2014 02:45	840	4.80	0.00
01-Aug-2014 04:45	960	4.77	0.01	04-Aug-2014 04:45	960	4.80	0.00
01-Aug-2014 06:45	1080	4.78	0.02	04-Aug-2014 06:45	1080	4.80	0.00
01-Aug-2014 08:45	1200	4.79	0.03	04-Aug-2014 08:45	1200	4.80	0.00
01-Aug-2014 10:45	1320	4.79	0.04	04-Aug-2014 10:45	1320	4.80	0.00
01-Aug-2014 12:45	1440	4.80	0.04	04-Aug-2014 12:45	1440	4.80	0.00
01-Aug-2014 14:45	1560	4.80	0.04	04-Aug-2014 14:45	1560	4.80	0.00
01-Aug-2014 16:45	1680	4.80	0.04	04-Aug-2014 16:45	1680	4.80	0.00
01-Aug-2014 18:45	1800	4.80	0.04	04-Aug-2014 18:45	1800	4.80	0.00
01-Aug-2014 20:45	1920	4.80	0.04	04-Aug-2014 20:45	1920	4.80	0.00
01-Aug-2014 22:45	2040	4.80	0.05	04-Aug-2014 22:45	2040	4.80	0.00
02-Aug-2014 00:45	2160	4.81	0.05	05-Aug-2014 00:45	2160	4.80	0.00
02-Aug-2014 02:45	2280	4.80	0.05	05-Aug-2014 02:45	2280	4.80	0.00
02-Aug-2014 04:45	2400	4.80	0.05	05-Aug-2014 04:45	2400	4.80	0.00
02-Aug-2014 06:45	2520	4.81	0.05	05-Aug-2014 06:45	2520	4.80	0.00
02-Aug-2014 08:45	2640	4.81	0.06	05-Aug-2014 08:45	2640	4.80	0.00
02-Aug-2014 10:45	2760	4.81	0.06	05-Aug-2014 10:45	2760	4.80	0.00
02-Aug-2014 12:45	2880	4.82	0.06	05-Aug-2014 12:45	2880	4.80	0.00
02-Aug-2014 14:45	3000	4.81	0.05	05-Aug-2014 14:45	3000	4.80	0.00
02-Aug-2014 16:45	3120	4.80	0.05	05-Aug-2014 16:45	3120	4.80	0.00
02-Aug-2014 18:45	3240	4.80	0.04	05-Aug-2014 18:45	3240	4.80	0.00
02-Aug-2014 20:45	3360	4.80	0.05	05-Aug-2014 20:45	3360	4.80	0.00
02-Aug-2014 22:45	3480	4.80	0.04	05-Aug-2014 22:45	3480	4.80	0.00
03-Aug-2014 00:45	3600	4.80	0.04	06-Aug-2014 00:45	3600	4.80	0.00
03-Aug-2014 02:45	3720	4.80	0.05	06-Aug-2014 02:45	3720	4.80	0.00
03-Aug-2014 04:45	3840	4.79	0.04	06-Aug-2014 04:45	3840	4.80	0.00
03-Aug-2014 06:45	3960	4.80	0.04	06-Aug-2014 06:45	3960	4.80	0.00
03-Aug-2014 08:45	4080	4.80	0.04	06-Aug-2014 08:45	4080	4.80	0.00
03-Aug-2014 10:45	4200	4.80	0.04	06-Aug-2014 10:45	4200	4.80	0.00
03-Aug-2014 12:45	4320	4.80	0.04	06-Aug-2014 12:45	4320	4.80	0.00

Table D-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G42357 **REPORT No. B14-19352**

Report To:

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Attention: Alicia Beynon

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Ottawa Ontario K1V 7P1
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Fax: 613-526-1244

DATE RECEIVED: 05-Aug-14
DATE REPORTED: 13-Aug-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1311700040 Ph 2000
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW21 - 23h			
			Sample I.D.		B14-19352-1			
			Date Collected		01-Aug-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	06-Aug-14/O	266			
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	05-Aug-14/O	200			
Conductivity @25°C	µmho/cm	1	SM 2510B	05-Aug-14/O	533			
pH @25°C	pH Units		SM 4500H	05-Aug-14/O	7.98			
Fluoride	mg/L	0.1	SM4110C	06-Aug-14/O	< 0.1			
Chloride	mg/L	0.5	SM4110C	06-Aug-14/O	27.9			
Nitrite (N)	mg/L	0.1	SM4110C	06-Aug-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	06-Aug-14/O	3.3			
Bromide	mg/L	0.4	SM4110C	06-Aug-14/O	< 0.4			
Sulphate	mg/L	1	SM4110C	06-Aug-14/O	16			
Calcium	mg/L	0.02	SM 3120	06-Aug-14/O	78.9			
Magnesium	mg/L	0.01	SM 3120	06-Aug-14/O	16.8			
Sodium	mg/L	0.2	SM 3120	06-Aug-14/O	9.6			
Potassium	mg/L	0.1	SM 3120	06-Aug-14/O	1.9			
Iron	mg/L	0.005	SM 3120	06-Aug-14/O	0.024			
Manganese	mg/L	0.001	SM 3120	06-Aug-14/O	0.003			
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	08-Aug-14/O	< 0.01			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	08-Aug-14/O	1.2			
Tannins and Lignins	mg/L	0.1	N/A	08-Aug-14	< 0.1 [1]			
Anion Sum	meq/L		Calc.	07-Aug-14/O	5.36			
Cation Sum	meq/L		Calc.	07-Aug-14/O	5.79			
% Difference	%		Calc.	07-Aug-14/O	3.84			
Ion Ratio	AS/CS		Calc.	07-Aug-14/O	0.926			
Sodium Adsorption Ratio	-		Calc.	07-Aug-14/O	0.256			
TDS(ion sum calc.)	mg/L		Calc.	07-Aug-14/O	286			
Conductivity (calc.)	µmho/cm		Calc.	07-Aug-14/O	540			
TDS(calc.)/EC(actual)	-		Calc.	07-Aug-14/O	0.537			
EC(calc.)/EC(actual)	-		Calc.	07-Aug-14/O	1.01			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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Final Report

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2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 05-Aug-14
DATE REPORTED: 13-Aug-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1311700040 Ph 2000
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW21 - 23h			
			Sample I.D.		B14-19352-1			
			Date Collected		01-Aug-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Langelier Index(25°C)	S.I.		Calc.	07-Aug-14/O	0.735			

1 . subcontracted to Paracel Labs

Table D-2: Water Quality Results

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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Table D-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G42358 **REPORT No. B14-19681**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 06-Aug-14
DATE REPORTED: 05-Sep-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW21-72 hour			
			Sample I.D.		B14-19681-1			
			Date Collected		05-Aug-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	07-Aug-14/O	274			
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	06-Aug-14/O	203			
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	06-Aug-14/O	203			
Carbonate (as CaCO3)	mg/L	5	SM 2320B	06-Aug-14/O	< 5			
Conductivity @25°C	µmho/cm	1	SM 2510B	07-Aug-14/O	523			
pH @25°C	pH Units		SM 4500H	06-Aug-14/O	7.99			
Colour	TCU	2	SM 2120C	08-Aug-14/O	8			
Turbidity	NTU	0.1	SM 2130	08-Aug-14/O	0.3			
UV transmittance	%		N/A	14-Aug-14	97.1 [3]			
Fluoride	mg/L	0.1	SM4110C	07-Aug-14/O	< 0.1			
Chloride	mg/L	0.5	SM4110C	07-Aug-14/O	28.6			
Nitrite (N)	mg/L	0.1	SM4110C	07-Aug-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	07-Aug-14/O	3.1			
Nitrate + Nitrite (N)	mg/L	0.1	SM4110C	07-Aug-14/O	3.1			
Sulphate	mg/L	1	SM4110C	07-Aug-14/O	17			
Calcium	mg/L	0.02	SM 3120	07-Aug-14/O	81.5			
Magnesium	mg/L	0.01	SM 3120	07-Aug-14/O	17.2			
Sodium	mg/L	0.2	SM 3120	07-Aug-14/O	12.3			
Potassium	mg/L	0.1	SM 3120	07-Aug-14/O	2.2			
Aluminum	mg/L	0.01	SM 3120	07-Aug-14/O	0.02			
Antimony	mg/L	0.0001	EPA 200.8	07-Aug-14/O	0.0002			
Arsenic	mg/L	0.0001	EPA 200.8	07-Aug-14/O	< 0.0001			
Barium	mg/L	0.001	SM 3120	07-Aug-14/O	0.056			
Boron	mg/L	0.005	SM 3120	07-Aug-14/O	< 0.005			
Cadmium	mg/L	0.00002	EPA 200.8	07-Aug-14/O	< 0.00002			
Chromium	mg/L	0.002	SM 3120	07-Aug-14/O	< 0.002			
Copper	mg/L	0.002	SM 3120	07-Aug-14/O	0.003			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 06-Aug-14
DATE REPORTED: 05-Sep-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

	Client I.D.	TW21-72 hour			
	Sample I.D.	B14-19681-1			
	Date Collected	05-Aug-14			

Parameter	Units	M.D.L.	Reference Method	Date/Site Analyzed				
Total Cyanide	mg/L	0.005	SM 4500CN	11-Aug-14/K	< 0.005			
Iron	mg/L	0.005	SM 3120	07-Aug-14/O	0.015			
Iron (Total)	mg/L	0.005	SM 3120	07-Aug-14/O	0.066			
Lead	mg/L	0.00002	EPA 200.8	07-Aug-14/O	< 0.00002			
Manganese	mg/L	0.001	SM 3120	07-Aug-14/O	0.002			
Manganese (Total)	mg/L	0.001	SM 3120	07-Aug-14/O	0.008			
Mercury	mg/L	0.00002	SM 3112 B	11-Aug-14/O	< 0.00002			
Selenium	mg/L	0.001	EPA 200.8	07-Aug-14/O	< 0.001			
Uranium	mg/L	0.00005	EPA 200.8	07-Aug-14/O	0.00435			
Zinc	mg/L	0.005	SM 3120	07-Aug-14/O	0.021			
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	08-Aug-14/O	< 0.01			
Total Kjeldahl Nitrogen	mg/L	0.05	MOEE 3367	14-Aug-14/O	< 0.05			
Organic Nitrogen	mg/L	0.05	MOEE 3367	14-Aug-14/O	< 0.05			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	08-Aug-14/O	1.2			
Sulphide	mg/L	0.01	SM4500-S2	11-Aug-14/K	< 0.01			
Anion Sum	meq/L		Calc.	08-Aug-14/O	5.44			
Cation Sum	meq/L		Calc.	08-Aug-14/O	6.41			
% Difference	%		Calc.	08-Aug-14/O	8.22			
Ion Ratio	AS/CS		Calc.	08-Aug-14/O	0.848			
Sodium Adsorption Ratio	-		Calc.	08-Aug-14/O	0.350			
TDS(ion sum calc.)	mg/L		Calc.	08-Aug-14/O	301			
Conductivity (calc.)	µmho/cm		Calc.	08-Aug-14/O	572			
TDS(calc.)/EC(actual)	-		Calc.	08-Aug-14/O	0.575			
EC(calc.)/EC(actual)	-		Calc.	08-Aug-14/O	1.09			
Langelier Index(25°C)	S.I.		Calc.	08-Aug-14/O	0.785			
Methane	L/m3	0.006	EPA 8000	11-Aug-14/O	< 0.006 [3]			
Benzene	µg/L	0.5	EPA 8260	07-Aug-14/O	< 0.5			



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 06-Aug-14
DATE REPORTED: 05-Sep-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW21-72 hour			
			Sample I.D.		B14-19681-1			
			Date Collected		05-Aug-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Carbon Tetrachloride	µg/L	0.2	EPA 8260	07-Aug-14/O	< 0.2			
Monochlorobenzene (Chlorobenzene)	µg/L	0.2	EPA 8260	07-Aug-14/O	< 0.2			
Dichlorobenzene,1,2-	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Dichlorobenzene,1,4-	µg/L	0.2	EPA 8260	07-Aug-14/O	< 0.2			
Dichloroethane,1,2-	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Dichloroethene, 1,1-	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Ethylbenzene	µg/L	0.5	EPA 8260	07-Aug-14/O	< 0.5			
Dichloromethane (Methylene Chloride)	µg/L	0.3	EPA 8260	07-Aug-14/O	< 0.3			
Tetrachloroethylene	µg/L	0.2	EPA 8260	07-Aug-14/O	< 0.2			
Toluene	µg/L	0.5	EPA 8260	07-Aug-14/O	< 0.5			
Trichloroethylene	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Vinyl Chloride	µg/L	0.2	EPA 8260	07-Aug-14/O	< 0.2			
Xylene, m,p,o-	µg/L	0.4	EPA 8260	07-Aug-14/O	< 0.4			
Bromodichloromethane	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Bromoform	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Chloroform	µg/L	0.3	EPA 8260	07-Aug-14/O	< 0.3			
Dibromochloromethane	µg/L	0.1	EPA 8260	07-Aug-14/O	< 0.1			
Total Trihalomethanes	µg/L	0.3	EPA 8260	07-Aug-14/O	< 0.3			
Alachlor	µg/L	0.3	EPA 8270	15-Aug-14/K	< 0.3			
Aldicarb	µg/L	3	EPA 8270	15-Aug-14/K	< 3			
Aldrin + Dieldrin	µg/L	0.02	EPA 8080	14-Aug-14/K	< 0.02			
Atrazine + Metabolites	µg/L	0.5	Calc.	15-Aug-14/K	< 0.5			
Azinphos-methyl	µg/L	1	EPA 8270	15-Aug-14/K	< 1			
Bendiocarb	µg/L	3	EPA 8270	15-Aug-14/K	< 3			
Benzo(a)pyrene	µg/L	0.005	EPA 8270	15-Aug-14/K	< 0.005			
Bromoxynil	µg/L	0.3	EPA 8270	15-Aug-14/K	< 0.3			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 06-Aug-14
DATE REPORTED: 05-Sep-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW21-72 hour			
			Sample I.D.		B14-19681-1			
			Date Collected		05-Aug-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Carbaryl	µg/L	3	EPA 8270	15-Aug-14/K	< 3			
Carbofuran	µg/L	1	EPA 8270	15-Aug-14/K	< 1			
Chlordane (Total)	µg/L	0.04	EPA 8080	14-Aug-14/K	< 0.04			
Chlorpyrifos	µg/L	0.5	EPA 8270	15-Aug-14/K	< 0.5			
Cyanazine	µg/L	0.5	EPA 8270	15-Aug-14/K	< 0.5			
DDT + Metabolites	µg/L	0.01	EPA 8080	14-Aug-14/K	< 0.01			
Diazinon	µg/L	1	EPA 8270	15-Aug-14/K	< 1			
Dicamba	µg/L	5	EPA 8270	15-Aug-14/K	< 5			
Dichlorophenol, 2,4-	µg/L	0.1	EPA 8270	15-Aug-14/K	< 0.1			
Dichlorophenoxy acetic acid, 2,4- (2,4-D)	µg/L	5	EPA 8270	15-Aug-14/K	< 5			
Diclofop-methyl	µg/L	0.5	EPA 8270	15-Aug-14/K	< 0.5			
Dimethoate	µg/L	1	EPA 8270	15-Aug-14/K	< 1			
Dinoseb	µg/L	0.5	EPA 8270	15-Aug-14/K	< 0.5			
Dioxin & Furan (TEQ)	ppq	0.1	E.C. 1/RM/19	03-Sep-14	< 0.1 [4]			
Diquat	µg/L	5	EPA 549.1	11-Aug-14/K	< 5			
Diuron	µg/L	5	EPA 8270	15-Aug-14/K	< 5			
Glyphosate	µg/L	25	EPA 547	11-Aug-14/K	< 25			
Heptachlor + Heptachlor Epoxide	µg/L	0.1	EPA 8080	14-Aug-14/K	< 0.1			
Lindane (Hexachlorocyclohexane, Gamma)	µg/L	0.1	EPA 8080	14-Aug-14/K	< 0.1			
Malathion	µg/L	5	EPA 8270	15-Aug-14/K	< 5			
Methoxychlor	µg/L	0.1	EPA 8080	14-Aug-14/K	< 0.1			
Metolachlor	µg/L	3	EPA 8270	15-Aug-14/K	< 3			
Metribuzin	µg/L	3	EPA 8270	15-Aug-14/K	< 3			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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P.O. NUMBER:
WATERWORKS NO.

	Client I.D.	TW21-72 hour			
	Sample I.D.	B14-19681-1			
	Date Collected	05-Aug-14			

Parameter	Units	M.D.L.	Reference Method	Date/Site Analyzed				
NTA	mg/L	0.03	J. Chrom A 690	11-Aug-14	< 0.03	3		
N-Nitrosodimethylamine	µg/L	0.0008	E3209A/SM 6410B	11-Aug-14	< 0.0008	3		
Paraquat	µg/L	1	EPA 549.1	11-Aug-14/K	< 1			
Parathion	µg/L	3	EPA 8270	15-Aug-14/K	< 3			
Pentachlorophenol	µg/L	0.1	EPA 8270	15-Aug-14/K	< 0.1			
Phorate	µg/L	0.3	EPA 8270	15-Aug-14/K	< 0.3			
Picloram	µg/L	5	EPA 8270	15-Aug-14/K	< 5			
Poly-Chlorinated Biphenyls (PCB's)	µg/L	0.05	EPA 8080	14-Aug-14/K	< 0.05			
Prometryne	µg/L	0.1	EPA 8270	15-Aug-14/K	< 0.1			
Simazine	µg/L	0.5	EPA 8270	15-Aug-14/K	< 0.5			
Temephos	µg/L	10	EPA 8270	15-Aug-14/K	< 10			
Terbufos	µg/L	0.3	EPA 8270	15-Aug-14/K	< 0.3			
Tetrachlorophenol, 2,3,4,6-	µg/L	0.1	EPA 8270	15-Aug-14/K	< 0.1			
Triallate	µg/L	10	EPA 8270	15-Aug-14/K	< 10			
Trichlorophenol 2,4,6-	µg/L	0.1	EPA 8270	15-Aug-14/K	< 0.1			
Trichlorophenoxy acetic acid, 2,4,5-	µg/L	10	EPA 8270	15-Aug-14/K	< 10			
Trifluralin	µg/L	0.5	EPA 8270	15-Aug-14/K	< 0.5			
Gross Alpha	Bq/L	0.1	GFPC	21-Aug-14	< 0.1	1		
Gross Beta	Bq/L	0.15	GFPC	21-Aug-14	< 0.15	1		
Tritium	Bq/L	100	LSC	21-Aug-14	< 100	1		
Total Coliform	cfu/100mL	1	MOE E3407	06-Aug-14/O	0			
E coli	cfu/100mL	1	MOE E3407	06-Aug-14/O	0			
Background	cfu/100mL	1	MOE E3407	06-Aug-14/O	76			
Heterotrophic Plate Count	cfu/mL	2	SM 9215C	06-Aug-14/O	< 2			

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW21-72 hour			
			Sample I.D.		B14-19681-1			
			Date Collected		05-Aug-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Microcystin DM	ppb	0.1	NA	11-Aug-14	< 0.1 [2]			

1 Subcontracted to Becquerel Labs
2 subcontracted to COAL Inc.
3 Subcontracted to SGS Lakefield
4 Subcontracted to Wellington Labs

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Table D-2: Water Quality Results

CENTRAL ONTARIO ANALYTICAL LABORATORY INC.

4260 Burnside Line, R.R. #4
Orillia, ON L3V 6H4
Tel: (705) 326-8285 Fax: (705) 326-9316
www.coalab.ca

Final Certificate of Microbiological Analysis of Drinking Water

Date & Time Received:	Temp. Rec'd. (°C):	Receiver:	Date & Time Incubated:	2014-08-05 11:30
2014-08-05 11:00	3.1	AB	HPC & FS Date & Time Incubated:	

Date Sampled: 2014-08-05

Collected By: Alicia Beynon

Name of Facility: Golder Associates

Drinking Water System (DWS) #

Submitted By: Alicia Beynon

Twp/Town	
Systems Health Unit	SMDHU
Regulation	N/A
Total # of pages sent	3
# of samples sent	15
# of samples received	15

Report To: **Golder Associates Ltd.**

Address: 121 Commerce Park Drive, Unit L, Barrie, ON. L4N 8X1

Telephone: 705 722-4492 Ext: Fax: 705-722-3786

Email Address: patricia_chapple@golder.com ; Alicia_Beynon@golder.com

"Live Person" After Hours Contact Name and Tel. No:

Conditions/ Comments 13-1170-0040

Time Sampled	Sample Identifier	Identification of Collection Site	Water Type	Temp. Of Sample (°C/°F)	Treatment Information				Laboratory Number	Total Coliform		E. coli		Background		HPC		
					U.V.	Other	Total Cl_2 (mg/L)	Free Cl_2 (mg/L)		>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/1 ml	
10:00	TW21	(R)	R						905721		1		0		17			

All samples will be considered DISTRIBUTION samples unless otherwise indicated.

All times are transcribed in the 24-hour clock for upload to the Ministry of the Environment (MOE) and/or Ministry of Health and Long Term Care (MoHLTC).

Analysis performed by qualified analysts. Results relate only to the aliquot submitted. Samples have been analyzed as received. COAL is accredited by SCC and licensed by MOE in these specific microbiological parameters and the following inorganic and physical parameters: pH, turbidity, and alkalinity.

COAL accepts no responsibility for parameters selected, misidentification of samples or incorrect quantity, this is the responsibility of the submitting agency.

For collection and handling procedures visit www.coalab.ca/watersamples.html

Raw = R
Distribution = D
Point of Entry = E
Raw Water Comsumed = RWC

F.S. & Faecal Strep. = Faecal Streptococcus HPC = Hetero HPM = Heavy Particulate Matter N/R = Not Received F.S. and HPC require 48 hours of incubation

Analysis Date & Time: 2014-08-06 11:00 Enumerated By: LJ Audited By: GD Methodology: M/F CFU/100ml

Analysis Date & Time: Enumerated By: Audited By: HPC Methodology: SP CFU/1ml; FS Methodology: M/F CFU/100ml

Transcribed By: HM Authorized & Rechecked By: TJ/JT Copy Released By: AB, CAB, LJ

Lab No. ımitting Agenc Health Unit @ Spills Action Centre (SAC) @ AWQI # By: Date:

Test Methodology and Detection Limit

Total Coliform (Treated)	COAL Endo	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Total Coliform (Untreated)	COAL DC	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
E. coli	COAL DC	0 - 60	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL Endo	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL DC	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
HPC	COAL HPC	10 - 2.00 x 10^3	Indicates Deterioration:	>500	Performed by Spread Plate	SP CFU/1 ml
Faecal Streptococcus	COAL FS	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml

Approved for use by TJ prior to use.

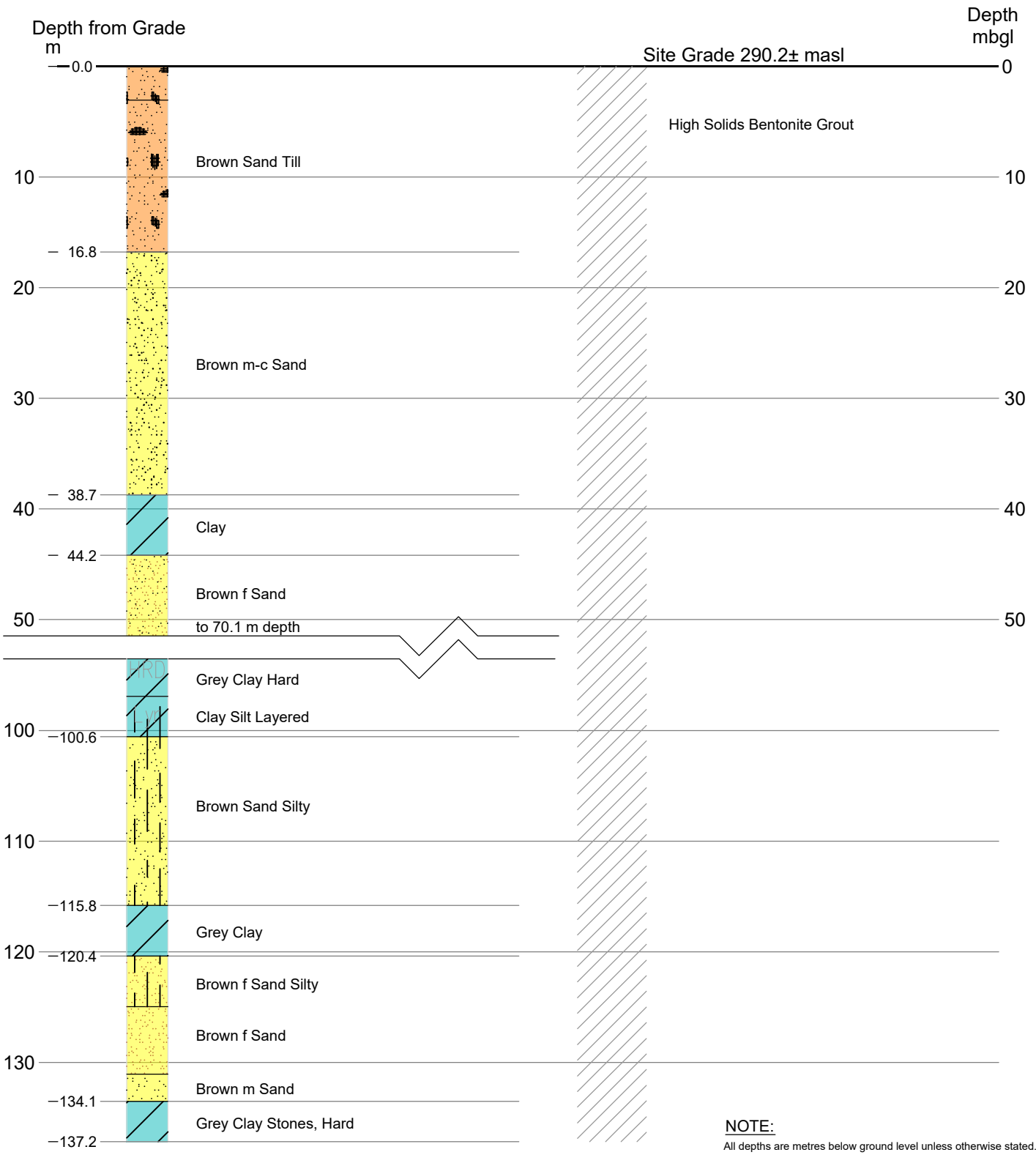
APPENDIX E

Site 4: Well Construction and Testing Doran Road

TH23

Golder ID L0424

Sealed and Abandoned



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-09-25
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

TEST HOLE TH23
ABANDONED

FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **E-1**

PLOT DATE: September 25, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure E-1]

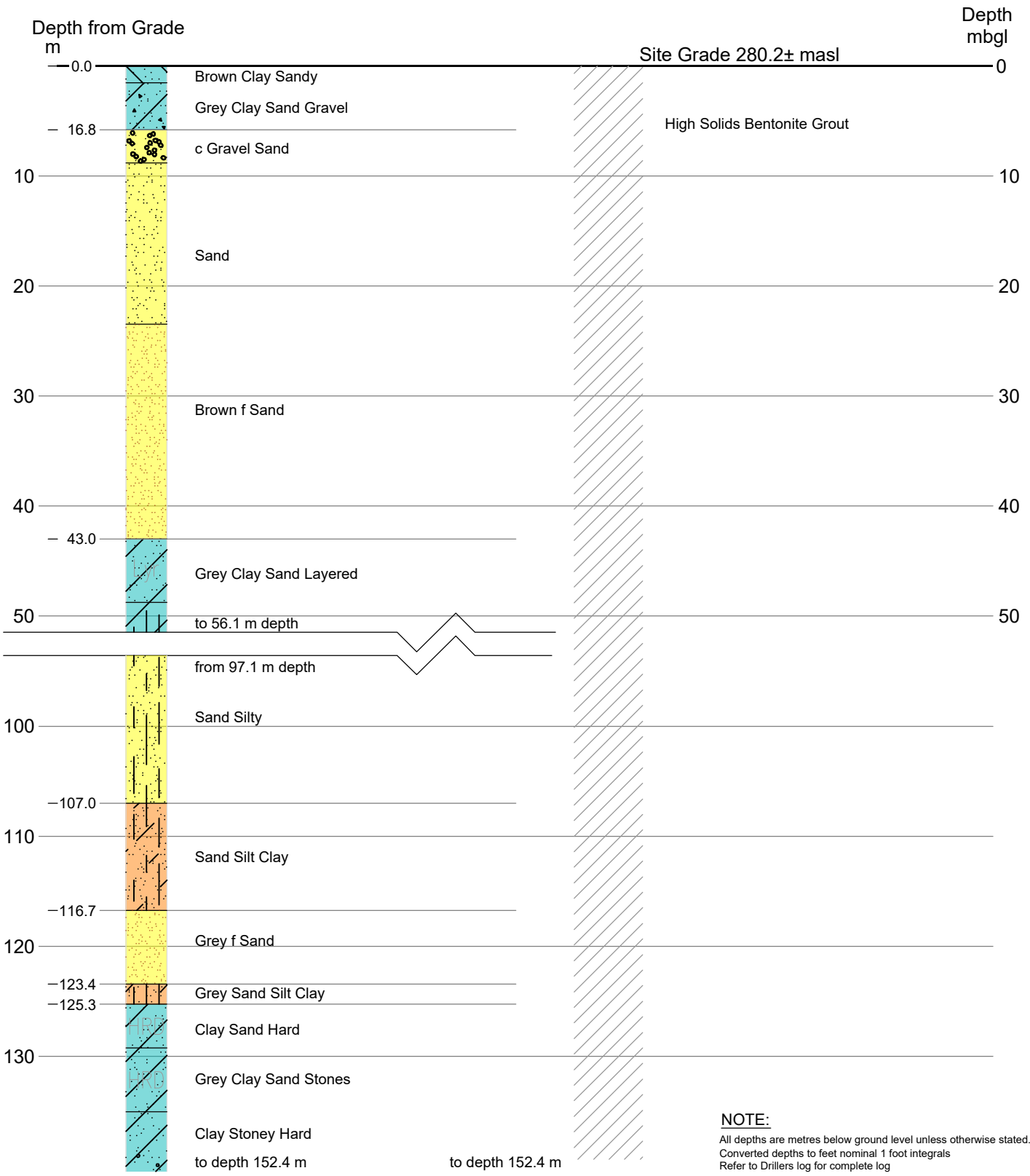
APPENDIX F

Site 5: Well Construction and Testing: Anne Street

TH26

Golder ID L0428

Sealed and Abandoned



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-09-25
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

TEST HOLE TH26
ABANDONED

FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **F-1**

PLOT DATE: September 25, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB-\1311700040CBLOGS.dwg: [Figure F-1]

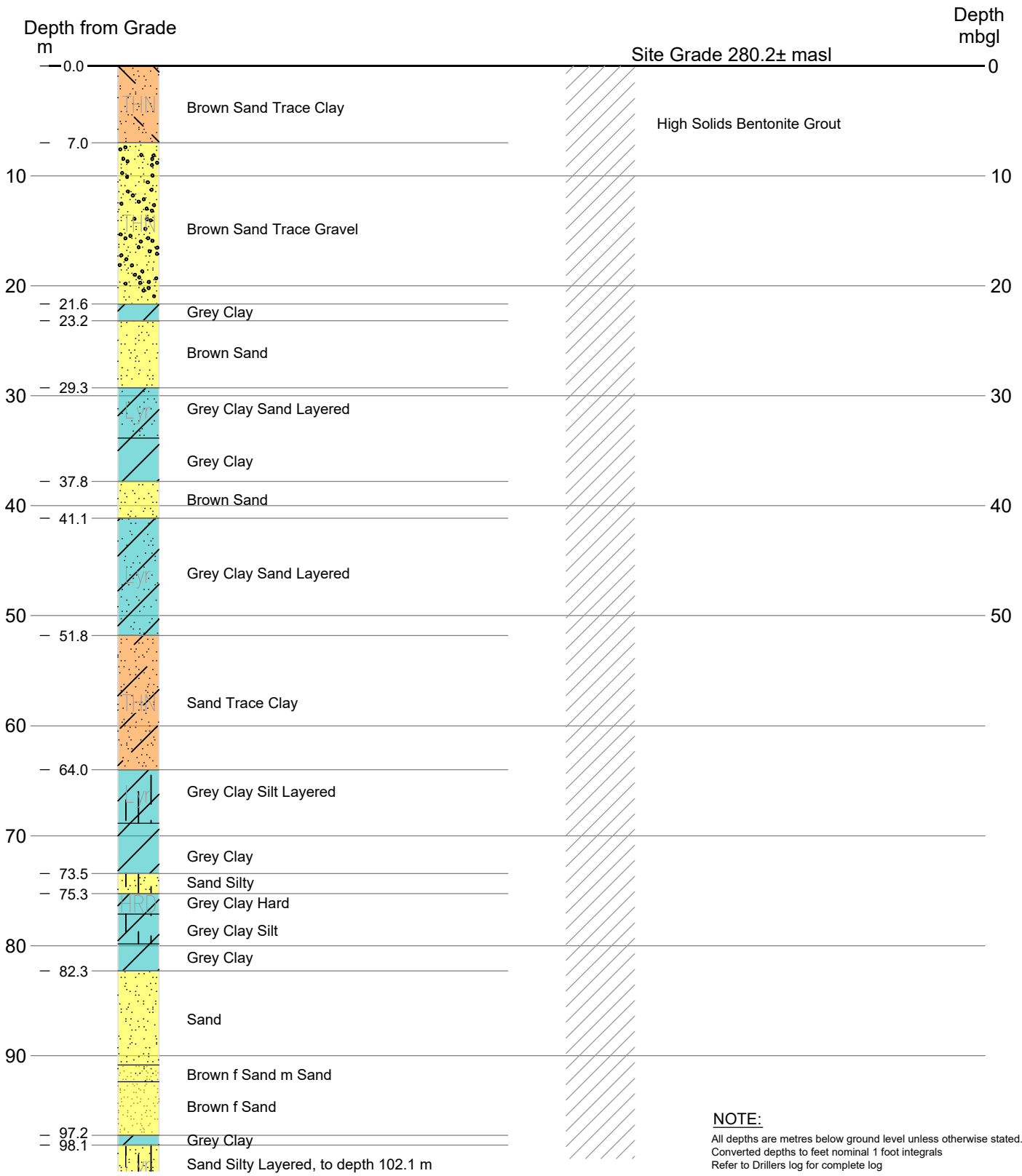
APPENDIX G

Site 6: Well Construction and Testing: Hickling Farm

TH27

Golder ID L0429

Sealed and Abandoned



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-09-25
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

TEST HOLE TH27 ABANDONED

FILE No. 1311700040CBLOGS.dwg		
PROJECT No. 13-1170-0040	REV.	

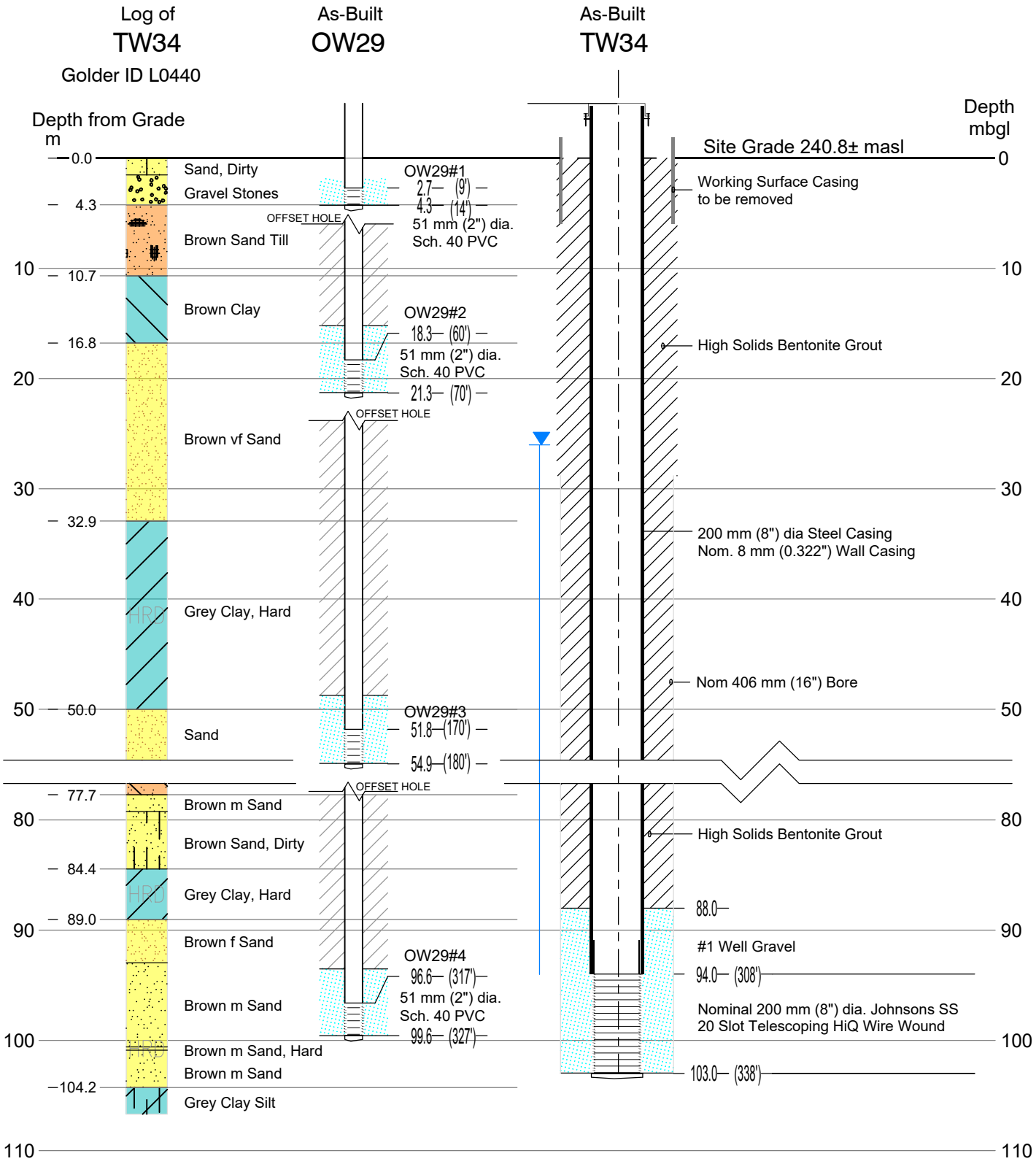
MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **G-1**

PLOT DATE: September 25, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure G-1]

APPENDIX H

Site 7: Well Construction and Testing: Snow Valley Road (West)



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log
Construction of OW29 is adjusted for difference relative to grade at TW34

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

PRODUCTION WELL TW34
AS-BUILT

FILE No.	1311700040CBLOGS.dwg
PROJECT No.	13-1170-0040
REV.	

MIDHURST
WATER SUPPLY EXPLORATION

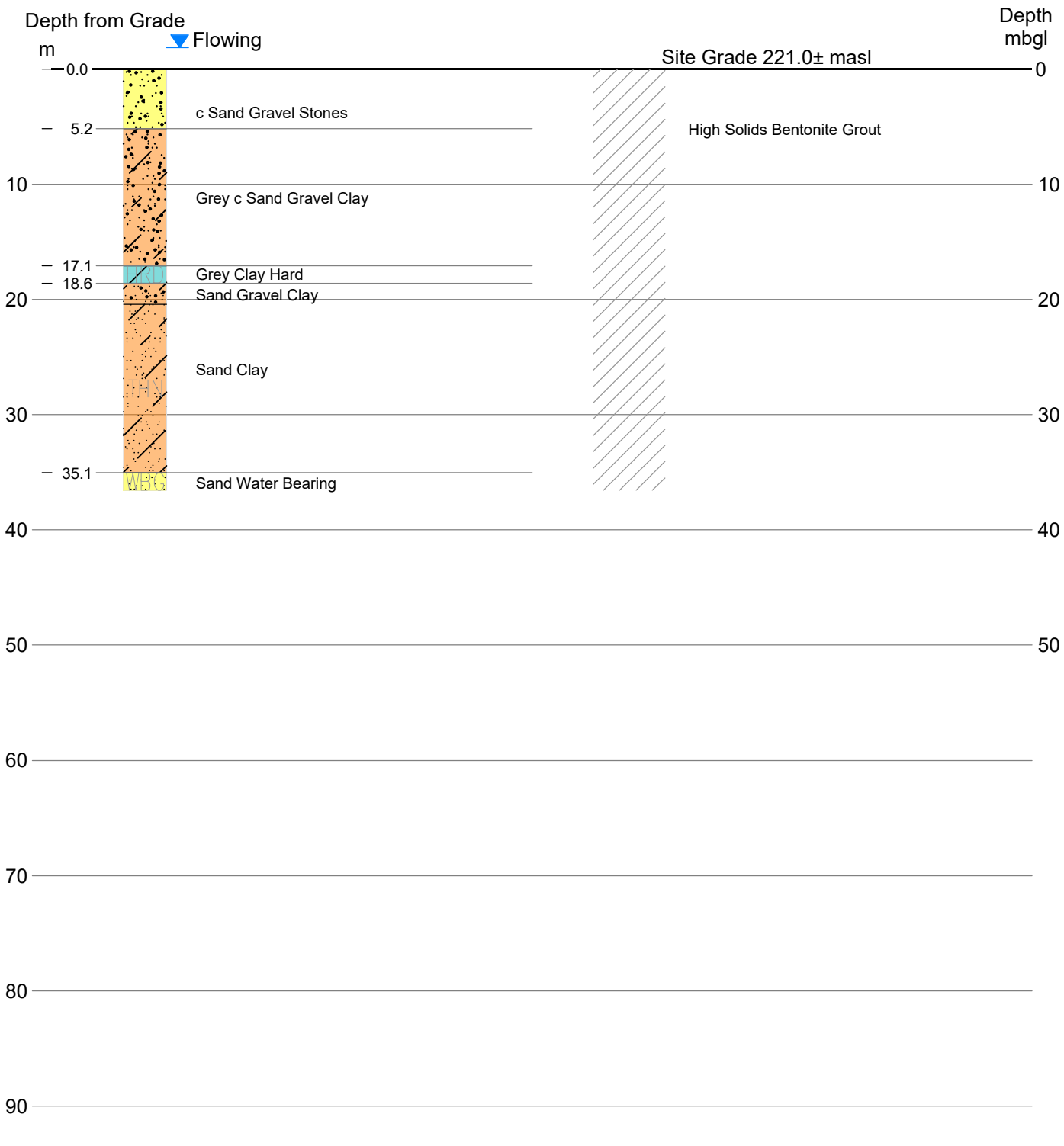
FIGURE
H-1

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure H-1]

TH33

Golder ID L0438

Sealed and Abandoned



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-09-25
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

TEST HOLE TH33
ABANDONED

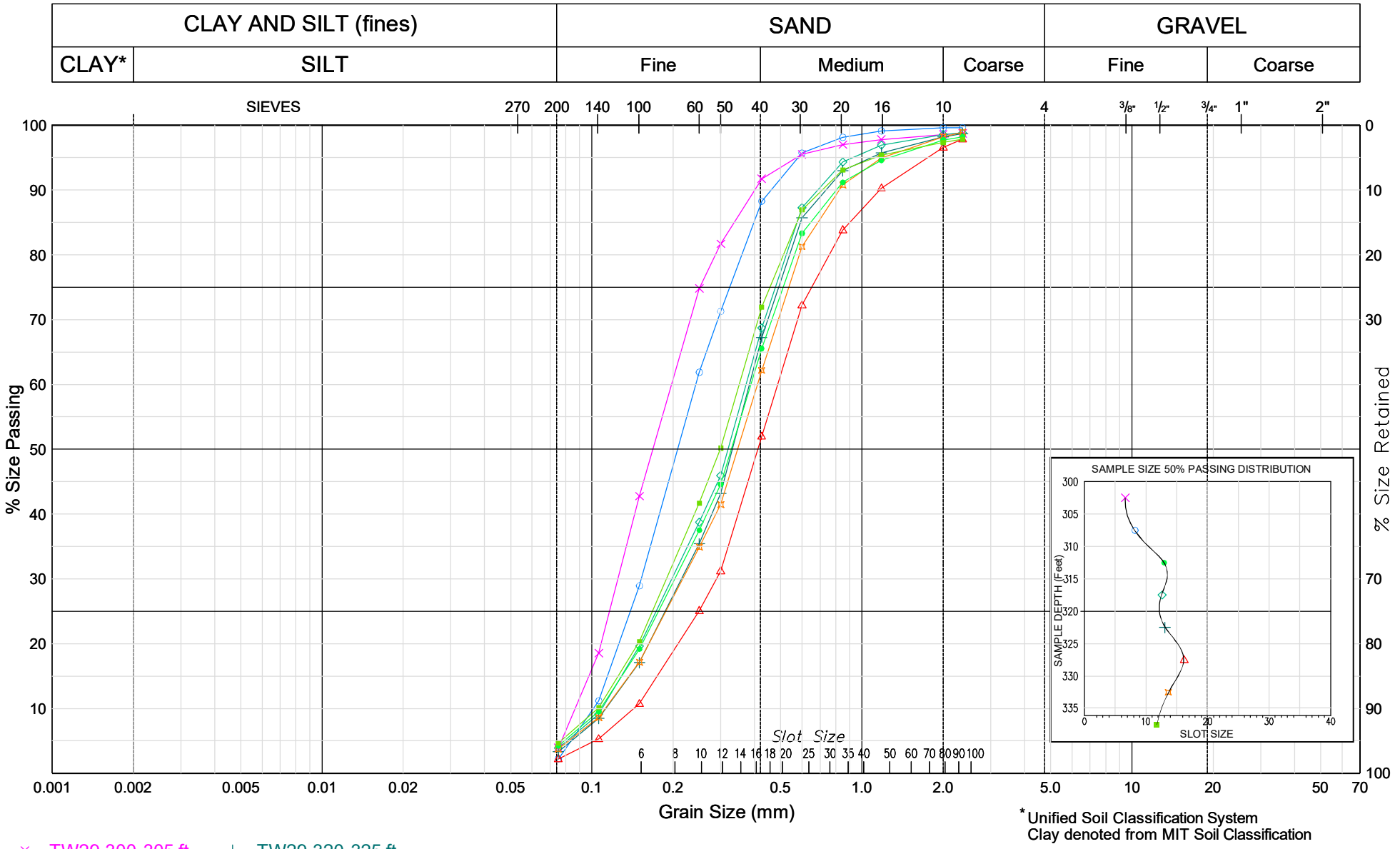
FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE **H-2**

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure H-2]

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE29.dwg



*Unified Soil Classification System
Clay denoted from MIT Soil Classification

TITLE

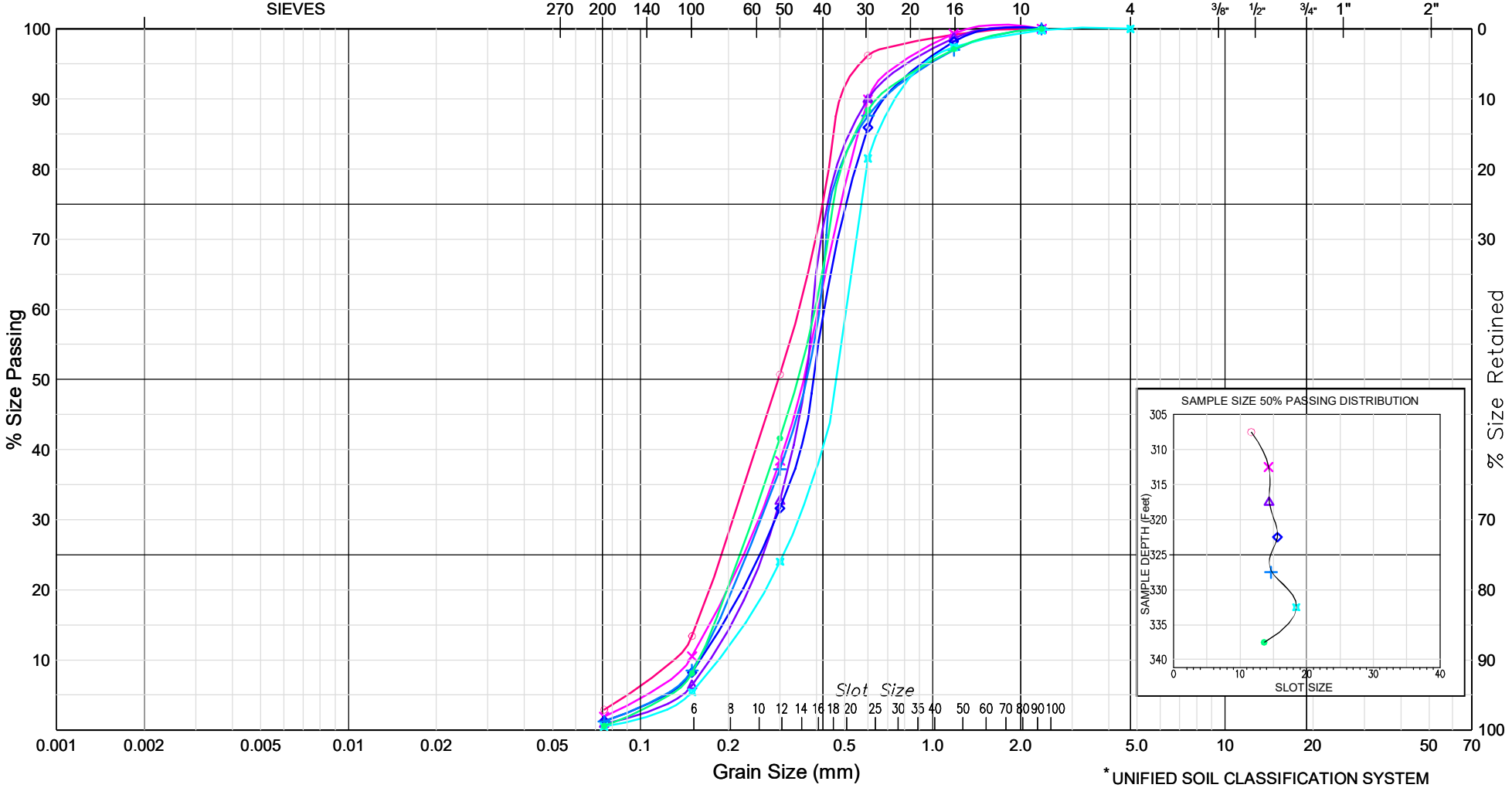
GRAIN SIZE ANALYSIS
OW29

MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-04-04
CAD	JPR
CHECK	
REVIEW	
FILE No.	1311700040BASVE29.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	H-3

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE34.dwg



LEGEND

- TW34 305-310 ft
- TW34 310-315 ft
- TW34 315-320 ft
- TW34 320-325 ft
- TW34 325-330 ft
- TW34 330-335 ft
- TW34 335-340 ft

*UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

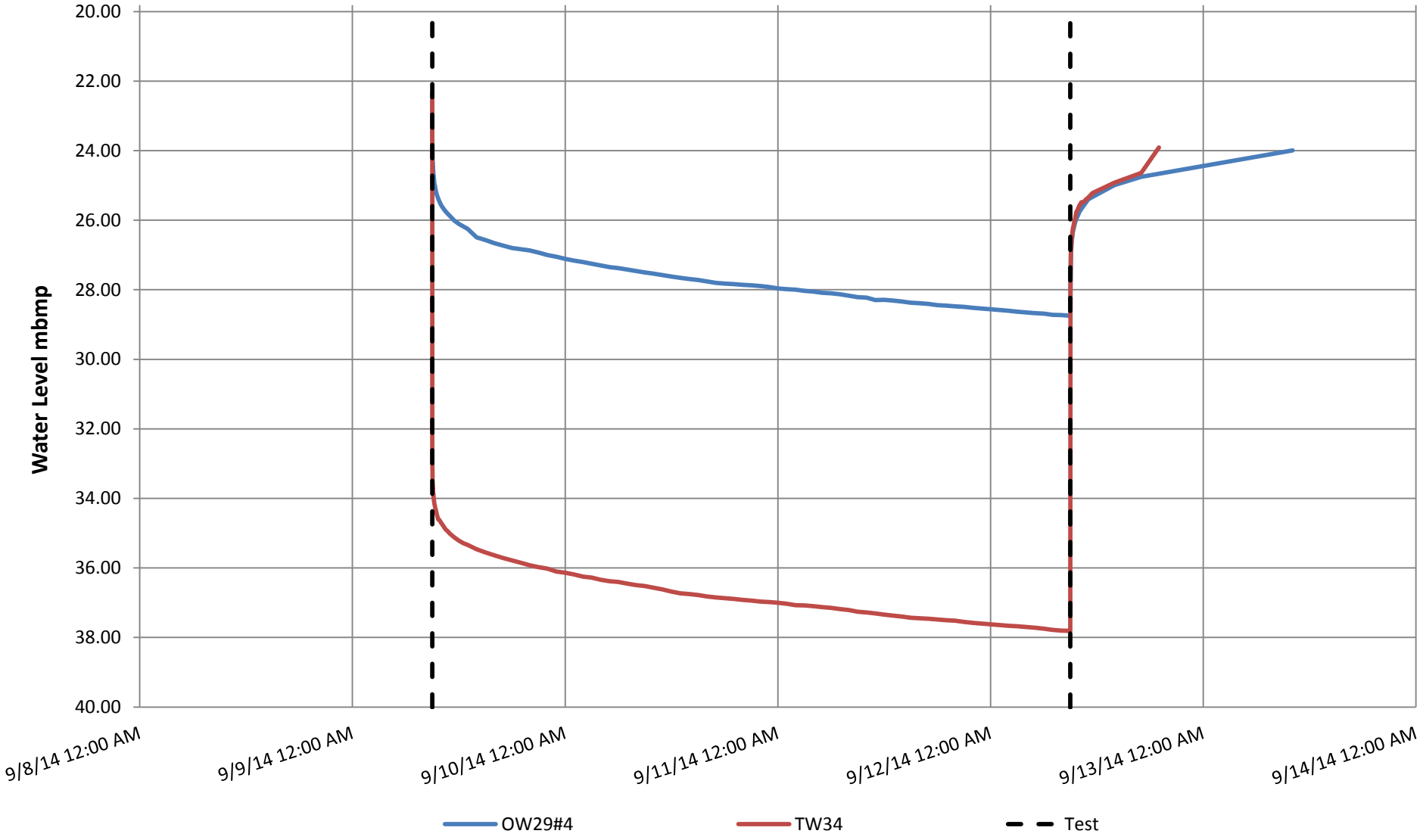
TITLE

GRAIN SIZE ANALYSIS
TW34

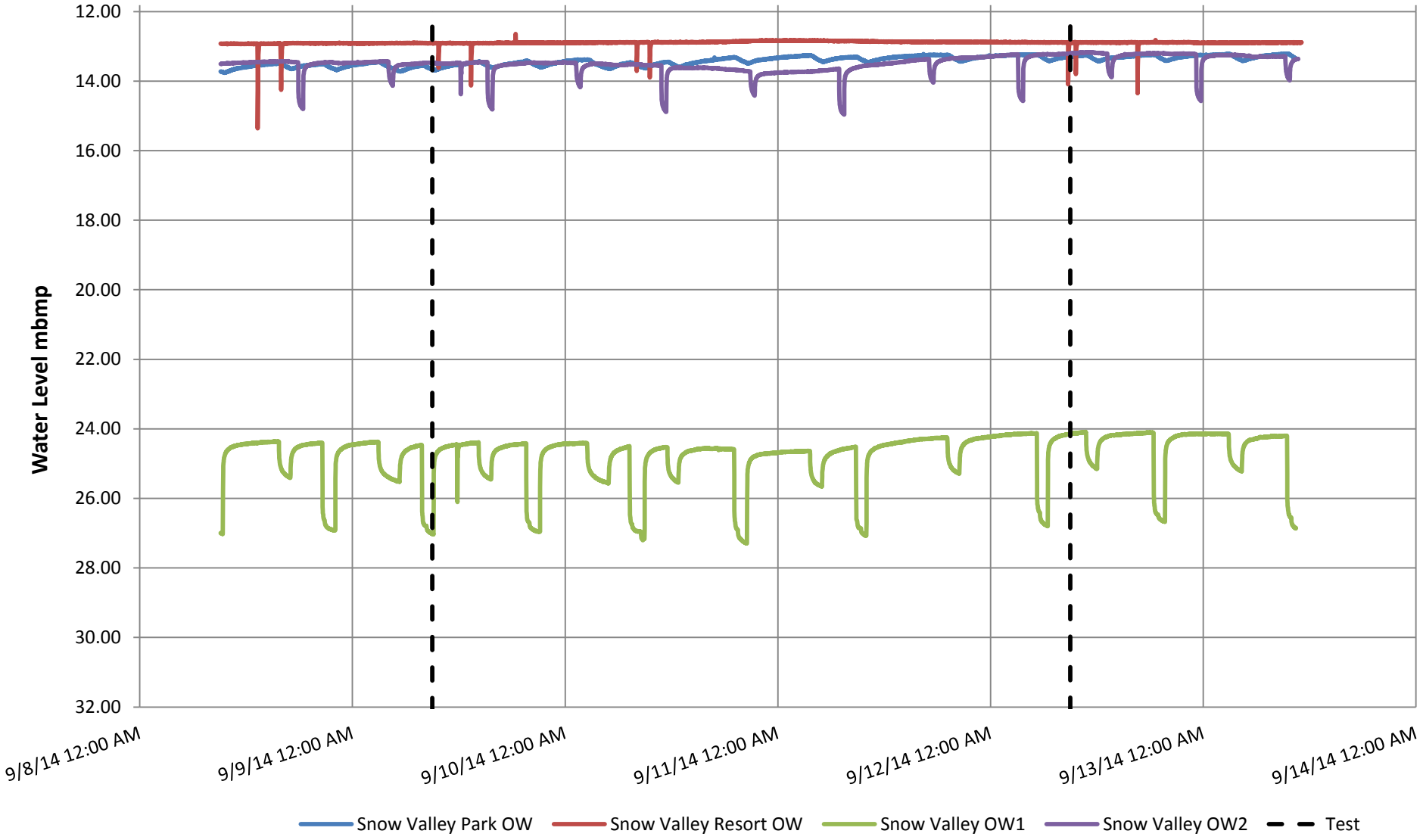
MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

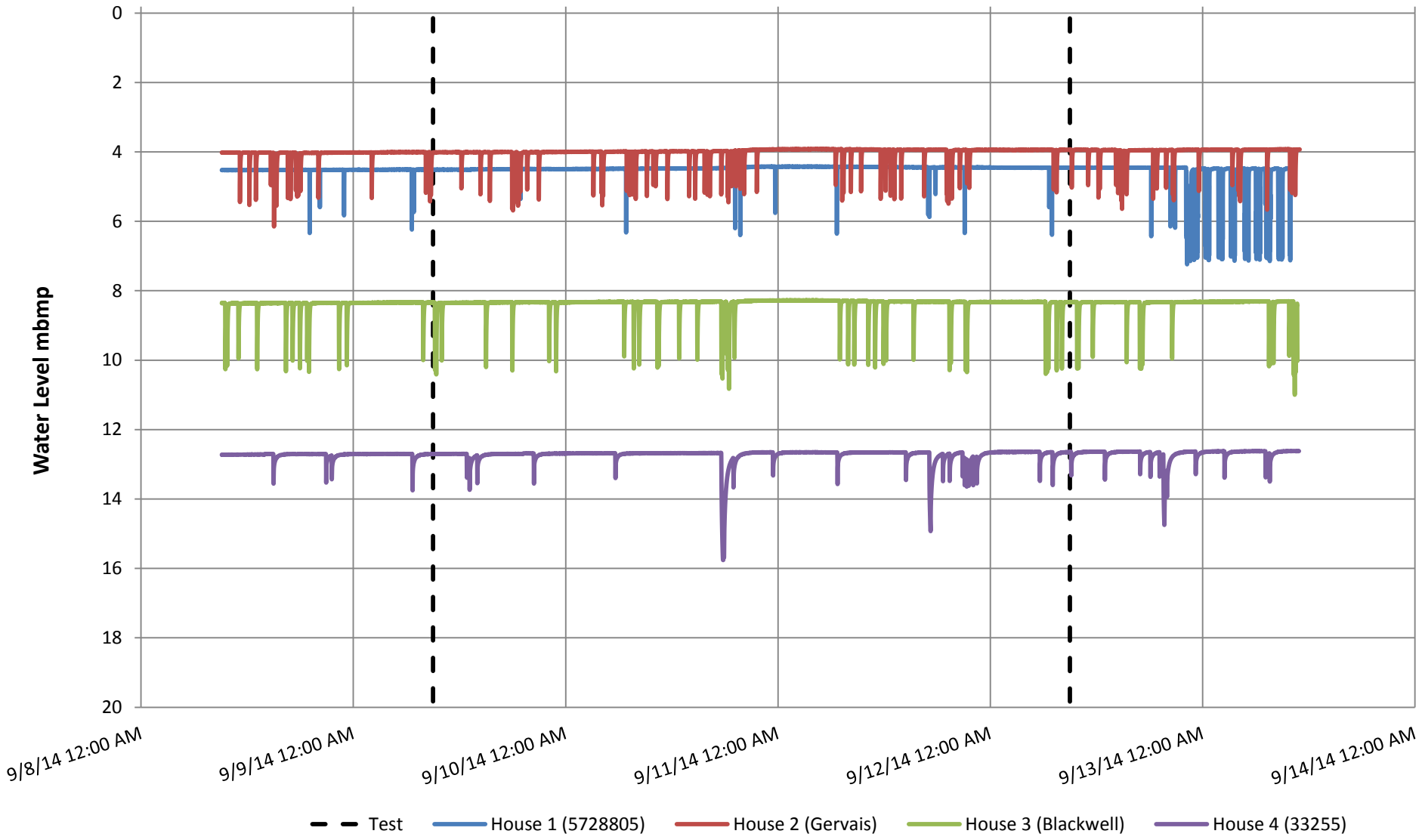
SCALE	AS SHOWN
DATE	2014-10-30
CAD	JPR
CHECK	ALB
REVIEW	JAE
FILE No.	1311700040BASVE34.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	H-4



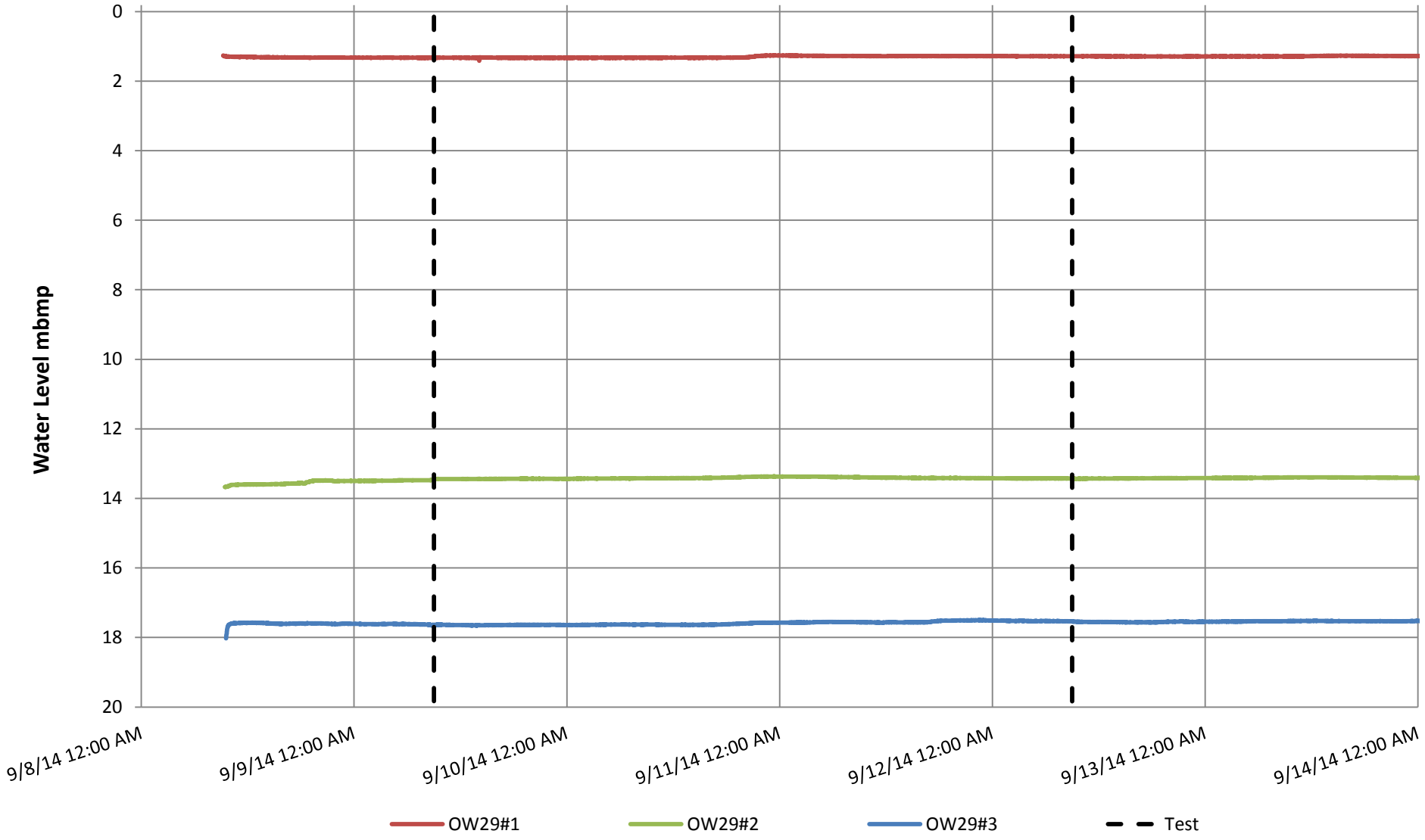
Test Date: September 9, 2014	Golder Associates	SCALE: NTS	**Testing of TW34**	
Pumping Rate: 20 L/s		DATE: 29-Oct-14	**Record of Observation Wells**	
		CAD: ALB		
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY	FIGURE No.
	PROJECT No. 13-1170-0040	REVIEW:	CONSTRUCTION & TESTING of TW34	H-5



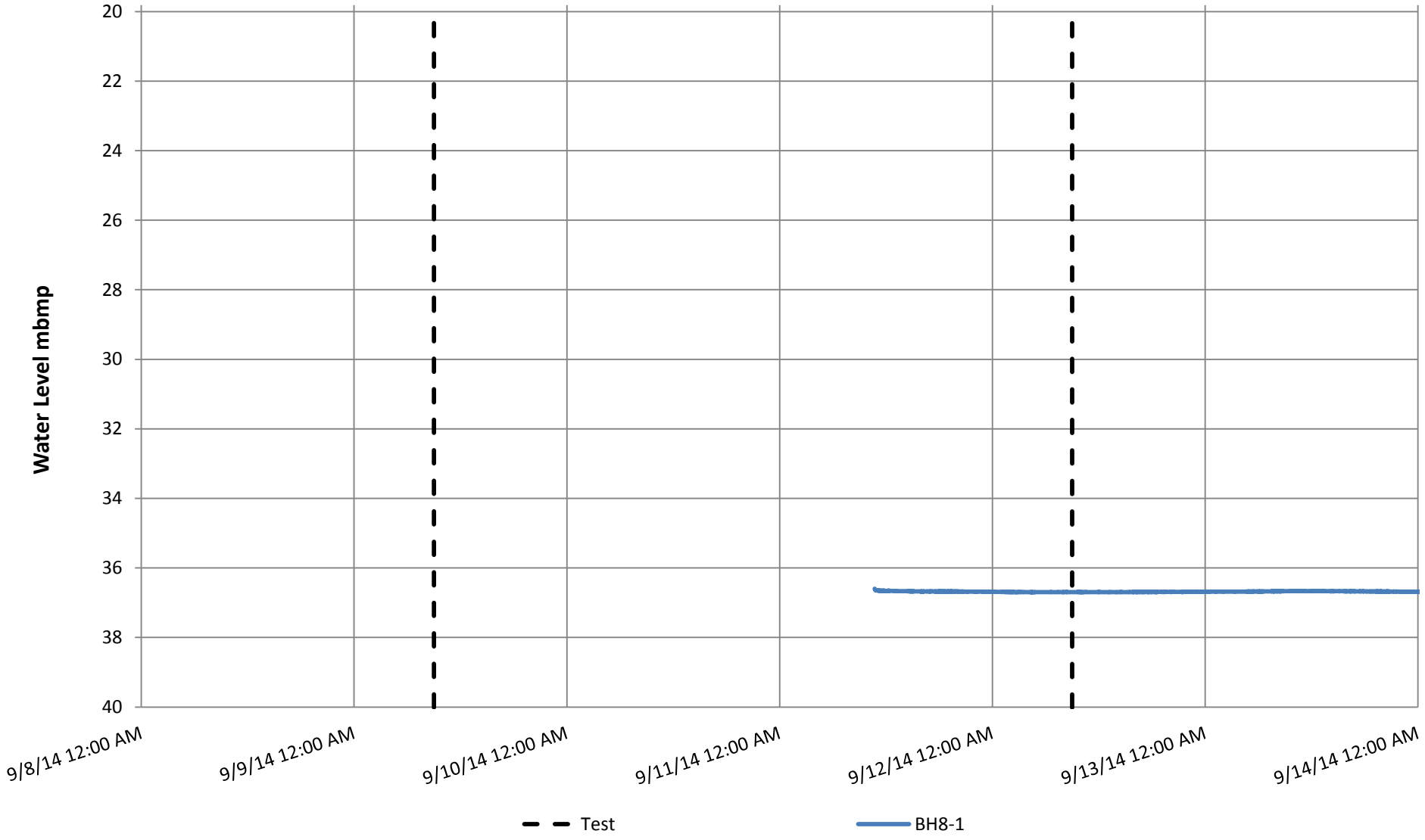
Test Date: September 9, 2014	Golder Associates	SCALE: NTS	**Testing of TW34**	
Pumping Rate: 20 L/s		DATE: 29-Oct-14	**Record of Observation Wells**	
		CAD: ALB		
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY	FIGURE No.
	PROJECT No. 13-1170-0040	REVIEW:	CONSTRUCTION & TESTING of TW34	H-6



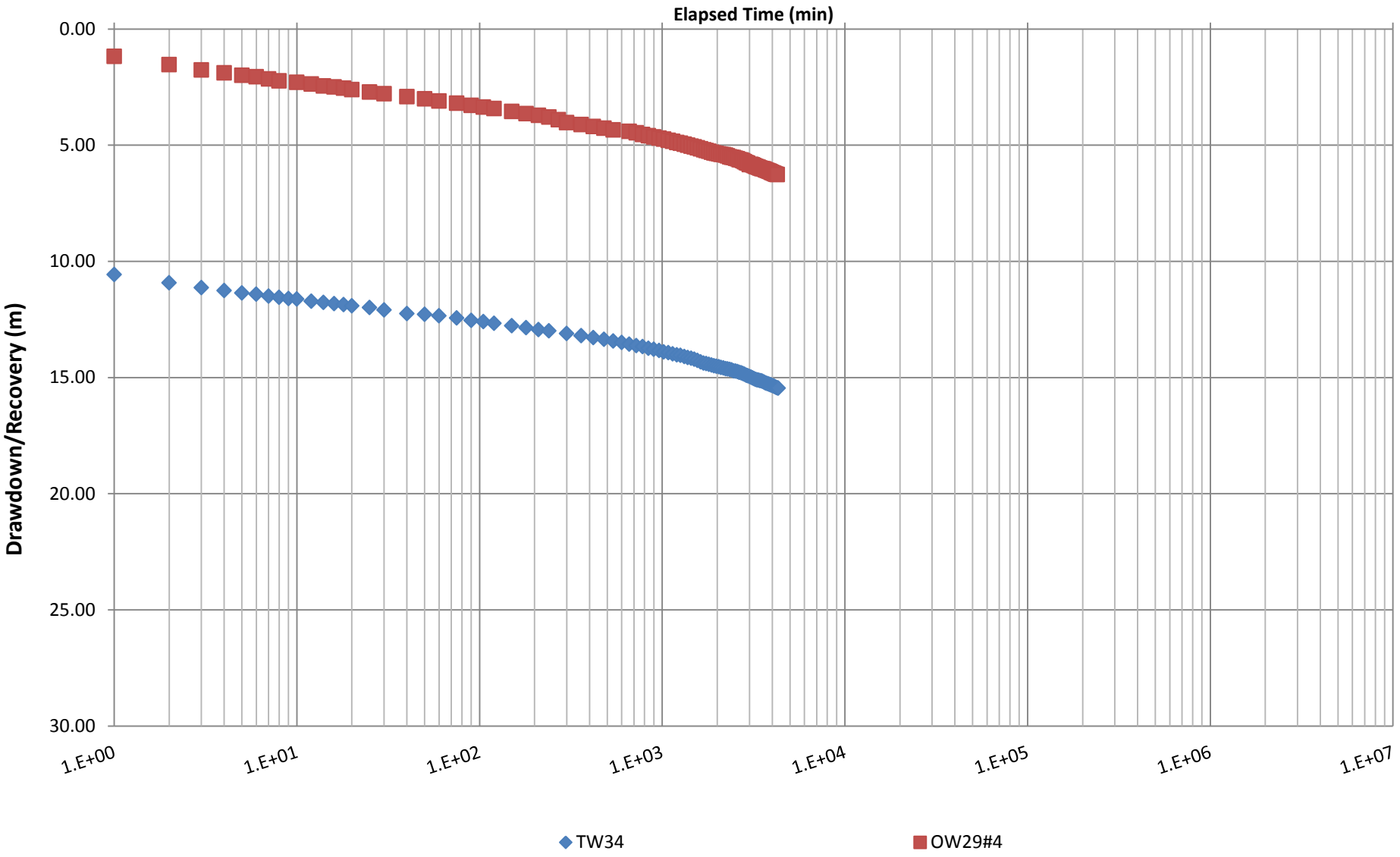
Test Date: September 9, 2014	Golder Associates	SCALE: NTS	**Testing of TW34** **Record of Oberservation Wells**
Pumping Rate: 20 L/s		DATE: 29-Oct-14	
		CAD: ALB	
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW34 — FIGURE No. H-7
	PROJECT No. 13-1170-0040	REVIEW:	



Test Date: September 9, 2014	Golder Associates	SCALE: NTS	**Testing of TW34**	
Pumping Rate: 20 L/s		DATE: 29-Oct-14	**Record of Observation Wells**	
		CAD: ALB		
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY	FIGURE No.
	PROJECT No. 13-1170-0040	REVIEW:	CONSTRUCTION AND TEST of TW34	H-8



Test Date:	September 9, 2014	Golder Associates	SCALE:	NTS	**Testing of TW34** **Record of Observation Well BH8-1**
Pumping Rate:	20 L/s		DATE:	29-Oct-14	
			CAD:	ALB	
Static Water Level (mbmp):	36.6	FILE No. 1311700040TRANS	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of TW34
		PROJECT No. 13-1170-0040	REVIEW:		FIGURE No. H-9



Test Date:	September 9, 2014	SCALE:	NTS
Pumping Rate:	20 L/s	DATE:	30-Oct-14
TW34 Static Level (mbmp):	22.35	CAD:	ALB
TW34 Pumping Level (mbmp):	37.81	CHECK:	
		REVIEW:	

Golder Associates

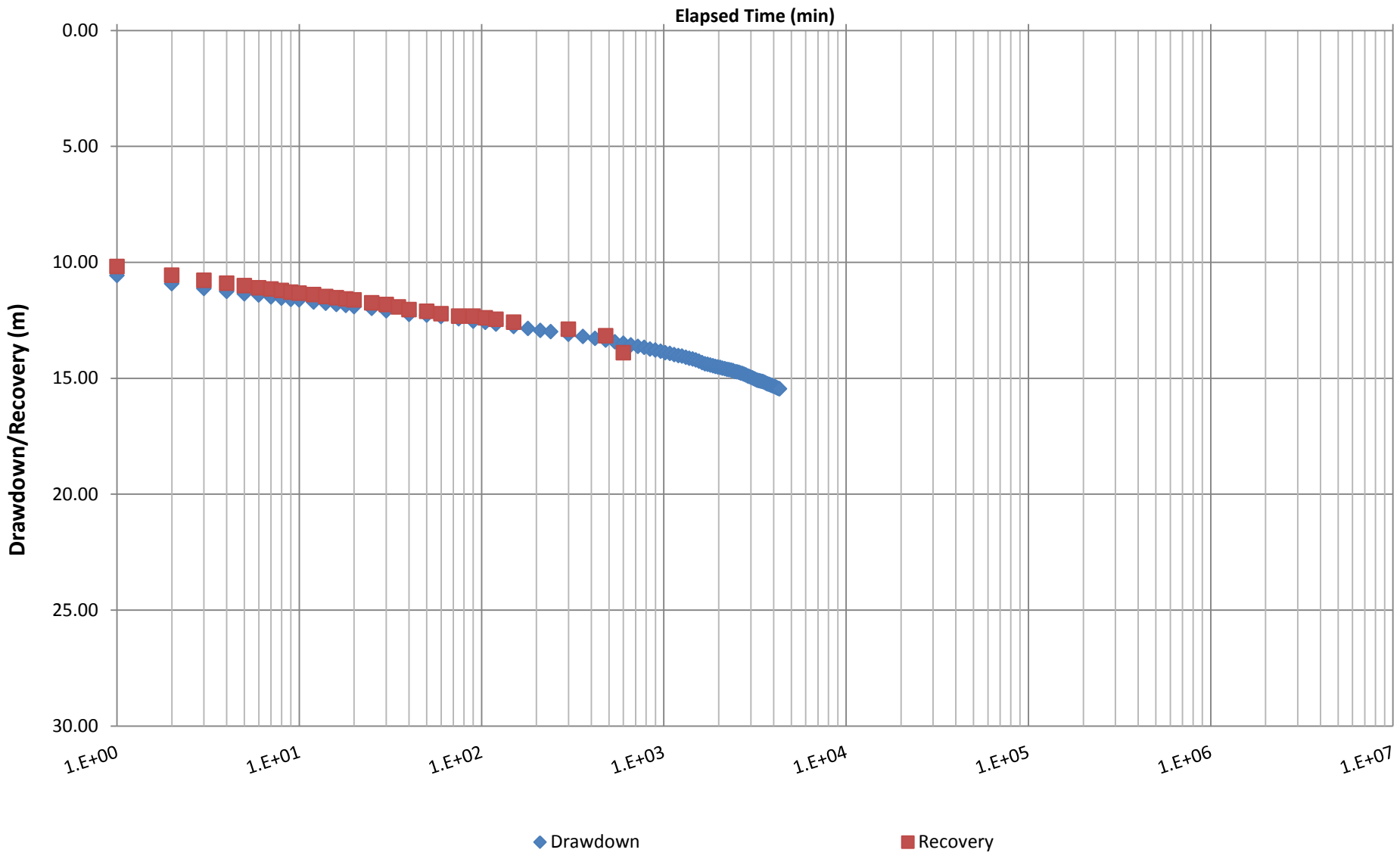
FILE No. 1311700040TRANS

PROJECT No. 13-1170-0040

Pumping Test Hydrograph
Record of OW29#4 and TW34

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW34

FIGURE No.
H-10



Test Date:	September 9, 2014
Pumping Rate:	20 L/s
Distance from TW34 (m):	0
Static Water Level (mbmp):	22.35
Pumping Water Level (mbmp):	37.81

Golder Associates

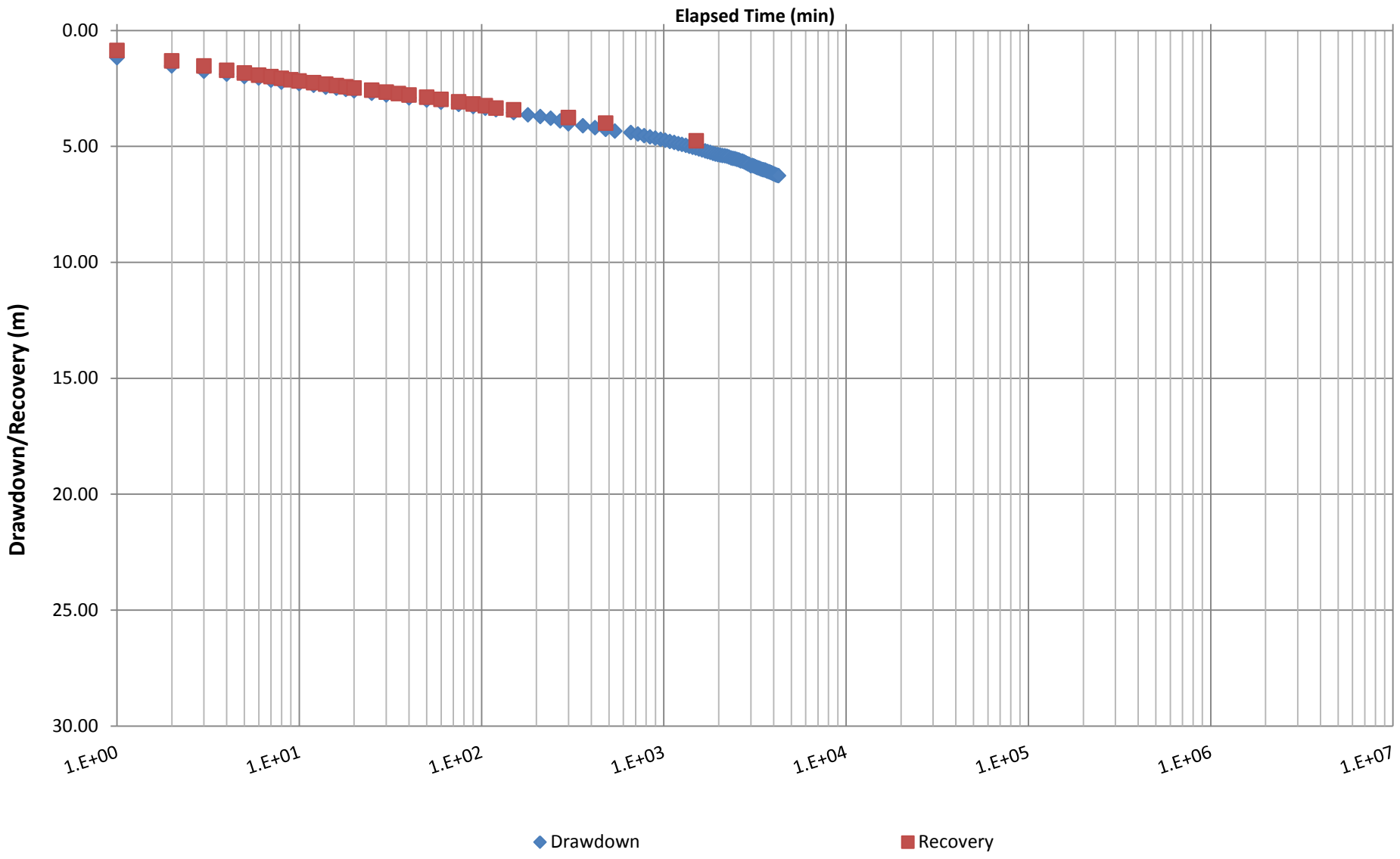
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	29-Oct-14
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of TW34

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW34

FIGURE No.
H-11



Test Date:	September 9, 2014
Pumping Rate:	20 L/s
Distance from TW34:	17 m
Static Water Level (mbmp):	22.46
Pumping Water Level (mbmp):	28.75

Golder Associates

FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	29-Oct-14
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of OW29#4

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of TW34

FIGURE No.
H-12

Tabulated Levels forTW34

Pump On:	09-Sep-2014 09:00			Static Level:	22.35		
Pump Off:	12-Sep-2014 09:00			Pumping Level:	37.81		
Pumping Well:	**TW34**			DD:	15.46		
Distance from Pumping Well:	0 m			20 Yr DD:	24		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	22.35	0.00	12-Sep-2014 09:00	0	37.81	0.00
09-Sep-2014 09:01	1	32.92	10.57	12-Sep-2014 09:00	0.500000002	28.12	9.69
09-Sep-2014 09:02	2	33.28	10.93	12-Sep-2014 09:01	1.000000003	27.63	10.18
09-Sep-2014 09:03	3	33.48	11.13	12-Sep-2014 09:02	1.999999996	27.25	10.56
09-Sep-2014 09:04	4	33.61	11.26	12-Sep-2014 09:03	2.999999999	27.03	10.78
09-Sep-2014 09:05	5	33.71	11.36	12-Sep-2014 09:04	4.000000003	26.91	10.90
09-Sep-2014 09:06	6	33.77	11.42	12-Sep-2014 09:05	4.999999995	26.80	11.01
09-Sep-2014 09:07	7	33.85	11.50	12-Sep-2014 09:06	5.999999999	26.71	11.10
09-Sep-2014 09:08	8	33.90	11.55	12-Sep-2014 09:07	7.000000002	26.65	11.16
09-Sep-2014 09:09	9	33.95	11.60	12-Sep-2014 09:08	8.000000005	26.59	11.22
09-Sep-2014 09:10	10	33.98	11.63	12-Sep-2014 09:09	8.999999998	26.52	11.29
09-Sep-2014 09:12	12	34.07	11.72	12-Sep-2014 09:10	10	26.48	11.33
09-Sep-2014 09:14	14	34.12	11.77	12-Sep-2014 09:12	12	26.42	11.39
09-Sep-2014 09:16	16	34.17	11.82	12-Sep-2014 09:14	14	26.33	11.48
09-Sep-2014 09:18	18	34.22	11.87	12-Sep-2014 09:16	16	26.28	11.53
09-Sep-2014 09:20	20	34.27	11.92	12-Sep-2014 09:18	18	26.23	11.58
09-Sep-2014 09:25	25	34.34	11.99	12-Sep-2014 09:20	20	26.18	11.63
09-Sep-2014 09:30	30	34.44	12.09	12-Sep-2014 09:25	25	26.06	11.75
09-Sep-2014 09:40	40	34.60	12.25	12-Sep-2014 09:30	30	25.99	11.82
09-Sep-2014 09:50	50	34.63	12.28	12-Sep-2014 09:35	35	25.88	11.93
09-Sep-2014 10:00	60	34.70	12.35	12-Sep-2014 09:40	40	25.77	12.04
09-Sep-2014 10:15	75	34.79	12.44	12-Sep-2014 09:50	50	25.69	12.12
09-Sep-2014 10:30	90	34.89	12.54	12-Sep-2014 10:00	60	25.59	12.22
09-Sep-2014 10:45	105	34.95	12.60	12-Sep-2014 10:15	75	25.48	12.33
09-Sep-2014 11:00	120	35.02	12.67	12-Sep-2014 10:30	90	25.48	12.33
09-Sep-2014 11:30	150	35.12	12.77	12-Sep-2014 10:45	105	25.41	12.40
09-Sep-2014 12:00	180	35.21	12.86	12-Sep-2014 11:00	120	25.35	12.46
09-Sep-2014 12:30	210	35.29	12.94	12-Sep-2014 11:30	150	25.22	12.59
09-Sep-2014 13:00	240	35.34	12.99	12-Sep-2014 14:00	300	24.92	12.89
09-Sep-2014 14:00	300	35.46	13.11	12-Sep-2014 17:00	480	24.64	13.17
09-Sep-2014 15:00	360	35.55	13.20	12-Sep-2014 19:00	600	23.91	13.90
09-Sep-2014 16:00	420	35.64	13.29				
09-Sep-2014 17:00	480	35.71	13.36				
09-Sep-2014 18:00	540	35.78	13.43				
09-Sep-2014 19:00	600	35.85	13.50				
09-Sep-2014 20:00	660	35.92	13.57				
09-Sep-2014 21:00	720	35.98	13.63				
09-Sep-2014 22:00	780	36.02	13.67				
09-Sep-2014 23:00	840	36.10	13.75				
10-Sep-2014 00:00	900	36.14	13.79				
10-Sep-2014 01:00	960	36.19	13.84				
10-Sep-2014 02:00	1020	36.25	13.90				
10-Sep-2014 03:00	1080	36.28	13.93				
10-Sep-2014 04:00	1140	36.34	13.99				
10-Sep-2014 05:00	1200	36.38	14.03				
10-Sep-2014 06:00	1260	36.40	14.05				
10-Sep-2014 07:00	1320	36.45	14.10				
10-Sep-2014 08:00	1380	36.49	14.14				
10-Sep-2014 09:00	1440	36.52	14.17				
10-Sep-2014 10:00	1500	36.57	14.22				
10-Sep-2014 11:00	1560	36.62	14.27				
10-Sep-2014 12:00	1620	36.68	14.33				
10-Sep-2014 13:00	1680	36.73	14.38				
10-Sep-2014 14:00	1740	36.75	14.40				
10-Sep-2014 15:00	1800	36.78	14.43				
10-Sep-2014 16:00	1860	36.82	14.47				
10-Sep-2014 17:00	1920	36.85	14.50				
10-Sep-2014 18:00	1980	36.87	14.52				
10-Sep-2014 19:00	2040	36.89	14.54				
10-Sep-2014 20:00	2100	36.92	14.57				
10-Sep-2014 21:00	2160	36.94	14.59				
10-Sep-2014 22:00	2220	36.97	14.62				
10-Sep-2014 23:00	2280	36.98	14.63				
11-Sep-2014 00:00	2340	37.00	14.65				
11-Sep-2014 01:00	2400	37.03	14.68				
11-Sep-2014 02:00	2460	37.07	14.72				
11-Sep-2014 03:00	2520	37.08	14.73				
11-Sep-2014 04:00	2580	37.10	14.75				
11-Sep-2014 05:00	2640	37.13	14.78				
11-Sep-2014 06:00	2700	37.15	14.80				
11-Sep-2014 07:00	2760	37.18	14.83				
11-Sep-2014 08:00	2820	37.21	14.86				
11-Sep-2014 09:00	2880	37.26	14.91				
11-Sep-2014 10:00	2940	37.28	14.93				
11-Sep-2014 11:00	3000	37.31	14.96				
11-Sep-2014 12:00	3060	37.34	14.99				
11-Sep-2014 13:00	3120	37.37	15.02				
11-Sep-2014 14:00	3180	37.40	15.05				
11-Sep-2014 15:00	3240	37.43	15.08				
11-Sep-2014 16:00	3300	37.45	15.10				

11-Sep-2014 17:00	3360	37.46	15.11
11-Sep-2014 18:00	3420	37.48	15.13
11-Sep-2014 19:00	3480	37.50	15.15
11-Sep-2014 20:00	3540	37.52	15.17
11-Sep-2014 21:00	3600	37.55	15.20
11-Sep-2014 22:00	3660	37.58	15.23
11-Sep-2014 23:00	3720	37.60	15.25
12-Sep-2014 00:00	3780	37.62	15.27
12-Sep-2014 01:00	3840	37.64	15.29
12-Sep-2014 02:00	3900	37.66	15.31
12-Sep-2014 03:00	3960	37.68	15.33
12-Sep-2014 04:00	4020	37.70	15.35
12-Sep-2014 05:00	4080	37.72	15.37
12-Sep-2014 06:00	4140	37.75	15.40
12-Sep-2014 07:00	4200	37.78	15.43
12-Sep-2014 08:00	4260	37.80	15.45
12-Sep-2014 09:00	4320	37.81	15.46

Tabulated Levels for Ow29#4

Pump On:	09-Sep-2014 09:00			Static Level:	22.46		
Pump Off:	12-Sep-2014 09:00			Pumping Level:	28.75		
Pumping Well:	**TW34**			DD:	6.29		
Distance from Pumping Well:	17 m			20 Yr DD:	15.5		
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	22.46	0.00	12-Sep-2014 09:00	0	28.75	0.00
09-Sep-2014 09:01	1	23.64	1.18	12-Sep-2014 09:01	1	27.88	0.87
09-Sep-2014 09:02	2	23.99	1.53	12-Sep-2014 09:02	2	27.44	1.31
09-Sep-2014 09:03	3	24.22	1.76	12-Sep-2014 09:03	3	27.22	1.53
09-Sep-2014 09:04	4	24.35	1.89	12-Sep-2014 09:04	4	27.03	1.72
09-Sep-2014 09:05	5	24.45	1.99	12-Sep-2014 09:05	5	26.91	1.84
09-Sep-2014 09:06	6	24.52	2.06	12-Sep-2014 09:06	6	26.82	1.93
09-Sep-2014 09:07	7	24.61	2.15	12-Sep-2014 09:07	7	26.76	1.99
09-Sep-2014 09:08	8	24.69	2.23	12-Sep-2014 09:08	8	26.68	2.07
09-Sep-2014 09:10	10	24.76	2.30	12-Sep-2014 09:09	9	26.62	2.13
09-Sep-2014 09:12	12	24.83	2.37	12-Sep-2014 09:10	10	26.57	2.18
09-Sep-2014 09:14	14	24.91	2.45	12-Sep-2014 09:12	12	26.50	2.25
09-Sep-2014 09:16	16	24.96	2.50	12-Sep-2014 09:14	14	26.43	2.32
09-Sep-2014 09:18	18	25.01	2.55	12-Sep-2014 09:16	16	26.37	2.38
09-Sep-2014 09:20	20	25.07	2.61	12-Sep-2014 09:18	18	26.32	2.43
09-Sep-2014 09:25	25	25.17	2.71	12-Sep-2014 09:20	20	26.27	2.48
09-Sep-2014 09:30	30	25.25	2.79	12-Sep-2014 09:25	25	26.17	2.58
09-Sep-2014 09:40	40	25.37	2.91	12-Sep-2014 09:30	30	26.09	2.66
09-Sep-2014 09:50	50	25.47	3.01	12-Sep-2014 09:35	35	26.02	2.73
09-Sep-2014 10:00	60	25.56	3.10	12-Sep-2014 09:40	40	25.96	2.79
09-Sep-2014 10:15	75	25.66	3.20	12-Sep-2014 09:50	50	25.87	2.88
09-Sep-2014 10:30	90	25.75	3.29	12-Sep-2014 10:00	60	25.77	2.98
09-Sep-2014 10:45	105	25.82	3.36	12-Sep-2014 10:15	75	25.67	3.08
09-Sep-2014 11:00	120	25.88	3.42	12-Sep-2014 10:30	90	25.58	3.17
09-Sep-2014 11:30	150	26.01	3.55	12-Sep-2014 10:45	105	25.50	3.25
09-Sep-2014 12:00	180	26.10	3.64	12-Sep-2014 11:00	120	25.40	3.35
09-Sep-2014 12:30	210	26.18	3.72	12-Sep-2014 11:30	150	25.33	3.42
09-Sep-2014 13:00	240	26.25	3.79	12-Sep-2014 14:00	300	24.99	3.76
09-Sep-2014 13:30	270	26.37	3.91	12-Sep-2014 17:00	480	24.75	4.00
09-Sep-2014 14:00	300	26.49	4.03	13-Sep-2014 10:05	1505	23.99	4.76
09-Sep-2014 15:00	360	26.57	4.11				
09-Sep-2014 16:00	420	26.66	4.20				
09-Sep-2014 17:00	480	26.73	4.27				
09-Sep-2014 18:00	540	26.80	4.34				
09-Sep-2014 20:00	660	26.87	4.41				
09-Sep-2014 21:00	720	26.93	4.47				
09-Sep-2014 22:00	780	27.00	4.54				
09-Sep-2014 23:00	840	27.05	4.59				
10-Sep-2014 00:00	900	27.11	4.65				
10-Sep-2014 01:00	960	27.16	4.70				
10-Sep-2014 02:00	1020	27.20	4.74				
10-Sep-2014 03:00	1080	27.25	4.79				
10-Sep-2014 04:00	1140	27.30	4.84				
10-Sep-2014 05:00	1200	27.35	4.89				
10-Sep-2014 06:00	1260	27.38	4.92				
10-Sep-2014 07:00	1320	27.42	4.96				
10-Sep-2014 08:00	1380	27.46	5.00				
10-Sep-2014 09:00	1440	27.50	5.04				
10-Sep-2014 10:00	1500	27.54	5.08				
10-Sep-2014 11:00	1560	27.58	5.12				
10-Sep-2014 12:00	1620	27.62	5.16				
10-Sep-2014 13:10	1690	27.66	5.20				
10-Sep-2014 14:00	1740	27.69	5.23				
10-Sep-2014 15:00	1800	27.72	5.26				
10-Sep-2014 16:00	1860	27.76	5.30				
10-Sep-2014 17:00	1920	27.80	5.34				
10-Sep-2014 18:00	1980	27.82	5.36				
10-Sep-2014 19:00	2040	27.84	5.38				
10-Sep-2014 20:00	2100	27.86	5.40				
10-Sep-2014 21:00	2160	27.87	5.41				
10-Sep-2014 22:00	2220	27.89	5.43				
10-Sep-2014 23:00	2280	27.92	5.46				
11-Sep-2014 00:00	2340	27.96	5.50				
11-Sep-2014 01:00	2400	27.98	5.52				
11-Sep-2014 02:00	2460	28.00	5.54				
11-Sep-2014 03:00	2520	28.03	5.57				
11-Sep-2014 04:00	2580	28.05	5.59				
11-Sep-2014 05:00	2640	28.09	5.63				
11-Sep-2014 06:00	2700	28.10	5.64				
11-Sep-2014 07:00	2760	28.13	5.67				
11-Sep-2014 08:00	2820	28.17	5.71				
11-Sep-2014 09:00	2880	28.21	5.75				
11-Sep-2014 10:00	2940	28.23	5.77				
11-Sep-2014 11:00	3000	28.30	5.84				
11-Sep-2014 12:00	3060	28.29	5.83				
11-Sep-2014 13:00	3120	28.31	5.85				
11-Sep-2014 14:00	3180	28.34	5.88				
11-Sep-2014 15:00	3240	28.37	5.91				
11-Sep-2014 16:00	3300	28.39	5.93				
11-Sep-2014 17:00	3360	28.41	5.95				

11-Sep-2014 18:00	3420	28.44	5.98
11-Sep-2014 19:00	3480	28.46	6.00
11-Sep-2014 20:00	3540	28.48	6.02
11-Sep-2014 21:00	3600	28.49	6.03
11-Sep-2014 22:00	3660	28.52	6.06
11-Sep-2014 23:00	3720	28.54	6.08
12-Sep-2014 00:00	3780	28.56	6.10
12-Sep-2014 01:00	3840	28.58	6.12
12-Sep-2014 02:00	3900	28.60	6.14
12-Sep-2014 03:00	3960	28.63	6.17
12-Sep-2014 04:00	4020	28.65	6.19
12-Sep-2014 05:00	4080	28.67	6.21
12-Sep-2014 06:00	4140	28.69	6.23
12-Sep-2014 07:00	4200	28.72	6.26
12-Sep-2014 08:00	4260	28.73	6.27
12-Sep-2014 09:00	4320	28.75	6.29

Tabulated Levels for Ow29#3

	Pump On:	09-Sep-2014 09:00			Static Level:	17.64	
	Pump Off:	12-Sep-2014 09:00			Pumping Level:	17.54	
	Pumping Well:	**TW34**			DD:	-0.10	
	Distance from Pumping Well:	13.64 m					
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	17.64	0.00	12-Sep-2014 09:00	0	17.54	0.00
09-Sep-2014 09:01	1	17.64	0.00	12-Sep-2014 09:01	1	17.54	0.00
09-Sep-2014 09:02	2	17.64	0.00	12-Sep-2014 09:02	2	17.54	0.00
09-Sep-2014 09:03	3	17.64	0.00	12-Sep-2014 09:03	3	17.54	0.00
09-Sep-2014 09:04	4	17.64	0.00	12-Sep-2014 09:04	4	17.54	-0.01
09-Sep-2014 09:05	5	17.64	0.00	12-Sep-2014 09:05	5	17.54	0.00
09-Sep-2014 09:06	6	17.64	0.00	12-Sep-2014 09:06	6	17.54	0.00
09-Sep-2014 09:07	7	17.64	0.00	12-Sep-2014 09:07	7	17.54	0.00
09-Sep-2014 09:08	8	17.64	0.00	12-Sep-2014 09:08	8	17.54	0.00
09-Sep-2014 09:10	10	17.64	0.00	12-Sep-2014 09:09	9	17.54	0.00
09-Sep-2014 09:12	12	17.64	0.00	12-Sep-2014 09:10	10	17.54	0.00
09-Sep-2014 09:14	14	17.63	0.00	12-Sep-2014 09:12	12	17.54	0.00
09-Sep-2014 09:16	16	17.64	0.00	12-Sep-2014 09:14	14	17.54	-0.01
09-Sep-2014 09:18	18	17.63	-0.01	12-Sep-2014 09:16	16	17.54	-0.01
09-Sep-2014 09:20	20	17.64	0.00	12-Sep-2014 09:18	18	17.54	0.00
09-Sep-2014 09:25	25	17.63	-0.01	12-Sep-2014 09:20	20	17.55	-0.01
09-Sep-2014 09:30	30	17.63	0.00	12-Sep-2014 09:25	25	17.55	-0.01
09-Sep-2014 09:40	40	17.63	0.00	12-Sep-2014 09:30	30	17.55	-0.01
09-Sep-2014 09:50	50	17.63	-0.01	12-Sep-2014 09:35	35	17.55	-0.01
09-Sep-2014 10:00	60	17.63	-0.01	12-Sep-2014 09:40	40	17.55	-0.01
09-Sep-2014 10:15	75	17.63	-0.01	12-Sep-2014 09:50	50	17.55	-0.01
09-Sep-2014 10:30	90	17.64	0.00	12-Sep-2014 10:00	60	17.55	-0.01
09-Sep-2014 10:45	105	17.64	0.00	12-Sep-2014 10:15	75	17.55	-0.01
09-Sep-2014 11:00	120	17.64	0.00	12-Sep-2014 10:30	90	17.55	-0.01
09-Sep-2014 11:30	150	17.64	0.00	12-Sep-2014 10:45	105	17.55	-0.01
09-Sep-2014 12:00	180	17.64	0.00	12-Sep-2014 11:00	120	17.56	-0.02
09-Sep-2014 12:30	210	17.64	0.00	12-Sep-2014 11:30	150	17.56	-0.02
09-Sep-2014 13:00	240	17.65	0.01	12-Sep-2014 14:00	300	17.56	-0.02
09-Sep-2014 13:30	270	17.65	0.01	12-Sep-2014 17:00	480	17.57	-0.03
09-Sep-2014 14:00	300	17.65	0.01	13-Sep-2014 10:05	1505	17.53	0.01
09-Sep-2014 15:00	360	17.65	0.01				
09-Sep-2014 16:00	420	17.65	0.01				
09-Sep-2014 17:00	480	17.64	0.00				
09-Sep-2014 18:00	540	17.64	0.00				
09-Sep-2014 20:00	660	17.64	0.00				
09-Sep-2014 21:00	720	17.64	0.00				
09-Sep-2014 22:00	780	17.64	0.00				
09-Sep-2014 23:00	840	17.64	0.00				
10-Sep-2014 00:00	900	17.64	0.00				
10-Sep-2014 01:00	960	17.64	0.00				
10-Sep-2014 02:00	1020	17.64	0.00				
10-Sep-2014 03:00	1080	17.64	0.00				
10-Sep-2014 04:00	1140	17.63	-0.01				
10-Sep-2014 05:00	1200	17.63	-0.01				
10-Sep-2014 06:00	1260	17.63	-0.01				
10-Sep-2014 07:00	1320	17.63	-0.01				
10-Sep-2014 08:00	1380	17.63	-0.01				
10-Sep-2014 09:00	1440	17.62	-0.02				
10-Sep-2014 10:00	1500	17.63	-0.01				
10-Sep-2014 11:00	1560	17.63	-0.01				
10-Sep-2014 12:00	1620	17.64	0.00				
10-Sep-2014 13:10	1690	17.63	-0.01				
10-Sep-2014 14:00	1740	17.64	0.00				
10-Sep-2014 15:00	1800	17.64	0.00				
10-Sep-2014 16:00	1860	17.63	-0.01				
10-Sep-2014 17:00	1920	17.63	-0.01				
10-Sep-2014 18:00	1980	17.62	-0.02				
10-Sep-2014 19:00	2040	17.61	-0.03				
10-Sep-2014 20:00	2100	17.60	-0.04				
10-Sep-2014 21:00	2160	17.59	-0.05				
10-Sep-2014 22:00	2220	17.57	-0.06				
10-Sep-2014 23:00	2280	17.58	-0.06				
11-Sep-2014 00:00	2340	17.57	-0.07				
11-Sep-2014 01:00	2400	17.57	-0.06				
11-Sep-2014 02:00	2460	17.57	-0.07				
11-Sep-2014 03:00	2520	17.57	-0.07				
11-Sep-2014 04:00	2580	17.56	-0.08				
11-Sep-2014 05:00	2640	17.55	-0.09				
11-Sep-2014 06:00	2700	17.56	-0.08				
11-Sep-2014 07:00	2760	17.56	-0.08				
11-Sep-2014 08:00	2820	17.56	-0.08				
11-Sep-2014 09:00	2880	17.56	-0.08				
11-Sep-2014 10:00	2940	17.57	-0.07				
11-Sep-2014 11:00	3000	17.57	-0.07				
11-Sep-2014 12:00	3060	17.57	-0.07				
11-Sep-2014 13:00	3120	17.56	-0.08				
11-Sep-2014 14:00	3180	17.57	-0.07				
11-Sep-2014 15:00	3240	17.56	-0.07				
11-Sep-2014 16:00	3300	17.56	-0.08				
11-Sep-2014 17:00	3360	17.55	-0.09				

11-Sep-2014 18:00	3420	17.52	-0.12
11-Sep-2014 19:00	3480	17.52	-0.12
11-Sep-2014 20:00	3540	17.51	-0.13
11-Sep-2014 21:00	3600	17.51	-0.13
11-Sep-2014 22:00	3660	17.50	-0.14
11-Sep-2014 23:00	3720	17.50	-0.14
12-Sep-2014 00:00	3780	17.52	-0.12
12-Sep-2014 01:00	3840	17.52	-0.12
12-Sep-2014 02:00	3900	17.52	-0.12
12-Sep-2014 03:00	3960	17.52	-0.12
12-Sep-2014 04:00	4020	17.53	-0.11
12-Sep-2014 05:00	4080	17.53	-0.11
12-Sep-2014 06:00	4140	17.53	-0.11
12-Sep-2014 07:00	4200	17.53	-0.11
12-Sep-2014 08:00	4260	17.53	-0.11
12-Sep-2014 09:00	4320	17.54	-0.10

Tabulated Levels for Ow29#2

Pump On:	09-Sep-2014 09:00		Static Level:	13.46	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	13.42	
Pumping Well:	**TW34**		DD:	-0.03	
Distance from Pumping Well:	13.64 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	13.46	0.00	12-Sep-2014 09:00	0	13.42	0.00
09-Sep-2014 09:01	1	13.45	-0.01	12-Sep-2014 09:01	1	13.42	0.00
09-Sep-2014 09:02	2	13.44	-0.02	12-Sep-2014 09:02	2	13.42	0.00
09-Sep-2014 09:03	3	13.44	-0.02	12-Sep-2014 09:03	3	13.42	0.00
09-Sep-2014 09:04	4	13.44	-0.02	12-Sep-2014 09:04	4	13.43	0.00
09-Sep-2014 09:05	5	13.44	-0.02	12-Sep-2014 09:05	5	13.42	0.00
09-Sep-2014 09:06	6	13.44	-0.02	12-Sep-2014 09:06	6	13.42	0.00
09-Sep-2014 09:07	7	13.44	-0.02	12-Sep-2014 09:07	7	13.42	0.00
09-Sep-2014 09:08	8	13.44	-0.02	12-Sep-2014 09:08	8	13.43	0.00
09-Sep-2014 09:10	10	13.44	-0.01	12-Sep-2014 09:09	9	13.42	0.00
09-Sep-2014 09:12	12	13.44	-0.02	12-Sep-2014 09:10	10	13.43	0.00
09-Sep-2014 09:14	14	13.44	-0.02	12-Sep-2014 09:12	12	13.42	0.00
09-Sep-2014 09:16	16	13.44	-0.02	12-Sep-2014 09:14	14	13.42	0.00
09-Sep-2014 09:18	18	13.44	-0.02	12-Sep-2014 09:16	16	13.43	-0.01
09-Sep-2014 09:20	20	13.44	-0.01	12-Sep-2014 09:18	18	13.44	-0.01
09-Sep-2014 09:25	25	13.44	-0.02	12-Sep-2014 09:20	20	13.44	-0.02
09-Sep-2014 09:30	30	13.44	-0.02	12-Sep-2014 09:25	25	13.44	-0.02
09-Sep-2014 09:40	40	13.44	-0.02	12-Sep-2014 09:30	30	13.44	-0.01
09-Sep-2014 09:50	50	13.44	-0.01	12-Sep-2014 09:35	35	13.44	-0.01
09-Sep-2014 10:00	60	13.44	-0.01	12-Sep-2014 09:40	40	13.43	-0.01
09-Sep-2014 10:15	75	13.44	-0.02	12-Sep-2014 09:50	50	13.43	-0.01
09-Sep-2014 10:30	90	13.44	-0.02	12-Sep-2014 10:00	60	13.43	-0.01
09-Sep-2014 10:45	105	13.44	-0.02	12-Sep-2014 10:15	75	13.44	-0.01
09-Sep-2014 11:00	120	13.44	-0.02	12-Sep-2014 10:30	90	13.43	-0.01
09-Sep-2014 11:30	150	13.45	-0.01	12-Sep-2014 10:45	105	13.43	-0.01
09-Sep-2014 12:00	180	13.44	-0.02	12-Sep-2014 11:00	120	13.43	0.00
09-Sep-2014 12:30	210	13.44	-0.02	12-Sep-2014 11:30	150	13.43	-0.01
09-Sep-2014 13:00	240	13.44	-0.02	12-Sep-2014 14:00	300	13.43	0.00
09-Sep-2014 13:30	270	13.44	-0.02	12-Sep-2014 17:00	480	13.42	0.00
09-Sep-2014 14:00	300	13.44	-0.02	13-Sep-2014 10:05	1505	13.39	0.03
09-Sep-2014 15:00	360	13.44	-0.02				
09-Sep-2014 16:00	420	13.44	-0.02				
09-Sep-2014 17:00	480	13.44	-0.02				
09-Sep-2014 18:00	540	13.44	-0.02				
09-Sep-2014 20:00	660	13.43	-0.03				
09-Sep-2014 21:00	720	13.44	-0.02				
09-Sep-2014 22:00	780	13.44	-0.02				
09-Sep-2014 23:00	840	13.44	-0.02				
10-Sep-2014 00:00	900	13.44	-0.02				
10-Sep-2014 01:00	960	13.43	-0.02				
10-Sep-2014 02:00	1020	13.43	-0.03				
10-Sep-2014 03:00	1080	13.43	-0.03				
10-Sep-2014 04:00	1140	13.43	-0.03				
10-Sep-2014 05:00	1200	13.43	-0.03				
10-Sep-2014 06:00	1260	13.42	-0.03				
10-Sep-2014 07:00	1320	13.42	-0.03				
10-Sep-2014 08:00	1380	13.42	-0.04				
10-Sep-2014 09:00	1440	13.42	-0.04				
10-Sep-2014 10:00	1500	13.42	-0.04				
10-Sep-2014 11:00	1560	13.42	-0.04				
10-Sep-2014 12:00	1620	13.42	-0.04				
10-Sep-2014 13:10	1690	13.42	-0.04				
10-Sep-2014 14:00	1740	13.42	-0.04				
10-Sep-2014 15:00	1800	13.41	-0.04				
10-Sep-2014 16:00	1860	13.41	-0.05				
10-Sep-2014 17:00	1920	13.41	-0.05				
10-Sep-2014 18:00	1980	13.40	-0.06				
10-Sep-2014 19:00	2040	13.39	-0.06				
10-Sep-2014 20:00	2100	13.39	-0.07				
10-Sep-2014 21:00	2160	13.38	-0.08				
10-Sep-2014 22:00	2220	13.37	-0.09				
10-Sep-2014 23:00	2280	13.37	-0.09				
11-Sep-2014 00:00	2340	13.37	-0.09				
11-Sep-2014 01:00	2400	13.38	-0.08				
11-Sep-2014 02:00	2460	13.37	-0.09				
11-Sep-2014 03:00	2520	13.38	-0.08				
11-Sep-2014 04:00	2580	13.38	-0.08				
11-Sep-2014 05:00	2640	13.38	-0.08				
11-Sep-2014 06:00	2700	13.38	-0.07				
11-Sep-2014 07:00	2760	13.39	-0.07				
11-Sep-2014 08:00	2820	13.39	-0.07				
11-Sep-2014 09:00	2880	13.39	-0.07				
11-Sep-2014 10:00	2940	13.40	-0.06				
11-Sep-2014 11:00	3000	13.40	-0.06				
11-Sep-2014 12:00	3060	13.40	-0.05				
11-Sep-2014 13:00	3120	13.41	-0.05				
11-Sep-2014 14:00	3180	13.41	-0.05				
11-Sep-2014 15:00	3240	13.41	-0.05				
11-Sep-2014 16:00	3300	13.41	-0.04				
11-Sep-2014 17:00	3360	13.41	-0.05				

11-Sep-2014 18:00	3420	13.41	-0.05
11-Sep-2014 19:00	3480	13.41	-0.04
11-Sep-2014 20:00	3540	13.41	-0.05
11-Sep-2014 21:00	3600	13.42	-0.04
11-Sep-2014 22:00	3660	13.42	-0.04
11-Sep-2014 23:00	3720	13.42	-0.04
12-Sep-2014 00:00	3780	13.42	-0.04
12-Sep-2014 01:00	3840	13.42	-0.04
12-Sep-2014 02:00	3900	13.43	-0.03
12-Sep-2014 03:00	3960	13.43	-0.03
12-Sep-2014 04:00	4020	13.43	-0.03
12-Sep-2014 05:00	4080	13.43	-0.03
12-Sep-2014 06:00	4140	13.43	-0.03
12-Sep-2014 07:00	4200	13.43	-0.03
12-Sep-2014 08:00	4260	13.43	-0.03
12-Sep-2014 09:00	4320	13.42	-0.03

Tabulated Levels for Ow29#1

Pump On:	09-Sep-2014 09:00			Static Level:	1.33		
Pump Off:	12-Sep-2014 09:00			Pumping Level:	1.28		
Pumping Well:	**TW34**			DD:	-0.05		
Distance from Pumping Well:	15.4 m						
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	1.33	0.00	12-Sep-2014 09:00	0	1.28	0.00
09-Sep-2014 09:01	1	1.33	0.00	12-Sep-2014 09:01	1	1.28	0.00
09-Sep-2014 09:02	2	1.33	0.00	12-Sep-2014 09:02	2	1.28	0.00
09-Sep-2014 09:03	3	1.33	0.00	12-Sep-2014 09:03	3	1.29	0.00
09-Sep-2014 09:04	4	1.33	0.00	12-Sep-2014 09:04	4	1.29	0.00
09-Sep-2014 09:05	5	1.33	0.00	12-Sep-2014 09:05	5	1.28	0.00
09-Sep-2014 09:06	6	1.33	0.00	12-Sep-2014 09:06	6	1.28	0.00
09-Sep-2014 09:07	7	1.33	0.00	12-Sep-2014 09:07	7	1.28	0.00
09-Sep-2014 09:08	8	1.33	0.00	12-Sep-2014 09:08	8	1.29	0.00
09-Sep-2014 09:10	10	1.33	0.00	12-Sep-2014 09:09	9	1.29	0.00
09-Sep-2014 09:12	12	1.33	0.00	12-Sep-2014 09:10	10	1.28	0.00
09-Sep-2014 09:14	14	1.33	0.00	12-Sep-2014 09:12	12	1.28	0.00
09-Sep-2014 09:16	16	1.33	0.00	12-Sep-2014 09:14	14	1.28	0.00
09-Sep-2014 09:18	18	1.33	0.00	12-Sep-2014 09:16	16	1.29	0.00
09-Sep-2014 09:20	20	1.33	0.00	12-Sep-2014 09:18	18	1.28	0.00
09-Sep-2014 09:25	25	1.33	0.00	12-Sep-2014 09:20	20	1.29	0.00
09-Sep-2014 09:30	30	1.33	0.00	12-Sep-2014 09:25	25	1.29	0.00
09-Sep-2014 09:40	40	1.33	0.00	12-Sep-2014 09:30	30	1.28	0.00
09-Sep-2014 09:50	50	1.33	0.00	12-Sep-2014 09:35	35	1.28	0.00
09-Sep-2014 10:00	60	1.33	0.00	12-Sep-2014 09:40	40	1.29	0.00
09-Sep-2014 10:15	75	1.33	0.00	12-Sep-2014 09:50	50	1.29	0.00
09-Sep-2014 10:30	90	1.33	-0.01	12-Sep-2014 10:00	60	1.29	0.00
09-Sep-2014 10:45	105	1.33	0.00	12-Sep-2014 10:15	75	1.29	0.00
09-Sep-2014 11:00	120	1.33	-0.01	12-Sep-2014 10:30	90	1.28	0.00
09-Sep-2014 11:30	150	1.33	0.00	12-Sep-2014 10:45	105	1.28	0.00
09-Sep-2014 12:00	180	1.33	-0.01	12-Sep-2014 11:00	120	1.28	0.00
09-Sep-2014 12:30	210	1.33	0.00	12-Sep-2014 11:30	150	1.29	0.00
09-Sep-2014 13:00	240	1.33	0.00	12-Sep-2014 14:00	300	1.29	-0.01
09-Sep-2014 13:30	270	1.33	0.00	12-Sep-2014 17:00	480	1.29	-0.01
09-Sep-2014 14:00	300	1.33	0.00	13-Sep-2014 10:05	1505	1.29	0.00
09-Sep-2014 15:00	360	1.32	-0.01				
09-Sep-2014 16:00	420	1.33	0.00				
09-Sep-2014 17:00	480	1.33	0.00				
09-Sep-2014 18:00	540	1.33	0.00				
09-Sep-2014 20:00	660	1.33	-0.01				
09-Sep-2014 21:00	720	1.33	0.00				
09-Sep-2014 22:00	780	1.33	0.00				
09-Sep-2014 23:00	840	1.33	0.00				
10-Sep-2014 00:00	900	1.33	0.00				
10-Sep-2014 01:00	960	1.33	0.00				
10-Sep-2014 02:00	1020	1.33	0.00				
10-Sep-2014 03:00	1080	1.33	0.00				
10-Sep-2014 04:00	1140	1.33	0.00				
10-Sep-2014 05:00	1200	1.33	0.00				
10-Sep-2014 06:00	1260	1.33	0.00				
10-Sep-2014 07:00	1320	1.33	0.00				
10-Sep-2014 08:00	1380	1.33	0.00				
10-Sep-2014 09:00	1440	1.32	-0.01				
10-Sep-2014 10:00	1500	1.33	0.00				
10-Sep-2014 11:00	1560	1.33	0.00				
10-Sep-2014 12:00	1620	1.33	-0.01				
10-Sep-2014 13:10	1690	1.33	0.00				
10-Sep-2014 14:00	1740	1.33	0.00				
10-Sep-2014 15:00	1800	1.33	0.00				
10-Sep-2014 16:00	1860	1.33	0.00				
10-Sep-2014 17:00	1920	1.33	0.00				
10-Sep-2014 18:00	1980	1.33	0.00				
10-Sep-2014 19:00	2040	1.32	-0.01				
10-Sep-2014 20:00	2100	1.32	-0.01				
10-Sep-2014 21:00	2160	1.30	-0.03				
10-Sep-2014 22:00	2220	1.27	-0.06				
10-Sep-2014 23:00	2280	1.26	-0.07				
11-Sep-2014 00:00	2340	1.27	-0.06				
11-Sep-2014 01:00	2400	1.27	-0.06				
11-Sep-2014 02:00	2460	1.27	-0.07				
11-Sep-2014 03:00	2520	1.27	-0.06				
11-Sep-2014 04:00	2580	1.27	-0.06				
11-Sep-2014 05:00	2640	1.27	-0.06				
11-Sep-2014 06:00	2700	1.28	-0.05				
11-Sep-2014 07:00	2760	1.27	-0.06				
11-Sep-2014 08:00	2820	1.28	-0.05				
11-Sep-2014 09:00	2880	1.28	-0.05				
11-Sep-2014 10:00	2940	1.28	-0.05				
11-Sep-2014 11:00	3000	1.28	-0.05				
11-Sep-2014 12:00	3060	1.29	-0.05				
11-Sep-2014 13:00	3120	1.28	-0.05				
11-Sep-2014 14:00	3180	1.28	-0.05				
11-Sep-2014 15:00	3240	1.28	-0.05				
11-Sep-2014 16:00	3300	1.28	-0.05				
11-Sep-2014 17:00	3360	1.28	-0.05				

11-Sep-2014 18:00	3420	1.28	-0.05
11-Sep-2014 19:00	3480	1.28	-0.05
11-Sep-2014 20:00	3540	1.28	-0.05
11-Sep-2014 21:00	3600	1.28	-0.05
11-Sep-2014 22:00	3660	1.28	-0.05
11-Sep-2014 23:00	3720	1.28	-0.05
12-Sep-2014 00:00	3780	1.28	-0.05
12-Sep-2014 01:00	3840	1.28	-0.05
12-Sep-2014 02:00	3900	1.28	-0.05
12-Sep-2014 03:00	3960	1.28	-0.05
12-Sep-2014 04:00	4020	1.29	-0.05
12-Sep-2014 05:00	4080	1.29	-0.05
12-Sep-2014 06:00	4140	1.28	-0.05
12-Sep-2014 07:00	4200	1.28	-0.05
12-Sep-2014 08:00	4260	1.29	-0.04
12-Sep-2014 09:00	4320	1.28	-0.05

Tabulated Levels for House 2

Pump On:	09-Sep-2014 09:00		Static Level:	4.02	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	3.94	
Pumping Well:	**TW34**		DD:	-0.08	
Distance from Pumping Well:	627 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	4.02	0.00	12-Sep-2014 09:00	0	3.94	0.00
09-Sep-2014 09:01	1	4.02	0.00	12-Sep-2014 09:01	1	3.94	0.01
09-Sep-2014 09:02	2	4.02	0.00	12-Sep-2014 09:02	2	3.94	0.00
09-Sep-2014 09:03	3	4.01	0.00	12-Sep-2014 09:03	3	3.94	0.00
09-Sep-2014 09:04	4	4.01	0.00	12-Sep-2014 09:04	4	3.94	0.00
09-Sep-2014 09:05	5	4.02	0.00	12-Sep-2014 09:05	5	3.94	0.00
09-Sep-2014 09:06	6	4.02	0.00	12-Sep-2014 09:06	6	3.94	0.00
09-Sep-2014 09:07	7	4.02	0.00	12-Sep-2014 09:07	7	3.94	0.00
09-Sep-2014 09:08	8	4.01	-0.01	12-Sep-2014 09:08	8	3.94	0.00
09-Sep-2014 09:10	10	4.02	0.00	12-Sep-2014 09:09	9	3.94	0.00
09-Sep-2014 09:12	12	4.01	0.00	12-Sep-2014 09:10	10	3.94	0.00
09-Sep-2014 09:14	14	4.01	-0.01	12-Sep-2014 09:12	12	5.03	-1.09
09-Sep-2014 09:16	16	4.01	0.00	12-Sep-2014 09:14	14	4.42	-0.48
09-Sep-2014 09:18	18	4.01	-0.01	12-Sep-2014 09:16	16	4.16	-0.21
09-Sep-2014 09:20	20	4.01	0.00	12-Sep-2014 09:18	18	4.04	-0.10
09-Sep-2014 09:25	25	4.01	-0.01	12-Sep-2014 09:20	20	3.99	-0.05
09-Sep-2014 09:30	30	4.01	-0.01	12-Sep-2014 09:25	25	3.95	-0.01
09-Sep-2014 09:40	40	4.01	-0.01	12-Sep-2014 09:30	30	3.94	0.00
09-Sep-2014 09:50	50	4.01	-0.01	12-Sep-2014 09:35	35	3.94	0.00
09-Sep-2014 10:00	60	4.01	-0.01	12-Sep-2014 09:40	40	3.94	0.00
09-Sep-2014 10:15	75	4.01	-0.01	12-Sep-2014 09:50	50	3.94	0.00
09-Sep-2014 10:30	90	4.01	-0.01	12-Sep-2014 10:00	60	3.94	0.00
09-Sep-2014 10:45	105	4.01	-0.01	12-Sep-2014 10:15	75	3.94	0.00
09-Sep-2014 11:00	120	4.01	-0.01	12-Sep-2014 10:30	90	3.94	0.00
09-Sep-2014 11:30	150	4.01	-0.01	12-Sep-2014 10:45	105	3.94	0.00
09-Sep-2014 12:00	180	4.01	-0.01	12-Sep-2014 11:00	120	3.94	0.00
09-Sep-2014 12:30	210	4.01	-0.01	12-Sep-2014 11:30	150	3.94	0.00
09-Sep-2014 13:00	240	4.01	-0.01	12-Sep-2014 14:00	300	3.95	0.00
09-Sep-2014 13:30	270	4.01	-0.01	12-Sep-2014 17:00	480	3.95	-0.01
09-Sep-2014 14:00	300	4.01	-0.01	13-Sep-2014 10:05	1505	3.94	0.01
09-Sep-2014 15:00	360	4.01	-0.01				
09-Sep-2014 16:00	420	4.01	-0.01				
09-Sep-2014 17:00	480	4.01	-0.01				
09-Sep-2014 18:00	540	4.48	0.46				
09-Sep-2014 20:00	660	4.01	-0.01				
09-Sep-2014 21:00	720	4.61	0.59				
09-Sep-2014 22:00	780	4.01	-0.01				
09-Sep-2014 23:00	840	4.01	-0.01				
10-Sep-2014 00:00	900	4.00	-0.02				
10-Sep-2014 01:00	960	4.00	-0.02				
10-Sep-2014 02:00	1020	4.00	-0.02				
10-Sep-2014 03:00	1080	4.00	-0.02				
10-Sep-2014 04:00	1140	3.99	-0.03				
10-Sep-2014 05:00	1200	3.99	-0.02				
10-Sep-2014 06:00	1260	3.99	-0.03				
10-Sep-2014 07:00	1320	4.09	0.07				
10-Sep-2014 08:00	1380	4.19	0.17				
10-Sep-2014 09:00	1440	3.99	-0.03				
10-Sep-2014 10:00	1500	4.11	0.10				
10-Sep-2014 11:00	1560	3.99	-0.03				
10-Sep-2014 12:00	1620	3.98	-0.03				
10-Sep-2014 13:10	1690	3.98	-0.03				
10-Sep-2014 14:00	1740	4.42	0.40				
10-Sep-2014 15:00	1800	3.98	-0.04				
10-Sep-2014 16:00	1860	3.98	-0.04				
10-Sep-2014 17:00	1920	3.98	-0.04				
10-Sep-2014 18:00	1980	3.97	-0.05				
10-Sep-2014 19:00	2040	3.97	-0.04				
10-Sep-2014 20:00	2100	3.96	-0.06				
10-Sep-2014 21:00	2160	3.94	-0.08				
10-Sep-2014 22:00	2220	3.93	-0.08				
10-Sep-2014 23:00	2280	3.93	-0.09				
11-Sep-2014 00:00	2340	3.93	-0.09				
11-Sep-2014 01:00	2400	3.93	-0.09				
11-Sep-2014 02:00	2460	3.92	-0.10				
11-Sep-2014 03:00	2520	3.92	-0.10				
11-Sep-2014 04:00	2580	3.92	-0.10				
11-Sep-2014 05:00	2640	3.92	-0.10				
11-Sep-2014 06:00	2700	3.92	-0.10				
11-Sep-2014 07:00	2760	3.92	-0.09				
11-Sep-2014 08:00	2820	3.92	-0.09				
11-Sep-2014 09:00	2880	3.92	-0.09				
11-Sep-2014 10:00	2940	3.93	-0.09				
11-Sep-2014 11:00	3000	3.93	-0.09				
11-Sep-2014 12:00	3060	3.94	-0.08				
11-Sep-2014 13:00	3120	3.94	-0.08				
11-Sep-2014 14:00	3180	4.13	0.12				
11-Sep-2014 15:00	3240	3.94	-0.08				
11-Sep-2014 16:00	3300	3.94	-0.08				
11-Sep-2014 17:00	3360	3.94	-0.08				

11-Sep-2014 18:00	3420	3.94	-0.08
11-Sep-2014 19:00	3480	3.94	-0.08
11-Sep-2014 20:00	3540	3.94	-0.08
11-Sep-2014 21:00	3600	3.95	-0.07
11-Sep-2014 22:00	3660	3.95	-0.07
11-Sep-2014 23:00	3720	3.95	-0.07
12-Sep-2014 00:00	3780	3.94	-0.08
12-Sep-2014 01:00	3840	3.94	-0.08
12-Sep-2014 02:00	3900	3.94	-0.07
12-Sep-2014 03:00	3960	3.94	-0.07
12-Sep-2014 04:00	4020	3.94	-0.07
12-Sep-2014 05:00	4080	3.94	-0.08
12-Sep-2014 06:00	4140	3.94	-0.08
12-Sep-2014 07:00	4200	3.94	-0.08
12-Sep-2014 08:00	4260	3.94	-0.08
12-Sep-2014 09:00	4320	3.94	-0.08

Tabulated Levels for House 3

	Pump On:	09-Sep-2014 09:00			Static Level:	8.34	
	Pump Off:	12-Sep-2014 09:00			Pumping Level:	8.33	
	Pumping Well:	**TW34**			DD:	-0.01	
	Distance from Pumping Well:	655 m					
Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	8.34	0.00	12-Sep-2014 09:00	0	8.33	0.00
09-Sep-2014 09:01	1	8.34	0.00	12-Sep-2014 09:01	1	8.32	0.01
09-Sep-2014 09:02	2	8.34	0.00	12-Sep-2014 09:02	2	8.32	0.00
09-Sep-2014 09:03	3	8.34	0.00	12-Sep-2014 09:03	3	8.32	0.00
09-Sep-2014 09:04	4	8.34	0.00	12-Sep-2014 09:04	4	8.33	0.00
09-Sep-2014 09:05	5	8.34	0.00	12-Sep-2014 09:05	5	8.32	0.00
09-Sep-2014 09:06	6	8.35	0.01	12-Sep-2014 09:06	6	8.32	0.00
09-Sep-2014 09:07	7	8.35	0.01	12-Sep-2014 09:07	7	8.33	0.00
09-Sep-2014 09:08	8	8.34	0.00	12-Sep-2014 09:08	8	8.33	0.00
09-Sep-2014 09:10	10	8.35	0.01	12-Sep-2014 09:09	9	8.33	0.00
09-Sep-2014 09:12	12	8.34	0.00	12-Sep-2014 09:10	10	8.33	0.00
09-Sep-2014 09:14	14	10.28	1.94	12-Sep-2014 09:12	12	8.33	0.00
09-Sep-2014 09:16	16	9.36	1.02	12-Sep-2014 09:14	14	8.33	0.00
09-Sep-2014 09:18	18	8.83	0.49	12-Sep-2014 09:16	16	8.33	0.00
09-Sep-2014 09:20	20	8.58	0.24	12-Sep-2014 09:18	18	8.32	0.00
09-Sep-2014 09:25	25	9.21	0.87	12-Sep-2014 09:20	20	8.33	0.00
09-Sep-2014 09:30	30	8.50	0.16	12-Sep-2014 09:25	25	8.33	0.00
09-Sep-2014 09:40	40	8.36	0.02	12-Sep-2014 09:30	30	8.32	0.00
09-Sep-2014 09:50	50	8.35	0.01	12-Sep-2014 09:35	35	8.32	0.00
09-Sep-2014 10:00	60	9.73	1.39	12-Sep-2014 09:40	40	8.32	0.00
09-Sep-2014 10:15	75	8.36	0.02	12-Sep-2014 09:50	50	9.65	-1.32
09-Sep-2014 10:30	90	8.35	0.01	12-Sep-2014 10:00	60	9.23	-0.90
09-Sep-2014 10:45	105	8.35	0.01	12-Sep-2014 10:15	75	8.35	-0.02
09-Sep-2014 11:00	120	8.35	0.01	12-Sep-2014 10:30	90	8.33	-0.01
09-Sep-2014 11:30	150	8.35	0.01	12-Sep-2014 10:45	105	8.33	0.00
09-Sep-2014 12:00	180	8.34	0.00	12-Sep-2014 11:00	120	8.33	0.00
09-Sep-2014 12:30	210	8.34	0.00	12-Sep-2014 11:30	150	8.33	0.00
09-Sep-2014 13:00	240	8.34	0.00	12-Sep-2014 14:00	300	8.33	0.00
09-Sep-2014 13:30	270	8.34	0.00	12-Sep-2014 17:00	480	8.59	-0.27
09-Sep-2014 14:00	300	8.34	0.00	13-Sep-2014 10:05	1505	8.31	0.01
09-Sep-2014 15:00	360	10.20	1.86				
09-Sep-2014 16:00	420	8.34	0.00				
09-Sep-2014 17:00	480	8.34	0.00				
09-Sep-2014 18:00	540	9.52	1.18				
09-Sep-2014 20:00	660	8.33	-0.01				
09-Sep-2014 21:00	720	8.33	-0.01				
09-Sep-2014 22:00	780	8.34	0.00				
09-Sep-2014 23:00	840	8.67	0.33				
10-Sep-2014 00:00	900	8.34	0.00				
10-Sep-2014 01:00	960	8.33	-0.01				
10-Sep-2014 02:00	1020	8.33	-0.01				
10-Sep-2014 03:00	1080	8.33	-0.01				
10-Sep-2014 04:00	1140	8.33	-0.01				
10-Sep-2014 05:00	1200	8.32	-0.02				
10-Sep-2014 06:00	1260	8.32	-0.02				
10-Sep-2014 07:00	1320	8.32	-0.02				
10-Sep-2014 08:00	1380	8.33	-0.01				
10-Sep-2014 09:00	1440	8.32	-0.02				
10-Sep-2014 10:00	1500	8.32	-0.02				
10-Sep-2014 11:00	1560	8.33	-0.01				
10-Sep-2014 12:00	1620	8.32	-0.02				
10-Sep-2014 13:10	1690	8.32	-0.02				
10-Sep-2014 14:00	1740	8.32	-0.02				
10-Sep-2014 15:00	1800	8.47	0.13				
10-Sep-2014 16:00	1860	8.32	-0.02				
10-Sep-2014 17:00	1920	8.32	-0.03				
10-Sep-2014 18:00	1980	8.33	-0.01				
10-Sep-2014 19:00	2040	8.32	-0.02				
10-Sep-2014 20:00	2100	8.30	-0.04				
10-Sep-2014 21:00	2160	8.30	-0.04				
10-Sep-2014 22:00	2220	8.28	-0.06				
10-Sep-2014 23:00	2280	8.28	-0.06				
11-Sep-2014 00:00	2340	8.28	-0.06				
11-Sep-2014 01:00	2400	8.28	-0.06				
11-Sep-2014 02:00	2460	8.28	-0.06				
11-Sep-2014 03:00	2520	8.28	-0.06				
11-Sep-2014 04:00	2580	8.28	-0.06				
11-Sep-2014 05:00	2640	8.28	-0.06				
11-Sep-2014 06:00	2700	8.28	-0.06				
11-Sep-2014 07:00	2760	9.70	1.36				
11-Sep-2014 08:00	2820	8.64	0.30				
11-Sep-2014 09:00	2880	8.30	-0.04				
11-Sep-2014 10:00	2940	8.30	-0.04				
11-Sep-2014 11:00	3000	9.40	1.06				
11-Sep-2014 12:00	3060	8.68	0.34				
11-Sep-2014 13:00	3120	8.31	-0.03				
11-Sep-2014 14:00	3180	8.32	-0.02				
11-Sep-2014 15:00	3240	8.31	-0.03				
11-Sep-2014 16:00	3300	8.32	-0.02				
11-Sep-2014 17:00	3360	8.32	-0.03				

11-Sep-2014 18:00	3420	8.32	-0.02
11-Sep-2014 19:00	3480	8.32	-0.02
11-Sep-2014 20:00	3540	8.33	-0.02
11-Sep-2014 21:00	3600	8.32	-0.02
11-Sep-2014 22:00	3660	8.33	-0.01
11-Sep-2014 23:00	3720	8.33	-0.01
12-Sep-2014 00:00	3780	8.33	-0.02
12-Sep-2014 01:00	3840	8.32	-0.02
12-Sep-2014 02:00	3900	8.32	-0.02
12-Sep-2014 03:00	3960	8.33	-0.01
12-Sep-2014 04:00	4020	8.33	-0.01
12-Sep-2014 05:00	4080	8.32	-0.02
12-Sep-2014 06:00	4140	8.32	-0.02
12-Sep-2014 07:00	4200	8.33	-0.01
12-Sep-2014 08:00	4260	8.33	-0.01
12-Sep-2014 09:00	4320	8.33	-0.01

Tabulated Levels for House 4

Pump On:	09-Sep-2014 09:00		Static Level:	12.71	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	12.64	
Pumping Well:	**TW34**		DD:	-0.06	
Distance from Pumping Well:	717 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	12.71	0.00	12-Sep-2014 09:00	0	12.64	0.00
09-Sep-2014 09:01	1	12.71	0.00	12-Sep-2014 09:01	1	12.64	0.00
09-Sep-2014 09:02	2	12.70	0.00	12-Sep-2014 09:02	2	12.64	0.00
09-Sep-2014 09:03	3	12.71	0.00	12-Sep-2014 09:03	3	12.64	0.00
09-Sep-2014 09:04	4	12.70	0.00	12-Sep-2014 09:04	4	12.65	0.00
09-Sep-2014 09:05	5	12.71	0.00	12-Sep-2014 09:05	5	12.64	0.00
09-Sep-2014 09:06	6	12.71	0.00	12-Sep-2014 09:06	6	12.64	0.00
09-Sep-2014 09:07	7	12.71	0.00	12-Sep-2014 09:07	7	12.64	0.00
09-Sep-2014 09:08	8	12.71	0.00	12-Sep-2014 09:08	8	13.08	-0.43
09-Sep-2014 09:10	10	12.71	0.00	12-Sep-2014 09:09	9	13.32	-0.68
09-Sep-2014 09:12	12	12.71	0.00	12-Sep-2014 09:10	10	13.03	-0.39
09-Sep-2014 09:14	14	12.71	0.00	12-Sep-2014 09:12	12	12.92	-0.27
09-Sep-2014 09:16	16	12.71	0.00	12-Sep-2014 09:14	14	12.87	-0.23
09-Sep-2014 09:18	18	12.70	0.00	12-Sep-2014 09:16	16	12.83	-0.19
09-Sep-2014 09:20	20	12.71	0.00	12-Sep-2014 09:18	18	12.81	-0.16
09-Sep-2014 09:25	25	12.70	-0.01	12-Sep-2014 09:20	20	12.79	-0.15
09-Sep-2014 09:30	30	12.71	0.00	12-Sep-2014 09:25	25	12.75	-0.11
09-Sep-2014 09:40	40	12.70	0.00	12-Sep-2014 09:30	30	12.72	-0.07
09-Sep-2014 09:50	50	12.70	0.00	12-Sep-2014 09:35	35	12.70	-0.06
09-Sep-2014 10:00	60	12.71	0.00	12-Sep-2014 09:40	40	12.69	-0.05
09-Sep-2014 10:15	75	12.70	-0.01	12-Sep-2014 09:50	50	12.67	-0.03
09-Sep-2014 10:30	90	12.70	0.00	12-Sep-2014 10:00	60	12.66	-0.02
09-Sep-2014 10:45	105	12.70	0.00	12-Sep-2014 10:15	75	12.66	-0.01
09-Sep-2014 11:00	120	12.70	0.00	12-Sep-2014 10:30	90	12.64	0.00
09-Sep-2014 11:30	150	12.70	-0.01	12-Sep-2014 10:45	105	12.64	0.00
09-Sep-2014 12:00	180	12.70	0.00	12-Sep-2014 11:00	120	12.64	0.00
09-Sep-2014 12:30	210	12.70	-0.01	12-Sep-2014 11:30	150	12.64	0.00
09-Sep-2014 13:00	240	12.88	0.18	12-Sep-2014 14:00	300	12.65	-0.01
09-Sep-2014 13:30	270	12.85	0.14	12-Sep-2014 17:00	480	12.90	-0.25
09-Sep-2014 14:00	300	12.74	0.03	13-Sep-2014 10:05	1505	12.62	0.03
09-Sep-2014 15:00	360	12.73	0.02				
09-Sep-2014 16:00	420	12.71	0.00				
09-Sep-2014 17:00	480	12.70	0.00				
09-Sep-2014 18:00	540	12.70	-0.01				
09-Sep-2014 20:00	660	12.69	-0.02				
09-Sep-2014 21:00	720	12.74	0.03				
09-Sep-2014 22:00	780	12.70	-0.01				
09-Sep-2014 23:00	840	12.70	-0.01				
10-Sep-2014 00:00	900	12.69	-0.02				
10-Sep-2014 01:00	960	12.69	-0.02				
10-Sep-2014 02:00	1020	12.68	-0.02				
10-Sep-2014 03:00	1080	12.69	-0.02				
10-Sep-2014 04:00	1140	12.69	-0.02				
10-Sep-2014 05:00	1200	12.68	-0.03				
10-Sep-2014 06:00	1260	12.76	0.05				
10-Sep-2014 07:00	1320	12.69	-0.02				
10-Sep-2014 08:00	1380	12.68	-0.02				
10-Sep-2014 09:00	1440	12.68	-0.03				
10-Sep-2014 10:00	1500	12.68	-0.02				
10-Sep-2014 11:00	1560	12.68	-0.02				
10-Sep-2014 12:00	1620	12.68	-0.03				
10-Sep-2014 13:10	1690	12.68	-0.03				
10-Sep-2014 14:00	1740	12.68	-0.03				
10-Sep-2014 15:00	1800	12.68	-0.03				
10-Sep-2014 16:00	1860	12.68	-0.03				
10-Sep-2014 17:00	1920	12.68	-0.03				
10-Sep-2014 18:00	1980	14.33	1.62				
10-Sep-2014 19:00	2040	13.31	0.60				
10-Sep-2014 20:00	2100	12.71	0.01				
10-Sep-2014 21:00	2160	12.67	-0.04				
10-Sep-2014 22:00	2220	12.66	-0.05				
10-Sep-2014 23:00	2280	12.66	-0.05				
11-Sep-2014 00:00	2340	12.71	0.00				
11-Sep-2014 01:00	2400	12.66	-0.04				
11-Sep-2014 02:00	2460	12.65	-0.06				
11-Sep-2014 03:00	2520	12.65	-0.05				
11-Sep-2014 04:00	2580	12.65	-0.05				
11-Sep-2014 05:00	2640	12.65	-0.05				
11-Sep-2014 06:00	2700	12.66	-0.05				
11-Sep-2014 07:00	2760	12.78	0.07				
11-Sep-2014 08:00	2820	12.67	-0.04				
11-Sep-2014 09:00	2880	12.66	-0.05				
11-Sep-2014 10:00	2940	12.66	-0.04				
11-Sep-2014 11:00	3000	12.66	-0.04				
11-Sep-2014 12:00	3060	12.66	-0.05				
11-Sep-2014 13:00	3120	12.66	-0.05				
11-Sep-2014 14:00	3180	12.66	-0.04				
11-Sep-2014 15:00	3240	12.71	0.01				
11-Sep-2014 16:00	3300	12.67	-0.04				
11-Sep-2014 17:00	3360	12.66	-0.05				

11-Sep-2014 18:00	3420	12.82	0.11
11-Sep-2014 19:00	3480	12.76	0.05
11-Sep-2014 20:00	3540	12.71	0.01
11-Sep-2014 21:00	3600	12.86	0.16
11-Sep-2014 22:00	3660	12.79	0.08
11-Sep-2014 23:00	3720	12.75	0.04
12-Sep-2014 00:00	3780	12.66	-0.04
12-Sep-2014 01:00	3840	12.65	-0.06
12-Sep-2014 02:00	3900	12.65	-0.06
12-Sep-2014 03:00	3960	12.65	-0.06
12-Sep-2014 04:00	4020	12.65	-0.06
12-Sep-2014 05:00	4080	12.64	-0.07
12-Sep-2014 06:00	4140	12.71	0.00
12-Sep-2014 07:00	4200	12.65	-0.05
12-Sep-2014 08:00	4260	12.67	-0.04
12-Sep-2014 09:00	4320	12.64	-0.06

Tabulated Levels for BH8-1

Pump On:	09-Sep-2014 09:00		Static Level:	36.60	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	36.70	
Pumping Well:	**TW34**		DD:	0.09	
Distance from Pumping Well:	771 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
11-Sep-2014 11:00	3000	36.65	0.05	12-Sep-2014 09:00	0	36.70	0.00
11-Sep-2014 12:00	3060	36.66	0.06	12-Sep-2014 09:01	1	36.69	0.00
11-Sep-2014 13:00	3120	36.66	0.06	12-Sep-2014 09:02	2	36.69	0.00
11-Sep-2014 14:00	3180	36.67	0.07	12-Sep-2014 09:03	3	36.69	0.00
11-Sep-2014 15:00	3240	36.68	0.07	12-Sep-2014 09:04	4	36.70	0.00
11-Sep-2014 16:00	3300	36.68	0.08	12-Sep-2014 09:05	5	36.69	0.00
11-Sep-2014 17:00	3360	36.67	0.07	12-Sep-2014 09:06	6	36.70	0.00
11-Sep-2014 18:00	3420	36.68	0.08	12-Sep-2014 09:07	7	36.70	0.00
11-Sep-2014 19:00	3480	36.68	0.08	12-Sep-2014 09:08	8	36.70	0.00
11-Sep-2014 20:00	3540	36.68	0.08	12-Sep-2014 09:09	9	36.70	0.00
11-Sep-2014 21:00	3600	36.68	0.08	12-Sep-2014 09:10	10	36.70	0.00
11-Sep-2014 22:00	3660	36.68	0.08	12-Sep-2014 09:12	12	36.70	0.00
11-Sep-2014 23:00	3720	36.69	0.09	12-Sep-2014 09:14	14	36.70	0.00
12-Sep-2014 00:00	3780	36.68	0.08	12-Sep-2014 09:16	16	36.70	0.00
12-Sep-2014 01:00	3840	36.69	0.09	12-Sep-2014 09:18	18	36.70	0.00
12-Sep-2014 02:00	3900	36.69	0.09	12-Sep-2014 09:20	20	36.70	0.00
12-Sep-2014 03:00	3960	36.69	0.09	12-Sep-2014 09:25	25	36.70	0.00
12-Sep-2014 04:00	4020	36.70	0.10	12-Sep-2014 09:30	30	36.69	0.00
12-Sep-2014 05:00	4080	36.69	0.09	12-Sep-2014 09:35	35	36.69	0.00
12-Sep-2014 06:00	4140	36.69	0.09	12-Sep-2014 09:40	40	36.69	0.00
12-Sep-2014 07:00	4200	36.70	0.09	12-Sep-2014 09:50	50	36.69	0.00
12-Sep-2014 08:00	4260	36.69	0.09	12-Sep-2014 10:00	60	36.69	0.00
12-Sep-2014 09:00	4320	36.70	0.09	12-Sep-2014 10:15	75	36.70	0.00
				12-Sep-2014 10:30	90	36.70	0.00
				12-Sep-2014 10:45	105	36.69	0.00
				12-Sep-2014 11:00	120	36.70	0.00
				12-Sep-2014 11:30	150	36.70	0.00
				12-Sep-2014 14:00	300	36.70	0.00
				12-Sep-2014 17:00	480	36.69	0.01
				13-Sep-2014 10:05	1505	36.66	0.03

Tabulated Levels for SV Resort OW

Pump On:	09-Sep-2014 09:00		Static Level:	12.91	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	12.90	
Pumping Well:	**TW34**		DD:	-0.02	
Distance from Pumping Well:	915 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	12.91	0.00	12-Sep-2014 09:00	0	12.90	0.00
09-Sep-2014 09:01	1	12.91	0.00	12-Sep-2014 09:01	1	12.89	0.00
09-Sep-2014 09:02	2	12.91	-0.01	12-Sep-2014 09:02	2	12.90	0.00
09-Sep-2014 09:03	3	12.91	0.00	12-Sep-2014 09:03	3	12.89	0.00
09-Sep-2014 09:04	4	12.91	0.00	12-Sep-2014 09:04	4	12.89	0.01
09-Sep-2014 09:05	5	12.91	0.00	12-Sep-2014 09:05	5	12.89	0.01
09-Sep-2014 09:06	6	12.92	0.01	12-Sep-2014 09:06	6	12.89	0.00
09-Sep-2014 09:07	7	12.91	0.00	12-Sep-2014 09:07	7	12.89	0.01
09-Sep-2014 09:08	8	12.92	0.00	12-Sep-2014 09:08	8	12.90	-0.01
09-Sep-2014 09:10	10	12.92	0.00	12-Sep-2014 09:09	9	12.89	0.00
09-Sep-2014 09:12	12	12.91	-0.01	12-Sep-2014 09:10	10	12.89	0.00
09-Sep-2014 09:14	14	12.91	0.00	12-Sep-2014 09:12	12	12.89	0.01
09-Sep-2014 09:16	16	12.91	0.00	12-Sep-2014 09:14	14	12.90	0.00
09-Sep-2014 09:18	18	12.90	-0.01	12-Sep-2014 09:16	16	12.89	0.00
09-Sep-2014 09:20	20	12.91	0.00	12-Sep-2014 09:18	18	12.89	0.01
09-Sep-2014 09:25	25	12.90	-0.01	12-Sep-2014 09:20	20	12.89	0.00
09-Sep-2014 09:30	30	12.91	0.00	12-Sep-2014 09:25	25	12.89	0.01
09-Sep-2014 09:40	40	12.90	-0.01	12-Sep-2014 09:30	30	12.89	0.01
09-Sep-2014 09:50	50	12.94	0.03	12-Sep-2014 09:35	35	12.88	0.01
09-Sep-2014 10:00	60	12.91	-0.01	12-Sep-2014 09:40	40	13.15	-0.26
09-Sep-2014 10:15	75	12.91	0.00	12-Sep-2014 09:50	50	12.89	0.00
09-Sep-2014 10:30	90	12.91	0.00	12-Sep-2014 10:00	60	12.89	0.01
09-Sep-2014 10:45	105	12.91	-0.01	12-Sep-2014 10:15	75	12.89	0.01
09-Sep-2014 11:00	120	12.90	-0.02	12-Sep-2014 10:30	90	12.89	0.01
09-Sep-2014 11:30	150	12.91	0.00	12-Sep-2014 10:45	105	12.88	0.01
09-Sep-2014 12:00	180	12.91	0.00	12-Sep-2014 11:00	120	12.89	0.01
09-Sep-2014 12:30	210	12.91	0.00	12-Sep-2014 11:30	150	12.88	0.01
09-Sep-2014 13:00	240	12.91	0.00	12-Sep-2014 14:00	300	12.89	0.01
09-Sep-2014 13:30	270	12.98	0.07	12-Sep-2014 17:00	480	12.89	0.00
09-Sep-2014 14:00	300	12.91	0.00	13-Sep-2014 10:05	1505	12.90	0.00
09-Sep-2014 15:00	360	12.90	-0.01				
09-Sep-2014 16:00	420	12.90	-0.01				
09-Sep-2014 17:00	480	12.90	-0.02				
09-Sep-2014 18:00	540	12.91	0.00				
09-Sep-2014 20:00	660	12.90	-0.02				
09-Sep-2014 21:00	720	12.90	-0.02				
09-Sep-2014 22:00	780	12.90	-0.01				
09-Sep-2014 23:00	840	12.90	-0.01				
10-Sep-2014 00:00	900	12.90	-0.01				
10-Sep-2014 01:00	960	12.90	-0.02				
10-Sep-2014 02:00	1020	12.89	-0.02				
10-Sep-2014 03:00	1080	12.90	-0.02				
10-Sep-2014 04:00	1140	12.89	-0.02				
10-Sep-2014 05:00	1200	12.90	-0.02				
10-Sep-2014 06:00	1260	12.89	-0.03				
10-Sep-2014 07:00	1320	12.89	-0.03				
10-Sep-2014 08:00	1380	12.89	-0.02				
10-Sep-2014 09:00	1440	12.88	-0.03				
10-Sep-2014 10:00	1500	12.89	-0.03				
10-Sep-2014 11:00	1560	12.88	-0.03				
10-Sep-2014 12:00	1620	12.88	-0.03				
10-Sep-2014 13:10	1690	12.88	-0.03				
10-Sep-2014 14:00	1740	12.88	-0.03				
10-Sep-2014 15:00	1800	12.88	-0.03				
10-Sep-2014 16:00	1860	12.87	-0.04				
10-Sep-2014 17:00	1920	12.88	-0.03				
10-Sep-2014 18:00	1980	12.87	-0.04				
10-Sep-2014 19:00	2040	12.85	-0.06				
10-Sep-2014 20:00	2100	12.86	-0.05				
10-Sep-2014 21:00	2160	12.85	-0.06				
10-Sep-2014 22:00	2220	12.84	-0.07				
10-Sep-2014 23:00	2280	12.84	-0.08				
11-Sep-2014 00:00	2340	12.84	-0.08				
11-Sep-2014 01:00	2400	12.84	-0.08				
11-Sep-2014 02:00	2460	12.83	-0.08				
11-Sep-2014 03:00	2520	12.84	-0.07				
11-Sep-2014 04:00	2580	12.83	-0.08				
11-Sep-2014 05:00	2640	12.84	-0.07				
11-Sep-2014 06:00	2700	12.85	-0.07				
11-Sep-2014 07:00	2760	12.85	-0.06				
11-Sep-2014 08:00	2820	12.84	-0.07				
11-Sep-2014 09:00	2880	12.85	-0.06				
11-Sep-2014 10:00	2940	12.86	-0.05				
11-Sep-2014 11:00	3000	12.87	-0.04				
11-Sep-2014 12:00	3060	12.87	-0.05				
11-Sep-2014 13:00	3120	12.87	-0.04				
11-Sep-2014 14:00	3180	12.87	-0.04				
11-Sep-2014 15:00	3240	12.87	-0.04				
11-Sep-2014 16:00	3300	12.88	-0.03				
11-Sep-2014 17:00	3360	12.87	-0.04				

11-Sep-2014 18:00	3420	12.88	-0.03
11-Sep-2014 19:00	3480	12.87	-0.04
11-Sep-2014 20:00	3540	12.87	-0.04
11-Sep-2014 21:00	3600	12.87	-0.04
11-Sep-2014 22:00	3660	12.87	-0.04
11-Sep-2014 23:00	3720	12.88	-0.03
12-Sep-2014 00:00	3780	12.87	-0.04
12-Sep-2014 01:00	3840	12.88	-0.03
12-Sep-2014 02:00	3900	12.89	-0.02
12-Sep-2014 03:00	3960	12.88	-0.03
12-Sep-2014 04:00	4020	12.89	-0.02
12-Sep-2014 05:00	4080	12.89	-0.02
12-Sep-2014 06:00	4140	12.89	-0.03
12-Sep-2014 07:00	4200	12.89	-0.02
12-Sep-2014 08:00	4260	12.89	-0.02
12-Sep-2014 09:00	4320	12.90	-0.02

Tabulated Levels for House 1

Pump On:	09-Sep-2014 09:00		Static Level:	4.51	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	4.45	
Pumping Well:	**TW34**		DD:	-0.06	
Distance from Pumping Well:	926 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	4.51	0.00	12-Sep-2014 09:00	0	4.45	0.00
09-Sep-2014 09:01	1	4.51	0.00	12-Sep-2014 09:01	1	4.45	0.00
09-Sep-2014 09:02	2	4.51	0.00	12-Sep-2014 09:02	2	4.45	0.00
09-Sep-2014 09:03	3	4.51	0.00	12-Sep-2014 09:03	3	4.45	0.00
09-Sep-2014 09:04	4	4.51	0.00	12-Sep-2014 09:04	4	4.46	0.00
09-Sep-2014 09:05	5	4.51	0.00	12-Sep-2014 09:05	5	4.45	0.00
09-Sep-2014 09:06	6	4.51	0.00	12-Sep-2014 09:06	6	4.45	0.00
09-Sep-2014 09:07	7	4.51	0.00	12-Sep-2014 09:07	7	4.45	0.00
09-Sep-2014 09:08	8	4.51	0.00	12-Sep-2014 09:08	8	4.46	-0.01
09-Sep-2014 09:10	10	4.52	0.01	12-Sep-2014 09:09	9	4.46	-0.01
09-Sep-2014 09:12	12	4.51	0.00	12-Sep-2014 09:10	10	4.46	0.00
09-Sep-2014 09:14	14	4.51	0.00	12-Sep-2014 09:12	12	4.45	0.00
09-Sep-2014 09:16	16	4.51	0.00	12-Sep-2014 09:14	14	4.45	0.00
09-Sep-2014 09:18	18	4.51	0.00	12-Sep-2014 09:16	16	4.45	0.00
09-Sep-2014 09:20	20	4.51	0.00	12-Sep-2014 09:18	18	4.45	0.00
09-Sep-2014 09:25	25	4.51	0.00	12-Sep-2014 09:20	20	4.46	-0.01
09-Sep-2014 09:30	30	4.51	0.00	12-Sep-2014 09:25	25	4.46	0.00
09-Sep-2014 09:40	40	4.51	0.00	12-Sep-2014 09:30	30	4.45	0.00
09-Sep-2014 09:50	50	4.51	0.00	12-Sep-2014 09:35	35	4.45	0.00
09-Sep-2014 10:00	60	4.51	0.00	12-Sep-2014 09:40	40	4.45	0.00
09-Sep-2014 10:15	75	4.51	0.00	12-Sep-2014 09:50	50	4.45	0.00
09-Sep-2014 10:30	90	4.51	0.00	12-Sep-2014 10:00	60	4.45	0.00
09-Sep-2014 10:45	105	4.51	0.00	12-Sep-2014 10:15	75	4.46	0.00
09-Sep-2014 11:00	120	4.51	0.00	12-Sep-2014 10:30	90	4.45	0.00
09-Sep-2014 11:30	150	4.51	0.00	12-Sep-2014 10:45	105	4.46	0.00
09-Sep-2014 12:00	180	4.51	0.00	12-Sep-2014 11:00	120	4.45	0.00
09-Sep-2014 12:30	210	4.51	0.00	12-Sep-2014 11:30	150	4.46	-0.01
09-Sep-2014 13:00	240	4.51	0.00	12-Sep-2014 14:00	300	4.46	-0.01
09-Sep-2014 13:30	270	4.50	-0.01	12-Sep-2014 17:00	480	4.46	0.00
09-Sep-2014 14:00	300	4.50	-0.01	13-Sep-2014 10:05	1505	4.50	-0.05
09-Sep-2014 15:00	360	4.50	-0.01				
09-Sep-2014 16:00	420	4.50	-0.01				
09-Sep-2014 17:00	480	4.50	-0.01				
09-Sep-2014 18:00	540	4.50	-0.01				
09-Sep-2014 20:00	660	4.49	-0.02				
09-Sep-2014 21:00	720	4.50	-0.01				
09-Sep-2014 22:00	780	4.49	-0.01				
09-Sep-2014 23:00	840	4.50	-0.01				
10-Sep-2014 00:00	900	4.50	-0.01				
10-Sep-2014 01:00	960	4.49	-0.02				
10-Sep-2014 02:00	1020	4.49	-0.02				
10-Sep-2014 03:00	1080	4.49	-0.01				
10-Sep-2014 04:00	1140	4.49	-0.02				
10-Sep-2014 05:00	1200	4.49	-0.02				
10-Sep-2014 06:00	1260	4.48	-0.03				
10-Sep-2014 07:00	1320	4.49	-0.02				
10-Sep-2014 08:00	1380	4.48	-0.03				
10-Sep-2014 09:00	1440	4.48	-0.03				
10-Sep-2014 10:00	1500	4.48	-0.03				
10-Sep-2014 11:00	1560	4.48	-0.03				
10-Sep-2014 12:00	1620	4.48	-0.03				
10-Sep-2014 13:10	1690	4.48	-0.03				
10-Sep-2014 14:00	1740	4.48	-0.03				
10-Sep-2014 15:00	1800	4.48	-0.03				
10-Sep-2014 16:00	1860	4.47	-0.04				
10-Sep-2014 17:00	1920	4.47	-0.04				
10-Sep-2014 18:00	1980	4.47	-0.04				
10-Sep-2014 19:00	2040	4.45	-0.06				
10-Sep-2014 20:00	2100	4.44	-0.07				
10-Sep-2014 21:00	2160	4.43	-0.08				
10-Sep-2014 22:00	2220	4.43	-0.08				
10-Sep-2014 23:00	2280	4.42	-0.09				
11-Sep-2014 00:00	2340	4.43	-0.08				
11-Sep-2014 01:00	2400	4.43	-0.08				
11-Sep-2014 02:00	2460	4.43	-0.08				
11-Sep-2014 03:00	2520	4.43	-0.08				
11-Sep-2014 04:00	2580	4.42	-0.09				
11-Sep-2014 05:00	2640	4.42	-0.09				
11-Sep-2014 06:00	2700	4.43	-0.08				
11-Sep-2014 07:00	2760	4.43	-0.08				
11-Sep-2014 08:00	2820	4.43	-0.08				
11-Sep-2014 09:00	2880	4.43	-0.08				
11-Sep-2014 10:00	2940	4.43	-0.08				
11-Sep-2014 11:00	3000	4.44	-0.07				
11-Sep-2014 12:00	3060	4.44	-0.07				
11-Sep-2014 13:00	3120	4.44	-0.07				
11-Sep-2014 14:00	3180	4.44	-0.07				
11-Sep-2014 15:00	3240	4.44	-0.06				
11-Sep-2014 16:00	3300	4.45	-0.06				
11-Sep-2014 17:00	3360	4.65	0.15				

11-Sep-2014 18:00	3420	4.45	-0.06
11-Sep-2014 19:00	3480	4.45	-0.06
11-Sep-2014 20:00	3540	4.44	-0.07
11-Sep-2014 21:00	3600	4.45	-0.06
11-Sep-2014 22:00	3660	4.45	-0.06
11-Sep-2014 23:00	3720	4.45	-0.06
12-Sep-2014 00:00	3780	4.45	-0.06
12-Sep-2014 01:00	3840	4.45	-0.06
12-Sep-2014 02:00	3900	4.46	-0.05
12-Sep-2014 03:00	3960	4.45	-0.05
12-Sep-2014 04:00	4020	4.46	-0.05
12-Sep-2014 05:00	4080	4.46	-0.05
12-Sep-2014 06:00	4140	4.46	-0.05
12-Sep-2014 07:00	4200	4.53	0.02
12-Sep-2014 08:00	4260	4.45	-0.05
12-Sep-2014 09:00	4320	4.45	-0.06

Tabulated Levels for SVR OW1

Pump On:	09-Sep-2014 09:00		Static Level:	27.02	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	24.15	
Pumping Well:	**TW34**		DD:	-2.88	
Distance from Pumping Well:	1047 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	27.02	0.00	12-Sep-2014 09:00	0	24.15	0.00
09-Sep-2014 09:01	1	27.02	0.00	12-Sep-2014 09:01	1	24.15	0.00
09-Sep-2014 09:02	2	27.02	0.00	12-Sep-2014 09:02	2	24.15	0.00
09-Sep-2014 09:03	3	27.03	0.01	12-Sep-2014 09:03	3	24.15	0.00
09-Sep-2014 09:04	4	27.03	0.00	12-Sep-2014 09:04	4	24.14	0.01
09-Sep-2014 09:05	5	27.03	0.00	12-Sep-2014 09:05	5	24.15	-0.01
09-Sep-2014 09:06	6	27.03	0.01	12-Sep-2014 09:06	6	24.15	-0.01
09-Sep-2014 09:07	7	27.02	0.00	12-Sep-2014 09:07	7	24.14	0.00
09-Sep-2014 09:08	8	27.03	0.01	12-Sep-2014 09:08	8	24.14	0.00
09-Sep-2014 09:10	10	26.03	-0.99	12-Sep-2014 09:09	9	24.14	0.01
09-Sep-2014 09:12	12	25.09	-1.93	12-Sep-2014 09:10	10	24.14	0.01
09-Sep-2014 09:14	14	24.96	-2.07	12-Sep-2014 09:12	12	24.13	0.01
09-Sep-2014 09:16	16	24.89	-2.14	12-Sep-2014 09:14	14	24.14	0.01
09-Sep-2014 09:18	18	24.85	-2.18	12-Sep-2014 09:16	16	24.13	0.01
09-Sep-2014 09:20	20	24.80	-2.22	12-Sep-2014 09:18	18	24.14	0.01
09-Sep-2014 09:25	25	24.75	-2.28	12-Sep-2014 09:20	20	24.12	0.02
09-Sep-2014 09:30	30	24.70	-2.32	12-Sep-2014 09:25	25	24.13	0.01
09-Sep-2014 09:40	40	24.64	-2.38	12-Sep-2014 09:30	30	24.13	0.02
09-Sep-2014 09:50	50	24.60	-2.43	12-Sep-2014 09:35	35	24.13	0.01
09-Sep-2014 10:00	60	24.58	-2.45	12-Sep-2014 09:40	40	24.12	0.02
09-Sep-2014 10:15	75	24.55	-2.48	12-Sep-2014 09:50	50	24.12	0.03
09-Sep-2014 10:30	90	24.52	-2.50	12-Sep-2014 10:00	60	24.11	0.04
09-Sep-2014 10:45	105	24.51	-2.51	12-Sep-2014 10:15	75	24.10	0.05
09-Sep-2014 11:00	120	24.48	-2.54	12-Sep-2014 10:30	90	24.10	0.05
09-Sep-2014 11:30	150	24.47	-2.56	12-Sep-2014 10:45	105	24.09	0.05
09-Sep-2014 12:00	180	24.51	-2.51	12-Sep-2014 11:00	120	24.85	-0.70
09-Sep-2014 12:30	210	24.45	-2.58	12-Sep-2014 11:30	150	25.05	-0.91
09-Sep-2014 13:00	240	24.43	-2.60	12-Sep-2014 14:00	300	24.18	-0.04
09-Sep-2014 13:30	270	24.41	-2.62	12-Sep-2014 17:00	480	24.12	0.02
09-Sep-2014 14:00	300	24.40	-2.62	13-Sep-2014 10:05	1505	26.77	-2.63
09-Sep-2014 15:00	360	25.35	-1.67				
09-Sep-2014 16:00	420	24.68	-2.35				
09-Sep-2014 17:00	480	24.53	-2.50				
09-Sep-2014 18:00	540	24.46	-2.56				
09-Sep-2014 20:00	660	26.79	-0.23				
09-Sep-2014 21:00	720	26.94	-0.08				
09-Sep-2014 22:00	780	24.56	-2.47				
09-Sep-2014 23:00	840	24.47	-2.56				
10-Sep-2014 00:00	900	24.42	-2.60				
10-Sep-2014 01:00	960	24.43	-2.59				
10-Sep-2014 02:00	1020	24.41	-2.62				
10-Sep-2014 03:00	1080	25.30	-1.72				
10-Sep-2014 04:00	1140	25.49	-1.54				
10-Sep-2014 05:00	1200	25.03	-1.99				
10-Sep-2014 06:00	1260	24.61	-2.41				
10-Sep-2014 07:00	1320	24.53	-2.50				
10-Sep-2014 08:00	1380	26.94	-0.08				
10-Sep-2014 09:00	1440	25.23	-1.79				
10-Sep-2014 10:00	1500	24.62	-2.41				
10-Sep-2014 11:00	1560	24.54	-2.48				
10-Sep-2014 12:00	1620	25.38	-1.64				
10-Sep-2014 13:10	1690	24.78	-2.24				
10-Sep-2014 14:00	1740	24.63	-2.39				
10-Sep-2014 15:00	1800	24.59	-2.44				
10-Sep-2014 16:00	1860	24.56	-2.47				
10-Sep-2014 17:00	1920	24.56	-2.46				
10-Sep-2014 18:00	1980	24.58	-2.45				
10-Sep-2014 19:00	2040	24.60	-2.43				
10-Sep-2014 20:00	2100	27.22	0.19				
10-Sep-2014 21:00	2160	24.86	-2.16				
10-Sep-2014 22:00	2220	24.75	-2.28				
10-Sep-2014 23:00	2280	24.71	-2.31				
11-Sep-2014 00:00	2340	24.68	-2.34				
11-Sep-2014 01:00	2400	24.66	-2.36				
11-Sep-2014 02:00	2460	24.65	-2.37				
11-Sep-2014 03:00	2520	24.65	-2.37				
11-Sep-2014 04:00	2580	25.47	-1.56				
11-Sep-2014 05:00	2640	25.38	-1.64				
11-Sep-2014 06:00	2700	24.70	-2.33				
11-Sep-2014 07:00	2760	24.61	-2.41				
11-Sep-2014 08:00	2820	24.55	-2.47				
11-Sep-2014 09:00	2880	26.78	-0.24				
11-Sep-2014 10:00	2940	26.71	-0.31				
11-Sep-2014 11:00	3000	24.55	-2.48				
11-Sep-2014 12:00	3060	24.47	-2.55				
11-Sep-2014 13:00	3120	24.43	-2.60				
11-Sep-2014 14:00	3180	24.38	-2.64				
11-Sep-2014 15:00	3240	24.34	-2.69				
11-Sep-2014 16:00	3300	24.30	-2.72				
11-Sep-2014 17:00	3360	24.28	-2.74				

11-Sep-2014 18:00	3420	24.27	-2.75
11-Sep-2014 19:00	3480	24.25	-2.78
11-Sep-2014 20:00	3540	25.22	-1.81
11-Sep-2014 21:00	3600	24.43	-2.59
11-Sep-2014 22:00	3660	24.30	-2.72
11-Sep-2014 23:00	3720	24.25	-2.77
12-Sep-2014 00:00	3780	24.23	-2.79
12-Sep-2014 01:00	3840	24.20	-2.83
12-Sep-2014 02:00	3900	24.18	-2.85
12-Sep-2014 03:00	3960	24.15	-2.87
12-Sep-2014 04:00	4020	24.14	-2.88
12-Sep-2014 05:00	4080	24.13	-2.89
12-Sep-2014 06:00	4140	26.73	-0.29
12-Sep-2014 07:00	4200	24.33	-2.70
12-Sep-2014 08:00	4260	24.20	-2.83
12-Sep-2014 09:00	4320	24.15	-2.88

Tabulated Levels for SV Park OW

Pump On:	09-Sep-2014 09:00		Static Level:	13.66	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	13.30	
Pumping Well:	**TW34**		DD:	-0.36	
Distance from Pumping Well:	1564 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	13.66	0.00	12-Sep-2014 09:00	0	13.30	0.00
09-Sep-2014 09:01	1	13.64	-0.02	12-Sep-2014 09:01	1	13.30	0.01
09-Sep-2014 09:02	2	13.65	-0.01	12-Sep-2014 09:02	2	13.30	0.00
09-Sep-2014 09:03	3	13.68	0.02	12-Sep-2014 09:03	3	13.30	0.00
09-Sep-2014 09:04	4	13.67	0.01	12-Sep-2014 09:04	4	13.30	0.00
09-Sep-2014 09:05	5	13.68	0.02	12-Sep-2014 09:05	5	13.30	0.00
09-Sep-2014 09:06	6	13.68	0.02	12-Sep-2014 09:06	6	13.30	0.01
09-Sep-2014 09:07	7	13.68	0.02	12-Sep-2014 09:07	7	13.30	0.01
09-Sep-2014 09:08	8	13.69	0.03	12-Sep-2014 09:08	8	13.30	0.00
09-Sep-2014 09:10	10	13.67	0.01	12-Sep-2014 09:09	9	13.29	0.01
09-Sep-2014 09:12	12	13.68	0.02	12-Sep-2014 09:10	10	13.29	0.01
09-Sep-2014 09:14	14	13.69	0.03	12-Sep-2014 09:12	12	13.29	0.01
09-Sep-2014 09:16	16	13.69	0.03	12-Sep-2014 09:14	14	13.29	0.01
09-Sep-2014 09:18	18	13.69	0.03	12-Sep-2014 09:16	16	13.29	0.01
09-Sep-2014 09:20	20	13.69	0.03	12-Sep-2014 09:18	18	13.28	0.02
09-Sep-2014 09:25	25	13.67	0.01	12-Sep-2014 09:20	20	13.29	0.01
09-Sep-2014 09:30	30	13.68	0.02	12-Sep-2014 09:25	25	13.28	0.02
09-Sep-2014 09:40	40	13.66	0.00	12-Sep-2014 09:30	30	13.28	0.02
09-Sep-2014 09:50	50	13.64	-0.02	12-Sep-2014 09:35	35	13.27	0.03
09-Sep-2014 10:00	60	13.63	-0.03	12-Sep-2014 09:40	40	13.29	0.01
09-Sep-2014 10:15	75	13.60	-0.06	12-Sep-2014 09:50	50	13.28	0.03
09-Sep-2014 10:30	90	13.59	-0.07	12-Sep-2014 10:00	60	13.27	0.04
09-Sep-2014 10:45	105	13.58	-0.08	12-Sep-2014 10:15	75	13.27	0.03
09-Sep-2014 11:00	120	13.56	-0.10	12-Sep-2014 10:30	90	13.26	0.05
09-Sep-2014 11:30	150	13.54	-0.12	12-Sep-2014 10:45	105	13.26	0.04
09-Sep-2014 12:00	180	13.52	-0.14	12-Sep-2014 11:00	120	13.27	0.04
09-Sep-2014 12:30	210	13.51	-0.15	12-Sep-2014 11:30	150	13.35	-0.04
09-Sep-2014 13:00	240	13.49	-0.17	12-Sep-2014 14:00	300	13.33	-0.03
09-Sep-2014 13:30	270	13.46	-0.20	12-Sep-2014 17:00	480	13.25	0.05
09-Sep-2014 14:00	300	13.45	-0.21	13-Sep-2014 10:05	1505	13.30	0.01
09-Sep-2014 15:00	360	13.53	-0.13				
09-Sep-2014 16:00	420	13.61	-0.05				
09-Sep-2014 17:00	480	13.55	-0.11				
09-Sep-2014 18:00	540	13.49	-0.17				
09-Sep-2014 20:00	660	13.44	-0.22				
09-Sep-2014 21:00	720	13.57	-0.09				
09-Sep-2014 22:00	780	13.55	-0.11				
09-Sep-2014 23:00	840	13.49	-0.17				
10-Sep-2014 00:00	900	13.43	-0.23				
10-Sep-2014 01:00	960	13.41	-0.25				
10-Sep-2014 02:00	1020	13.39	-0.27				
10-Sep-2014 03:00	1080	13.45	-0.21				
10-Sep-2014 04:00	1140	13.57	-0.09				
10-Sep-2014 05:00	1200	13.65	-0.01				
10-Sep-2014 06:00	1260	13.55	-0.11				
10-Sep-2014 07:00	1320	13.48	-0.18				
10-Sep-2014 08:00	1380	13.53	-0.13				
10-Sep-2014 09:00	1440	13.62	-0.04				
10-Sep-2014 10:00	1500	13.53	-0.13				
10-Sep-2014 11:00	1560	13.46	-0.20				
10-Sep-2014 12:00	1620	13.50	-0.16				
10-Sep-2014 13:10	1690	13.58	-0.09				
10-Sep-2014 14:00	1740	13.51	-0.15				
10-Sep-2014 15:00	1800	13.46	-0.20				
10-Sep-2014 16:00	1860	13.41	-0.25				
10-Sep-2014 17:00	1920	13.38	-0.28				
10-Sep-2014 18:00	1980	13.35	-0.31				
10-Sep-2014 19:00	2040	13.32	-0.34				
10-Sep-2014 20:00	2100	13.43	-0.23				
10-Sep-2014 21:00	2160	13.47	-0.19				
10-Sep-2014 22:00	2220	13.38	-0.28				
10-Sep-2014 23:00	2280	13.36	-0.30				
11-Sep-2014 00:00	2340	13.34	-0.32				
11-Sep-2014 01:00	2400	13.31	-0.35				
11-Sep-2014 02:00	2460	13.29	-0.37				
11-Sep-2014 03:00	2520	13.27	-0.39				
11-Sep-2014 04:00	2580	13.29	-0.37				
11-Sep-2014 05:00	2640	13.43	-0.23				
11-Sep-2014 06:00	2700	13.38	-0.28				
11-Sep-2014 07:00	2760	13.34	-0.32				
11-Sep-2014 08:00	2820	13.32	-0.34				
11-Sep-2014 09:00	2880	13.32	-0.34				
11-Sep-2014 10:00	2940	13.45	-0.22				
11-Sep-2014 11:00	3000	13.40	-0.26				
11-Sep-2014 12:00	3060	13.36	-0.30				
11-Sep-2014 13:00	3120	13.32	-0.34				
11-Sep-2014 14:00	3180	13.29	-0.37				
11-Sep-2014 15:00	3240	13.28	-0.38				
11-Sep-2014 16:00	3300	13.27	-0.39				
11-Sep-2014 17:00	3360	13.24	-0.42				

11-Sep-2014 18:00	3420	13.25	-0.41
11-Sep-2014 19:00	3480	13.25	-0.41
11-Sep-2014 20:00	3540	13.37	-0.29
11-Sep-2014 21:00	3600	13.42	-0.24
11-Sep-2014 22:00	3660	13.35	-0.31
11-Sep-2014 23:00	3720	13.31	-0.35
12-Sep-2014 00:00	3780	13.29	-0.37
12-Sep-2014 01:00	3840	13.28	-0.38
12-Sep-2014 02:00	3900	13.26	-0.40
12-Sep-2014 03:00	3960	13.25	-0.41
12-Sep-2014 04:00	4020	13.24	-0.42
12-Sep-2014 05:00	4080	13.25	-0.41
12-Sep-2014 06:00	4140	13.35	-0.32
12-Sep-2014 07:00	4200	13.39	-0.27
12-Sep-2014 08:00	4260	13.34	-0.32
12-Sep-2014 09:00	4320	13.30	-0.36

Tabulated Levels for SVR OW2

Pump On:	09-Sep-2014 09:00		Static Level:	13.47	
Pump Off:	12-Sep-2014 09:00		Pumping Level:	13.20	
Pumping Well:	**TW34**		DD:	-0.27	
Distance from Pumping Well:	2213 m				

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
09-Sep-2014 09:00	0	13.47	0.00	12-Sep-2014 09:00	0	13.20	0.00
09-Sep-2014 09:01	1	13.47	0.00	12-Sep-2014 09:01	1	13.21	0.00
09-Sep-2014 09:02	2	13.46	-0.01	12-Sep-2014 09:02	2	13.20	0.00
09-Sep-2014 09:03	3	13.45	-0.02	12-Sep-2014 09:03	3	13.20	0.00
09-Sep-2014 09:04	4	13.47	0.00	12-Sep-2014 09:04	4	13.20	0.00
09-Sep-2014 09:05	5	13.47	0.00	12-Sep-2014 09:05	5	13.20	0.00
09-Sep-2014 09:06	6	13.48	0.00	12-Sep-2014 09:06	6	13.20	0.00
09-Sep-2014 09:07	7	13.48	0.00	12-Sep-2014 09:07	7	13.20	0.00
09-Sep-2014 09:08	8	13.48	0.00	12-Sep-2014 09:08	8	13.20	0.01
09-Sep-2014 09:10	10	13.48	0.00	12-Sep-2014 09:09	9	13.20	0.00
09-Sep-2014 09:12	12	13.48	0.00	12-Sep-2014 09:10	10	13.20	0.00
09-Sep-2014 09:14	14	13.48	0.01	12-Sep-2014 09:12	12	13.20	0.01
09-Sep-2014 09:16	16	13.48	0.00	12-Sep-2014 09:14	14	13.20	0.00
09-Sep-2014 09:18	18	13.48	0.01	12-Sep-2014 09:16	16	13.20	0.01
09-Sep-2014 09:20	20	13.48	0.01	12-Sep-2014 09:18	18	13.20	0.00
09-Sep-2014 09:25	25	13.49	0.01	12-Sep-2014 09:20	20	13.20	0.01
09-Sep-2014 09:30	30	13.49	0.01	12-Sep-2014 09:25	25	13.20	0.01
09-Sep-2014 09:40	40	13.49	0.02	12-Sep-2014 09:30	30	13.20	0.01
09-Sep-2014 09:50	50	13.50	0.02	12-Sep-2014 09:35	35	13.20	0.00
09-Sep-2014 10:00	60	13.49	0.02	12-Sep-2014 09:40	40	13.20	0.01
09-Sep-2014 10:15	75	13.50	0.03	12-Sep-2014 09:50	50	13.19	0.01
09-Sep-2014 10:30	90	13.49	0.02	12-Sep-2014 10:00	60	13.19	0.02
09-Sep-2014 10:45	105	13.49	0.02	12-Sep-2014 10:15	75	13.18	0.02
09-Sep-2014 11:00	120	13.50	0.02	12-Sep-2014 10:30	90	13.18	0.02
09-Sep-2014 11:30	150	13.49	0.01	12-Sep-2014 10:45	105	13.18	0.03
09-Sep-2014 12:00	180	13.48	0.01	12-Sep-2014 11:00	120	13.18	0.03
09-Sep-2014 12:30	210	13.51	0.04	12-Sep-2014 11:30	150	13.18	0.03
09-Sep-2014 13:00	240	13.48	0.01	12-Sep-2014 14:00	300	13.35	-0.15
09-Sep-2014 13:30	270	13.48	0.00	12-Sep-2014 17:00	480	13.21	-0.01
09-Sep-2014 14:00	300	13.46	-0.01	13-Sep-2014 10:05	1505	13.43	-0.23
09-Sep-2014 15:00	360	13.46	-0.02				
09-Sep-2014 16:00	420	13.66	0.18				
09-Sep-2014 17:00	480	13.54	0.07				
09-Sep-2014 18:00	540	13.51	0.04				
09-Sep-2014 20:00	660	13.47	0.00				
09-Sep-2014 21:00	720	13.47	0.00				
09-Sep-2014 22:00	780	13.48	0.01				
09-Sep-2014 23:00	840	13.47	-0.01				
10-Sep-2014 00:00	900	13.46	-0.02				
10-Sep-2014 01:00	960	13.47	0.00				
10-Sep-2014 02:00	1020	13.63	0.16				
10-Sep-2014 03:00	1080	13.51	0.03				
10-Sep-2014 04:00	1140	13.50	0.03				
10-Sep-2014 05:00	1200	13.52	0.05				
10-Sep-2014 06:00	1260	13.54	0.07				
10-Sep-2014 07:00	1320	13.53	0.05				
10-Sep-2014 08:00	1380	13.53	0.05				
10-Sep-2014 09:00	1440	13.55	0.07				
10-Sep-2014 10:00	1500	13.55	0.08				
10-Sep-2014 11:00	1560	14.70	1.23				
10-Sep-2014 12:00	1620	13.64	0.17				
10-Sep-2014 13:10	1690	13.62	0.14				
10-Sep-2014 14:00	1740	13.62	0.15				
10-Sep-2014 15:00	1800	13.61	0.14				
10-Sep-2014 16:00	1860	13.62	0.14				
10-Sep-2014 17:00	1920	13.63	0.16				
10-Sep-2014 18:00	1980	13.66	0.19				
10-Sep-2014 19:00	2040	13.67	0.20				
10-Sep-2014 20:00	2100	13.70	0.22				
10-Sep-2014 21:00	2160	14.18	0.70				
10-Sep-2014 22:00	2220	13.82	0.35				
10-Sep-2014 23:00	2280	13.78	0.31				
11-Sep-2014 00:00	2340	13.75	0.28				
11-Sep-2014 01:00	2400	13.74	0.27				
11-Sep-2014 02:00	2460	13.74	0.27				
11-Sep-2014 03:00	2520	13.73	0.26				
11-Sep-2014 04:00	2580	13.72	0.25				
11-Sep-2014 05:00	2640	13.70	0.23				
11-Sep-2014 06:00	2700	13.67	0.20				
11-Sep-2014 07:00	2760	14.71	1.23				
11-Sep-2014 08:00	2820	13.70	0.23				
11-Sep-2014 09:00	2880	13.60	0.13				
11-Sep-2014 10:00	2940	13.55	0.08				
11-Sep-2014 11:00	3000	13.53	0.05				
11-Sep-2014 12:00	3060	13.50	0.03				
11-Sep-2014 13:00	3120	13.48	0.01				
11-Sep-2014 14:00	3180	13.45	-0.03				
11-Sep-2014 15:00	3240	13.41	-0.06				
11-Sep-2014 16:00	3300	13.39	-0.09				
11-Sep-2014 17:00	3360	13.37	-0.10				

11-Sep-2014 18:00	3420	13.46	-0.01
11-Sep-2014 19:00	3480	13.37	-0.10
11-Sep-2014 20:00	3540	13.34	-0.13
11-Sep-2014 21:00	3600	13.33	-0.15
11-Sep-2014 22:00	3660	13.33	-0.15
11-Sep-2014 23:00	3720	13.31	-0.16
12-Sep-2014 00:00	3780	13.29	-0.18
12-Sep-2014 01:00	3840	13.27	-0.20
12-Sep-2014 02:00	3900	13.25	-0.22
12-Sep-2014 03:00	3960	13.24	-0.24
12-Sep-2014 04:00	4020	13.36	-0.12
12-Sep-2014 05:00	4080	13.26	-0.21
12-Sep-2014 06:00	4140	13.23	-0.25
12-Sep-2014 07:00	4200	13.23	-0.24
12-Sep-2014 08:00	4260	13.22	-0.25
12-Sep-2014 09:00	4320	13.20	-0.27

Table H-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G26765 **REPORT No. B14-23683**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 12-Sep-14
DATE REPORTED: 17-Sep-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1407634 (McCarthy)
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW34 (24 hours)			
			Sample I.D.		B14-23683-1			
			Date Collected		10-Sep-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	15-Sep-14/O	231			
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	15-Sep-14/O	231			
Conductivity @25°C	µmho/cm	1	SM 2510B	15-Sep-14/O	404			
pH @25°C	pH Units		SM 4500H	15-Sep-14/O	8.06			
Fluoride	mg/L	0.1	SM4110C	12-Sep-14/O	0.1			
Bromide	mg/L	0.4	SM4110C	12-Sep-14/O	< 0.4			
Chloride	mg/L	0.5	SM4110C	12-Sep-14/O	1.4			
Nitrite (N)	mg/L	0.1	SM4110C	12-Sep-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	12-Sep-14/O	< 0.1			
Sulphate	mg/L	1	SM4110C	12-Sep-14/O	5			
Calcium	mg/L	0.02	SM 3120	15-Sep-14/O	63.6			
Magnesium	mg/L	0.01	SM 3120	15-Sep-14/O	17.5			
Sodium	mg/L	0.2	SM 3120	15-Sep-14/O	5.2			
Potassium	mg/L	0.1	SM 3120	15-Sep-14/O	2.0			
Iron	mg/L	0.005	SM 3120	15-Sep-14/O	1.45			
Manganese	mg/L	0.001	SM 3120	15-Sep-14/O	0.289			
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	16-Sep-14/O	0.12			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	15-Sep-14/O	2.0			
Tannins and Lignins	mg/L	0.1	N/A	15-Sep-14	0.1 [1]			
Anion Sum	meq/L		Calc.	16-Sep-14/O	4.78			
Cation Sum	meq/L		Calc.	16-Sep-14/O	4.99			
% Difference	%		Calc.	16-Sep-14/O	2.15			
Ion Ratio	AS/CS		Calc.	16-Sep-14/O	0.958			
Sodium Adsorption Ratio	-		Calc.	16-Sep-14/O	0.148			
TDS(ion sum calc.)	mg/L		Calc.	16-Sep-14/O	236			
Conductivity (calc.)	µmho/cm		Calc.	16-Sep-14/O	442			
TDS(calc.)/EC(actual)	-		Calc.	16-Sep-14/O	0.584			



M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Table H-2: Water Quality Results

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G26765 **REPORT No. B14-23683**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 12-Sep-14
DATE REPORTED: 17-Sep-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 1407634 (McCarthy)
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW34 (24 hours)			
			Sample I.D.		B14-23683-1			
			Date Collected		10-Sep-14			
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
EC(calc.)/EC(actual)	-		Calc.	16-Sep-14/O	1.09			
Langelier Index(25°C)	S.I.		Calc.	16-Sep-14/O	0.795			

1 . subcontracted to Paracel Labs

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Table H-2: Water Quality Results

CENTRAL ONTARIO ANALYTICAL LABORATORY INC.

4260 Burnside Line, R.R. #4
Orillia, ON L3V 6H4
Tel: (705) 326-8285 Fax: (705) 326-9316
www.coalab.ca

Final Certificate of Microbiological Analysis of Drinking Water

Date & Time Received:	Temp. Rec'd. (°C):	Receiver:	Date & Time Incubated:	2014-09-10 10:30
2014-09-10 09:50	10.4	AB	HPC & FS Date & Time Incubated:	

Date Sampled: 2014-09-09

Collected By: John Easton

Name of Facility: Golder Associates

Drinking Water System (DWS) #

Submitted By: John Easton

Twp/Town	
Systems Health Unit	SMDHU
Regulation	319/08
Total # of pages sent	1
# of samples sent	1
# of samples received	1

Report To: **Golder Associates Ltd.**

Address: 121 Commerce Park Drive, Unit L, Barrie, ON. L4N 8X1

Telephone: 705 722-4492 Ext: Fax: 705-722-3786

Email Address: patricia_chapple@golder.com

"Live Person" After Hours Contact Name and Tel. No:

Conditions/ Comments Test for Total Coliform, E Coli + Background

Time Sampled	Sample Identifier	Identification of Collection Site	Water Type	Temp. Of Sample (°C/°F)	Treatment Information				Laboratory Number	Total Coliform		E. coli		Background		HPC		
					U.V.	Other	Total Cl_2 (mg/L)	Free Cl_2 (mg/L)		>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/100 ml	>/<	CFU/1 ml	
09:30	TW34	Raw 13-1170-0040 ph 2000	R						906926		0		0		2			

All samples will be considered DISTRIBUTION samples unless otherwise indicated.

All times are transcribed in the 24-hour clock for upload to the Ministry of the Environment (MOE) and/or Ministry of Health and Long Term Care (MoHLTC).

Analysis performed by qualified analysts. Results relate only to the aliquot submitted. Samples have been analyzed as received. COAL is accredited by SCC and licensed by MOE in these specific microbiological parameters and the following inorganic and physical parameters: pH, turbidity, and alkalinity.

COAL accepts no responsibility for parameters selected, misidentification of samples or incorrect quantity, this is the responsibility of the submitting agency.
For collection and handling procedures visit www.coalab.ca/watersamples.html

F.S. & Faecal Strep. = Faecal Streptococcus HPC = Heterotrophic Plate Count HPM = Heavy Particulate Matter N/R = Not Received F.S. and HPC require 48 hours of incubation

Raw = R
Distribution = D
Point of Entry = E
Raw Water Comsumed = RWC

Analysis Date & Time: 2014-09-11 10:00 Enumerated By: LJ Audited By: GD Methodology (COAL Endo - COAL DC): M/F CFU/100ml

Analysis Date & Time: Enumerated By: Audited By: HPC Methodology: SP CFU/1ml; FS Methodology: M/F CFU/100ml

Transcribed By: ST Authorized & Rechecked By: JT/TJ Copy Released By: LJ/CAB

Lab No. Submitting Agency @ Health Unit @ Spills Action Centre (SAC) @ AWQI # By: Date:

Test Methodology and Detection Limit

Total Coliform (Treated)	COAL Endo	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Total Coliform (Untreated)	COAL DC	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
E. coli	COAL DC	Detection Limit	0 - 60	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL Endo	Detection Limit	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
Background	COAL DC	Detection Limit	0 - 200	Indicates Deterioration:	>200	Performed by Membrane Filtration	M/F CFU/100 ml
HPC	COAL HPC	Detection Limit	10 - 2.00 x 10^3	Indicates Deterioration:	>500	Performed by Spread Plate	SP CFU/1 ml
Faecal Streptococcus	COAL FS	Detection Limit	0 - 80	Reportable Limit:	1	Performed by Membrane Filtration	M/F CFU/100 ml

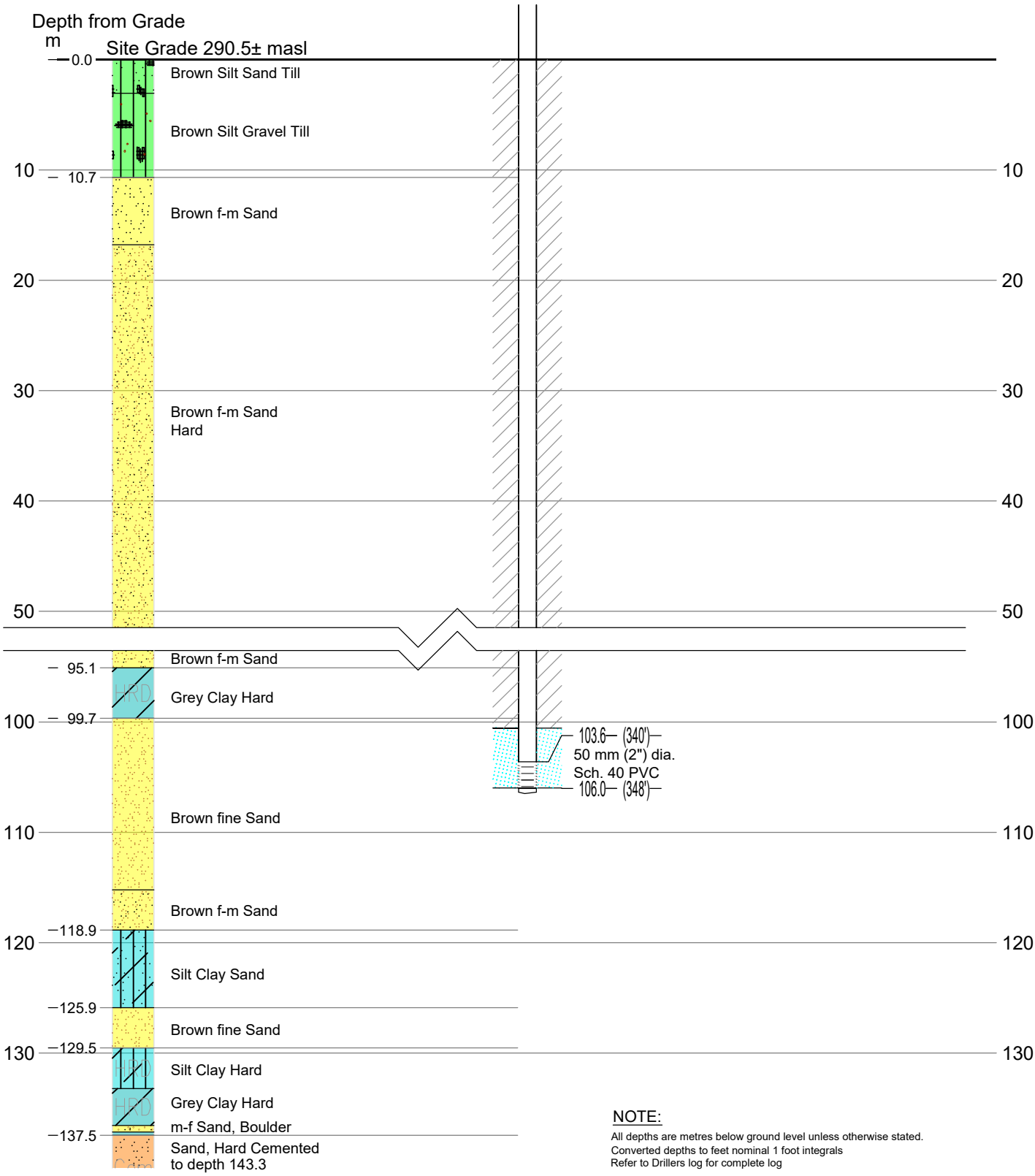
Approved for use by TJ prior to use.

APPENDIX I

Site 8: Well Construction and Testing: Walt Road

OW30

Golder ID L0435



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-10-30
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

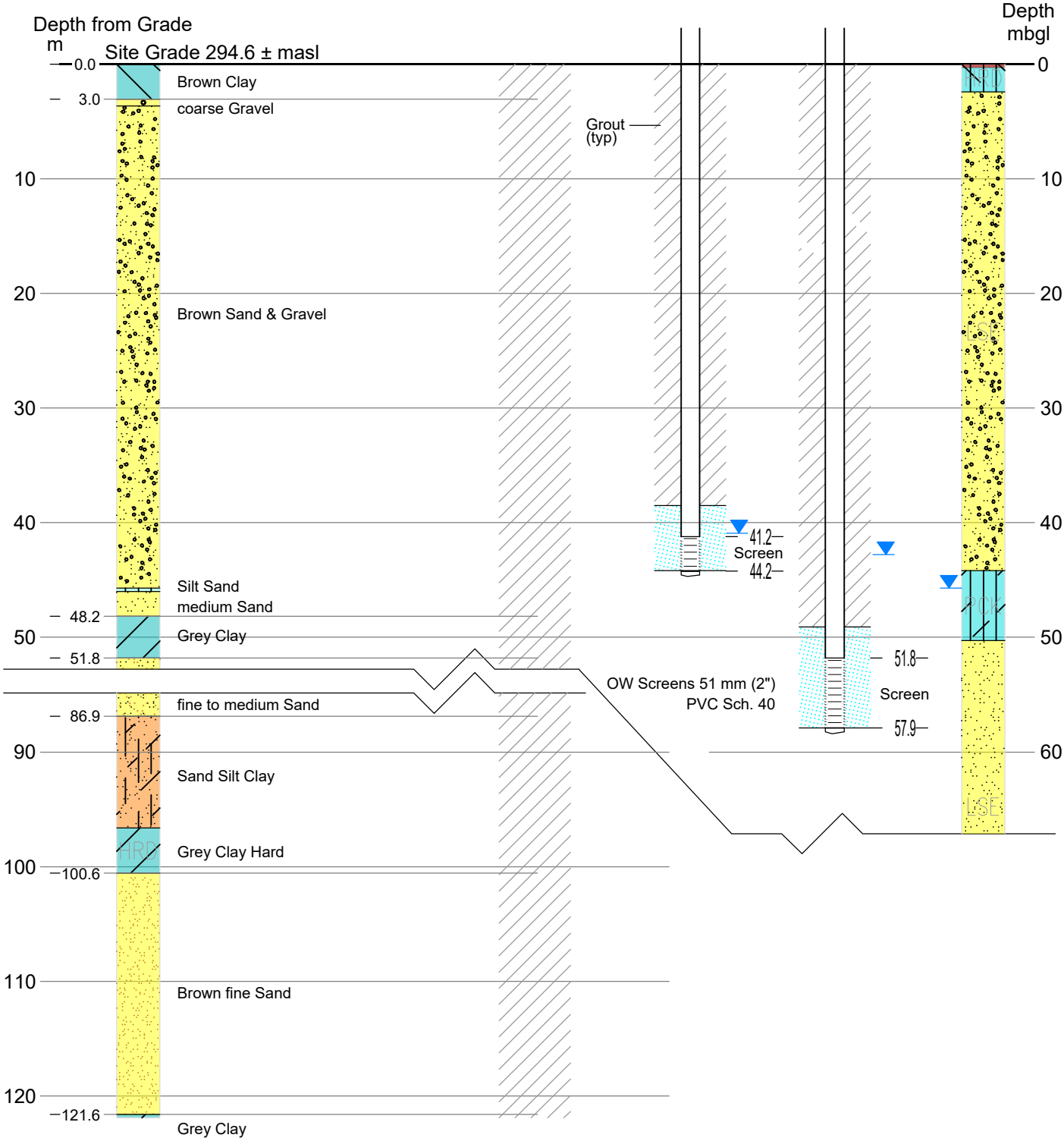
OBSERVATION WELL OW30 AS-BUILT

FILE No. 1311700040CBLOGS.dwg		
PROJECT No. 13-1170-0040	REV.	

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
I -1

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure I-1]



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

TEST HOLE TH31
CONSTRUCTION & ABANDONMENT

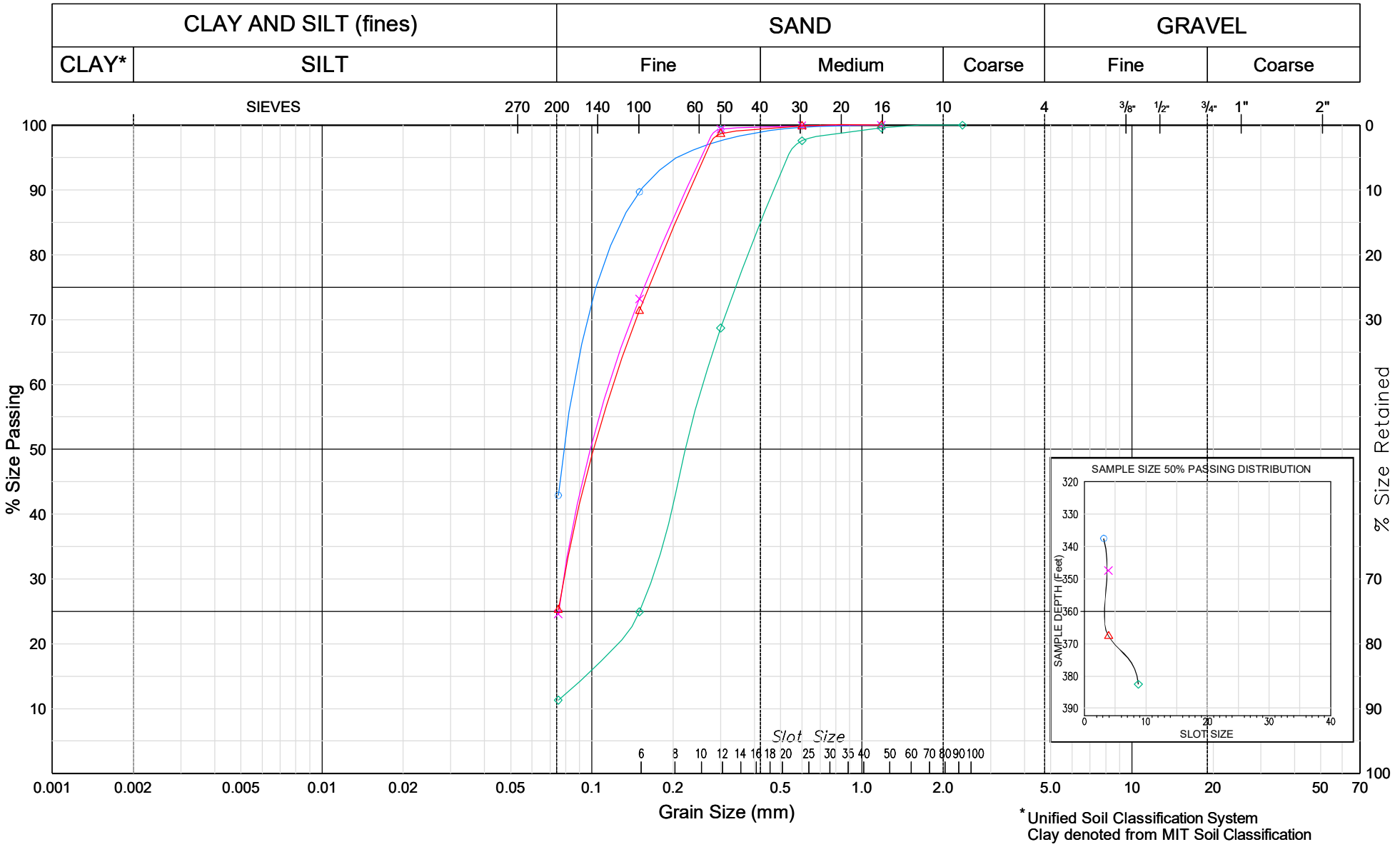
FILE No. 1311700040CBLOGS.dwg		
PROJECT No. 13-1170-0040	REV.	

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
I-2

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB-\1311700040CBLOGS.dwg: [Figure I-2]

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE30.dwg



*Unified Soil Classification System
Clay denoted from MIT Soil Classification

TITLE

GRAIN SIZE ANALYSIS
OW30

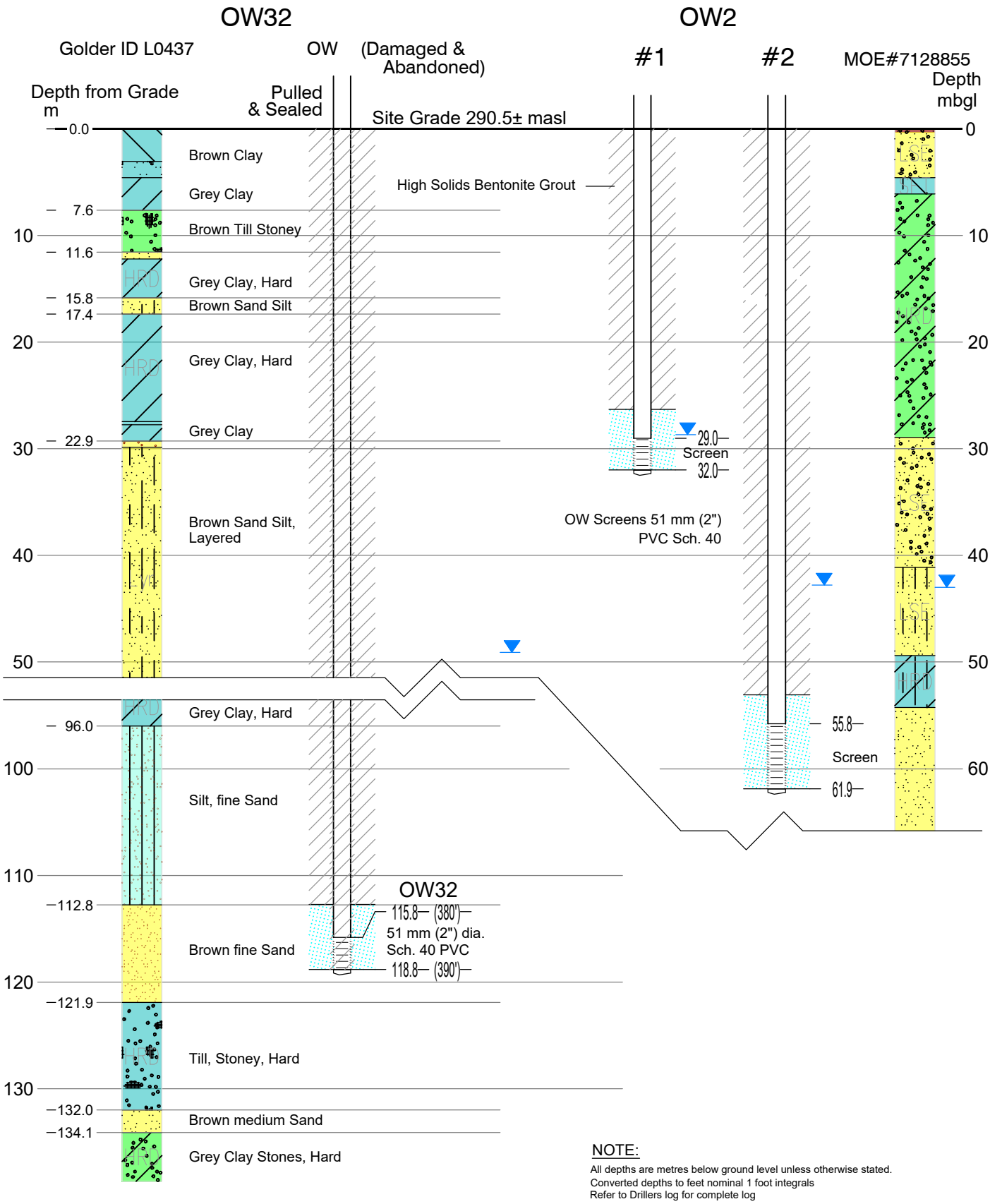
MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-04-04
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040BASVE30.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	I-3

APPENDIX J

Site 9: Well Construction and Testing: Coutts Site



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

OBSERVATION WELL OW32 AS-BUILT

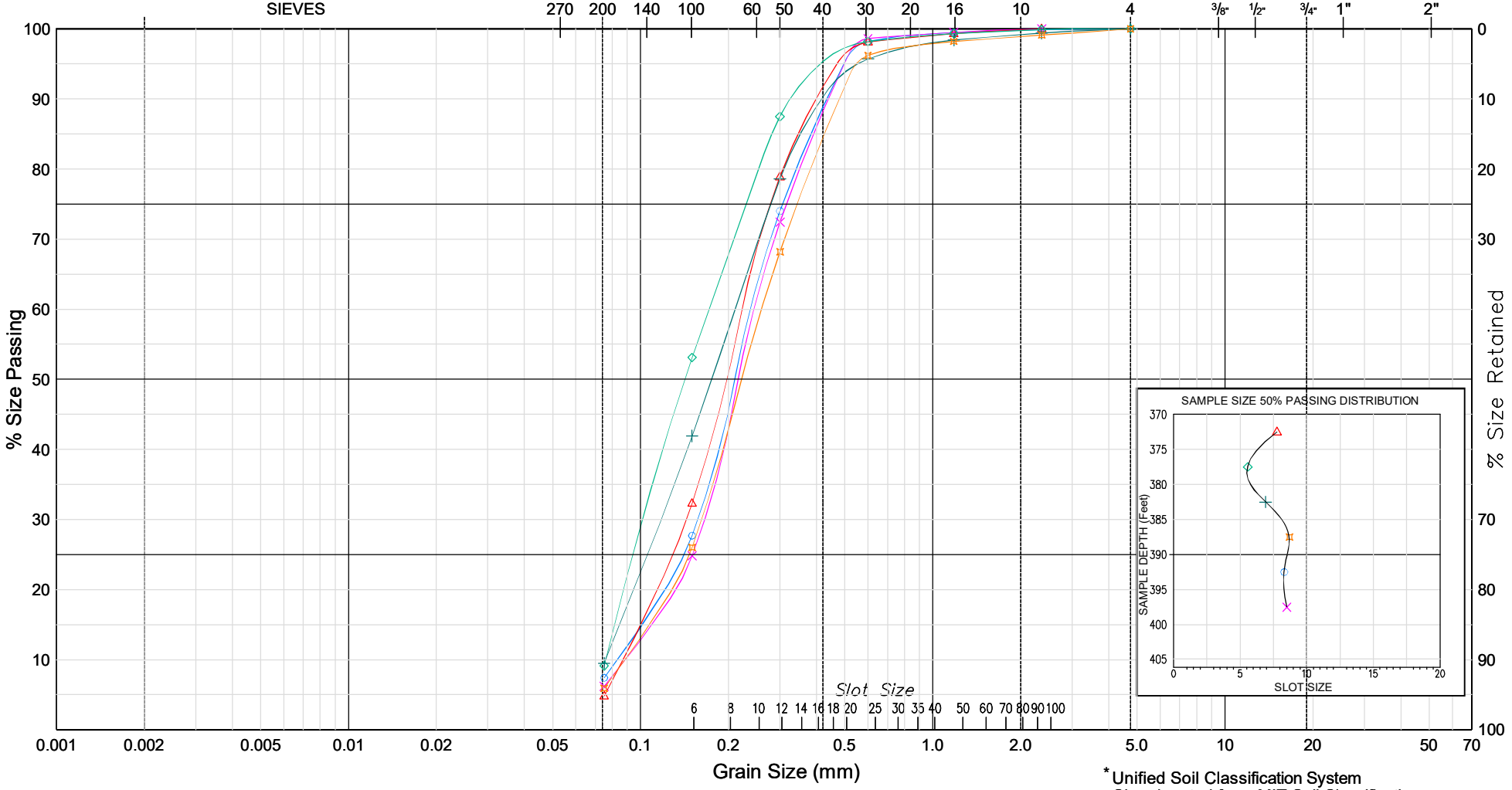
FILE No. 1311700040CBLOGS.dwg		
PROJECT No. 13-1170-0040	REV.	

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
J -1

PLOT DATE: March 10, 2016
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-CB-\1311700040CBLOGS.dwg: [Figure J-1]

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE32.dwg



△ TW32 370-375 ft
◇ TW32 375-380 ft
+ TW32 380-385 ft
⌑ TW32 385-390 ft
○ TW32 390-395 ft
× TW32 395-400 ft

*Unified Soil Classification System
Clay denoted from MIT Soil Classification

TITLE

GRAIN SIZE ANALYSIS
OW32

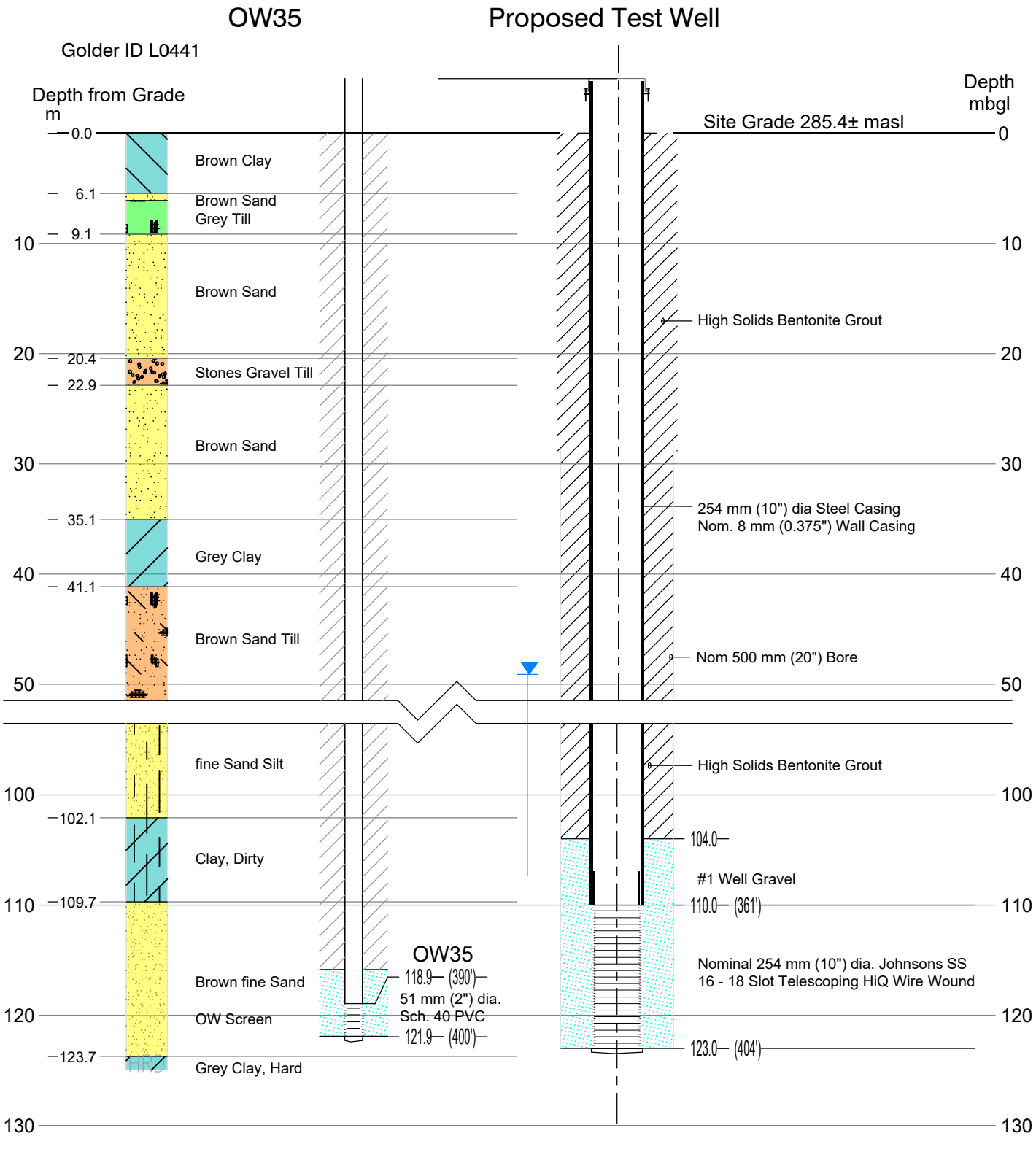
MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-04-04
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040BASVE32.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	J-2

APPENDIX K

Site 10: Well Construction and Testing: Alliance Site



NOTE:

All depths are metres below ground level unless otherwise stated.
Converted depths to feet nominal 1 foot integrals
Refer to Drillers log for complete log

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-08
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

PRODUCTION WELL OW35 SITE
PROPOSED CONSTRUCTION

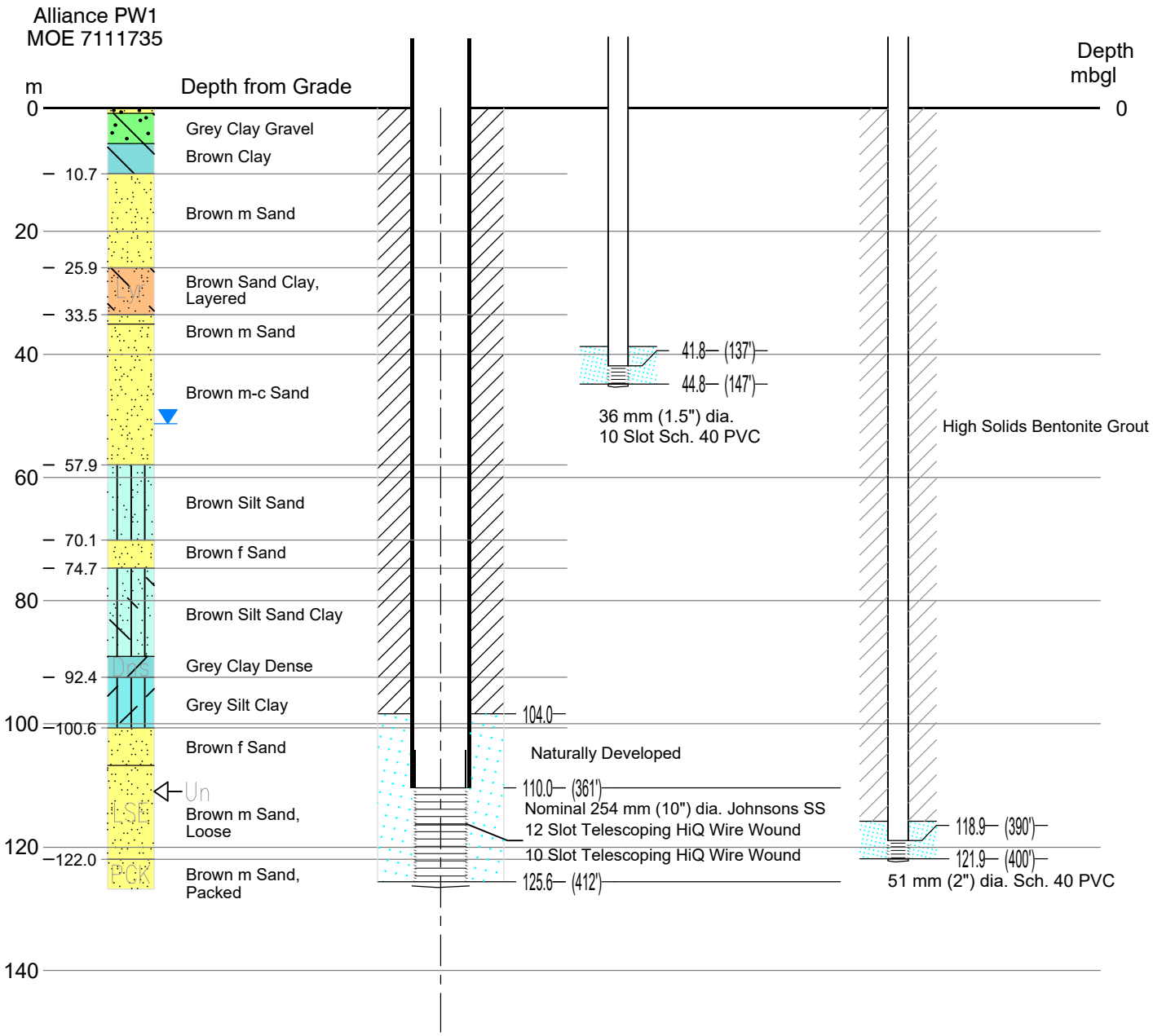
FILE No.	1311700040CBLOGS.dwg
PROJECT No.	13-1170-0040
REV.	

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
K-1

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure K-1]

ALLIANCE WELL TH3 OW35



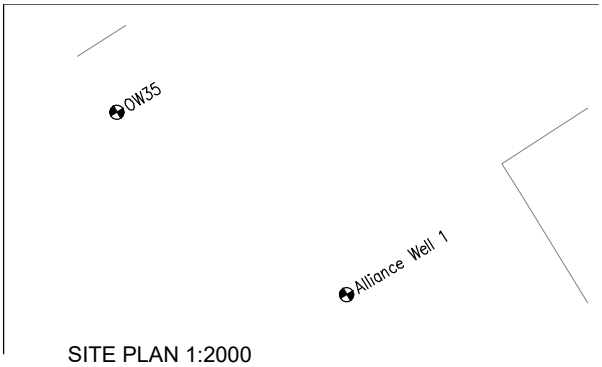
Notes:

All depths are metres below ground level unless otherwise stated.

Converted depths to feet nominal 1 foot integrals

OW's at distance from Pilot Hole of TW20 are truncated above grade at elevation of Test Well, with depths relative approximate to Site Grade of TW20

Observation Well Screens 51 mm (2") dia. Sch. 40 PVC



SITE PLAN 1:2000

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-07-14
DESIGN	
CAD	JPR
CHECK	
REVIEW	

TITLE

AS-BUILT ALLIANCE PW1

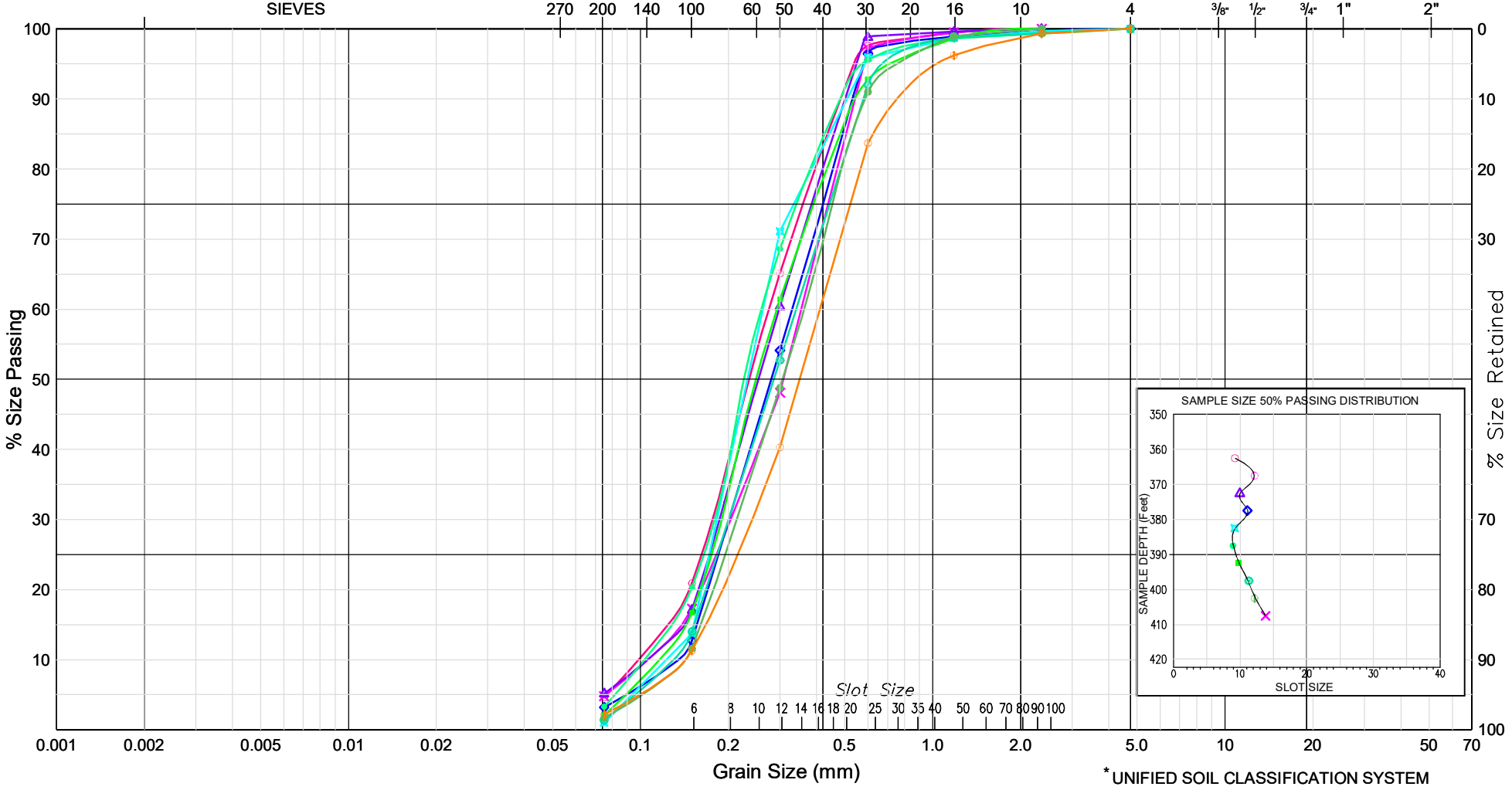
FILE No. 1311700040CBLOGS.dwg
PROJECT No. 13-1170-0040 REV.

MIDHURST
WATER SUPPLY EXPLORATION

FIGURE
K-2

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\CB\1311700040CBLOGS.dwg: [Figure K-2]

PLOT DATE: October 30, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-BA-\1311700040BASVE35.dwg



*UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

LEGEND

- TW35 360-365'
- TW35 365-370'
- TW35 370-375'
- TW35 375-380'
- TW35 380-385'
- TW35 385-390'
- TW35 390-395'
- TW35 395-400'
- TW35 400-405'
- TW35 405-410'

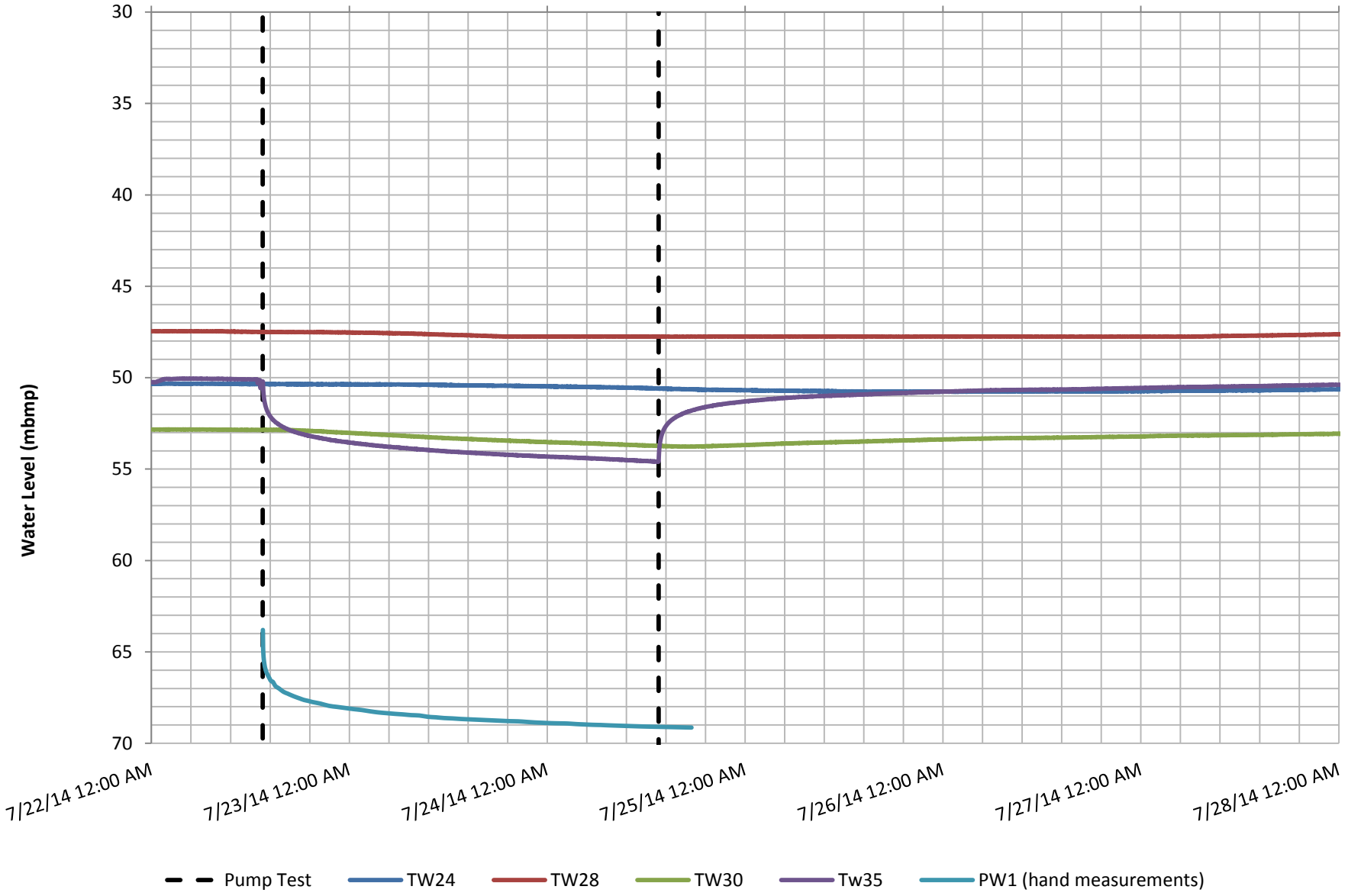
TITLE

GRAIN SIZE ANALYSIS
OW35

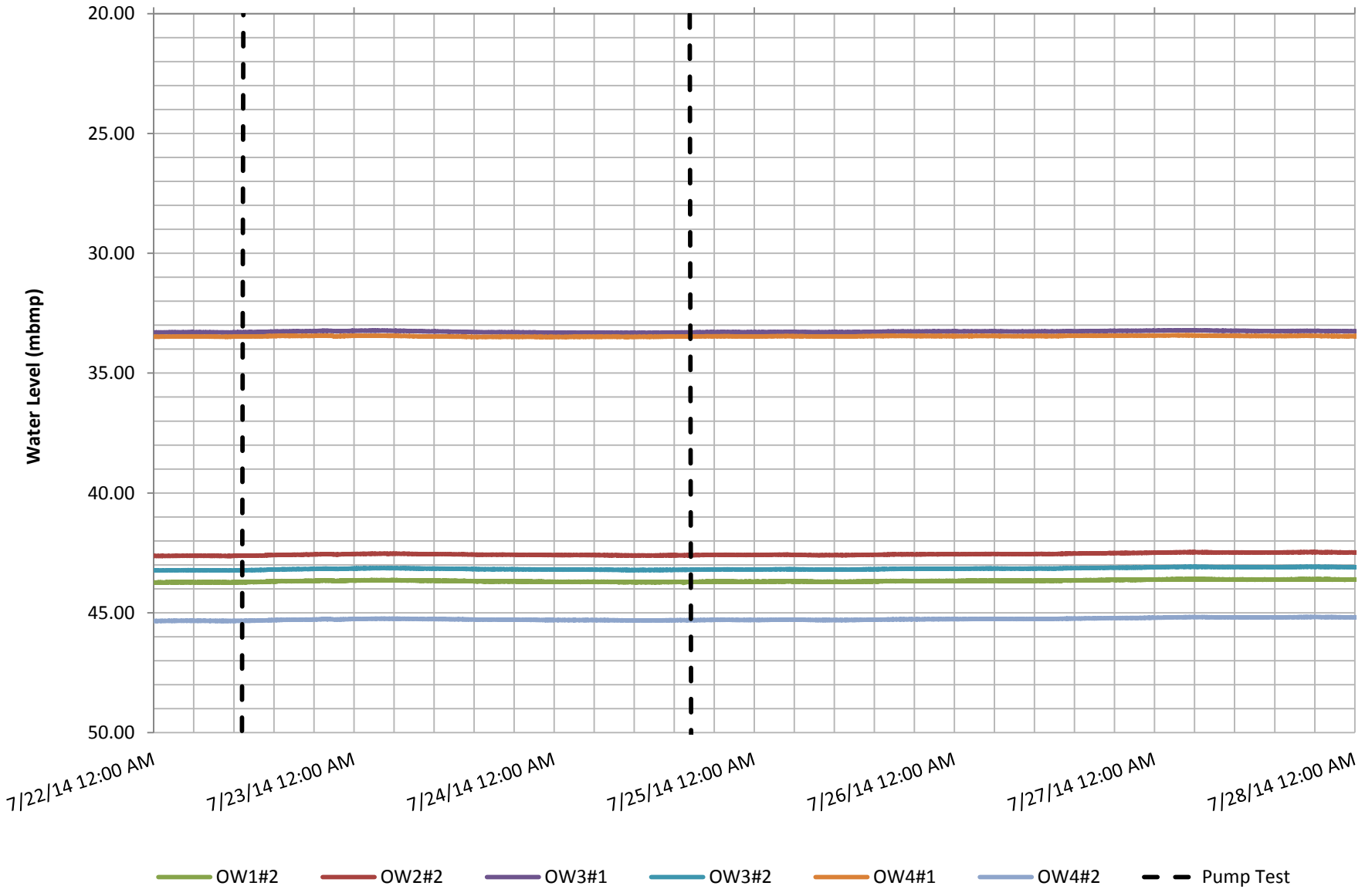
MIDHURST
WATER SUPPLY EXPLORATION

Golder Associates
Barrie, Ontario, Canada

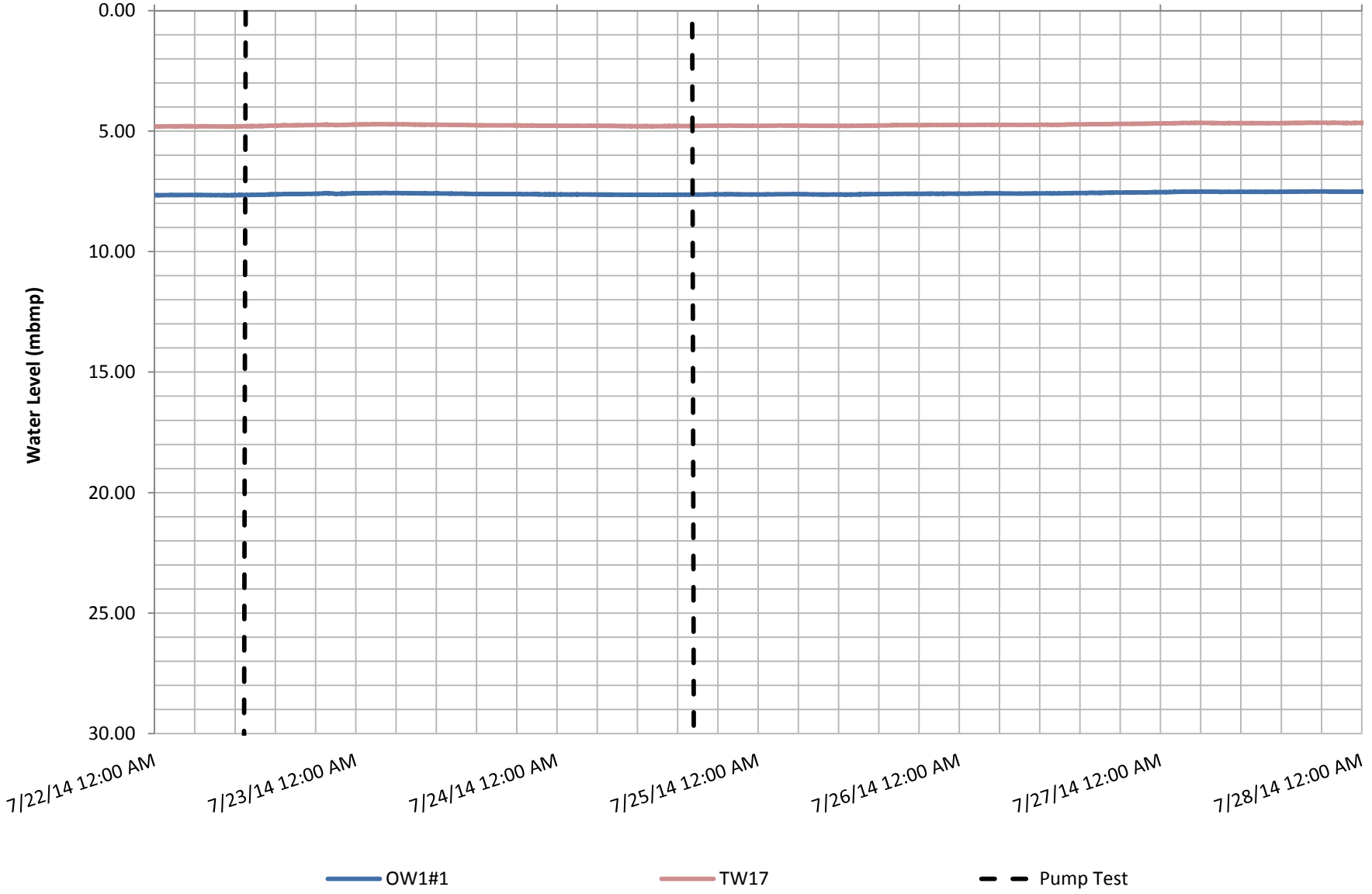
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DATE	2014-10-30
CAD	JPR
CHECK	ALB
REVIEW	JAE
FILE No.	1311700040BASVE35.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	K-3



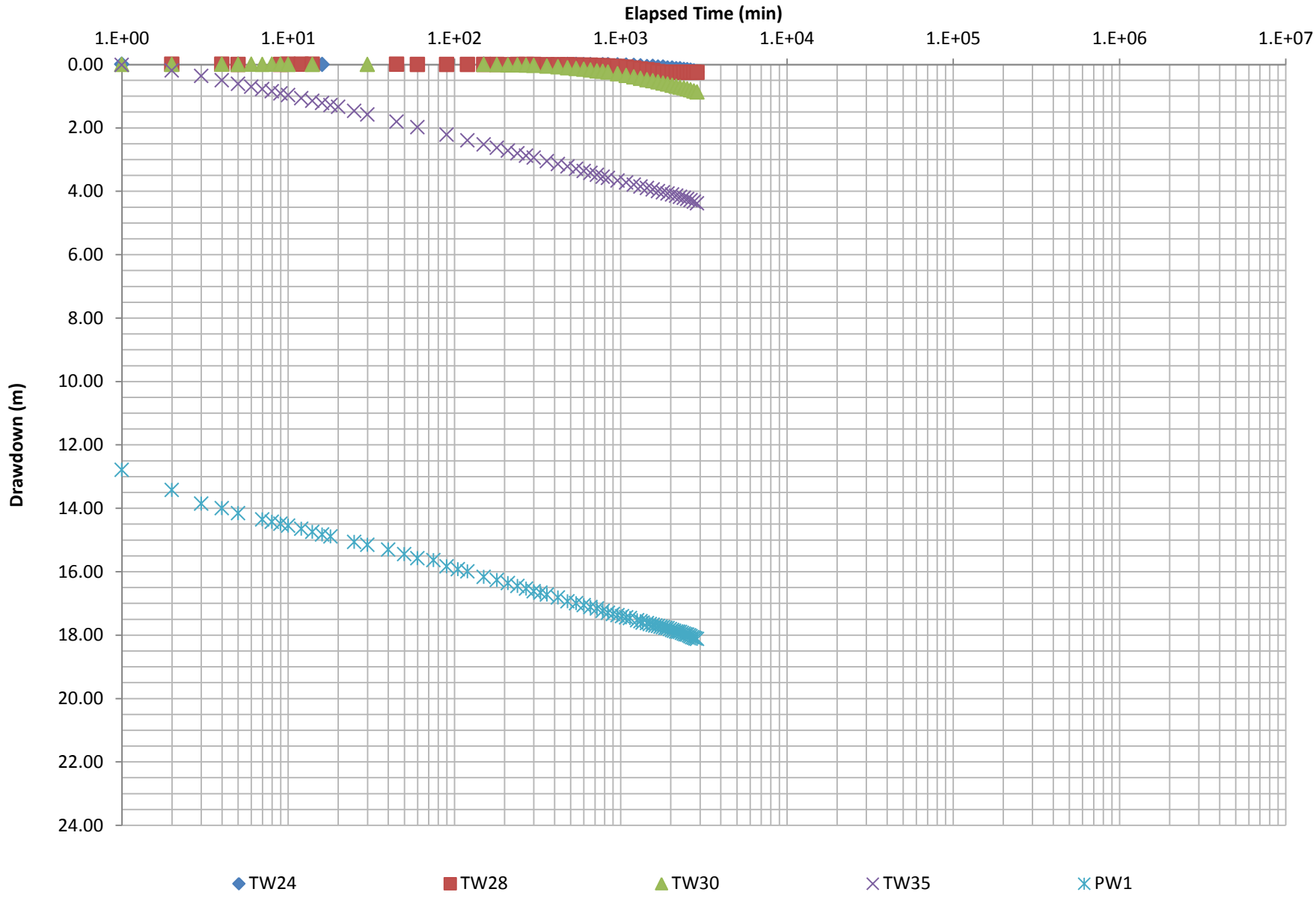
Test Date:	22-Jul-14	Golder Associates	SCALE:	NTS	**Testing of PW1** **Record of Observation Wells**
Pumping Rates L/s:	45		DATE:	29-Oct-14	
			CAD:	ALB	
		FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of PW1
		PROJECT No. 1311700040	REVIEW:		FIGURE No. K-4



Test Date:	22-Jul-14	Golder Associates	SCALE:	NTS	**Testing of PW1** **Record of Observation Wells**
Pumping Rates L/s:	45		DATE:	29-Oct-14	
			CAD:	ALB	
		FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of PW1
		PROJECT No. 1311700040	REVIEW:		FIGURE No. K-5



Test Date:	22-Jul-14	Golder Associates	SCALE:	NTS	**Testing of PW1** **Record of Observation Wells**
Pumping Rates L/s:	45		DATE:	29-Oct-14	
			CAD:	ALB	
		FILE No. 1311700040	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of PW1
		PROJECT No. 1311700040	REVIEW:		FIGURE No. K-6



Test Date:	22-Jul-2014
Pumping Rates L/s:	45
PW1 Static Level (mbmp):	51.01
PW1 Pumping Level (mbmp):	69.14

Golder Associates

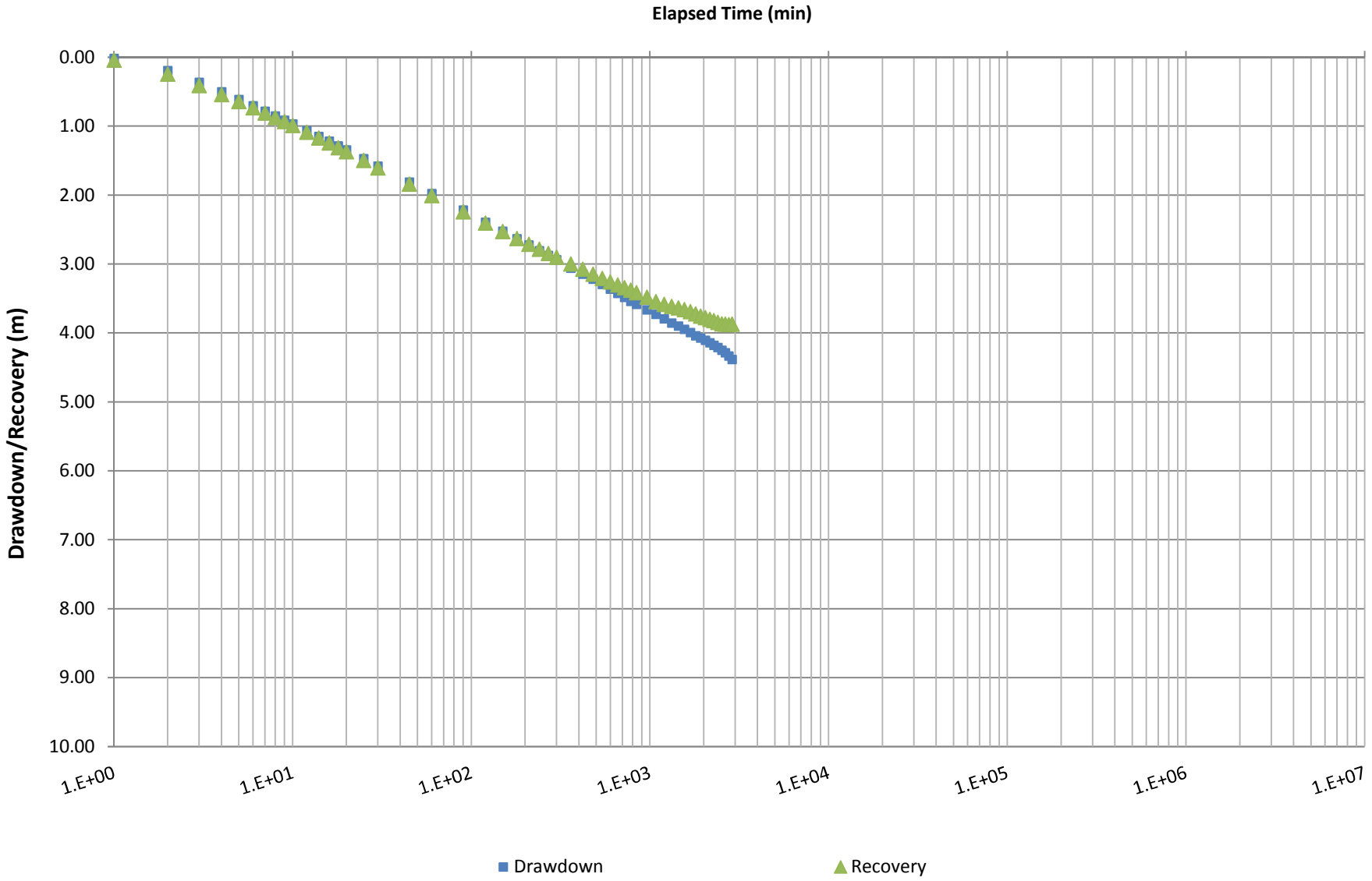
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PROJECT No.	1311700040

SCALE:	NTS
DATE:	30-Oct-14
CAD:	ALB
CHECK:	
REVIEW:	

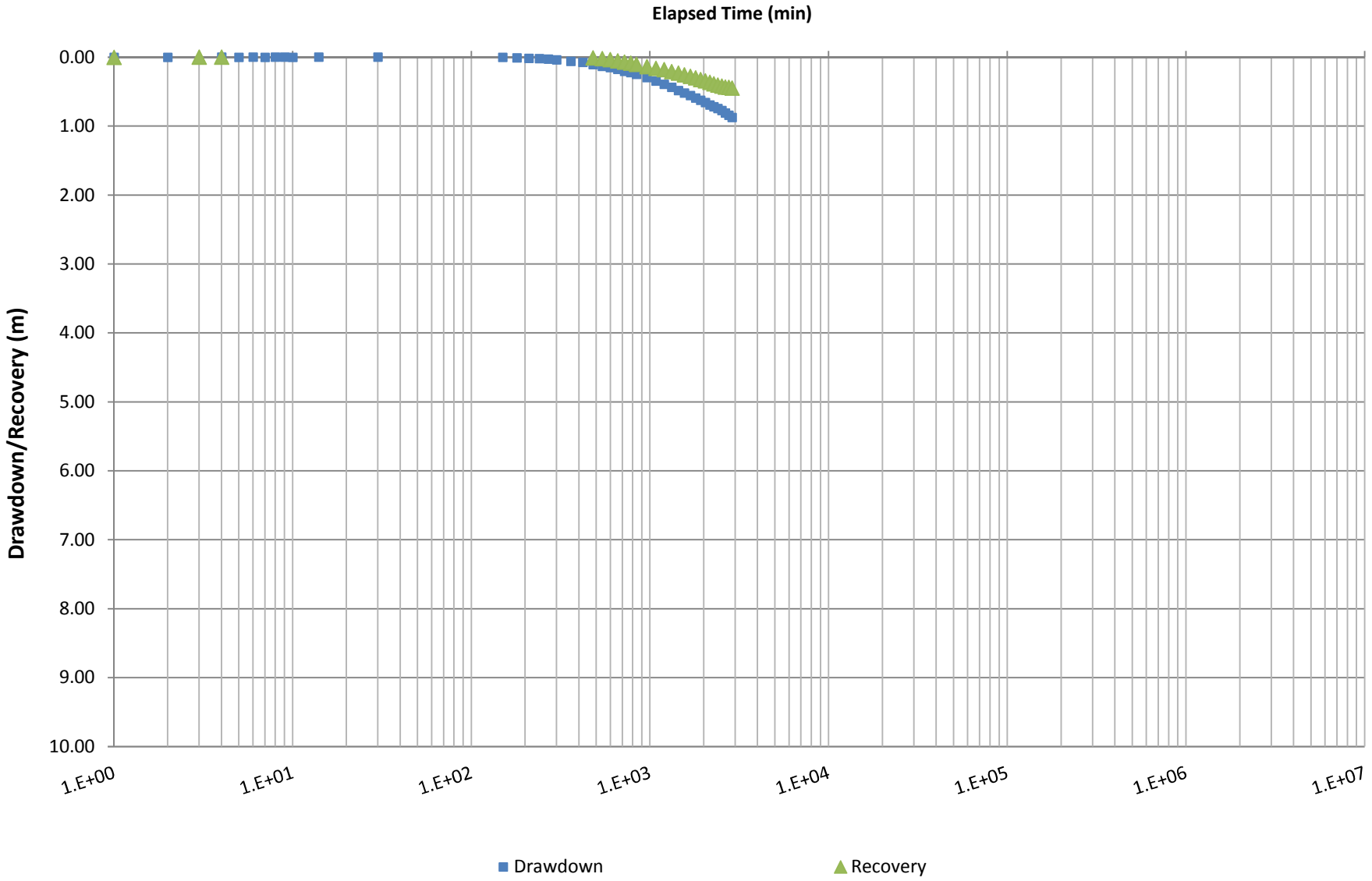
Pumping Test Hydrograph
Record of PW1 and
Aquifer A3 Observation Wells

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of PW1

FIGURE No.
K-7



Test Date:	July 22, 2014	Golder Associates	SCALE:	NTS	**Pumping Test Hydrograph Record of OW35**
Pumping Rate:	45 L/s		DATE:	9/Mar/16	
Distance from PW1 (m):	79		CAD:	ALB	
Static Water Level (mbmp):	50.12	FILE No. 1311700040TRANS	CHECK:		MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of PW1
Pumping Water Level (mbmp):	54.5	PROJECT No. 13-1170-0040	REVIEW:		FIGURE No. K-8



Test Date:	July 22, 2014
Pumping Rate:	45 L/s
Distance from PW1 (m):	1500
Static Water Level (mbmp):	52.86
Pumping Water Level (mbmp):	53.73

Golder Associates

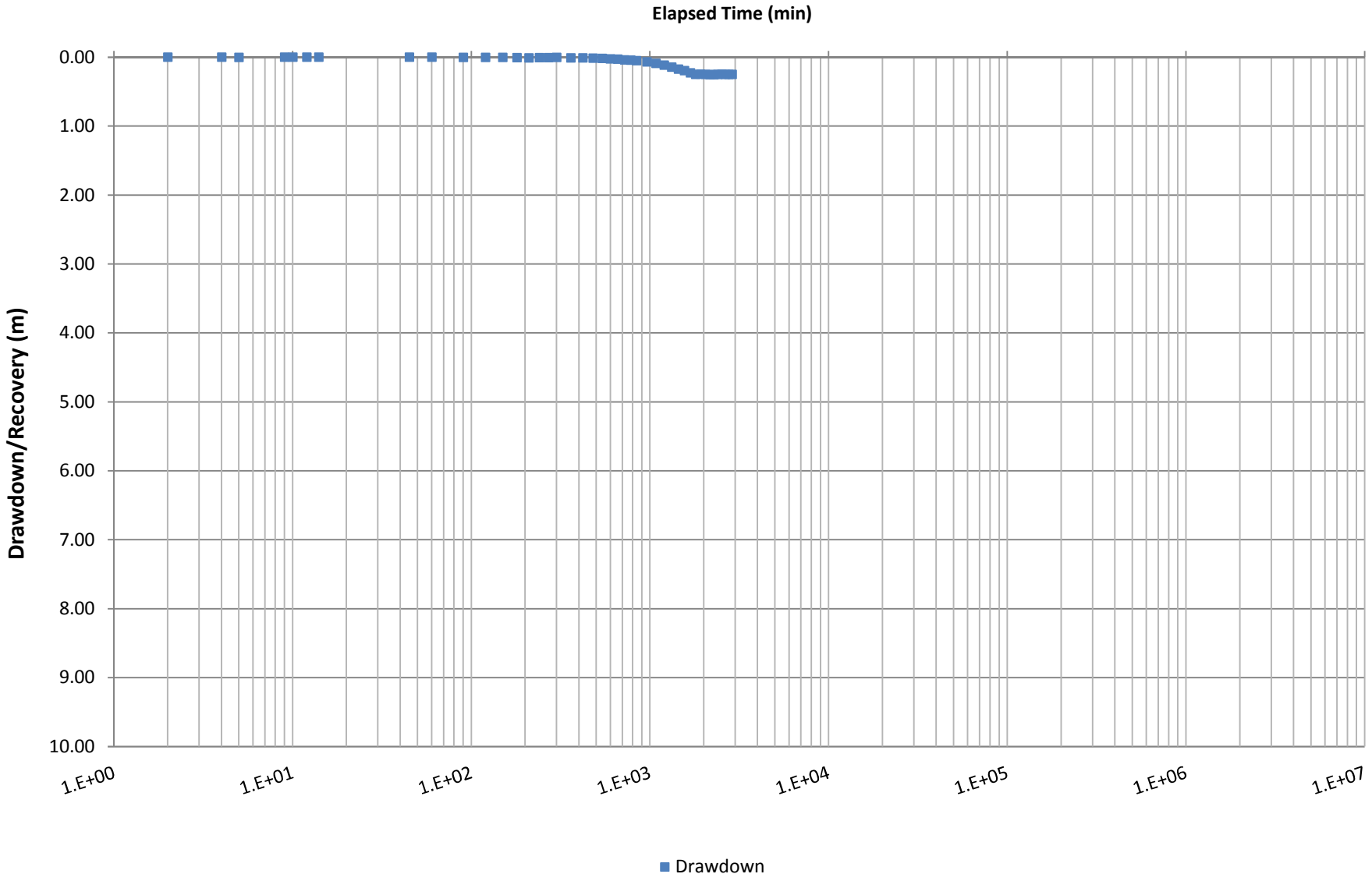
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	9/Mar/16
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of OW30

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of PW1

FIGURE No.
K-9



Test Date:	July 22, 2014
Pumping Rate:	45 L/s
Distance from PW1 (m):	2000
Static Water Level (mbmp):	47.50
Pumping Water Level (mbmp):	47.75

Golder Associates

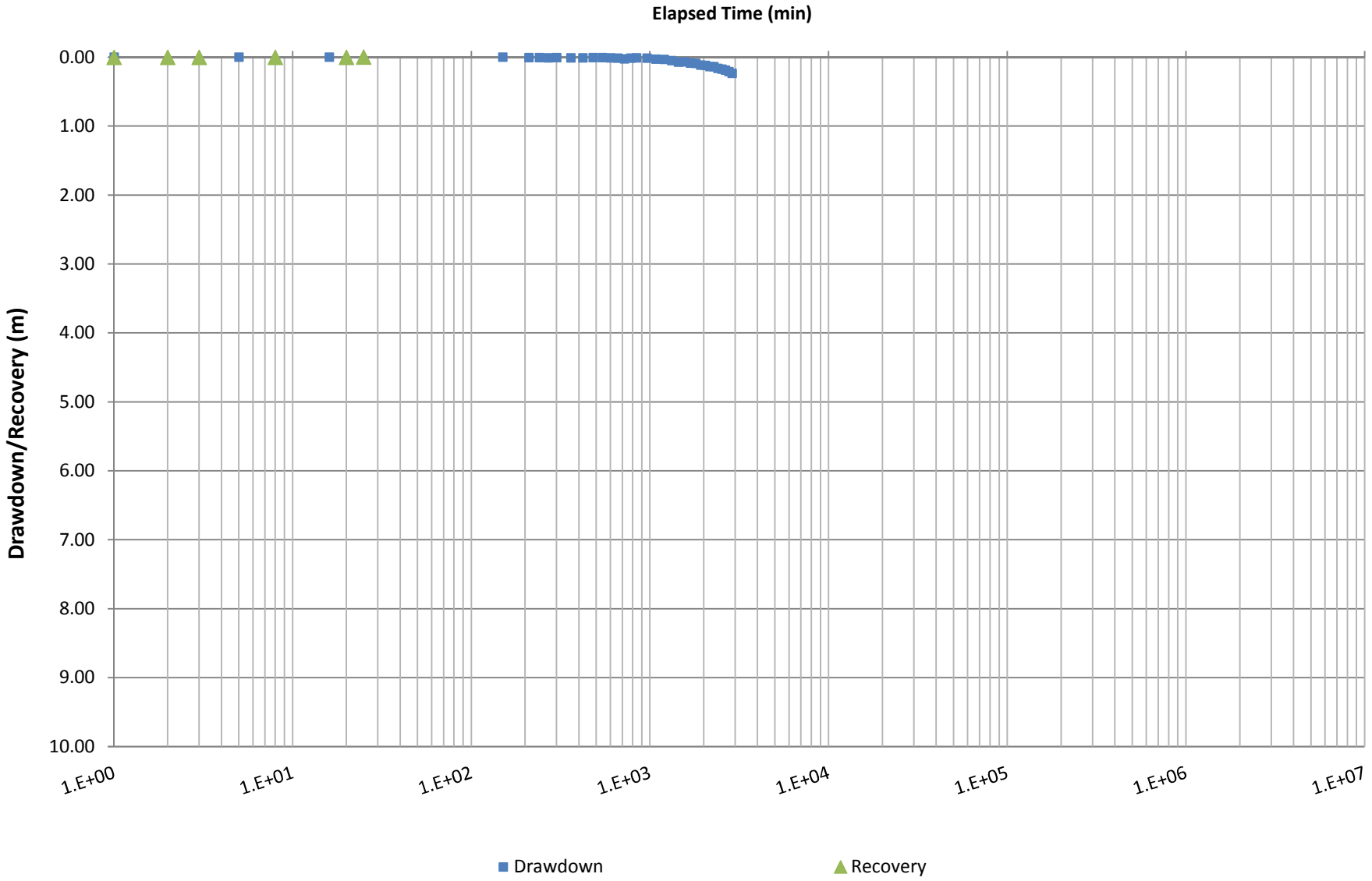
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	9/Mar/16
CAD:	ALB
CHECK:	
REVIEW:	

Pumping Test Hydrograph
Record of OW28

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of PW1

FIGURE No.
K-10



Test Date:	July 22, 2014
Pumping Rate:	45 L/s
Distance from PW1 (m):	2400
Static Water Level (mbmp):	50.35
Pumping Water Level (mbmp):	50.59

Golder Associates

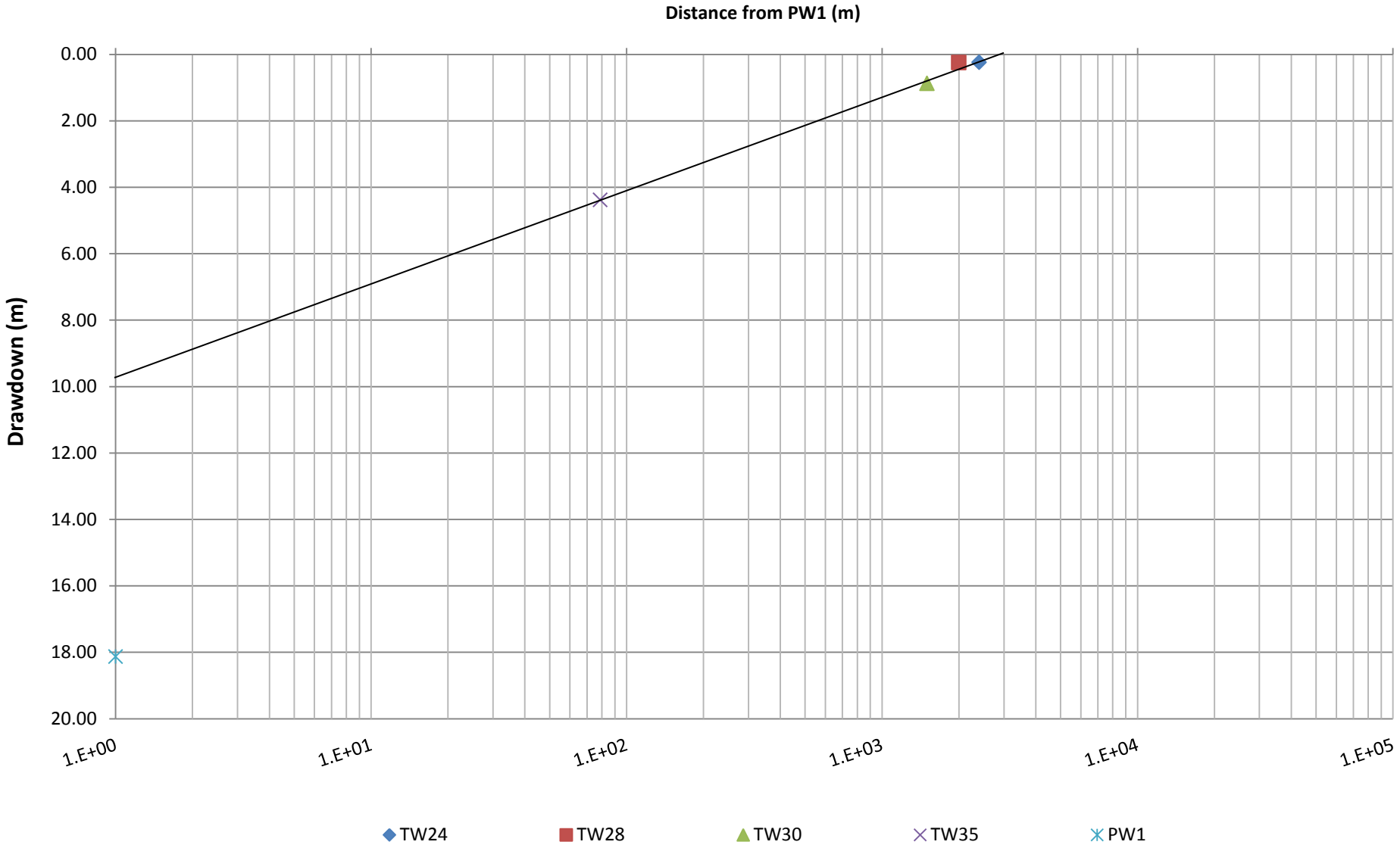
FILE No.	1311700040TRANS
PROJECT No.	13-1170-0040

SCALE:	NTS
DATE:	9/Mar/16
CAD:	ALB
CHECK:	
REVIEW:	

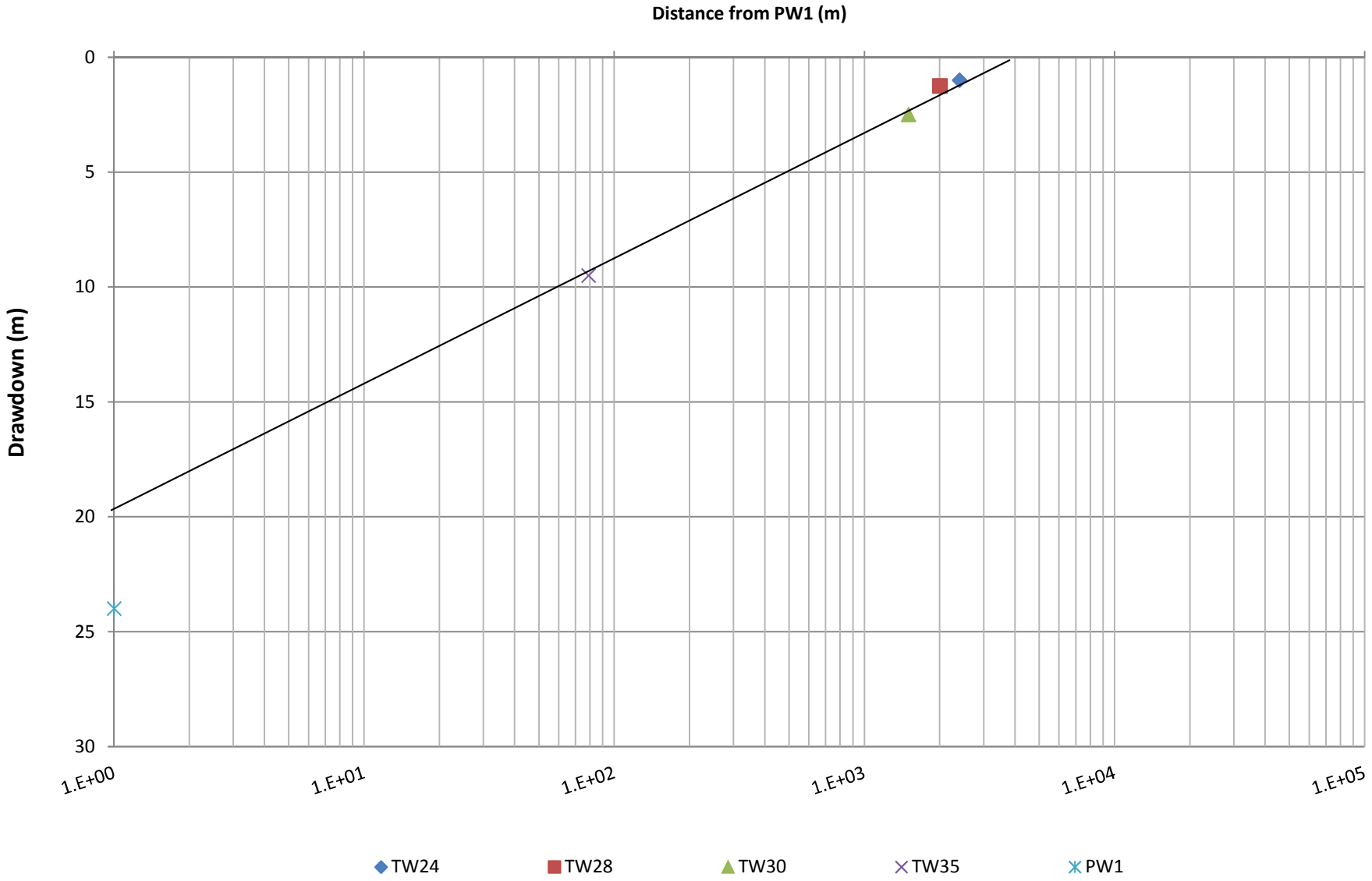
Pumping Test Hydrograph
Record of OW24

MIDHURST WATER SUPPLY
CONSTRUCTION & TESTING of PW1

FIGURE No.
K-11



Test Date: July 22, 2014	Golder Associates	SCALE: NTS	**Test Data Drawdown vs Distance Interference From PW1**	
Pumping Rate: 45 L/s		DATE: 30-Oct-14		
		CAD: ALB		
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of PW1	FIGURE No. K-12
	PROJECT No. 13-1170-0040	REVIEW:		



Test Date: July 22, 2014	Golder Associates	SCALE: NTS	**20- Year Drawdown vs Distance Interference From PW1**
Pumping Rate: 45 L/s		DATE: 9/Mar/16	
		CAD: ALB	
	FILE No. 1311700040TRANS	CHECK:	MIDHURST WATER SUPPLY CONSTRUCTION & TESTING of PW1 — FIGURE No. K-13
	PROJECT No. 13-1170-0040	REVIEW:	

Tabulated Levels for PW1

Pump On:	22-Jul-2014 13:30	Static Level:	51.01
Pump Off:	24-Jul-2014 13:30	Pumping Level:	69.14
Pumping Well:	**PW1**	DD:	18.13
Distance from Pumping Well:	0.1 m	20 yr DD:	24

Date:Time	Elapsed	WL	DD
dd-mmm-yyyy hh:mm	(min)	m	m
22-07-2014 13:31	1.00	63.80	12.79
22-07-2014 13:32	2.00	64.44	13.43
22-07-2014 13:33	3	64.87	13.86
22-07-2014 13:34	4	65.01	14.00
22-07-2014 13:35	5	65.17	14.16
22-07-2014 13:37	7	65.37	14.36
22-07-2014 13:38	8	65.44	14.43
22-07-2014 13:39	9	65.50	14.49
22-07-2014 13:40	10	65.56	14.55
22-07-2014 13:42	12	65.66	14.65
22-07-2014 13:44	14	65.76	14.75
22-07-2014 13:46	16	65.84	14.83
22-07-2014 13:48	18	65.90	14.89
22-07-2014 13:55	25	66.08	15.07
22-07-2014 14:00	30	66.17	15.16
22-07-2014 14:10	40	66.32	15.31
22-07-2014 14:20	50	66.46	15.45
22-07-2014 14:30	60	66.59	15.58
22-07-2014 14:45	75	66.65	15.64
22-07-2014 15:00	90	66.85	15.84
22-07-2014 15:15	105	66.94	15.93
22-07-2014 15:30	120	67.01	16.00
22-07-2014 16:00	150	67.18	16.17
22-07-2014 16:30	180	67.28	16.27
22-07-2014 17:00	210	67.38	16.37
22-07-2014 17:30	240	67.47	16.46
22-07-2014 18:00	270	67.55	16.54
22-07-2014 18:30	300	67.63	16.62
22-07-2014 19:00	330	67.68	16.67
22-07-2014 19:30	360	67.74	16.73
22-07-2014 20:30	420	67.83	16.82
22-07-2014 21:30	480	67.95	16.94
22-07-2014 22:30	540	68.01	17.00
22-07-2014 23:30	600	68.07	17.06
23-07-2014 00:30	660	68.13	17.12
23-07-2014 01:30	720	68.18	17.17
23-07-2014 02:30	780	68.25	17.24
23-07-2014 03:30	840	68.31	17.30
23-07-2014 04:30	900	68.35	17.34
23-07-2014 05:30	960	68.39	17.38
23-07-2014 06:30	1020	68.42	17.41
23-07-2014 07:30	1080	68.46	17.45
23-07-2014 08:30	1140	68.48	17.47
23-07-2014 09:30	1260	68.55	17.54
23-07-2014 10:30	1320	68.58	17.57
23-07-2014 11:30	1360	68.62	17.61
23-07-2014 12:30	1440	68.64	17.63
23-07-2014 13:30	1500	68.67	17.66
23-07-2014 14:30	1560	68.69	17.68
23-07-2014 15:30	1620	68.71	17.70
23-07-2014 16:30	1680	68.73	17.72
23-07-2014 17:30	1740	68.75	17.74
23-07-2014 18:30	1800	68.77	17.76
23-07-2014 19:30	1860	68.79	17.78
23-07-2014 20:30	1920	68.8	17.79

Tabulated Levels for PW1

Pump On:	22-Jul-2014 13:30	Static Level:	51.01
Pump Off:	24-Jul-2014 13:30	Pumping Level:	69.14
Pumping Well:	**PW1**	DD:	18.13
Distance from Pumping Well:	0.1 m	20 yr DD:	24

Date:Time	Elapsed	WL	DD
dd-mmm-yyyy hh:mm	(min)	m	m
23-07-2014 21:30	1980	68.83	17.82
23-07-2014 22:30	2040	68.86	17.85
23-07-2014 23:30	2100	68.88	17.87
24-07-2014 00:30	2160	68.9	17.89
24-07-2014 01:30	2220	68.91	17.90
24-07-2014 02:30	2280	68.92	17.91
24-07-2014 03:30	2340	68.95	17.94
24-07-2014 04:30	2400	68.97	17.96
24-07-2014 05:30	2460	68.99	17.98
24-07-2014 06:30	2520	69	17.99
24-07-2014 07:30	2580	69.02	18.01
24-07-2014 09:30	2640	69.05	18.04
24-07-2014 11:30	2700	69.08	18.07
24-07-2014 13:30	2760	69.10	18.09
24-07-2014 15:30	2820	69.12	18.11
24-07-2014 17:30	2880	69.14	18.13

Tabulated Levels for TW35

Pump On:	22-Jul-2014 13:30	Static Level:	50.12
Pump Off:	24-Jul-2014 13:30	Pumping Level:	54.5
Pumping Well:	**PW1**	DD:	4.39
Distance from Pumping Well:	79 m	20 yr DD:	9.5

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	50.13	0.02	24-Jul-2014 13:31	1	54.46	0.04
22-Jul-2014 13:32	2	50.31	0.20	24-Jul-2014 13:32	2	54.26	0.25
22-Jul-2014 13:33	3	50.48	0.37	24-Jul-2014 13:33	3	54.09	0.41
22-Jul-2014 13:34	4	50.62	0.50	24-Jul-2014 13:34	4	53.96	0.54
22-Jul-2014 13:35	5	50.73	0.62	24-Jul-2014 13:35	5	53.86	0.64
22-Jul-2014 13:36	6	50.82	0.71	24-Jul-2014 13:36	6	53.77	0.73
22-Jul-2014 13:37	7	50.90	0.79	24-Jul-2014 13:37	7	53.69	0.81
22-Jul-2014 13:38	8	50.97	0.85	24-Jul-2014 13:38	8	53.62	0.88
22-Jul-2014 13:39	9	51.03	0.92	24-Jul-2014 13:39	9	53.57	0.94
22-Jul-2014 13:40	10	51.08	0.97	24-Jul-2014 13:40	10	53.51	0.99
22-Jul-2014 13:42	12	51.18	1.07	24-Jul-2014 13:42	12	53.41	1.09
22-Jul-2014 13:44	14	51.27	1.15	24-Jul-2014 13:44	14	53.33	1.17
22-Jul-2014 13:46	16	51.34	1.22	24-Jul-2014 13:46	16	53.26	1.24
22-Jul-2014 13:48	18	51.40	1.29	24-Jul-2014 13:48	18	53.19	1.31
22-Jul-2014 13:50	20	51.46	1.35	24-Jul-2014 13:50	20	53.13	1.37
22-Jul-2014 13:55	25	51.59	1.47	24-Jul-2014 13:55	25	53.00	1.50
22-Jul-2014 14:00	30	51.70	1.58	24-Jul-2014 14:00	30	52.89	1.61
22-Jul-2014 14:15	45	51.93	1.81	24-Jul-2014 14:15	45	52.66	1.84
22-Jul-2014 14:30	60	52.10	1.98	24-Jul-2014 14:30	60	52.49	2.01
22-Jul-2014 15:00	90	52.33	2.22	24-Jul-2014 15:00	90	52.26	2.24
22-Jul-2014 15:30	120	52.51	2.40	24-Jul-2014 15:30	120	52.09	2.41
22-Jul-2014 16:00	150	52.64	2.53	24-Jul-2014 16:00	150	51.97	2.53
22-Jul-2014 16:30	180	52.75	2.63	24-Jul-2014 16:30	180	51.87	2.63
22-Jul-2014 17:00	210	52.84	2.73	24-Jul-2014 17:00	210	51.79	2.72
22-Jul-2014 17:30	240	52.92	2.81	24-Jul-2014 17:30	240	51.71	2.79
22-Jul-2014 18:00	270	52.99	2.88	24-Jul-2014 18:00	270	51.65	2.85
22-Jul-2014 18:30	300	53.06	2.94	24-Jul-2014 18:30	300	51.60	2.90
22-Jul-2014 19:30	360	53.18	3.06	24-Jul-2014 19:30	360	51.50	3.00
22-Jul-2014 20:30	420	53.26	3.15	24-Jul-2014 20:30	420	51.42	3.08
22-Jul-2014 21:30	480	53.34	3.22	24-Jul-2014 21:30	480	51.35	3.15
22-Jul-2014 22:30	540	53.41	3.30	24-Jul-2014 22:30	540	51.29	3.21
22-Jul-2014 23:30	600	53.48	3.36	24-Jul-2014 23:30	600	51.24	3.26
23-Jul-2014 00:30	660	53.54	3.43	25-Jul-2014 00:30	660	51.20	3.31
23-Jul-2014 01:30	720	53.60	3.49	25-Jul-2014 01:30	720	51.16	3.35
23-Jul-2014 02:30	780	53.66	3.54	25-Jul-2014 02:30	780	51.12	3.38
23-Jul-2014 03:30	840	53.70	3.59	25-Jul-2014 03:30	840	51.08	3.42
23-Jul-2014 05:30	960	53.78	3.67	25-Jul-2014 05:30	960	51.02	3.48
23-Jul-2014 07:30	1080	53.85	3.73	25-Jul-2014 07:30	1080	50.95	3.55
23-Jul-2014 09:30	1200	53.91	3.80	25-Jul-2014 09:30	1200	50.91	3.59
23-Jul-2014 11:30	1320	53.97	3.86	25-Jul-2014 11:30	1320	50.89	3.62
23-Jul-2014 13:30	1440	54.02	3.90	25-Jul-2014 13:30	1440	50.86	3.64
23-Jul-2014 15:30	1560	54.07	3.95	25-Jul-2014 15:30	1560	50.84	3.66
23-Jul-2014 17:30	1680	54.11	4.00	25-Jul-2014 17:30	1680	50.81	3.69
23-Jul-2014 19:30	1800	54.16	4.04	25-Jul-2014 19:30	1800	50.78	3.72
23-Jul-2014 21:30	1920	54.19	4.07	25-Jul-2014 21:30	1920	50.75	3.76
23-Jul-2014 23:30	2040	54.22	4.11	25-Jul-2014 23:30	2040	50.72	3.78
24-Jul-2014 01:30	2160	54.26	4.14	26-Jul-2014 01:30	2160	50.70	3.80
24-Jul-2014 03:30	2280	54.29	4.18	26-Jul-2014 03:30	2280	50.68	3.82
24-Jul-2014 05:30	2400	54.33	4.21	26-Jul-2014 05:30	2400	50.65	3.85
24-Jul-2014 07:30	2520	54.37	4.25	26-Jul-2014 07:30	2520	50.63	3.87
24-Jul-2014 09:30	2640	54.40	4.29	26-Jul-2014 09:30	2640	50.63	3.87
24-Jul-2014 11:30	2760	54.45	4.33	26-Jul-2014 11:30	2760	50.62	3.88
24-Jul-2014 13:30	2880	54.50	4.39	26-Jul-2014 13:30	2880	50.63	3.87

Tabulated Levels forTW24

Pump On:	22-Jul-2014 13:30	Static Level:	50.35
Pump Off:	24-Jul-2014 13:30	Pumping Level:	50.59
Pumping Well:	**PW1**	DD:	0.24
Distance from Pumping Well:	2400 m	20 yr DD:	1

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	50.35	0.00	24-Jul-2014 13:31	1	50.59	0.01
22-Jul-2014 13:32	2	50.34	-0.01	24-Jul-2014 13:32	2	50.59	0.00
22-Jul-2014 13:33	3	50.35	0.00	24-Jul-2014 13:33	3	50.59	0.00
22-Jul-2014 13:34	4	50.35	0.00	24-Jul-2014 13:34	4	50.60	-0.01
22-Jul-2014 13:35	5	50.35	0.00	24-Jul-2014 13:35	5	50.61	-0.02
22-Jul-2014 13:36	6	50.35	0.00	24-Jul-2014 13:36	6	50.60	-0.01
22-Jul-2014 13:37	7	50.35	0.00	24-Jul-2014 13:37	7	50.60	-0.01
22-Jul-2014 13:38	8	50.35	0.00	24-Jul-2014 13:38	8	50.59	0.00
22-Jul-2014 13:39	9	50.35	0.00	24-Jul-2014 13:39	9	50.60	-0.01
22-Jul-2014 13:40	10	50.35	0.00	24-Jul-2014 13:40	10	50.60	-0.01
22-Jul-2014 13:42	12	50.35	-0.01	24-Jul-2014 13:42	12	50.61	-0.02
22-Jul-2014 13:44	14	50.35	0.00	24-Jul-2014 13:44	14	50.60	-0.01
22-Jul-2014 13:46	16	50.35	0.00	24-Jul-2014 13:46	16	50.60	0.00
22-Jul-2014 13:48	18	50.34	-0.01	24-Jul-2014 13:48	18	50.60	-0.01
22-Jul-2014 13:50	20	50.34	-0.01	24-Jul-2014 13:50	20	50.59	0.00
22-Jul-2014 13:55	25	50.33	-0.02	24-Jul-2014 13:55	25	50.59	0.00
22-Jul-2014 14:00	30	50.34	-0.01	24-Jul-2014 14:00	30	50.60	-0.01
22-Jul-2014 14:15	45	50.35	0.00	24-Jul-2014 14:15	45	50.60	-0.01
22-Jul-2014 14:30	60	50.35	0.00	24-Jul-2014 14:30	60	50.61	-0.02
22-Jul-2014 15:00	90	50.35	-0.01	24-Jul-2014 15:00	90	50.62	-0.02
22-Jul-2014 15:30	120	50.35	0.00	24-Jul-2014 15:30	120	50.62	-0.02
22-Jul-2014 16:00	150	50.35	0.00	24-Jul-2014 16:00	150	50.61	-0.02
22-Jul-2014 16:30	180	50.35	0.00	24-Jul-2014 16:30	180	50.64	-0.04
22-Jul-2014 17:00	210	50.36	0.01	24-Jul-2014 17:00	210	50.63	-0.04
22-Jul-2014 17:30	240	50.36	0.01	24-Jul-2014 17:30	240	50.64	-0.05
22-Jul-2014 18:00	270	50.36	0.01	24-Jul-2014 18:00	270	50.65	-0.06
22-Jul-2014 18:30	300	50.36	0.01	24-Jul-2014 18:30	300	50.65	-0.06
22-Jul-2014 19:30	360	50.36	0.01	24-Jul-2014 19:30	360	50.66	-0.07
22-Jul-2014 20:30	420	50.36	0.01	24-Jul-2014 20:30	420	50.66	-0.07
22-Jul-2014 21:30	480	50.36	0.01	24-Jul-2014 21:30	480	50.67	-0.08
22-Jul-2014 22:30	540	50.36	0.01	24-Jul-2014 22:30	540	50.68	-0.09
22-Jul-2014 23:30	600	50.36	0.01	24-Jul-2014 23:30	600	50.69	-0.10
23-Jul-2014 00:30	660	50.37	0.01	25-Jul-2014 00:30	660	50.69	-0.10
23-Jul-2014 01:30	720	50.38	0.02	25-Jul-2014 01:30	720	50.70	-0.11
23-Jul-2014 02:30	780	50.37	0.02	25-Jul-2014 02:30	780	50.71	-0.12
23-Jul-2014 03:30	840	50.36	0.01	25-Jul-2014 03:30	840	50.71	-0.11
23-Jul-2014 05:30	960	50.37	0.02	25-Jul-2014 05:30	960	50.71	-0.12
23-Jul-2014 07:30	1080	50.38	0.03	25-Jul-2014 07:30	1080	50.74	-0.15
23-Jul-2014 09:30	1200	50.38	0.03	25-Jul-2014 09:30	1200	50.74	-0.15
23-Jul-2014 11:30	1320	50.40	0.05	25-Jul-2014 11:30	1320	50.75	-0.15
23-Jul-2014 13:30	1440	50.42	0.07	25-Jul-2014 13:30	1440	50.75	-0.16
23-Jul-2014 15:30	1560	50.42	0.07	25-Jul-2014 15:30	1560	50.76	-0.16
23-Jul-2014 17:30	1680	50.44	0.09	25-Jul-2014 17:30	1680	50.76	-0.17
23-Jul-2014 19:30	1800	50.44	0.09	25-Jul-2014 19:30	1800	50.76	-0.17
23-Jul-2014 21:30	1920	50.47	0.12	25-Jul-2014 21:30	1920	50.77	-0.17
23-Jul-2014 23:30	2040	50.47	0.12	25-Jul-2014 23:30	2040	50.77	-0.18
24-Jul-2014 01:30	2160	50.49	0.14	26-Jul-2014 01:30	2160	50.76	-0.17
24-Jul-2014 03:30	2280	50.49	0.14	26-Jul-2014 03:30	2280	50.75	-0.16
24-Jul-2014 05:30	2400	50.51	0.16	26-Jul-2014 05:30	2400	50.76	-0.17
24-Jul-2014 07:30	2520	50.53	0.17	26-Jul-2014 07:30	2520	50.76	-0.17
24-Jul-2014 09:30	2640	50.54	0.19	26-Jul-2014 09:30	2640	50.74	-0.15
24-Jul-2014 11:30	2760	50.56	0.21	26-Jul-2014 11:30	2760	50.74	-0.15
24-Jul-2014 13:30	2880	50.59	0.24	26-Jul-2014 13:30	2880	50.75	-0.16

Tabulated Levels for TW28

Pump On:	22-Jul-2014 13:30	Static Level:	47.50
Pump Off:	24-Jul-2014 13:30	Pumping Level:	47.75
Pumping Well:	**PW1**	DD:	0.25
Distance from Pumping Well:	2000 m	20 yr DD:	1.25

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	47.50	0.00	24-Jul-2014 13:31	1	47.75	0.00
22-Jul-2014 13:32	2	47.50	0.00	24-Jul-2014 13:32	2	47.75	0.00
22-Jul-2014 13:33	3	47.50	0.00	24-Jul-2014 13:33	3	47.75	0.00
22-Jul-2014 13:34	4	47.50	0.00	24-Jul-2014 13:34	4	47.75	0.00
22-Jul-2014 13:35	5	47.50	0.00	24-Jul-2014 13:35	5	47.75	0.00
22-Jul-2014 13:36	6	47.50	0.00	24-Jul-2014 13:36	6	47.75	0.00
22-Jul-2014 13:37	7	47.50	0.00	24-Jul-2014 13:37	7	47.76	-0.01
22-Jul-2014 13:38	8	47.50	0.00	24-Jul-2014 13:38	8	47.75	0.00
22-Jul-2014 13:39	9	47.50	0.00	24-Jul-2014 13:39	9	47.75	0.00
22-Jul-2014 13:40	10	47.50	0.00	24-Jul-2014 13:40	10	47.75	0.00
22-Jul-2014 13:42	12	47.50	0.00	24-Jul-2014 13:42	12	47.75	0.00
22-Jul-2014 13:44	14	47.50	0.00	24-Jul-2014 13:44	14	47.75	0.00
22-Jul-2014 13:46	16	47.50	0.00	24-Jul-2014 13:46	16	47.75	0.00
22-Jul-2014 13:48	18	47.50	0.00	24-Jul-2014 13:48	18	47.76	-0.01
22-Jul-2014 13:50	20	47.50	0.00	24-Jul-2014 13:50	20	47.76	-0.01
22-Jul-2014 13:55	25	47.50	0.00	24-Jul-2014 13:55	25	47.76	-0.01
22-Jul-2014 14:00	30	47.50	0.00	24-Jul-2014 14:00	30	47.75	0.00
22-Jul-2014 14:15	45	47.50	0.00	24-Jul-2014 14:15	45	47.75	0.00
22-Jul-2014 14:30	60	47.50	0.00	24-Jul-2014 14:30	60	47.76	-0.01
22-Jul-2014 15:00	90	47.50	0.00	24-Jul-2014 15:00	90	47.75	0.00
22-Jul-2014 15:30	120	47.50	0.00	24-Jul-2014 15:30	120	47.75	0.00
22-Jul-2014 16:00	150	47.50	0.00	24-Jul-2014 16:00	150	47.75	0.00
22-Jul-2014 16:30	180	47.51	0.01	24-Jul-2014 16:30	180	47.75	0.00
22-Jul-2014 17:00	210	47.51	0.01	24-Jul-2014 17:00	210	47.76	-0.01
22-Jul-2014 17:30	240	47.51	0.01	24-Jul-2014 17:30	240	47.75	0.00
22-Jul-2014 18:00	270	47.51	0.01	24-Jul-2014 18:00	270	47.76	-0.01
22-Jul-2014 18:30	300	47.51	0.01	24-Jul-2014 18:30	300	47.75	0.00
22-Jul-2014 19:30	360	47.51	0.01	24-Jul-2014 19:30	360	47.75	0.00
22-Jul-2014 20:30	420	47.51	0.01	24-Jul-2014 20:30	420	47.75	0.00
22-Jul-2014 21:30	480	47.51	0.01	24-Jul-2014 21:30	480	47.75	0.00
22-Jul-2014 22:30	540	47.52	0.02	24-Jul-2014 22:30	540	47.75	0.00
22-Jul-2014 23:30	600	47.52	0.02	24-Jul-2014 23:30	600	47.75	0.00
23-Jul-2014 00:30	660	47.53	0.03	25-Jul-2014 00:30	660	47.75	0.00
23-Jul-2014 01:30	720	47.54	0.04	25-Jul-2014 01:30	720	47.75	0.00
23-Jul-2014 02:30	780	47.54	0.04	25-Jul-2014 02:30	780	47.75	0.00
23-Jul-2014 03:30	840	47.55	0.05	25-Jul-2014 03:30	840	47.75	0.00
23-Jul-2014 05:30	960	47.57	0.07	25-Jul-2014 05:30	960	47.75	0.00
23-Jul-2014 07:30	1080	47.59	0.09	25-Jul-2014 07:30	1080	47.75	0.00
23-Jul-2014 09:30	1200	47.62	0.12	25-Jul-2014 09:30	1200	47.75	0.00
23-Jul-2014 11:30	1320	47.65	0.15	25-Jul-2014 11:30	1320	47.75	0.00
23-Jul-2014 13:30	1440	47.67	0.17	25-Jul-2014 13:30	1440	47.75	0.00
23-Jul-2014 15:30	1560	47.70	0.20	25-Jul-2014 15:30	1560	47.75	0.00
23-Jul-2014 17:30	1680	47.73	0.23	25-Jul-2014 17:30	1680	47.75	0.00
23-Jul-2014 19:30	1800	47.75	0.25	25-Jul-2014 19:30	1800	47.75	0.00
23-Jul-2014 21:30	1920	47.75	0.25	25-Jul-2014 21:30	1920	47.75	0.00
23-Jul-2014 23:30	2040	47.75	0.25	25-Jul-2014 23:30	2040	47.75	0.00
24-Jul-2014 01:30	2160	47.75	0.25	26-Jul-2014 01:30	2160	47.75	0.00
24-Jul-2014 03:30	2280	47.75	0.25	26-Jul-2014 03:30	2280	47.75	0.00
24-Jul-2014 05:30	2400	47.75	0.25	26-Jul-2014 05:30	2400	47.75	0.00
24-Jul-2014 07:30	2520	47.75	0.25	26-Jul-2014 07:30	2520	47.75	0.00
24-Jul-2014 09:30	2640	47.75	0.25	26-Jul-2014 09:30	2640	47.75	0.00
24-Jul-2014 11:30	2760	47.75	0.25	26-Jul-2014 11:30	2760	47.75	0.00
24-Jul-2014 13:30	2880	47.75	0.25	26-Jul-2014 13:30	2880	47.75	0.00

Tabulated Levels for TW30

Pump On:	22-Jul-2014 13:30	Static Level:	52.86
Pump Off:	24-Jul-2014 13:30	Pumping Level:	53.73
Pumping Well:	**PW1**	DD:	0.87
Distance from Pumping Well:	1500 m	20 yr DD:	2.5

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	52.86	0.00	24-Jul-2014 13:31	1	53.73	0.00
22-Jul-2014 13:32	2	52.86	0.00	24-Jul-2014 13:32	2	53.73	0.00
22-Jul-2014 13:33	3	52.85	0.00	24-Jul-2014 13:33	3	53.73	0.00
22-Jul-2014 13:34	4	52.86	0.00	24-Jul-2014 13:34	4	53.73	0.00
22-Jul-2014 13:35	5	52.86	0.00	24-Jul-2014 13:35	5	53.73	0.00
22-Jul-2014 13:36	6	52.86	0.00	24-Jul-2014 13:36	6	53.73	0.00
22-Jul-2014 13:37	7	52.86	0.00	24-Jul-2014 13:37	7	53.73	0.00
22-Jul-2014 13:38	8	52.86	0.00	24-Jul-2014 13:38	8	53.73	0.00
22-Jul-2014 13:39	9	52.86	0.00	24-Jul-2014 13:39	9	53.73	0.00
22-Jul-2014 13:40	10	52.86	0.00	24-Jul-2014 13:40	10	53.73	0.00
22-Jul-2014 13:42	12	52.86	0.00	24-Jul-2014 13:42	12	53.73	0.00
22-Jul-2014 13:44	14	52.86	0.00	24-Jul-2014 13:44	14	53.73	0.00
22-Jul-2014 13:46	16	52.85	0.00	24-Jul-2014 13:46	16	53.73	0.00
22-Jul-2014 13:48	18	52.85	0.00	24-Jul-2014 13:48	18	53.74	-0.01
22-Jul-2014 13:50	20	52.85	0.00	24-Jul-2014 13:50	20	53.74	-0.01
22-Jul-2014 13:55	25	52.85	0.00	24-Jul-2014 13:55	25	53.74	-0.01
22-Jul-2014 14:00	30	52.86	0.00	24-Jul-2014 14:00	30	53.74	-0.01
22-Jul-2014 14:15	45	52.85	0.00	24-Jul-2014 14:15	45	53.74	-0.01
22-Jul-2014 14:30	60	52.85	0.00	24-Jul-2014 14:30	60	53.75	-0.02
22-Jul-2014 15:00	90	52.86	0.00	24-Jul-2014 15:00	90	53.75	-0.02
22-Jul-2014 15:30	120	52.86	0.00	24-Jul-2014 15:30	120	53.76	-0.03
22-Jul-2014 16:00	150	52.86	0.00	24-Jul-2014 16:00	150	53.76	-0.03
22-Jul-2014 16:30	180	52.87	0.01	24-Jul-2014 16:30	180	53.77	-0.04
22-Jul-2014 17:00	210	52.87	0.02	24-Jul-2014 17:00	210	53.77	-0.04
22-Jul-2014 17:30	240	52.88	0.02	24-Jul-2014 17:30	240	53.76	-0.03
22-Jul-2014 18:00	270	52.89	0.03	24-Jul-2014 18:00	270	53.76	-0.03
22-Jul-2014 18:30	300	52.89	0.04	24-Jul-2014 18:30	300	53.76	-0.03
22-Jul-2014 19:30	360	52.92	0.06	24-Jul-2014 19:30	360	53.75	-0.02
22-Jul-2014 20:30	420	52.93	0.08	24-Jul-2014 20:30	420	53.73	0.00
22-Jul-2014 21:30	480	52.97	0.11	24-Jul-2014 21:30	480	53.72	0.01
22-Jul-2014 22:30	540	52.99	0.13	24-Jul-2014 22:30	540	53.71	0.02
22-Jul-2014 23:30	600	53.01	0.15	24-Jul-2014 23:30	600	53.69	0.04
23-Jul-2014 00:30	660	53.03	0.18	25-Jul-2014 00:30	660	53.68	0.05
23-Jul-2014 01:30	720	53.06	0.20	25-Jul-2014 01:30	720	53.66	0.07
23-Jul-2014 02:30	780	53.08	0.23	25-Jul-2014 02:30	780	53.64	0.09
23-Jul-2014 03:30	840	53.10	0.25	25-Jul-2014 03:30	840	53.63	0.10
23-Jul-2014 05:30	960	53.15	0.30	25-Jul-2014 05:30	960	53.59	0.14
23-Jul-2014 07:30	1080	53.21	0.35	25-Jul-2014 07:30	1080	53.57	0.16
23-Jul-2014 09:30	1200	53.25	0.39	25-Jul-2014 09:30	1200	53.55	0.18
23-Jul-2014 11:30	1320	53.30	0.44	25-Jul-2014 11:30	1320	53.52	0.21
23-Jul-2014 13:30	1440	53.34	0.49	25-Jul-2014 13:30	1440	53.50	0.23
23-Jul-2014 15:30	1560	53.38	0.52	25-Jul-2014 15:30	1560	53.47	0.26
23-Jul-2014 17:30	1680	53.41	0.56	25-Jul-2014 17:30	1680	53.45	0.28
23-Jul-2014 19:30	1800	53.45	0.59	25-Jul-2014 19:30	1800	53.43	0.30
23-Jul-2014 21:30	1920	53.48	0.63	25-Jul-2014 21:30	1920	53.40	0.33
23-Jul-2014 23:30	2040	53.51	0.66	25-Jul-2014 23:30	2040	53.39	0.34
24-Jul-2014 01:30	2160	53.55	0.69	26-Jul-2014 01:30	2160	53.37	0.36
24-Jul-2014 03:30	2280	53.58	0.72	26-Jul-2014 03:30	2280	53.34	0.39
24-Jul-2014 05:30	2400	53.60	0.75	26-Jul-2014 05:30	2400	53.33	0.40
24-Jul-2014 07:30	2520	53.63	0.78	26-Jul-2014 07:30	2520	53.31	0.42
24-Jul-2014 09:30	2640	53.67	0.81	26-Jul-2014 09:30	2640	53.30	0.44
24-Jul-2014 11:30	2760	53.70	0.84	26-Jul-2014 11:30	2760	53.29	0.44
24-Jul-2014 13:30	2880	53.73	0.87	26-Jul-2014 13:30	2880	53.28	0.45

Tabulated Levels for OW1#1

Pump On:	22-Jul-2014 13:30	Static Level:	7.62
Pump Off:	24-Jul-2014 13:30	Pumping Level:	7.64
Pumping Well:	**PW1**	DD:	0.02
Distance from Pumping Well:	2750 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	7.62	0.00	24-Jul-2014 13:31	1	7.64	0.00
22-Jul-2014 13:32	2	7.62	0.00	24-Jul-2014 13:32	2	7.63	0.00
22-Jul-2014 13:33	3	7.62	0.00	24-Jul-2014 13:33	3	7.63	0.00
22-Jul-2014 13:34	4	7.62	0.00	24-Jul-2014 13:34	4	7.64	0.00
22-Jul-2014 13:35	5	7.63	0.00	24-Jul-2014 13:35	5	7.63	0.00
22-Jul-2014 13:36	6	7.62	0.00	24-Jul-2014 13:36	6	7.64	0.00
22-Jul-2014 13:37	7	7.62	0.00	24-Jul-2014 13:37	7	7.63	0.00
22-Jul-2014 13:38	8	7.63	0.00	24-Jul-2014 13:38	8	7.64	0.00
22-Jul-2014 13:39	9	7.62	0.00	24-Jul-2014 13:39	9	7.63	0.00
22-Jul-2014 13:40	10	7.62	0.00	24-Jul-2014 13:40	10	7.63	0.00
22-Jul-2014 13:42	12	7.62	0.00	24-Jul-2014 13:42	12	7.63	0.00
22-Jul-2014 13:44	14	7.62	0.00	24-Jul-2014 13:44	14	7.63	0.00
22-Jul-2014 13:46	16	7.62	0.00	24-Jul-2014 13:46	16	7.64	0.00
22-Jul-2014 13:48	18	7.62	0.00	24-Jul-2014 13:48	18	7.63	0.00
22-Jul-2014 13:50	20	7.62	0.00	24-Jul-2014 13:50	20	7.63	0.00
22-Jul-2014 13:55	25	7.62	0.00	24-Jul-2014 13:55	25	7.63	0.00
22-Jul-2014 14:00	30	7.62	0.00	24-Jul-2014 14:00	30	7.64	0.00
22-Jul-2014 14:15	45	7.62	0.00	24-Jul-2014 14:15	45	7.63	0.00
22-Jul-2014 14:30	60	7.62	-0.01	24-Jul-2014 14:30	60	7.63	0.00
22-Jul-2014 15:00	90	7.61	-0.01	24-Jul-2014 15:00	90	7.63	0.00
22-Jul-2014 15:30	120	7.61	-0.01	24-Jul-2014 15:30	120	7.63	0.01
22-Jul-2014 16:00	150	7.61	-0.01	24-Jul-2014 16:00	150	7.63	0.00
22-Jul-2014 16:30	180	7.61	-0.01	24-Jul-2014 16:30	180	7.63	0.01
22-Jul-2014 17:00	210	7.61	-0.01	24-Jul-2014 17:00	210	7.63	0.01
22-Jul-2014 17:30	240	7.60	-0.02	24-Jul-2014 17:30	240	7.63	0.01
22-Jul-2014 18:00	270	7.60	-0.02	24-Jul-2014 18:00	270	7.62	0.02
22-Jul-2014 18:30	300	7.60	-0.03	24-Jul-2014 18:30	300	7.62	0.01
22-Jul-2014 19:30	360	7.59	-0.03	24-Jul-2014 19:30	360	7.62	0.02
22-Jul-2014 20:30	420	7.59	-0.03	24-Jul-2014 20:30	420	7.62	0.02
22-Jul-2014 21:30	480	7.60	-0.02	24-Jul-2014 21:30	480	7.63	0.01
22-Jul-2014 22:30	540	7.58	-0.04	24-Jul-2014 22:30	540	7.63	0.01
22-Jul-2014 23:30	600	7.58	-0.04	24-Jul-2014 23:30	600	7.63	0.01
23-Jul-2014 00:30	660	7.57	-0.05	25-Jul-2014 00:30	660	7.62	0.01
23-Jul-2014 01:30	720	7.57	-0.05	25-Jul-2014 01:30	720	7.62	0.02
23-Jul-2014 02:30	780	7.57	-0.06	25-Jul-2014 02:30	780	7.62	0.02
23-Jul-2014 03:30	840	7.57	-0.05	25-Jul-2014 03:30	840	7.61	0.02
23-Jul-2014 05:30	960	7.57	-0.05	25-Jul-2014 05:30	960	7.62	0.02
23-Jul-2014 07:30	1080	7.59	-0.04	25-Jul-2014 07:30	1080	7.63	0.01
23-Jul-2014 09:30	1200	7.58	-0.04	25-Jul-2014 09:30	1200	7.63	0.01
23-Jul-2014 11:30	1320	7.59	-0.03	25-Jul-2014 11:30	1320	7.62	0.01
23-Jul-2014 13:30	1440	7.60	-0.02	25-Jul-2014 13:30	1440	7.62	0.02
23-Jul-2014 15:30	1560	7.61	-0.01	25-Jul-2014 15:30	1560	7.60	0.03
23-Jul-2014 17:30	1680	7.61	-0.01	25-Jul-2014 17:30	1680	7.60	0.04
23-Jul-2014 19:30	1800	7.61	-0.01	25-Jul-2014 19:30	1800	7.60	0.04
23-Jul-2014 21:30	1920	7.62	0.00	25-Jul-2014 21:30	1920	7.60	0.04
23-Jul-2014 23:30	2040	7.63	0.00	25-Jul-2014 23:30	2040	7.59	0.04
24-Jul-2014 01:30	2160	7.63	0.00	26-Jul-2014 01:30	2160	7.59	0.05
24-Jul-2014 03:30	2280	7.63	0.01	26-Jul-2014 03:30	2280	7.58	0.06
24-Jul-2014 05:30	2400	7.63	0.01	26-Jul-2014 05:30	2400	7.59	0.05
24-Jul-2014 07:30	2520	7.64	0.02	26-Jul-2014 07:30	2520	7.59	0.05
24-Jul-2014 09:30	2640	7.64	0.02	26-Jul-2014 09:30	2640	7.58	0.06
24-Jul-2014 11:30	2760	7.64	0.02	26-Jul-2014 11:30	2760	7.58	0.06
24-Jul-2014 13:30	2880	7.64	0.02	26-Jul-2014 13:30	2880	7.57	0.07

Tabulated Levels for OW1#2

Pump On:	22-Jul-2014 13:30	Static Level:	43.70
Pump Off:	24-Jul-2014 13:30	Pumping Level:	43.72
Pumping Well:	**PW1**	DD:	0.03
Distance from Pumping Well:	2750 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	43.70	0.00	24-Jul-2014 13:31	1	43.72	0.01
22-Jul-2014 13:32	2	43.70	0.00	24-Jul-2014 13:32	2	43.72	0.00
22-Jul-2014 13:33	3	43.69	0.00	24-Jul-2014 13:33	3	43.72	0.00
22-Jul-2014 13:34	4	43.70	0.01	24-Jul-2014 13:34	4	43.72	0.01
22-Jul-2014 13:35	5	43.70	0.00	24-Jul-2014 13:35	5	43.71	0.01
22-Jul-2014 13:36	6	43.70	0.00	24-Jul-2014 13:36	6	43.72	0.00
22-Jul-2014 13:37	7	43.70	0.00	24-Jul-2014 13:37	7	43.73	-0.01
22-Jul-2014 13:38	8	43.70	0.01	24-Jul-2014 13:38	8	43.73	0.00
22-Jul-2014 13:39	9	43.70	0.01	24-Jul-2014 13:39	9	43.73	0.00
22-Jul-2014 13:40	10	43.71	0.01	24-Jul-2014 13:40	10	43.72	0.00
22-Jul-2014 13:42	12	43.70	0.00	24-Jul-2014 13:42	12	43.72	0.00
22-Jul-2014 13:44	14	43.70	0.01	24-Jul-2014 13:44	14	43.72	0.01
22-Jul-2014 13:46	16	43.70	0.00	24-Jul-2014 13:46	16	43.73	-0.01
22-Jul-2014 13:48	18	43.70	0.00	24-Jul-2014 13:48	18	43.72	0.01
22-Jul-2014 13:50	20	43.70	0.01	24-Jul-2014 13:50	20	43.72	0.00
22-Jul-2014 13:55	25	43.70	0.00	24-Jul-2014 13:55	25	43.72	0.00
22-Jul-2014 14:00	30	43.69	-0.01	24-Jul-2014 14:00	30	43.72	0.00
22-Jul-2014 14:15	45	43.69	0.00	24-Jul-2014 14:15	45	43.71	0.01
22-Jul-2014 14:30	60	43.69	0.00	24-Jul-2014 14:30	60	43.72	0.00
22-Jul-2014 15:00	90	43.68	-0.02	24-Jul-2014 15:00	90	43.72	0.01
22-Jul-2014 15:30	120	43.68	-0.01	24-Jul-2014 15:30	120	43.76	-0.04
22-Jul-2014 16:00	150	43.68	-0.01	24-Jul-2014 16:00	150	43.71	0.01
22-Jul-2014 16:30	180	43.69	-0.01	24-Jul-2014 16:30	180	43.72	0.01
22-Jul-2014 17:00	210	43.68	-0.02	24-Jul-2014 17:00	210	43.71	0.01
22-Jul-2014 17:30	240	43.68	-0.01	24-Jul-2014 17:30	240	43.70	0.02
22-Jul-2014 18:00	270	43.68	-0.02	24-Jul-2014 18:00	270	43.72	0.01
22-Jul-2014 18:30	300	43.68	-0.02	24-Jul-2014 18:30	300	43.70	0.02
22-Jul-2014 19:30	360	43.67	-0.03	24-Jul-2014 19:30	360	43.70	0.03
22-Jul-2014 20:30	420	43.64	-0.06	24-Jul-2014 20:30	420	43.70	0.02
22-Jul-2014 21:30	480	43.67	-0.03	24-Jul-2014 21:30	480	43.70	0.02
22-Jul-2014 22:30	540	43.66	-0.04	24-Jul-2014 22:30	540	43.72	0.01
22-Jul-2014 23:30	600	43.65	-0.05	24-Jul-2014 23:30	600	43.71	0.01
23-Jul-2014 00:30	660	43.65	-0.04	25-Jul-2014 00:30	660	43.70	0.02
23-Jul-2014 01:30	720	43.64	-0.06	25-Jul-2014 01:30	720	43.71	0.02
23-Jul-2014 02:30	780	43.64	-0.06	25-Jul-2014 02:30	780	43.70	0.02
23-Jul-2014 03:30	840	43.64	-0.05	25-Jul-2014 03:30	840	43.70	0.03
23-Jul-2014 05:30	960	43.64	-0.06	25-Jul-2014 05:30	960	43.69	0.03
23-Jul-2014 07:30	1080	43.67	-0.03	25-Jul-2014 07:30	1080	43.71	0.01
23-Jul-2014 09:30	1200	43.66	-0.04	25-Jul-2014 09:30	1200	43.71	0.02
23-Jul-2014 11:30	1320	43.67	-0.03	25-Jul-2014 11:30	1320	43.71	0.02
23-Jul-2014 13:30	1440	43.68	-0.02	25-Jul-2014 13:30	1440	43.70	0.03
23-Jul-2014 15:30	1560	43.69	-0.01	25-Jul-2014 15:30	1560	43.69	0.04
23-Jul-2014 17:30	1680	43.69	0.00	25-Jul-2014 17:30	1680	43.68	0.04
23-Jul-2014 19:30	1800	43.70	0.00	25-Jul-2014 19:30	1800	43.68	0.04
23-Jul-2014 21:30	1920	43.70	0.00	25-Jul-2014 21:30	1920	43.68	0.05
23-Jul-2014 23:30	2040	43.70	0.00	25-Jul-2014 23:30	2040	43.67	0.05
24-Jul-2014 01:30	2160	43.71	0.01	26-Jul-2014 01:30	2160	43.67	0.05
24-Jul-2014 03:30	2280	43.72	0.02	26-Jul-2014 03:30	2280	43.67	0.05
24-Jul-2014 05:30	2400	43.71	0.01	26-Jul-2014 05:30	2400	43.67	0.05
24-Jul-2014 07:30	2520	43.72	0.02	26-Jul-2014 07:30	2520	43.66	0.06
24-Jul-2014 09:30	2640	43.72	0.03	26-Jul-2014 09:30	2640	43.67	0.06
24-Jul-2014 11:30	2760	43.72	0.02	26-Jul-2014 11:30	2760	43.66	0.06
24-Jul-2014 13:30	2880	43.72	0.03	26-Jul-2014 13:30	2880	43.65	0.07

Tabulated Levels for OW2#2

Pump On:	22-Jul-2014 13:30	Static Level:	42.60
Pump Off:	24-Jul-2014 13:30	Pumping Level:	42.60
Pumping Well:	**PW1**	DD:	0.00
Distance from Pumping Well:	2200 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	42.60	0.00	24-Jul-2014 13:31	1	42.60	0.00
22-Jul-2014 13:32	2	42.60	0.00	24-Jul-2014 13:32	2	42.60	0.00
22-Jul-2014 13:33	3	42.60	0.00	24-Jul-2014 13:33	3	42.60	0.00
22-Jul-2014 13:34	4	42.60	0.00	24-Jul-2014 13:34	4	42.60	0.00
22-Jul-2014 13:35	5	42.60	0.00	24-Jul-2014 13:35	5	42.61	0.00
22-Jul-2014 13:36	6	42.60	-0.01	24-Jul-2014 13:36	6	42.61	0.00
22-Jul-2014 13:37	7	42.60	0.00	24-Jul-2014 13:37	7	42.61	0.00
22-Jul-2014 13:38	8	42.60	0.00	24-Jul-2014 13:38	8	42.60	0.00
22-Jul-2014 13:39	9	42.60	0.00	24-Jul-2014 13:39	9	42.60	0.00
22-Jul-2014 13:40	10	42.60	0.00	24-Jul-2014 13:40	10	42.60	0.00
22-Jul-2014 13:42	12	42.60	-0.01	24-Jul-2014 13:42	12	42.60	0.00
22-Jul-2014 13:44	14	42.60	0.00	24-Jul-2014 13:44	14	42.60	0.00
22-Jul-2014 13:46	16	42.60	-0.01	24-Jul-2014 13:46	16	42.60	0.01
22-Jul-2014 13:48	18	42.59	-0.01	24-Jul-2014 13:48	18	42.60	0.00
22-Jul-2014 13:50	20	42.59	-0.01	24-Jul-2014 13:50	20	42.60	0.00
22-Jul-2014 13:55	25	42.59	-0.01	24-Jul-2014 13:55	25	42.61	0.00
22-Jul-2014 14:00	30	42.60	-0.01	24-Jul-2014 14:00	30	42.61	0.00
22-Jul-2014 14:15	45	42.59	-0.01	24-Jul-2014 14:15	45	42.60	0.00
22-Jul-2014 14:30	60	42.59	-0.01	24-Jul-2014 14:30	60	42.60	0.00
22-Jul-2014 15:00	90	42.59	-0.01	24-Jul-2014 15:00	90	42.60	0.00
22-Jul-2014 15:30	120	42.58	-0.02	24-Jul-2014 15:30	120	42.60	0.00
22-Jul-2014 16:00	150	42.59	-0.02	24-Jul-2014 16:00	150	42.60	0.00
22-Jul-2014 16:30	180	42.58	-0.02	24-Jul-2014 16:30	180	42.60	0.00
22-Jul-2014 17:00	210	42.58	-0.02	24-Jul-2014 17:00	210	42.60	0.00
22-Jul-2014 17:30	240	42.58	-0.03	24-Jul-2014 17:30	240	42.59	0.01
22-Jul-2014 18:00	270	42.58	-0.02	24-Jul-2014 18:00	270	42.60	0.01
22-Jul-2014 18:30	300	42.57	-0.03	24-Jul-2014 18:30	300	42.59	0.02
22-Jul-2014 19:30	360	42.56	-0.04	24-Jul-2014 19:30	360	42.58	0.02
22-Jul-2014 20:30	420	42.55	-0.05	24-Jul-2014 20:30	420	42.58	0.02
22-Jul-2014 21:30	480	42.56	-0.04	24-Jul-2014 21:30	480	42.59	0.02
22-Jul-2014 22:30	540	42.56	-0.04	24-Jul-2014 22:30	540	42.59	0.02
22-Jul-2014 23:30	600	42.56	-0.05	24-Jul-2014 23:30	600	42.59	0.02
23-Jul-2014 00:30	660	42.54	-0.06	25-Jul-2014 00:30	660	42.59	0.02
23-Jul-2014 01:30	720	42.54	-0.06	25-Jul-2014 01:30	720	42.58	0.02
23-Jul-2014 02:30	780	42.54	-0.07	25-Jul-2014 02:30	780	42.58	0.02
23-Jul-2014 03:30	840	42.53	-0.07	25-Jul-2014 03:30	840	42.58	0.03
23-Jul-2014 05:30	960	42.54	-0.07	25-Jul-2014 05:30	960	42.58	0.02
23-Jul-2014 07:30	1080	42.55	-0.06	25-Jul-2014 07:30	1080	42.60	0.00
23-Jul-2014 09:30	1200	42.55	-0.05	25-Jul-2014 09:30	1200	42.60	0.01
23-Jul-2014 11:30	1320	42.56	-0.05	25-Jul-2014 11:30	1320	42.59	0.01
23-Jul-2014 13:30	1440	42.57	-0.03	25-Jul-2014 13:30	1440	42.58	0.02
23-Jul-2014 15:30	1560	42.58	-0.03	25-Jul-2014 15:30	1560	42.57	0.03
23-Jul-2014 17:30	1680	42.58	-0.03	25-Jul-2014 17:30	1680	42.57	0.04
23-Jul-2014 19:30	1800	42.58	-0.02	25-Jul-2014 19:30	1800	42.56	0.04
23-Jul-2014 21:30	1920	42.58	-0.02	25-Jul-2014 21:30	1920	42.56	0.04
23-Jul-2014 23:30	2040	42.59	-0.01	25-Jul-2014 23:30	2040	42.56	0.04
24-Jul-2014 01:30	2160	42.60	-0.01	26-Jul-2014 01:30	2160	42.56	0.05
24-Jul-2014 03:30	2280	42.60	-0.01	26-Jul-2014 03:30	2280	42.55	0.06
24-Jul-2014 05:30	2400	42.60	-0.01	26-Jul-2014 05:30	2400	42.55	0.05
24-Jul-2014 07:30	2520	42.60	0.00	26-Jul-2014 07:30	2520	42.56	0.05
24-Jul-2014 09:30	2640	42.61	0.00	26-Jul-2014 09:30	2640	42.55	0.05
24-Jul-2014 11:30	2760	42.61	0.00	26-Jul-2014 11:30	2760	42.55	0.05
24-Jul-2014 13:30	2880	42.60	0.00	26-Jul-2014 13:30	2880	42.53	0.07

Tabulated Levels for OW3#1

Pump On:	22-Jul-2014 13:30	Static Level:	33.28
Pump Off:	24-Jul-2014 13:30	Pumping Level:	33.31
Pumping Well:	**PW1**	DD:	0.03
Distance from Pumping Well:	2050 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	33.28	0.00	24-Jul-2014 13:31	1	33.30	0.00
22-Jul-2014 13:32	2	33.28	0.00	24-Jul-2014 13:32	2	33.31	0.00
22-Jul-2014 13:33	3	33.27	-0.01	24-Jul-2014 13:33	3	33.31	0.00
22-Jul-2014 13:34	4	33.28	0.00	24-Jul-2014 13:34	4	33.31	0.00
22-Jul-2014 13:35	5	33.28	0.00	24-Jul-2014 13:35	5	33.31	0.00
22-Jul-2014 13:36	6	33.27	0.00	24-Jul-2014 13:36	6	33.31	0.00
22-Jul-2014 13:37	7	33.28	0.00	24-Jul-2014 13:37	7	33.31	0.00
22-Jul-2014 13:38	8	33.27	-0.01	24-Jul-2014 13:38	8	33.31	0.00
22-Jul-2014 13:39	9	33.27	0.00	24-Jul-2014 13:39	9	33.31	0.00
22-Jul-2014 13:40	10	33.27	0.00	24-Jul-2014 13:40	10	33.31	0.00
22-Jul-2014 13:42	12	33.27	-0.01	24-Jul-2014 13:42	12	33.31	0.00
22-Jul-2014 13:44	14	33.27	0.00	24-Jul-2014 13:44	14	33.30	0.00
22-Jul-2014 13:46	16	33.27	-0.01	24-Jul-2014 13:46	16	33.31	0.00
22-Jul-2014 13:48	18	33.27	-0.01	24-Jul-2014 13:48	18	33.30	0.00
22-Jul-2014 13:50	20	33.27	-0.01	24-Jul-2014 13:50	20	33.31	0.00
22-Jul-2014 13:55	25	33.27	-0.01	24-Jul-2014 13:55	25	33.31	0.00
22-Jul-2014 14:00	30	33.27	-0.01	24-Jul-2014 14:00	30	33.31	0.00
22-Jul-2014 14:15	45	33.26	-0.01	24-Jul-2014 14:15	45	33.30	0.00
22-Jul-2014 14:30	60	33.26	-0.02	24-Jul-2014 14:30	60	33.31	0.00
22-Jul-2014 15:00	90	33.26	-0.02	24-Jul-2014 15:00	90	33.30	0.01
22-Jul-2014 15:30	120	33.26	-0.02	24-Jul-2014 15:30	120	33.30	0.01
22-Jul-2014 16:00	150	33.25	-0.02	24-Jul-2014 16:00	150	33.30	0.01
22-Jul-2014 16:30	180	33.26	-0.02	24-Jul-2014 16:30	180	33.30	0.00
22-Jul-2014 17:00	210	33.25	-0.02	24-Jul-2014 17:00	210	33.30	0.01
22-Jul-2014 17:30	240	33.25	-0.03	24-Jul-2014 17:30	240	33.29	0.01
22-Jul-2014 18:00	270	33.25	-0.03	24-Jul-2014 18:00	270	33.29	0.01
22-Jul-2014 18:30	300	33.24	-0.03	24-Jul-2014 18:30	300	33.29	0.02
22-Jul-2014 19:30	360	33.24	-0.04	24-Jul-2014 19:30	360	33.28	0.02
22-Jul-2014 20:30	420	33.23	-0.05	24-Jul-2014 20:30	420	33.28	0.02
22-Jul-2014 21:30	480	33.24	-0.04	24-Jul-2014 21:30	480	33.28	0.02
22-Jul-2014 22:30	540	33.24	-0.04	24-Jul-2014 22:30	540	33.29	0.01
22-Jul-2014 23:30	600	33.24	-0.04	24-Jul-2014 23:30	600	33.29	0.02
23-Jul-2014 00:30	660	33.23	-0.05	25-Jul-2014 00:30	660	33.29	0.02
23-Jul-2014 01:30	720	33.23	-0.04	25-Jul-2014 01:30	720	33.29	0.02
23-Jul-2014 02:30	780	33.23	-0.05	25-Jul-2014 02:30	780	33.28	0.03
23-Jul-2014 03:30	840	33.22	-0.05	25-Jul-2014 03:30	840	33.28	0.03
23-Jul-2014 05:30	960	33.23	-0.05	25-Jul-2014 05:30	960	33.28	0.03
23-Jul-2014 07:30	1080	33.25	-0.03	25-Jul-2014 07:30	1080	33.29	0.01
23-Jul-2014 09:30	1200	33.26	-0.02	25-Jul-2014 09:30	1200	33.29	0.02
23-Jul-2014 11:30	1320	33.27	-0.01	25-Jul-2014 11:30	1320	33.29	0.02
23-Jul-2014 13:30	1440	33.28	0.00	25-Jul-2014 13:30	1440	33.28	0.03
23-Jul-2014 15:30	1560	33.29	0.01	25-Jul-2014 15:30	1560	33.27	0.04
23-Jul-2014 17:30	1680	33.29	0.01	25-Jul-2014 17:30	1680	33.26	0.04
23-Jul-2014 19:30	1800	33.29	0.02	25-Jul-2014 19:30	1800	33.26	0.04
23-Jul-2014 21:30	1920	33.30	0.02	25-Jul-2014 21:30	1920	33.26	0.05
23-Jul-2014 23:30	2040	33.30	0.03	25-Jul-2014 23:30	2040	33.26	0.05
24-Jul-2014 01:30	2160	33.31	0.03	26-Jul-2014 01:30	2160	33.26	0.05
24-Jul-2014 03:30	2280	33.31	0.03	26-Jul-2014 03:30	2280	33.25	0.05
24-Jul-2014 05:30	2400	33.31	0.03	26-Jul-2014 05:30	2400	33.26	0.05
24-Jul-2014 07:30	2520	33.31	0.03	26-Jul-2014 07:30	2520	33.26	0.04
24-Jul-2014 09:30	2640	33.31	0.04	26-Jul-2014 09:30	2640	33.26	0.05
24-Jul-2014 11:30	2760	33.31	0.04	26-Jul-2014 11:30	2760	33.26	0.05
24-Jul-2014 13:30	2880	33.31	0.03	26-Jul-2014 13:30	2880	33.25	0.06

Tabulated Levels for OW3#2

Pump On:	22-Jul-2014 13:30	Static Level:	43.21
Pump Off:	24-Jul-2014 13:30	Pumping Level:	43.21
Pumping Well:	**PW1**	DD:	0.00
Distance from Pumping Well:	2050 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	43.21	0.00	24-Jul-2014 13:31	1	43.21	0.00
22-Jul-2014 13:32	2	43.21	0.00	24-Jul-2014 13:32	2	43.21	0.00
22-Jul-2014 13:33	3	43.20	0.00	24-Jul-2014 13:33	3	43.21	0.01
22-Jul-2014 13:34	4	43.21	0.00	24-Jul-2014 13:34	4	43.21	0.00
22-Jul-2014 13:35	5	43.21	0.00	24-Jul-2014 13:35	5	43.21	0.00
22-Jul-2014 13:36	6	43.20	0.00	24-Jul-2014 13:36	6	43.21	0.00
22-Jul-2014 13:37	7	43.20	0.00	24-Jul-2014 13:37	7	43.21	0.00
22-Jul-2014 13:38	8	43.20	0.00	24-Jul-2014 13:38	8	43.21	0.00
22-Jul-2014 13:39	9	43.20	-0.01	24-Jul-2014 13:39	9	43.21	0.00
22-Jul-2014 13:40	10	43.21	0.00	24-Jul-2014 13:40	10	43.21	0.00
22-Jul-2014 13:42	12	43.20	-0.01	24-Jul-2014 13:42	12	43.21	0.00
22-Jul-2014 13:44	14	43.20	-0.01	24-Jul-2014 13:44	14	43.21	0.00
22-Jul-2014 13:46	16	43.20	-0.01	24-Jul-2014 13:46	16	43.21	0.01
22-Jul-2014 13:48	18	43.20	-0.01	24-Jul-2014 13:48	18	43.21	0.00
22-Jul-2014 13:50	20	43.20	-0.01	24-Jul-2014 13:50	20	43.21	0.00
22-Jul-2014 13:55	25	43.20	-0.01	24-Jul-2014 13:55	25	43.21	0.00
22-Jul-2014 14:00	30	43.20	-0.01	24-Jul-2014 14:00	30	43.21	0.00
22-Jul-2014 14:15	45	43.20	-0.01	24-Jul-2014 14:15	45	43.21	0.00
22-Jul-2014 14:30	60	43.20	-0.01	24-Jul-2014 14:30	60	43.21	0.00
22-Jul-2014 15:00	90	43.19	-0.02	24-Jul-2014 15:00	90	43.21	0.01
22-Jul-2014 15:30	120	43.19	-0.02	24-Jul-2014 15:30	120	43.21	0.01
22-Jul-2014 16:00	150	43.19	-0.02	24-Jul-2014 16:00	150	43.20	0.01
22-Jul-2014 16:30	180	43.18	-0.02	24-Jul-2014 16:30	180	43.21	0.00
22-Jul-2014 17:00	210	43.18	-0.03	24-Jul-2014 17:00	210	43.20	0.01
22-Jul-2014 17:30	240	43.18	-0.03	24-Jul-2014 17:30	240	43.20	0.01
22-Jul-2014 18:00	270	43.18	-0.03	24-Jul-2014 18:00	270	43.20	0.01
22-Jul-2014 18:30	300	43.17	-0.03	24-Jul-2014 18:30	300	43.19	0.02
22-Jul-2014 19:30	360	43.17	-0.04	24-Jul-2014 19:30	360	43.19	0.02
22-Jul-2014 20:30	420	43.16	-0.05	24-Jul-2014 20:30	420	43.19	0.02
22-Jul-2014 21:30	480	43.17	-0.04	24-Jul-2014 21:30	480	43.19	0.02
22-Jul-2014 22:30	540	43.16	-0.04	24-Jul-2014 22:30	540	43.20	0.01
22-Jul-2014 23:30	600	43.16	-0.05	24-Jul-2014 23:30	600	43.20	0.01
23-Jul-2014 00:30	660	43.15	-0.06	25-Jul-2014 00:30	660	43.20	0.01
23-Jul-2014 01:30	720	43.15	-0.06	25-Jul-2014 01:30	720	43.19	0.02
23-Jul-2014 02:30	780	43.14	-0.07	25-Jul-2014 02:30	780	43.19	0.02
23-Jul-2014 03:30	840	43.14	-0.07	25-Jul-2014 03:30	840	43.19	0.03
23-Jul-2014 05:30	960	43.14	-0.07	25-Jul-2014 05:30	960	43.19	0.02
23-Jul-2014 07:30	1080	43.15	-0.05	25-Jul-2014 07:30	1080	43.20	0.02
23-Jul-2014 09:30	1200	43.16	-0.05	25-Jul-2014 09:30	1200	43.20	0.01
23-Jul-2014 11:30	1320	43.16	-0.04	25-Jul-2014 11:30	1320	43.20	0.02
23-Jul-2014 13:30	1440	43.17	-0.03	25-Jul-2014 13:30	1440	43.19	0.03
23-Jul-2014 15:30	1560	43.18	-0.03	25-Jul-2014 15:30	1560	43.18	0.03
23-Jul-2014 17:30	1680	43.18	-0.02	25-Jul-2014 17:30	1680	43.17	0.04
23-Jul-2014 19:30	1800	43.19	-0.02	25-Jul-2014 19:30	1800	43.17	0.04
23-Jul-2014 21:30	1920	43.19	-0.02	25-Jul-2014 21:30	1920	43.16	0.05
23-Jul-2014 23:30	2040	43.20	-0.01	25-Jul-2014 23:30	2040	43.16	0.05
24-Jul-2014 01:30	2160	43.20	0.00	26-Jul-2014 01:30	2160	43.16	0.05
24-Jul-2014 03:30	2280	43.20	0.00	26-Jul-2014 03:30	2280	43.16	0.06
24-Jul-2014 05:30	2400	43.21	0.00	26-Jul-2014 05:30	2400	43.16	0.05
24-Jul-2014 07:30	2520	43.21	0.00	26-Jul-2014 07:30	2520	43.16	0.05
24-Jul-2014 09:30	2640	43.21	0.00	26-Jul-2014 09:30	2640	43.15	0.06
24-Jul-2014 11:30	2760	43.22	0.01	26-Jul-2014 11:30	2760	43.16	0.06
24-Jul-2014 13:30	2880	43.21	0.00	26-Jul-2014 13:30	2880	43.14	0.07

Tabulated Levels for OW4#1

Pump On:	22-Jul-2014 13:30	Static Level:	33.46
Pump Off:	24-Jul-2014 13:30	Pumping Level:	33.48
Pumping Well:	**PW1**	DD:	0.02
Distance from Pumping Well:	1500 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	33.46	0.00	24-Jul-2014 13:31	1	33.47	0.00
22-Jul-2014 13:32	2	33.46	0.00	24-Jul-2014 13:32	2	33.48	0.00
22-Jul-2014 13:33	3	33.46	0.00	24-Jul-2014 13:33	3	33.48	0.00
22-Jul-2014 13:34	4	33.46	0.00	24-Jul-2014 13:34	4	33.47	0.00
22-Jul-2014 13:35	5	33.46	0.00	24-Jul-2014 13:35	5	33.48	0.00
22-Jul-2014 13:36	6	33.45	-0.01	24-Jul-2014 13:36	6	33.48	0.00
22-Jul-2014 13:37	7	33.46	0.00	24-Jul-2014 13:37	7	33.48	0.00
22-Jul-2014 13:38	8	33.45	-0.01	24-Jul-2014 13:38	8	33.48	0.00
22-Jul-2014 13:39	9	33.46	0.00	24-Jul-2014 13:39	9	33.48	0.00
22-Jul-2014 13:40	10	33.46	0.00	24-Jul-2014 13:40	10	33.48	0.00
22-Jul-2014 13:42	12	33.45	0.00	24-Jul-2014 13:42	12	33.47	0.00
22-Jul-2014 13:44	14	33.46	0.00	24-Jul-2014 13:44	14	33.47	0.00
22-Jul-2014 13:46	16	33.46	0.00	24-Jul-2014 13:46	16	33.47	0.00
22-Jul-2014 13:48	18	33.45	-0.01	24-Jul-2014 13:48	18	33.47	0.01
22-Jul-2014 13:50	20	33.45	-0.01	24-Jul-2014 13:50	20	33.48	0.00
22-Jul-2014 13:55	25	33.45	-0.01	24-Jul-2014 13:55	25	33.48	0.00
22-Jul-2014 14:00	30	33.45	-0.01	24-Jul-2014 14:00	30	33.48	0.00
22-Jul-2014 14:15	45	33.45	-0.01	24-Jul-2014 14:15	45	33.47	0.00
22-Jul-2014 14:30	60	33.45	-0.01	24-Jul-2014 14:30	60	33.48	0.00
22-Jul-2014 15:00	90	33.45	-0.01	24-Jul-2014 15:00	90	33.47	0.01
22-Jul-2014 15:30	120	33.44	-0.02	24-Jul-2014 15:30	120	33.47	0.00
22-Jul-2014 16:00	150	33.45	-0.01	24-Jul-2014 16:00	150	33.47	0.00
22-Jul-2014 16:30	180	33.45	-0.01	24-Jul-2014 16:30	180	33.47	0.00
22-Jul-2014 17:00	210	33.45	-0.01	24-Jul-2014 17:00	210	33.47	0.00
22-Jul-2014 17:30	240	33.45	-0.01	24-Jul-2014 17:30	240	33.47	0.01
22-Jul-2014 18:00	270	33.45	-0.01	24-Jul-2014 18:00	270	33.47	0.01
22-Jul-2014 18:30	300	33.44	-0.02	24-Jul-2014 18:30	300	33.46	0.01
22-Jul-2014 19:30	360	33.44	-0.02	24-Jul-2014 19:30	360	33.46	0.02
22-Jul-2014 20:30	420	33.43	-0.02	24-Jul-2014 20:30	420	33.46	0.02
22-Jul-2014 21:30	480	33.45	-0.01	24-Jul-2014 21:30	480	33.46	0.01
22-Jul-2014 22:30	540	33.45	-0.01	24-Jul-2014 22:30	540	33.47	0.01
22-Jul-2014 23:30	600	33.45	-0.01	24-Jul-2014 23:30	600	33.47	0.01
23-Jul-2014 00:30	660	33.44	-0.02	25-Jul-2014 00:30	660	33.47	0.00
23-Jul-2014 01:30	720	33.44	-0.02	25-Jul-2014 01:30	720	33.46	0.01
23-Jul-2014 02:30	780	33.44	-0.02	25-Jul-2014 02:30	780	33.46	0.02
23-Jul-2014 03:30	840	33.44	-0.02	25-Jul-2014 03:30	840	33.46	0.02
23-Jul-2014 05:30	960	33.45	-0.01	25-Jul-2014 05:30	960	33.46	0.02
23-Jul-2014 07:30	1080	33.46	0.00	25-Jul-2014 07:30	1080	33.47	0.01
23-Jul-2014 09:30	1200	33.47	0.01	25-Jul-2014 09:30	1200	33.47	0.00
23-Jul-2014 11:30	1320	33.48	0.02	25-Jul-2014 11:30	1320	33.47	0.01
23-Jul-2014 13:30	1440	33.48	0.02	25-Jul-2014 13:30	1440	33.46	0.02
23-Jul-2014 15:30	1560	33.49	0.03	25-Jul-2014 15:30	1560	33.45	0.03
23-Jul-2014 17:30	1680	33.49	0.03	25-Jul-2014 17:30	1680	33.45	0.03
23-Jul-2014 19:30	1800	33.48	0.02	25-Jul-2014 19:30	1800	33.45	0.02
23-Jul-2014 21:30	1920	33.48	0.02	25-Jul-2014 21:30	1920	33.45	0.02
23-Jul-2014 23:30	2040	33.49	0.03	25-Jul-2014 23:30	2040	33.45	0.02
24-Jul-2014 01:30	2160	33.49	0.03	26-Jul-2014 01:30	2160	33.46	0.02
24-Jul-2014 03:30	2280	33.49	0.03	26-Jul-2014 03:30	2280	33.45	0.03
24-Jul-2014 05:30	2400	33.48	0.03	26-Jul-2014 05:30	2400	33.46	0.02
24-Jul-2014 07:30	2520	33.48	0.02	26-Jul-2014 07:30	2520	33.46	0.02
24-Jul-2014 09:30	2640	33.48	0.02	26-Jul-2014 09:30	2640	33.45	0.02
24-Jul-2014 11:30	2760	33.48	0.02	26-Jul-2014 11:30	2760	33.46	0.02
24-Jul-2014 13:30	2880	33.48	0.02	26-Jul-2014 13:30	2880	33.45	0.03

Tabulated Levels for OW4#2

Pump On:	22-Jul-2014 13:30	Static Level:	45.32
Pump Off:	24-Jul-2014 13:30	Pumping Level:	45.32
Pumping Well:	**PW1**	DD:	0.00
Distance from Pumping Well:	1500 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	45.32	0.00	24-Jul-2014 13:31	1	45.31	0.00
22-Jul-2014 13:32	2	45.32	0.00	24-Jul-2014 13:32	2	45.32	0.00
22-Jul-2014 13:33	3	45.32	0.00	24-Jul-2014 13:33	3	45.31	0.00
22-Jul-2014 13:34	4	45.32	0.00	24-Jul-2014 13:34	4	45.31	0.00
22-Jul-2014 13:35	5	45.32	0.00	24-Jul-2014 13:35	5	45.32	0.00
22-Jul-2014 13:36	6	45.32	0.00	24-Jul-2014 13:36	6	45.32	0.00
22-Jul-2014 13:37	7	45.32	0.00	24-Jul-2014 13:37	7	45.32	0.00
22-Jul-2014 13:38	8	45.32	0.00	24-Jul-2014 13:38	8	45.32	0.00
22-Jul-2014 13:39	9	45.32	0.00	24-Jul-2014 13:39	9	45.32	0.00
22-Jul-2014 13:40	10	45.32	0.00	24-Jul-2014 13:40	10	45.32	0.00
22-Jul-2014 13:42	12	45.31	-0.01	24-Jul-2014 13:42	12	45.31	0.00
22-Jul-2014 13:44	14	45.32	-0.01	24-Jul-2014 13:44	14	45.31	0.00
22-Jul-2014 13:46	16	45.31	-0.01	24-Jul-2014 13:46	16	45.31	0.01
22-Jul-2014 13:48	18	45.31	-0.01	24-Jul-2014 13:48	18	45.31	0.00
22-Jul-2014 13:50	20	45.31	-0.01	24-Jul-2014 13:50	20	45.32	0.00
22-Jul-2014 13:55	25	45.31	-0.01	24-Jul-2014 13:55	25	45.32	0.00
22-Jul-2014 14:00	30	45.31	-0.01	24-Jul-2014 14:00	30	45.31	0.00
22-Jul-2014 14:15	45	45.31	-0.01	24-Jul-2014 14:15	45	45.32	0.00
22-Jul-2014 14:30	60	45.31	-0.01	24-Jul-2014 14:30	60	45.32	0.00
22-Jul-2014 15:00	90	45.30	-0.02	24-Jul-2014 15:00	90	45.31	0.01
22-Jul-2014 15:30	120	45.30	-0.02	24-Jul-2014 15:30	120	45.31	0.01
22-Jul-2014 16:00	150	45.30	-0.02	24-Jul-2014 16:00	150	45.31	0.00
22-Jul-2014 16:30	180	45.29	-0.03	24-Jul-2014 16:30	180	45.31	0.00
22-Jul-2014 17:00	210	45.30	-0.02	24-Jul-2014 17:00	210	45.31	0.01
22-Jul-2014 17:30	240	45.29	-0.03	24-Jul-2014 17:30	240	45.31	0.01
22-Jul-2014 18:00	270	45.29	-0.03	24-Jul-2014 18:00	270	45.31	0.01
22-Jul-2014 18:30	300	45.28	-0.04	24-Jul-2014 18:30	300	45.30	0.02
22-Jul-2014 19:30	360	45.28	-0.04	24-Jul-2014 19:30	360	45.30	0.02
22-Jul-2014 20:30	420	45.27	-0.05	24-Jul-2014 20:30	420	45.30	0.02
22-Jul-2014 21:30	480	45.28	-0.04	24-Jul-2014 21:30	480	45.30	0.02
22-Jul-2014 22:30	540	45.27	-0.05	24-Jul-2014 22:30	540	45.30	0.01
22-Jul-2014 23:30	600	45.27	-0.05	24-Jul-2014 23:30	600	45.30	0.01
23-Jul-2014 00:30	660	45.26	-0.06	25-Jul-2014 00:30	660	45.31	0.01
23-Jul-2014 01:30	720	45.26	-0.06	25-Jul-2014 01:30	720	45.30	0.02
23-Jul-2014 02:30	780	45.25	-0.07	25-Jul-2014 02:30	780	45.30	0.02
23-Jul-2014 03:30	840	45.25	-0.07	25-Jul-2014 03:30	840	45.29	0.03
23-Jul-2014 05:30	960	45.25	-0.07	25-Jul-2014 05:30	960	45.29	0.02
23-Jul-2014 07:30	1080	45.26	-0.06	25-Jul-2014 07:30	1080	45.30	0.01
23-Jul-2014 09:30	1200	45.27	-0.05	25-Jul-2014 09:30	1200	45.31	0.01
23-Jul-2014 11:30	1320	45.27	-0.05	25-Jul-2014 11:30	1320	45.30	0.01
23-Jul-2014 13:30	1440	45.28	-0.04	25-Jul-2014 13:30	1440	45.29	0.02
23-Jul-2014 15:30	1560	45.29	-0.03	25-Jul-2014 15:30	1560	45.28	0.03
23-Jul-2014 17:30	1680	45.29	-0.03	25-Jul-2014 17:30	1680	45.28	0.04
23-Jul-2014 19:30	1800	45.29	-0.03	25-Jul-2014 19:30	1800	45.28	0.04
23-Jul-2014 21:30	1920	45.30	-0.02	25-Jul-2014 21:30	1920	45.27	0.05
23-Jul-2014 23:30	2040	45.30	-0.02	25-Jul-2014 23:30	2040	45.27	0.04
24-Jul-2014 01:30	2160	45.31	-0.01	26-Jul-2014 01:30	2160	45.27	0.05
24-Jul-2014 03:30	2280	45.31	-0.01	26-Jul-2014 03:30	2280	45.26	0.06
24-Jul-2014 05:30	2400	45.31	-0.01	26-Jul-2014 05:30	2400	45.26	0.05
24-Jul-2014 07:30	2520	45.31	-0.01	26-Jul-2014 07:30	2520	45.27	0.05
24-Jul-2014 09:30	2640	45.32	0.00	26-Jul-2014 09:30	2640	45.26	0.06
24-Jul-2014 11:30	2760	45.32	0.00	26-Jul-2014 11:30	2760	45.26	0.06
24-Jul-2014 13:30	2880	45.32	0.00	26-Jul-2014 13:30	2880	45.25	0.07

Tabulated Levels for TW17

Pump On:	22-Jul-2014 13:30	Static Level:	4.78
Pump Off:	24-Jul-2014 13:30	Pumping Level:	4.79
Pumping Well:	**PW1**	DD:	0.01
Distance from Pumping Well:	2300 m		

Date:Time	Elapsed	WL	DD	Date:Time	Elapsed	WL	RC
dd-mmm-yyyy hh:mm	(min)	m	m	dd-mmm-yyyy hh:mm	(min)	m	m
22-Jul-2014 13:31	1	4.78	0.00	24-Jul-2014 13:31	1	4.78	0.00
22-Jul-2014 13:32	2	4.78	0.00	24-Jul-2014 13:32	2	4.79	0.00
22-Jul-2014 13:33	3	4.77	0.00	24-Jul-2014 13:33	3	4.79	0.00
22-Jul-2014 13:34	4	4.77	0.00	24-Jul-2014 13:34	4	4.79	0.00
22-Jul-2014 13:35	5	4.78	0.00	24-Jul-2014 13:35	5	4.79	0.00
22-Jul-2014 13:36	6	4.77	0.00	24-Jul-2014 13:36	6	4.79	0.00
22-Jul-2014 13:37	7	4.77	0.00	24-Jul-2014 13:37	7	4.79	0.00
22-Jul-2014 13:38	8	4.77	0.00	24-Jul-2014 13:38	8	4.79	0.00
22-Jul-2014 13:39	9	4.77	0.00	24-Jul-2014 13:39	9	4.79	0.00
22-Jul-2014 13:40	10	4.77	0.00	24-Jul-2014 13:40	10	4.79	0.00
22-Jul-2014 13:42	12	4.77	-0.01	24-Jul-2014 13:42	12	4.79	0.00
22-Jul-2014 13:44	14	4.77	0.00	24-Jul-2014 13:44	14	4.79	0.00
22-Jul-2014 13:46	16	4.77	-0.01	24-Jul-2014 13:46	16	4.78	0.00
22-Jul-2014 13:48	18	4.77	-0.01	24-Jul-2014 13:48	18	4.79	0.00
22-Jul-2014 13:50	20	4.77	-0.01	24-Jul-2014 13:50	20	4.79	0.00
22-Jul-2014 13:55	25	4.77	-0.01	24-Jul-2014 13:55	25	4.79	0.00
22-Jul-2014 14:00	30	4.77	-0.01	24-Jul-2014 14:00	30	4.79	0.00
22-Jul-2014 14:15	45	4.76	-0.01	24-Jul-2014 14:15	45	4.79	0.00
22-Jul-2014 14:30	60	4.76	-0.01	24-Jul-2014 14:30	60	4.79	0.00
22-Jul-2014 15:00	90	4.76	-0.01	24-Jul-2014 15:00	90	4.78	0.00
22-Jul-2014 15:30	120	4.76	-0.02	24-Jul-2014 15:30	120	4.78	0.00
22-Jul-2014 16:00	150	4.76	-0.02	24-Jul-2014 16:00	150	4.78	0.00
22-Jul-2014 16:30	180	4.76	-0.02	24-Jul-2014 16:30	180	4.78	0.00
22-Jul-2014 17:00	210	4.76	-0.02	24-Jul-2014 17:00	210	4.78	0.01
22-Jul-2014 17:30	240	4.75	-0.02	24-Jul-2014 17:30	240	4.78	0.01
22-Jul-2014 18:00	270	4.75	-0.03	24-Jul-2014 18:00	270	4.78	0.01
22-Jul-2014 18:30	300	4.75	-0.03	24-Jul-2014 18:30	300	4.77	0.02
22-Jul-2014 19:30	360	4.74	-0.04	24-Jul-2014 19:30	360	4.77	0.02
22-Jul-2014 20:30	420	4.73	-0.05	24-Jul-2014 20:30	420	4.77	0.02
22-Jul-2014 21:30	480	4.74	-0.03	24-Jul-2014 21:30	480	4.77	0.02
22-Jul-2014 22:30	540	4.74	-0.04	24-Jul-2014 22:30	540	4.78	0.01
22-Jul-2014 23:30	600	4.73	-0.05	24-Jul-2014 23:30	600	4.78	0.01
23-Jul-2014 00:30	660	4.72	-0.06	25-Jul-2014 00:30	660	4.78	0.01
23-Jul-2014 01:30	720	4.72	-0.06	25-Jul-2014 01:30	720	4.77	0.02
23-Jul-2014 02:30	780	4.71	-0.06	25-Jul-2014 02:30	780	4.77	0.02
23-Jul-2014 03:30	840	4.71	-0.07	25-Jul-2014 03:30	840	4.77	0.02
23-Jul-2014 05:30	960	4.71	-0.06	25-Jul-2014 05:30	960	4.77	0.02
23-Jul-2014 07:30	1080	4.73	-0.05	25-Jul-2014 07:30	1080	4.78	0.01
23-Jul-2014 09:30	1200	4.73	-0.05	25-Jul-2014 09:30	1200	4.78	0.01
23-Jul-2014 11:30	1320	4.74	-0.04	25-Jul-2014 11:30	1320	4.78	0.01
23-Jul-2014 13:30	1440	4.75	-0.03	25-Jul-2014 13:30	1440	4.77	0.02
23-Jul-2014 15:30	1560	4.76	-0.02	25-Jul-2014 15:30	1560	4.76	0.03
23-Jul-2014 17:30	1680	4.76	-0.02	25-Jul-2014 17:30	1680	4.75	0.04
23-Jul-2014 19:30	1800	4.76	-0.02	25-Jul-2014 19:30	1800	4.75	0.04
23-Jul-2014 21:30	1920	4.76	-0.01	25-Jul-2014 21:30	1920	4.74	0.04
23-Jul-2014 23:30	2040	4.77	-0.01	25-Jul-2014 23:30	2040	4.74	0.04
24-Jul-2014 01:30	2160	4.78	0.00	26-Jul-2014 01:30	2160	4.74	0.05
24-Jul-2014 03:30	2280	4.78	0.00	26-Jul-2014 03:30	2280	4.73	0.05
24-Jul-2014 05:30	2400	4.78	0.00	26-Jul-2014 05:30	2400	4.74	0.05
24-Jul-2014 07:30	2520	4.78	0.01	26-Jul-2014 07:30	2520	4.74	0.05
24-Jul-2014 09:30	2640	4.79	0.01	26-Jul-2014 09:30	2640	4.73	0.06
24-Jul-2014 11:30	2760	4.79	0.02	26-Jul-2014 11:30	2760	4.73	0.05
24-Jul-2014 13:30	2880	4.79	0.01	26-Jul-2014 13:30	2880	4.72	0.07

Table K-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: DW 60428 **REPORT No. B14-18587**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: John Easton

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 25-Jul-14
DATE REPORTED: 11-Aug-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		PW1	PW1 - Total		
			Sample I.D.		B14-18587-1	B14-18587-2		
			Date Collected		24-Jul-14	24-Jul-14		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	28-Jul-14/O	208			
Hardness (as CaCO3)	mg/L	1	SM 3120	28-Jul-14/O		217		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	25-Jul-14/O	201			
Conductivity @25°C	µmho/cm	1	SM 2510B	25-Jul-14/O	422			
pH @25°C	pH Units		SM 4500H	25-Jul-14/O	8.06			
Colour	TCU	2	SM 2120C	29-Jul-14/O	4			
Turbidity	NTU	0.1	SM 2130	25-Jul-14/O	1.4			
UV transmittance	%		N/A	31-Jul-14	92.0 [2]			
Fluoride	mg/L	0.1	SM4110C	25-Jul-14/O	0.2			
Chloride	mg/L	0.5	SM4110C	25-Jul-14/O	2.1			
Nitrite (N)	mg/L	0.1	SM4110C	25-Jul-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	25-Jul-14/O	< 0.1			
Sulphate	mg/L	1	SM4110C	25-Jul-14/O	14			
Calcium	mg/L	0.02	SM 3120	28-Jul-14/O	55.0			
Calcium	mg/L	0.02	SM 3120	28-Jul-14/O		57.6		
Magnesium	mg/L	0.01	SM 3120	28-Jul-14/O	17.1			
Magnesium	mg/L	0.01	SM 3120	28-Jul-14/O		17.7		
Sodium	mg/L	0.2	SM 3120	28-Jul-14/O	5.2			
Sodium	mg/L	0.2	SM 3120	28-Jul-14/O		5.5		
Potassium	mg/L	0.1	SM 3120	28-Jul-14/O	1.6			
Potassium	mg/L	0.1	SM 3120	28-Jul-14/O		1.7		
Copper	mg/L	0.002	SM 3120	28-Jul-14/O	< 0.002			
Copper	mg/L	0.002	SM 3120	28-Jul-14/O		< 0.002		
Iron	mg/L	0.005	SM 3120	28-Jul-14/O	0.298			
Iron	mg/L	0.005	SM 3120	28-Jul-14/O		0.383		
Manganese	mg/L	0.001	SM 3120	28-Jul-14/O	0.074			
Manganese	mg/L	0.001	SM 3120	28-Jul-14/O		0.078		
Silica	mg/L	0.02	SM 3120	28-Jul-14/O	14.1			



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Table K-2: Water Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: DW 60428 **REPORT No. B14-18587**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: John Easton

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 25-Jul-14
DATE REPORTED: 11-Aug-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		PW1	PW1 - Total		
			Sample I.D.		B14-18587-1	B14-18587-2		
			Date Collected		24-Jul-14	24-Jul-14		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Silica	mg/L	0.02	SM 3120	28-Jul-14/O		14.5		
Zinc	mg/L	0.005	SM 3120	28-Jul-14/O	< 0.005			
Zinc	mg/L	0.005	SM 3120	28-Jul-14/O		0.006		
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	28-Jul-14/O	0.22			
Total Kjeldahl Nitrogen	mg/L	0.05	MOEE 3367	05-Aug-14/O	0.23			
Organic Nitrogen	mg/L	0.05	MOEE 3367	05-Aug-14/O	< 0.05			
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	25-Jul-14/O	1.2			
Sulphide	mg/L	0.01	SM4500-S2	28-Jul-14/K	0.02			
Phenolics	mg/L	0.001	MOEE 3179	28-Jul-14/O	< 0.001			
Tannins and Lignins	mg/L	0.1	N/A	30-Jul-14	< 0.1 [1]			
Total Coliform	cfu/100mL	1	MOE E3371	25-Jul-14/O	0			
E coli	cfu/100mL	1	MOE E3371	25-Jul-14/O	0			
Background	cfu/100mL	1	MOE E3371	25-Jul-14/O	4			
Anion Sum	meq/L		Calc.	28-Jul-14/O	4.37			
Cation Sum	meq/L		Calc.	28-Jul-14/O	4.44			
% Difference	%		Calc.	28-Jul-14/O	0.803			
Ion Ratio	AS/CS		Calc.	28-Jul-14/O	0.984			
Sodium Adsorption Ratio	-		Calc.	28-Jul-14/O	0.156			
TDS(ion sum calc.)	mg/L		Calc.	28-Jul-14/O	216			
Conductivity (calc.)	µmho/cm		Calc.	28-Jul-14/O	407			
TDS(calc.)/EC(actual)	-		Calc.	28-Jul-14/O	0.512			
EC(calc.)/EC(actual)	-		Calc.	28-Jul-14/O	0.964			
Langelier Index(25°C)	S.I.		Calc.	28-Jul-14/O	0.670			

1 subcontracted to Paracel Labs
2 Subcontracted to SGS Lakefield



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

APPENDIX L

Observation Well Water Quality Results

		Aquifer	Hardness	Alkalinity	Cond	pH	F	Cl	NO_2	NO_3	SO_2	Ca	Mg	Na	K	Fe	Mn	NH_3	DOC	Tannins and Lignins	Anion Sum	Cation Sum	TDS
Units		--	mg/L	mg/L	µmho/cm		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	mg/L
ODWS Limits		--	80-100	30-500	--	6.5-8.5	1.5	250	1	10	500	--	--	200	--	0.3	0.05	--	5	--	--	--	500
OW19#1	23-May-14	A1	382	170	930	7.98	0.1	173	< 0.1	5.3	15	101	31.4	38.9	1.7	< 0.005	< 0.001	< 0.01	1.1	0.5	8.98	9.37	487
OW19#2	23-May-14	A1	422	233	2070	8.01	0.1	530	< 0.1	3.9	26	117	31.6	275	2.6	< 0.005	0.008	< 0.01	1.2	0.5	20.4	20.5	1140
OW3#1	28-May-14	A1	357	293	612	8.01	0.1	5.9	< 0.1	5	10	121	13.4	5.2	1	< 0.005	< 0.001	< 0.01	2.1	< 0.1	6.6	7.38	355
OW1#1	30-May-14	A1	387	274	728	7.95	< 0.1	9.2	< 0.1	24.3	20	116	23.6	5	0.9	< 0.005	< 0.001	< 0.01	2.2	< 0.1	7.89	7.96	0.613
OW4#1	30-May-14	A1	228	204	419	8.06	0.1	6.2	< 0.1	1	8	77.3	8.32	3.7	1.2	< 0.005	< 0.001	< 0.01	1.5	0.1	4.5	4.73	0.554
Hickling House	30-May-14	A1	364	295	681	7.98	0.2	8.9	< 0.1	13.6	15	119	16.4	5.9	1.6	< 0.005	< 0.001	< 0.01	1.8	< 0.1	7.43	7.57	0.593
OW3#2	28-May-14	A2	287	216	509	8.08	< 0.1	8	< 0.1	6.5	15	95.3	11.8	3	1.6	< 0.005	< 0.001	< 0.01	1.9	< 0.1	5.31	5.9	293
OW4#2	30-May-14	A2	237	208	429	8.09	0.2	4.7	< 0.1	0.6	16	76.5	11.2	3.4	1.5	< 0.005	0.004	< 0.01	1.4	0.2	4.66	4.93	0.561
OW19#4	30-May-14	A3	304	197	1320	7.97	0.2	278	< 0.1	0.6	37	80	25.4	147	1.8	< 0.005	0.119	0.28	2.1	1.2	12.6	12.5	0.523
OW19#5	30-May-14	A3	384	214	1010	7.95	0.2	173	< 0.1	7.1	23	104	30.4	48.7	2.2	< 0.005	0.025	< 0.01	1.3	0.7	10.2	9.84	0.537
OW8I	28-May-14	A3	211	169	372	8.17	0.2	3.2	< 0.1	< 0.1	30	64.5	12.1	4	1.8	0.182	0.018	< 0.01	1.5	0.6	4.1	4.45	217
TW30	4-Jun-14	A3/A4	121	174	321	8.24	0.3	2.1	< 0.1	0.7	7	30.4	10.9	25.7	2.1	< 0.005	0.028	0.56	1.8	0.3	3.74	3.63	0.582
TW21	1-Aug-14	A3/A4	266	200	533	7.98	<0.1	27.9	<0.1	3.3	16	78.9	16.8	9.6	1.9	0.024	0.003	<0.01	1.2	<0.1	5.36	5.79	286
TW22	16-Apr-14	A4	311	238	637	7.90	0.1	30.2	< 0.1	7.7	22	85.9	23.4	9.9	1.6	< 0.005	< 0.001	< 0.01	1.7		6.63	6.68	350
TW29	23-May-14	A4	181	215	354	8.18	0.2	3	0.3	0.1	13	48.8	14.5	32.4	1.4	0.057	0.153	0.29	1.6	1.5	4.67	5.08	243
OW8D	4-Jun-14	A4	233	182	406	8.05	0.2	4.3	< 0.1	1.4	36	70.9	13.7	4	1.9	0.142	0.005	< 0.01	1.3	< 0.1	4.61	4.89	0.607
PW1	24-Jul-14	A4	208	201	422	8.06	0.2	2.1	< 0.1	0.1	14	55	17.1	5.5	1.7	0.383	0.074	0.22	1.2	<0.1	4.37	4.44	216

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G36548 **REPORT No. B14-11736**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 24-May-14
DATE REPORTED: 09-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW19#1	TW19#2	TW29	
			Sample I.D.		B14-11736-1	B14-11736-2	B14-11736-3	
			Date Collected		23-May-14	23-May-14	23-May-14	
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	27-May-14/O	382	422	181	
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	27-May-14/O	170	233	215	
Conductivity @25°C	µmho/cm	1	SM 2510B	27-May-14/O	930	2070	354	
pH @25°C	pH Units		SM 4500H	27-May-14/O	7.98	8.01	8.18	
Fluoride	mg/L	0.1	SM4110C	27-May-14/O	0.1	0.1	0.2	
Chloride	mg/L	0.5	SM4110C	27-May-14/O	173	530	3.0	
Nitrite (N)	mg/L	0.1	SM4110C	27-May-14/O	< 0.1	< 0.1	0.3	
Nitrate (N)	mg/L	0.1	SM4110C	27-May-14/O	5.3	3.9	0.1	
Sulphate	mg/L	1	SM4110C	27-May-14/O	15	26	13	
Calcium	mg/L	0.02	SM 3120	27-May-14/O	101	117	48.8	
Magnesium	mg/L	0.01	SM 3120	27-May-14/O	31.4	31.6	14.5	
Sodium	mg/L	0.2	SM 3120	27-May-14/O	38.9	275	32.4	
Potassium	mg/L	0.1	SM 3120	27-May-14/O	1.7	2.6	1.4	
Iron	mg/L	0.005	SM 3120	27-May-14/O	< 0.005	< 0.005	0.057	
Manganese	mg/L	0.001	SM 3120	27-May-14/O	< 0.001	0.008	0.153	
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	09-Jun-14/O	< 0.01	< 0.01	0.29	
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	29-May-14/O	1.1	1.2	1.6	
Tannins and Lignins	mg/L	0.1	N/A	27-May-14	0.5 [1]	0.5 [1]	1.5 [1]	
Anion Sum	meq/L		Calc.	28-May-14/O	8.98	20.4	4.67	
Cation Sum	meq/L		Calc.	28-May-14/O	9.37	20.5	5.08	
% Difference	%		Calc.	28-May-14/O	2.14	0.125	4.16	
Ion Ratio	AS/CS		Calc.	28-May-14/O	0.958	0.998	0.920	
Sodium Adsorption Ratio	-		Calc.	28-May-14/O	0.866	5.83	1.05	
TDS(ion sum calc.)	mg/L		Calc.	28-May-14/O	487	1140	243	
Conductivity (calc.)	µmho/cm		Calc.	28-May-14/O	952	2090	445	
TDS(calc.)/EC(actual)	-		Calc.	28-May-14/O	0.524	0.551	0.687	
EC(calc.)/EC(actual)	-		Calc.	28-May-14/O	1.02	1.01	1.26	

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G36555 **REPORT No. B14-12274**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 29-May-14
DATE REPORTED: 12-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		OW81	OW3#1	OW3#2	
			Sample I.D.		B14-12274-1	B14-12274-2	B14-12274-3	
			Date Collected		28-May-14	28-May-14	28-May-14	
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	03-Jun-14/O	211	357	287	
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	30-May-14/O	169	293	216	
Conductivity @25°C	µmho/cm	1	SM 2510B	30-May-14/O	372	612	509	
pH @25°C	pH Units		SM 4500H	30-May-14/O	8.17	8.01	8.08	
Fluoride	mg/L	0.1	SM4110C	30-May-14/O	0.2	0.1	< 0.1	
Chloride	mg/L	0.5	SM4110C	30-May-14/O	3.2	5.9	8.0	
Nitrite (N)	mg/L	0.1	SM4110C	30-May-14/O	< 0.1	< 0.1	< 0.1	
Nitrate (N)	mg/L	0.1	SM4110C	30-May-14/O	< 0.1	5.0	6.5	
Sulphate	mg/L	1	SM4110C	30-May-14/O	30	10	15	
Calcium	mg/L	0.02	SM 3120	03-Jun-14/O	64.5	121	95.3	
Magnesium	mg/L	0.01	SM 3120	03-Jun-14/O	12.1	13.4	11.8	
Sodium	mg/L	0.2	SM 3120	03-Jun-14/O	4.0	5.2	3.0	
Potassium	mg/L	0.1	SM 3120	03-Jun-14/O	1.8	1.0	1.6	
Iron	mg/L	0.005	SM 3120	03-Jun-14/O	0.182	< 0.005	< 0.005	
Manganese	mg/L	0.001	SM 3120	03-Jun-14/O	0.018	< 0.001	< 0.001	
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	11-Jun-14/O	< 0.01	< 0.01	< 0.01	
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	02-Jun-14/O	1.5	2.1	1.9	
Tannins and Lignins	mg/L	0.1	N/A	30-May-14	0.6 [1]	< 0.1 [1]	< 0.1 [1]	
Anion Sum	meq/L		Calc.	02-Jun-14/O	4.10	6.60	5.31	
Cation Sum	meq/L		Calc.	02-Jun-14/O	4.45	7.38	5.90	
% Difference	%		Calc.	02-Jun-14/O	4.03	5.53	5.20	
Ion Ratio	AS/CS		Calc.	02-Jun-14/O	0.923	0.895	0.901	
Sodium Adsorption Ratio	-		Calc.	02-Jun-14/O	0.119	0.119	0.0773	
TDS(ion sum calc.)	mg/L		Calc.	02-Jun-14/O	217	355	293	
Conductivity (calc.)	µmho/cm		Calc.	02-Jun-14/O	408	645	536	
TDS(calc.)/EC(actual)	-		Calc.	02-Jun-14/O	0.584	0.579	0.576	
EC(calc.)/EC(actual)	-		Calc.	02-Jun-14/O	1.10	1.05	1.05	

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G36555 **REPORT No. B14-12274**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 29-May-14
DATE REPORTED: 12-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		OW81	OW3#1	OW3#2	
			Sample I.D.		B14-12274-1	B14-12274-2	B14-12274-3	
			Date Collected		28-May-14	28-May-14	28-May-14	
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Langelier Index(25°C)	S.I.		Calc.	02-Jun-14/O	0.776	1.11	0.950	

1 subcontracted to Paracel Labs

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G36257 **REPORT No. B14-12522**

Report To:

Golder Associates Ltd.
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Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 02-Jun-14
DATE REPORTED: 17-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		OW19#4	OW19#5	OW1#1	House
			Sample I.D.		B14-12522-1	B14-12522-2	B14-12522-3	B14-12522-4
			Date Collected		30-May-14	30-May-14	30-May-14	30-May-14
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	03-Jun-14/O	304	384	387	364
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	05-Jun-14/O	197	214	274	295
Conductivity @25°C	µmho/cm	1	SM 2510B	03-Jun-14/O	1320	1010	728	681
pH @25°C	pH Units		SM 4500H	05-Jun-14/O	7.97	7.95	7.95	7.98
Fluoride	mg/L	0.1	SM4110C	04-Jun-14/O	0.2	0.2	< 0.1	0.2
Chloride	mg/L	0.5	SM4110C	04-Jun-14/O	278	173	9.2	8.9
Nitrite (N)	mg/L	0.1	SM4110C	04-Jun-14/O	< 0.1	< 0.1	< 0.1	< 0.1
Nitrate (N)	mg/L	0.1	SM4110C	04-Jun-14/O	0.6	7.1	24.3	13.6
Sulphate	mg/L	1	SM4110C	04-Jun-14/O	37	23	20	15
Calcium	mg/L	0.02	SM 3120	03-Jun-14/O	80.0	104	116	119
Magnesium	mg/L	0.01	SM 3120	03-Jun-14/O	25.4	30.4	23.6	16.4
Sodium	mg/L	0.2	SM 3120	03-Jun-14/O	147	48.7	5.0	5.9
Potassium	mg/L	0.1	SM 3120	03-Jun-14/O	1.8	2.2	0.9	1.6
Iron	mg/L	0.005	SM 3120	03-Jun-14/O	< 0.005	< 0.005	< 0.005	< 0.005
Manganese	mg/L	0.001	SM 3120	03-Jun-14/O	0.119	0.025	< 0.001	< 0.001
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	17-Jun-14/O	0.28	< 0.01	< 0.01	< 0.01
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	03-Jun-14/O	2.1	1.3	2.2	1.8
Tannins and Lignins	mg/L	0.1	N/A	05-Jun-14	1.2 [1]	0.7 [1]	< 0.1 [1]	< 0.1 [1]
Anion Sum	meq/L		Calc.	06-Jun-14/O	12.6	10.2	7.89	7.43
Cation Sum	meq/L		Calc.	06-Jun-14/O	12.5	9.84	7.96	7.57
% Difference	%		Calc.	06-Jun-14/O	0.401	1.59	0.461	0.973
Ion Ratio	AS/CS		Calc.	06-Jun-14/O	1.01	1.03	0.991	0.981
Sodium Adsorption Ratio	-		Calc.	06-Jun-14/O	3.66	1.08	0.110	0.136
TDS(ion sum calc.)	mg/L		Calc.	06-Jun-14/O	690	541	447	404
Conductivity (calc.)	µmho/cm		Calc.	06-Jun-14/O	1290	1020	754	702
TDS(calc.)/EC(actual)	-		Calc.	06-Jun-14/O	0.523	0.537	0.613	0.593
EC(calc.)/EC(actual)	-		Calc.	06-Jun-14/O	0.980	1.01	1.04	1.03

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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Final Report

C.O.C.: G36257 **REPORT No. B14-12522**

Report To:

Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
Barrie ON. L4N 8X1 Canada
Attention: Alicia Beynon

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 02-Jun-14
DATE REPORTED: 17-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		OW19#4	OW19#5	OW1#1	House
			Sample I.D.		B14-12522-1	B14-12522-2	B14-12522-3	B14-12522-4
			Date Collected		30-May-14	30-May-14	30-May-14	30-May-14
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Langelier Index(25°C)	S.I.		Calc.	06-Jun-14/O	0.684	0.824	0.989	1.06

1 subcontracted to Paracel Labs

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DATE RECEIVED: 02-Jun-14
DATE REPORTED: 17-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		OW4#1	OW4#2		
			Sample I.D.		B14-12522-5	B14-12522-6		
			Date Collected		30-May-14	30-May-14		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	03-Jun-14/O	228	237		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	05-Jun-14/O	204	208		
Conductivity @25°C	µmho/cm	1	SM 2510B	03-Jun-14/O	419	429		
pH @25°C	pH Units		SM 4500H	05-Jun-14/O	8.06	8.09		
Fluoride	mg/L	0.1	SM4110C	04-Jun-14/O	0.1	0.2		
Chloride	mg/L	0.5	SM4110C	04-Jun-14/O	6.2	4.7		
Nitrite (N)	mg/L	0.1	SM4110C	04-Jun-14/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	04-Jun-14/O	1.0	0.6		
Sulphate	mg/L	1	SM4110C	04-Jun-14/O	8	16		
Calcium	mg/L	0.02	SM 3120	03-Jun-14/O	77.3	76.5		
Magnesium	mg/L	0.01	SM 3120	03-Jun-14/O	8.32	11.2		
Sodium	mg/L	0.2	SM 3120	03-Jun-14/O	3.7	3.4		
Potassium	mg/L	0.1	SM 3120	03-Jun-14/O	1.2	1.5		
Iron	mg/L	0.005	SM 3120	03-Jun-14/O	< 0.005	< 0.005		
Manganese	mg/L	0.001	SM 3120	03-Jun-14/O	< 0.001	0.004		
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	17-Jun-14/O	< 0.01	< 0.01		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	03-Jun-14/O	1.5	1.4		
Tannins and Lignins	mg/L	0.1	N/A	05-Jun-14	0.1 [1]	0.2 [1]		
Anion Sum	meq/L		Calc.	06-Jun-14/O	4.50	4.66		
Cation Sum	meq/L		Calc.	06-Jun-14/O	4.73	4.93		
% Difference	%		Calc.	06-Jun-14/O	2.51	2.78		
Ion Ratio	AS/CS		Calc.	06-Jun-14/O	0.951	0.946		
Sodium Adsorption Ratio	-		Calc.	06-Jun-14/O	0.106	0.0971		
TDS(ion sum calc.)	mg/L		Calc.	06-Jun-14/O	232	241		
Conductivity (calc.)	µmho/cm		Calc.	06-Jun-14/O	435	450		
TDS(calc.)/EC(actual)	-		Calc.	06-Jun-14/O	0.554	0.561		
EC(calc.)/EC(actual)	-		Calc.	06-Jun-14/O	1.04	1.05		

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Final Report

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Golder Associates Ltd.
121 Commerce Park Drive, Unit L,
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Attention: Alicia Beynon

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Fax: 613-526-1244

DATE RECEIVED: 02-Jun-14
DATE REPORTED: 17-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		OW4#1	OW4#2		
			Sample I.D.		B14-12522-5	B14-12522-6		
			Date Collected		30-May-14	30-May-14		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Langelier Index(25°C)	S.I.		Calc.	06-Jun-14/O	0.825	0.858		

1 subcontracted to Paracel Labs

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Preliminary Report

C.O.C.: ---

REPORT No. B14-13031

Report To:

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121 Commerce Park Drive, Unit L,
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DATE RECEIVED: 05-Jun-14
DATE REPORTED: 05-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW30	OW24	OW8D	
			Sample I.D.		B14-13031-1	B14-13031-2	B14-13031-3	
			Date Collected		04-Jun-14	04-Jun-14	04-Jun-14	
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L		SM 3120	/				
Alkalinity(CaCO3) to pH4.5	mg/L		SM 2320B	/				
Conductivity @25°C	µmho/cm		SM 2510B	/				
pH @25°C	pH Units		SM 4500H	/				
Fluoride	mg/L	0.1	SM4110C	05-Jun-14/O	0.3			
Chloride	mg/L	0.5	SM4110C	05-Jun-14/O	2.1			
Nitrite (N)	mg/L	0.1	SM4110C	05-Jun-14/O	< 0.1			
Nitrate (N)	mg/L	0.1	SM4110C	05-Jun-14/O	0.7			
Sulphate	mg/L	1	SM4110C	05-Jun-14/O	7			
Calcium	mg/L		SM 3120	/				
Magnesium	mg/L		SM 3120	/				
Sodium	mg/L		SM 3120	/				
Potassium	mg/L		SM 3120	/				
Iron	mg/L		SM 3120	/				
Manganese	mg/L		SM 3120	/				
Ammonia (N)-Total	mg/L		MOEE 3364	/				
Dissolved Organic Carbon	mg/L		EPA 415.1	/				
Tannins and Lignins	mg/L		N/A	/				
Anion Sum	meq/L		Calc.	/				
Cation Sum	meq/L		Calc.	/				
% Difference	%		Calc.	/				
Ion Ratio	AS/CS		Calc.	/				
Sodium Adsorption Ratio	-		Calc.	/				
TDS(ion sum calc.)	mg/L		Calc.	/				
Conductivity (calc.)	µmho/cm		Calc.	/				
TDS(calc.)/EC(actual)	-		Calc.	/				
EC(calc.)/EC(actual)	-		Calc.	/				
Langelier Index(25°C)	S.I.		Calc.	/				

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

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Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

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DATE RECEIVED: 05-Jun-14
DATE REPORTED: 05-Jun-14
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 13-1170-0040
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		TW30	OW24	OW8D	
			Sample I.D.		B14-13031-1	B14-13031-2	B14-13031-3	
			Date Collected		04-Jun-14	04-Jun-14	04-Jun-14	
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

Greg Clarkin , BSc., C. Chem
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APPENDIX M

Groundwater Flow Modelling

May 2018

MIDHURST, ONTARIO
REPORT ON CARSON AND DORAN NEIGHBOURHOODS PROPOSED WATER SUPPLY GROUNDWATER MODELLING

Submitted to:
The Township of Springwater c/o Ainley & Associates
2231 Nursery Road
Minesing ON L0L 1Y2



Report Number: 13-1170-0040 (4000)

REPORT

Golder Associates

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1.0 INTRODUCTION

Midhurst is a residential community located in Springwater Township, Ontario (Figure 1). The community has a population of about 3,100 people. The Midhurst Landowner's Group proposes to develop the Carson and Doran Neighbourhoods (Neighbourhoods) subdivisions north and south of the existing Midhurst residential area. The Neighbourhoods will be primarily residential and provide approximately 8,000 new dwellings for an estimated 29,000 additional people as specified in the Phase 1 and 2 Class Environmental Assessment (Ainley Group, 2009).

This report describes groundwater modelling undertaken to estimate the hydrogeological effects of the Neighbourhoods groundwater supply well pumping. The modelling is part of a larger hydrogeological study to be submitted as part of Phases 3 and 4 of the Midhurst Secondary Plan Class Environmental Assessment.

Modelling is conducted using the existing three-dimensional (3D) Kempenfelt Bay FEFLOW model with refinements in Midhurst and surrounding Willow Creek watershed areas. The use of regional scale models such as the Kempenfelt Bay FEFLOW model to assess groundwater impacts is an industry-accepted and commonly used approach in large water resource studies in Ontario. Groundwater models are an identified Source Water Protection assessment tool in the Ministry of Environment and Climate Change (MOECC) Technical Rules under the Clean Water Act. In addition, the original Kempenfelt Bay model formed the hydrogeologic basis of the City of Barrie Tier 3 Water Budget and Local Area Risk Assessment (AquaResource, 2013). The model was used to estimate impacts as a result of Barrie municipal well pumping and was a supporting tool for the MOECCs 2015 approval of the South Georgian Bay Lake Simcoe Source Protection Plan.

1.1 Scope of Work

The modelling scope of work involves two scenarios: 1) Existing Conditions; and 2) Future Conditions.

Existing Conditions

- Update model parameters in accordance with recent field activities including test well drilling and pumping tests; and
- Calibrate the model to transient (monthly) baseflow estimates along Willow Creek. "Baseflow" is the portion of stream flow supplied by groundwater discharge.

The Existing Conditions model forms the baseline for assessing the effects of Future Conditions pumping.

Future Conditions

- Input Future Conditions proposed wells and pumping rates;
- Estimate aquifer drawdown and potential well interference as a result of the additional water taking;
- Estimate monthly flow reductions at Willow Creek as a result of the additional water taking;
- Delineate capture zones for both existing Midhurst area wells and Carson and Doran Neighbourhood wells; and
- Assess the capture zones in the context of Aquifer Vulnerability Index (AVI).

The Future Conditions model considers the Carson and Doran Neighbourhoods at full build out. Note that this assessment also considers future takings at the City of Barrie municipal water supply system.

This report describes municipal supply pumping, original model construction, subsequent model updates, calibration, and future conditions assessment results.

2.0 MUNICIPAL WATER SUPPLY PUMPING

This section discusses municipal water supply well information as it pertains to the modelling. A summary of the pumping wells in the model and their rates for Existing and Future Conditions is provided in Table 1. In some instances proximate wells are grouped as a single "sink" in the model and share a combined rate.

2.1 Existing Conditions

Midhurst is entirely dependent on groundwater for its water supply. The community is currently serviced by eight wells in two wellfields (Figure 1):

1) Midhurst wellfield, consisting of Wells 1 and 4 (Greenpine wellfield), Wells 2 and 3 (Idlewood Drive wellfield) and Carson Road Well 4; and
2) Paddy Dunn's Circle wellfield, comprised of Wells 1, 2 and 3.

Water consumption ranges from about 880 m^3/d to 1,900 m^3/d (based on monthly data), with an average taking of 1,300 m^3/d during the course of a year (Figure 2). As is typical with municipal water supplies, the highest demand occurs during the summer months of June through August, where water demand is an average of 1.8 times greater than the remainder of the year. The varying demand shown in Figure 2 is simulated during transient calibration to baseflows in the Existing Conditions model.

Additional water takings occur around Midhurst, the most notable of these being the relatively large City of Barrie system. The City of Barrie Tier Three study (AquaResource, 2013) indicates that the total water taking at City of Barrie during 2010 was an average of 40,208 m^3/d. A 2012 water taking estimate, which accounts for the surface water plant being put online, is also listed in the study and predicts a lesser average groundwater demand of 32,465 m^3/d (although the actual rate may reach over 40,000 m^3/d during some months). For this analysis, the 2010 rates were used to reflect Existing Conditions as: 1) they better correlate with the surface water flow measurement period available for this study (the latest flow measurements are up to 2010); and 2) drawdown and baseflow impacts described in the Barrie Tier Three study were based on the 2010 condition as baseline; utilizing the same pumping regime allows comparison between the two studies, particularly with respect to Safe Additional Available Drawdown (SAAD). In addition, the 2010 rates provides a more conservative basis for assessing absolute impact as the lesser 2012 rates would allow for increased groundwater elevations and greater baseflows as a baseline.

For the smaller Snow Valley, Minesing and other systems, the Existing Conditions model uses the recent (circa 2009 to 2010) average water demands as listed in the Tier Three study (AquaResource, 2013).

2.2 Future Conditions

Approximately nine new water supply wells are proposed to supply the Carson and Doran Neighbourhoods (see TW-series and PW-series shown on Figure 1).

For Carson and Doran Neighbourhoods the planned maximum water taking is 221 L/s or approximately 19,094 m^3/d. This rate, if reached, would most likely occur during the June to August period. A pro-rating approach based on Existing Conditions demand ratios allows forecast of Future Conditions water takings for the remaining months of the year (Figure 3). The average water taking is thus anticipated to be approximately 13,134 m^3/d or 152 L/s.

Existing Midhurst and Paddy Dunn's Circle communities are currently near full build-out; as such, their Future Conditions pumping rates are assumed to continue as per Existing Conditions (Figure 2).

The City of Barrie Tier Three study provides an "Existing Plus Committed Plus Planned Demand" for the year 2031. These rates are used for City of Barrie wells in the Future Conditions modelling.

For the remainder of wells in the model, the Future Conditions rates continue as per recent average water demand (AquaResource, 2013).

3.0 MODEL BACKGROUND

The Kempenfelt Bay FEFLOW model was originally constructed in the early 2000s in support of the South Simcoe Groundwater Study. The model provides a computer-based, mathematical representation of the hydrogeologic system as understood through available physiographic mapping, borehole logs, well water levels, aquifer testing results, stream flow measurements and other field observations. A primary objective of the original model was the development of Wellhead Protection Areas (WHPAs) for South Simcoe municipal wells.

The model domain is regional in scale, encompassing an area of 746 km^2 (Figure 1). The Willow Creek watershed, wherein the proposed developments are located, lies almost entirely (>90%) within the model domain and comprises an area of 228 km^2.

An important feature of interest in the model is Willow Creek itself, which flows roughly centrally through the model domain from its source in the Oro uplands to its ultimate discharge location in the Minesing Swamp (Figure 1). The Creek demarcates topographic minima within the subwatershed and flows through granular soils for the majority of its length. As a result, Willow Creek is conceptualized and modelled as a major groundwater discharge zone along its entire reach (as opposed to discrete areas of upwelling).

Table 2 provides a summary of model attributes whereas Figure 4 illustrates an example model cross-section through the Midhurst area (see Figure 1 for plan view location of section).

This report focuses on model updates pertaining to the Midhurst area and encompassing the Willow Creek watershed. For a detailed description of the Midhurst area hydrogeology and prior model development the reader is referred to the following reports:

- *South Simcoe Municipal Groundwater Study* (Golder, WHI and Ainley, 2004);
- *South Simcoe Groundwater Study WHPA – Appendix E, City of Barrie* (Golder and WHI, 2004[1]);
- *South Simcoe Groundwater Study WHPA – Appendix L, Township of Springwater* (Golder and WHI, 2004[2]); and
- *Report On: Hydrogeological Study, Midhurst Water Supply Exploration Program Supporting Document, Midhurst Class EA, Township of Springwater, Ontario* (Golder, 2008).

In addition, the original Kempenfelt Bay model formed the hydrogeologic basis of the City of Barrie Tier 3 Water Budget and Local Area Risk Assessment (AquaResource, 2013). The model was used to estimate impacts as a result of Barrie municipal well pumping and was a supporting tool for the MOECCs 2015 approval of the South Georgian Bay Lake Simcoe Source Protection Plan.

4.0 MODEL UPDATES

Results of Golder's recent Midhurst-area water supply investigation guide the model updates described herein. The drilling and installation of 20 test wells and 13 observation well nests (21 observation wells total) has been completed. Subsequently, five aquifer tests (two in A3 and three in A4) have been conducted. The field study results and analysis allow for local-scale refinement of model parameters in the Midhurst area as follows:

- **Mesh Refinement:** The model mesh density is gradually increased around the new test wells to element dimensions of about 10 m to 15 m in order to better capture local-scale effects due to pumping.
- **Geologic Layering:** A review of borehole logs relative to model layering indicates that the field data is in good agreement with the pre-existing model elevations for deeper units A3, C3 and A4, with most unit "pick" elevations being within +/- 5 m of their model counterpart. No updates are deemed necessary for these layers. However, some minor updates to UC, A1, C1 and A2 are warranted in localized areas of Midhurst (Figure 5).
- **Hydraulic Conductivity:** Recent aquifer testing provides additional estimates of transmissivity for A3 and A4. This data is compared to the existing Midhurst and nearby Snow Valley pumping test results to determine a revised "average" for a sub-regional area encapsulating Midhurst (Figure 5).
  - **Aquifer A3:** The hydraulic conductivity of A3 is increased slightly from 2.3E-4 m/s to 3E-4 m/s.
  - **Aquifer A4:** Prior to the recent testing there were no local estimates of hydraulic conductivity for A4, hence the original value was assigned based on regional estimates. However, aquifer testing indicates that in Midhurst aquifer A4 is more transmissive than previously assumed and the hydraulic conductivity is increased from 6E-5 m/s to 3E-4 m/s.
- **Connection to Surface Water:** Aquifer testing did not reveal the potential for hydraulic connection between the pumping in deep Aquifers A3/A4 and surface water features. Water levels in Aquifer A1 did not decrease and gradients were not reversed as a result of the 72-hour pumping tests. This observation was considered when reviewing the modelled long-term impact of pumping at full build-out. Based on the field testing results, it was anticipated that any simulated potential impacts to surface water features from the deep pumping would take months or even years to propagate (this was later confirmed during the Future Conditions Assessment – Section 6.2).

5.0 MODEL CALIBRATION

The original (2004) Kempenfelt Bay model was calibrated to steady-state conditions. As such, the modelled stream baseflows reflected average yearly conditions. This was a reasonable approach as the goal of the 2004 modelling was to delineate WHPAs for wells screened in deep, confined aquifers; as such the behaviour of surficial aquifers and groundwater / surface water interaction was not a central focus.

For this current assessment it is important to more accurately depict seasonal stream flow fluctuations in order to understand how additional pumping may affect baseflow throughout the year. This is especially the case during the summer months when the dual effect of increased groundwater demand and decreased surface water discharge may accentuate baseflow losses.

As a result, the Existing Conditions model is calibrated in transient mode to Willow Creek monthly baseflow. In addition to improving the understanding of groundwater / surface water interaction in the Midhurst area, the transiently calibrated model serves as the "base case" to assess future effects due to increased pumping.

5.1 Calibration Dataset

The primary source of data for the calibration is continuous flow records for Water Survey of Canada (WSC) flow stations 02ED009, 02ED010, and 02ED032 (Environment Canada, 2012). All three stations are located on Willow Creek (Figure 1). These stations have varying period of records, with the most recent data being collected during 2010 at 02ED032 (Willow Creek at Matheson Creek).

The estimated watershed surplus, total measured stream flow and baseflow for each station is shown on Figure 6. The computer-based BFLOW algorithm (Arnold et al., 1995) is used to separate the baseflow (i.e., groundwater) portion of the total measured stream flow. The monthly baseflow estimates provide the targets for the transient model calibration.

5.2 Parameter Adjustment

Model parameters are refined in the areas of: 1) recharge rates; 2) surficial hydraulic conductivity assignments; 3) constant head constraints; and 4) storage parameters.

5.2.1 Recharge Rates

The 2004 model simulated average Willow Creek baseflow (110,000 m^3/d) is lower than the field-estimated average (156,000 m^3/d) at station 02ED032. This model under-prediction is in part due to the original calibration dataset being limited to low flows during summer, which would tend to bias baseflows to the low end of the measured range. Recharge rates in the original model range from 125 mm/yr to 230 mm/yr (see Figure 4.4 of Golder and WHI, 2004[1]); considerably lower than rates published in the more recent Barrie Tier Three study, which shows large areas of Willow Creek watershed with recharge in the 300 mm/yr to 600 mm/yr range (AquaResource, 2012).

Recharge rates are increased and a new recharge distribution is established to more accurately simulate measured baseflows (Figure 7). The revised distribution is refined through a concurrent review of surficial soil permeability and baseflow measurements at the three WSC stations. A satisfactory yearly average condition is first obtained; then, for monthly inputs, the yearly average recharge rate is pro-rated according to monthly surplus at the Barrie Water Pollution Control Centre (Environment Canada Climate Services, 2012) to approximate seasonal variation (Figure 7).

5.2.2 Hydraulic Conductivity

In tandem with increasing recharge rates, the surficial materials / hydraulic conductivity assignments (Layers 1 through 3) are reviewed. It is found that, in the original model, the surficial material within 500 m of Willow Creek from Little Lake westward to Minesing is typically assigned a hydraulic conductivity reflective of silty or clayey materials, whereas the majority (over 80%) of MOE WWIS logs indicate sand and/or gravel material at surface to

a depth of 3 m or greater. Thus the UC/A1 hydraulic conductivity within +/- 500 m along Willow Creek is increased locally up to 3E-4 m/s (the regional upper bound hydraulic conductivity for A1).

5.2.3 Constant Head Constraints

The original model has Willow Creek and Matheson Creek constant head nodes as unconstrained. This results in the streams being (potentially) both gaining and losing streams, depending on the surrounding groundwater elevation. In general, and as expected, the streams act primarily as discharge locations. However, in upland areas, streams defined as constant head could artificially sustain the water table at ground surface and recharge the system with unrepresentative volumes of groundwater.

For the current analysis, the Willow Creek and Matheson Creek constant head nodes are constrained to be "discharge only". This is consistent with the Creek's conceptual roles as groundwater discharge zones and improves the calibration to monthly baseflows, particularly at flow station 02ED009, which primarily reflects the upland catchment of Willow Creek.

5.2.4 Storage Parameters

The transient simulation requires input of groundwater system storage parameters. Table 2 lists the specific storage value applied for each hydrostratigraphic unit. The specific storage value of 2E-4/m for A2, A3 and A4 is consistent with aquifer test results. The specific storage value of 1E-4/m for C1, C2, C3 and C4 is an assumed input based on listed values for dense gravel to clayey materials that range from 4.9E-5/m to 2.6E-3/m (Batu, 1998). The specific storage value for UC and A1 (Layers 1 through 3) of 3E-4/m is developed through the calibration process.

An effective porosity of 0.25 is used for capture zone development.

5.3 Calibration Results

5.3.1 Transient Simulations

The final simulated versus field estimated (average) monthly baseflows are compared on Figure 8. The model captures the rise and fall of baseflow in accordance with seasonal climate patterns. Simulated discharge is typically within 10% of observed, indicating a reasonable match.

5.3.2 Steady-State Verification

The updated model is also run in steady-state (long term average conditions) to verify that the groundwater level calibration metrics are still satisfactory by comparing model output to 686 static water levels in the MOE WWIS (Figure 9).

Regional flow patterns (Figure 9) are consistent with past field inferences (see Figure 4.4.1 and Figure 4.4.2 of Golder, WHI, Ainley, 2004). Through the Midhurst area, groundwater flow in the A3 aquifer travels in a southwest direction from the uplands to the northeast, eventually moving in a more westerly direction as the influence of Willow Creek and Minesing Swamp discharge zones propagate to the deeper flow system.

A plot of simulated versus observed water levels and calibration statistics is provided on Figure 9 (see insert). For water levels below the 275 masl range, the model provides a good fit to measured data. Above 275 masl the model tends to underpredict water levels. Most of these higher water levels belong to shallow wells in the uplands northeast of Midhurst. At higher ground elevations (250 m up to 370 m) sub-regional, perched aquifers

(not directly related to aquifer A1) exist that are not explicitly captured in the regional-scale Kempenfelt Bay model and are difficult to calibrate to given the regionally continuous layer structure. However, the coarse representation of these upland areas is not considered an issue as the focus of this assessment is on baseflow changes at Willow Creek (lowland area) and drawdown in deep aquifer units (A3 / A4).

5.4 Calibration Summary

Through the calibration process the recharge rates, hydraulic properties of the geologic units and simulated flow patterns are found to be in satisfactory agreement with available field data. The Existing Conditions calibrated model input values are therefore considered to represent reasonable estimates for use in the assessment of Future Conditions. In particular, the calibrated model is considered sufficiently accurate for its ultimate purpose as an impact assessment tool given that:

- The focus of data collection and model refinement occurs in the area with the most pumping and potential for impact (Midhurst);
- Baseflow is evaluated at three “real world” stream gauges broadly positioned along Willow Creek upstream, adjacent to, and downstream of the proposed pumping;
- A high-degree of correspondence is demonstrated between average measured monthly baseflows and simulated monthly baseflows at these stream gauges during transient calibration.

6.0 FUTURE CONDITIONS ASSESSMENT

An assessment of the proposed Neighbourhoods water taking is undertaken for Future Conditions using the forecasted pumping rates listed in Table 1/Figure 3. The following measures are analyzed:

- Drawdown;
- Well interference; and
- Transient (monthly) changes to Willow Creek baseflow.

The Future Conditions model is simulated for a period of ten years. Note that the overall pattern of water level change in the model (including minimum and maximums) becomes reproducible year over year between five and ten years.

6.1 Drawdown

Figure 10 illustrates the simulated drawdown in Aquifers A1, A2, A3, and A4. The month of August during the tenth year of simulation time is used to illustrate drawdown, as this is related to an extended period of low recharge and high pumping (and thus greater drawdown). The 1 metre (m) drawdown contour is used to illustrate the lateral extent of drawdown.

The following is noted:

Aquifer A1

The drawdown in Aquifer A1 is relatively small (< 2.5 m). The lateral extent of response ranges from less than 1 km to approximately 4.5 km from the proposed development. A distant drawdown response is simulated east to northeast of the Doran area towards Oro-Medonte; this is in part a result of a relatively high transmissivity A1

overlain by low transmissivity (and hence lower recharge) UC material in this area. The greatest amount of vertical drawdown in Aquifer A1 emanates from the TW22 / TW19 area. Drawdown here appears to be accentuated by localized thinning of underlying aquitard units.

Aquifer A2

The drawdown in Aquifer A2 is also small (< 3 m), although the lateral drawdown extents have broadened as influence from the underlying municipal well pumping in A3 becomes more prominent.

Aquifer A3

The greatest drawdown occurs in Aquifer A3, where the majority of municipal pumping occurs. The high transmissivity of Aquifer A3 limits vertical drawdown in spite of high pumping rates; however, this same characteristic allows for a broad regional propagation of lateral drawdown. Drawdown reaches about 10 m at the Doran Neighbourhood whereas 3 m occurs at the Carson Neighbourhood. The zone of influence reaches a maximum extent of approximately 6 km from the proposed developments.

The zone of influence from City of Barrie pumping merges with that at Carson and Doran to produce a regionally continuous drawdown. The superposition results in a maximum drawdown of less than 2 m where the two responses merge.

Aquifer A4

Drawdown in Aquifer A4 is similar in extent to Aquifer A3. This is in part a reflection of the occasional absence or thinning of intermediary confining unit C3 throughout the Midhurst and Barrie areas (in other words, A3 and A4 combine into one aquifer). However, the maximum vertical magnitude of the drawdown is less than that in A3, with a maximum of about 7.5 m occurring at the Carson Neighbourhood. Local to TW34, an isolated 1.5 m of drawdown is simulated; the minor drawdown at this location is in part a result of its relatively low pumping rate.

6.1.1 Municipal Well Interference

Simulated well interference at surrounding municipal systems due to pumping at the Neighbourhoods is minimal and not anticipated to cause issues with well performance. The greatest amount of well interference occurs at the Midhurst and Paddy Dunn's Circle wells; where up to 1.7 m of additional drawdown is simulated. The remaining municipal well systems, including City of Barrie and Snow Valley, experience less than 1 m of additional drawdown as a result of Carson and Doran Neighbourhoods pumping, which is considered negligible from an operational standpoint.

6.1.2 Barrie Municipal Wells Safe Additional Available Drawdown (SAAD)

Safe additional available drawdown (SAAD) is defined as the additional drop in water level within a pumping well that could be sustained and still maintain that well's allocated pumping rate. A SAAD analysis was conducted for the Barrie municipal wells as part of the risk assessment portion of the Barrie Tier Three Study (AquaResource, 2013). The following is noted from that study:

- Under normal, current operating conditions the SAAD for Barrie pumping wells ranges from 17 m to 76 m.
- Under "diminished", current operating conditions – which may temporarily occur due to decreases in well efficiency from clogging of the well screen and aquifer materials – the SAAD for Barrie pumping wells ranges from 5 m (at Well 11) to 71 m. The Barrie well operators usually have sufficient time to temporarily

re-allocate pumping and shut a well down for rehabilitation; hence the SAAD for diminished conditions is not considered a strict limitation but rather a precautionary evaluation.

- The SAAD for the aquifer area adjacent to the wells – or the water level available above the top of the aquifer unit to maintain a confined response to pumping – ranges from 22 m to 56 m.
- Simulated drawdown that might occur under various *future* climate / demand risk assessment scenarios is presented. In each instance, the simulated drawdown still falls within the SAAD limits. Well 11 is the only well that exceeds the SAAD, and only under diminished well conditions. Note that this SAAD exceedance is simulated to occur prior to (or independent of) any additional drawdown imposed by Carson and Doran water takings.

Based on the findings above, the additional < 1 m of drawdown imposed by the Carson and Doran water takings at the City of Barrie municipal wells is considered acceptable and does not significantly add to water quantity risks.

6.2 Willow Creek Baseflow Changes

Figure 11 illustrates the Future Conditions simulated changes to monthly baseflows relative to Existing Conditions at the three Willow Creek flow stations. Also included in the chart is the Future Conditions total demand for the Midhurst area for reference.

The illustrated baseflow changes are a function of recharge and water demand. There is a seven month or longer day delay between pumping increase/decrease and associated baseflow response (see chart on left of Figure 11). Baseflow losses as a percent of Existing Conditions baseflow rates are amplified during summer months when recharge is lower and hence baseflow is minimized (see chart on right of Figure 11).

Geographically, the extent of baseflow losses occurs broadly from upstream of Little Lake downstream to Minesing Swamp; there are no highly localized areas of upwelling that are simulated as being discretely or uniquely impacted. The percentage baseflow loss is under 10% for all flow stations. The largest percent baseflow loss (about 9%) occurs at the Midhurst WSC station 02ED010 towards the end of summer; this is a result of the station's proximity to the source of pumping and the relative size of its catchment. The Willow Creek catchment in its entirety experiences within 3% to 7% baseflow loss depending on the time of year.

For context, the *Water Budget and Water Quantity Risk Assessment Guide* (MNR and MOE, 2011) defines an unacceptable impact to coldwater streams as a circumstance where groundwater discharge is reduced by more than 20% as compared to the average monthly baseflow of the watercourse, specifically the following is stated in this reference:

For coldwater streams, an unacceptable impact is defined by a circumstance where groundwater discharge is reduced by more than 20% as compared to the existing estimated monthly streamflow Qp80 (the flow that is exceeded 80 percent of the time) or the average monthly baseflow of the watercourse or another threshold that has already been defined as a condition in an existing permit. [Note: As described previously the modelling considers average monthly baseflow].

A discussion of the potential effect of these baseflow losses on natural environment receptors in the Willow Creek subwatershed is provided in the Hutchinson Environmental Sciences Report entitled *7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment*

(HESL, 2018). HESL concluded that "the predicted flow reductions in Willow Creek and its tributaries associated with the proposed water taking to supply the Midhurst Secondary Plan Area will have no adverse effects on habitat and water temperature in Matheson, Black and Willow Creeks." (HESL, 2018).

About 80% to 90% of the Midhurst area water taking is derived from the Willow Creek watershed. The remaining water taking is mostly sourced from the Nottawasaga River watershed (5% - 10%) or directly from Kempenfelt Bay (5% - 10%).

7.0 CAPTURE ZONES

Capture zones for the existing Midhurst and Paddy Dunn's Circle wells and the future Carson and Doran Neighbourhood wells are determined for the 2-year, 5-year, 10-year and 25-year time-of-travel using backward particle tracking in FEFLOW (Figure 12). Close proximity wells with similar capture zones are enveloped into a single capture zone in some cases. The capture zones are derived using Future Conditions average pumping rates and a steady-state (long-term yearly average) head distribution (Figure 12).

The capture zones reflect 2D projections to ground surface and do not necessarily account for vertical travel time. This conservative approach is frequently used to define capture zones for water supply systems in Ontario. The actual travel time for source water entering the groundwater table to reach the wells may be longer than illustrated as aquifers A3 and A4 are deep units residing beneath lower permeability aquitards.

The capture zones produced in this analysis provide the current best estimate of 2D well capture. After the water supply system design is finalized these capture zones may form the basis for Wellhead Protection Area (WHPA) delineation. At this time an uncertainty analysis may be incorporated into the results in order to provide an additional buffer for wellhead protection purposes.

7.1 Midhurst and Paddy Dunn's Circle Systems

Capture zones for Midhurst and Paddy Dunn's Circle wells are projected from Aquifer A3. The 25-year capture zones for the Midhurst Idlewood Drive and Greenpine wells extend about 3 km in an east to northeasterly direction, eventually bordering on the capture zone for TW21 / TW24. The Carson Road Well 4 and Paddy Dunn's Circle Wells 25-year capture zone travels approximately 3 km in a northeasterly direction.

7.2 Carson Neighbourhood

Capture zones for the Carson Neighbourhood are projected from Aquifer A4. The 25-year capture zone of TW22 extends about 3 km to the east. The 25-year capture zone for TW34 travels about 1 km south towards a groundwater high in the Snow Valley upland area.

7.3 Doran Neighbourhood

Capture zones for the Doran Neighbourhood are projected from Aquifer A3. The capture zones for the Doran Neighbourhood wells are oriented northeast as a result of the regional flow system emanating from the upland areas towards Oro-Medonte. The 25-year capture zone for the Alliance Wells extend approximately 4.5 km while the 25-year capture zone for TW21 / TW24 reaches about 3.5 km in length.

8.0 AQUIFER VULNERABILITY

The Aquifer Vulnerability Index (AVI) is a method for mapping the susceptibility of an aquifer to surficial contaminants. The AVI assigns a score based on two key parameters: 1) the thickness of each geologic unit above the aquifer; and 2) the hydraulic conductivity of each of these units.

An AVI analysis was completed by Golder for the South Georgian Bay Lake Simcoe Source Protection Region (Golder, 2010). A review of the mapping indicates that water supply aquifers A3 and A4 would remain classed as "low vulnerability" in the area of the capture zones described in Section 7. This classification is consistent with drilling observations recorded as part of Golder's recent water supply investigation that indicate substantial thicknesses of clayey materials overlying aquifer A3.

9.0 PERMIT TO TAKE WATER CONSIDERATIONS

All water takings in Ontario exceeding 50 m^3/day are required to obtain a Permit To Take Water (PTTW) from the MOECC. The Neighbourhood's future construction activities and proposed water supply will require PTTWs prior to operation, although the initial water supply permit request may be for significantly less water than reported herein as the subdivision will not be at full build-out. The groundwater model will be an important tool during the permitting review and approval process. In addition, and in consultation with the MOECC, a monitoring program may be instituted to ensure that private water supplies and surface water features are not adversely impacted by the water taking.

10.0 LIMITATIONS

10.1 Use of This Report

This report has been prepared by Golder Associates Ltd. (Golder) for use by The Midhurst Landowner's Group or its agents. The factual information, descriptions, interpretations, comments, results, conclusions and electronic files contained herein are specific to the project described in this report. Information used in this report should be restricted to that specified in the scope of work unless otherwise mutually agreed upon by The Midhurst Landowner's Group and Golder. This report should be read in its entirety as some sections could be falsely interpreted when taken individually or out-of-context. Golder is not responsible for any use of this report and its content by a third party, and/or for its use for purposes other than those intended.

Golder is not responsible for any damages that may result from unpredictable or unknown underground conditions, from erroneous information provided by and/or obtained from sources other than Golder, and from ulterior changes in the site conditions unless Golder has been notified of any occurrence, activity, information or discovery, past or future, susceptible of modifying the underground conditions described herein, and have had the opportunity of revising its interpretations. In addition, Golder is not responsible for any decrease of a property's value or any failure to complete a transaction as a consequence of this report.

10.2 Groundwater Modelling General Limitations

Hydrogeological investigations and groundwater modelling are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological system is changing with time and the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that field data provides a fraction of information for the site or model domain; as such a truly complete, comprehensive

characterization of the groundwater system is not possible. Therefore, every groundwater model is, by necessity, a simplification of a reality.

The professional groundwater modelling services described in this report are conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions. The results of previous or simultaneous work provided by sources other than Golder and quoted and/or used herein are considered as having been obtained according to recognized and accepted professional rules and practices, and therefore deemed valid.

The model presented herein provides a predictive scientific tool to evaluate the impacts of specified hydrological stressors on a real groundwater system and to compare various scenarios in support of a decision-making process. The model's accuracy is bound to the normal uncertainty associated to groundwater modelling and no warranty, express or implied, is made.

11.0 CLOSURE

A hydrogeological assessment of the proposed Carson and Doran Neighborhoods groundwater supply system is conducted using the Kempenfelt Bay FEFLOW model. An Existing Conditions model scenario is refined and further calibrated in Midhurst and greater Willow Creek watershed areas in accordance with recent drilling, aquifer testing, and stream flow data. Subsequently, a Future Conditions model simulates anticipated water taking at full build-out. Drawdown, well interference, baseflow changes, capture zones and Aquifer Vulnerability Index (AVI) status are assessed. A summary of the Future Conditions assessment results is provided below:

- The additional Carson and Doran water takings result in drawdowns of up to 10 m in Aquifer A3 in the area of the Doran Neighborhood, with a lateral zone of influence reaching 6 km from the proposed development. Well interference at surrounding municipal systems is minimal (1.5 metres or less) and not anticipated to impact well performance.
- Baseflow reductions at Willow Creek are highest during late summer period. The maximum reduction simulated is about 9% in the Midhurst area. The Willow Creek catchment experiences between about 3% to 7% baseflow loss depending on the time of year.
- Capture zones for the Midhurst and Paddy Dunn's Circle and Carson and Doran Neighbourhood wells are developed by delineating the 2 year, 5 year, 10 year and 25 year capture zones at each well. Most capture zones are directed east to northeast in conformance with regional flow patterns emanating from the Oro-Medonte uplands. The 25-year time of travel zones reach upgradient distances ranging from about 1 km to 4.5 km in length.
- Water supply aquifers A3 and A4 have a "low vulnerability" AVI in the areas of the capture zones.

Report Signature Page

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DAH/JAE/plc

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12.0 REFERENCES

Ainley Group (2009). *Township of Springwater, Class Environmental Assessment Study for the Midhurst Water, Wastewater and Transportation Master Plan, Phase 1 and 2 Report.* 208017. July 2009.

Arnold, J.G., P.M. Allen, R. Muttiah, and G. Bernhardt (1995). *Automated base flow separation and recession analysis techniques*. Ground Water 33(6): 1010-1018.

AquaResource (2013). *City of Barrie Tier Three Water Budget and Local Area Risk Assessment.* Prepared for Lake Simcoe Region Conservation Authority. BarrieT3_RA_15074-527 R-0412 Final. May 2013.

AquaResource (2012). *City of Barrie Tier Three Recharge Estimation Using MIKE SHE Technical Memorandum.* Prepared for Lake Simcoe Region Conservation Authority. 15074-527 Recharge LR-0612.docx. June 2012.

Batu, V., 1998. *Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis*. John Wiley & Sons, New York, 727p.

Environment Canada (2012). Environment Canada, Water Survey of Canada: *Environment Canada Data Explorer V1.2.30 using HYDAT Version 1.0.* November, 2012

Environment Canada Climate Services (2012). *Barrie WPCC Water Budget, 1978 – 2012.* Ordered by Golder in 2013.

Golder (2010). *City of Barrie Source Water Protection Threat Assessment.* 07-1170-0014 (1000). Submitted to City of Barrie. June 2010.

Golder (2008). *Report On Hydrogeological Study, Midhurst Water Supply Exploration Program, Supporting Document, Midhurst Class EA, Township of Springwater, Ontario.* 08-1170-0081. Submitted to: Midhurst Development Doran Road Inc. and Carson Road Development Inc. December 2008.

Golder, WHI and Ainley (2004). *South Simcoe Municipal Groundwater Study.* Prepared for South Simcoe Groundwater Partnership. S41W01. August 2004.

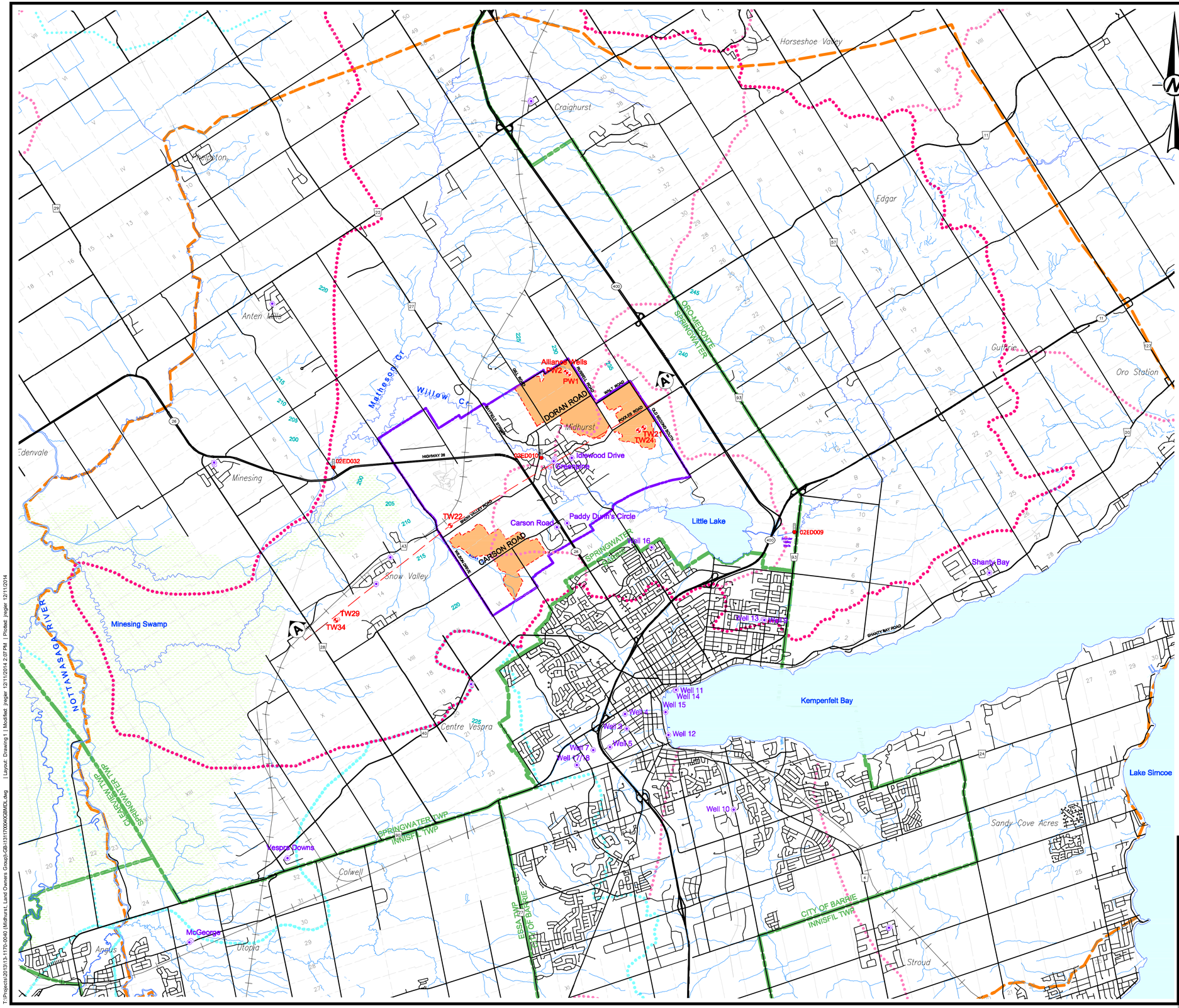
Golder and WHI (2004[1]). *South Simcoe Groundwater Study WHPA – City of Barrie Appendix E*. 04-1112-551. August 2004.

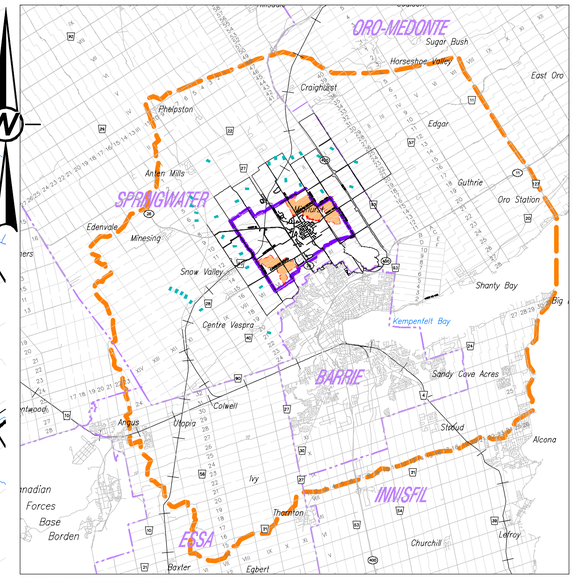
Golder and WHI (2004[2]). *South Simcoe Groundwater Study WHPA – Township of Springwater Appendix L.* 04-1112-551. August 2004.

Hutchinson Environmental Sciences Ltd. [HESL] (2018). *7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment Final Report*. J130030. Prepared for Ainley and Associates Ltd. May 2018.

Ministry of Natural Resources and Ministry of Environment (2011). *Water Budget & Water Quantity Risk Assessment Guide.* Prepared for the Ontario Ministries of Natural Resources and Environment by AquaResource Inc.. Drinking Water Source Protection Program.

FIGURES





MODEL EXTENTS KEY PLAN 1:200,000

LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Model Domain
- Willow Creek Watershed Boundary
- Nottawasaga River Watershed Boundary
- Watershed Sub-Basin
- Minesing Wetland Extents (Approximate)
- Existing Municipal / Public Supply Well
- 2014 Municipal Well Test Site
- 02ED009 WSC Flow Station

0 500 1000 2500 5000

SCALE 1:50000 metres

NOTES

1. Base Map from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013, SCS Consulting
3. Wells are approximate to Survey accuracy, GPS, and or measurement from mapped features.

PROJECT

CARSON AND DORAN NEIGHBOURHOODS GROUNDWATER MODELLING

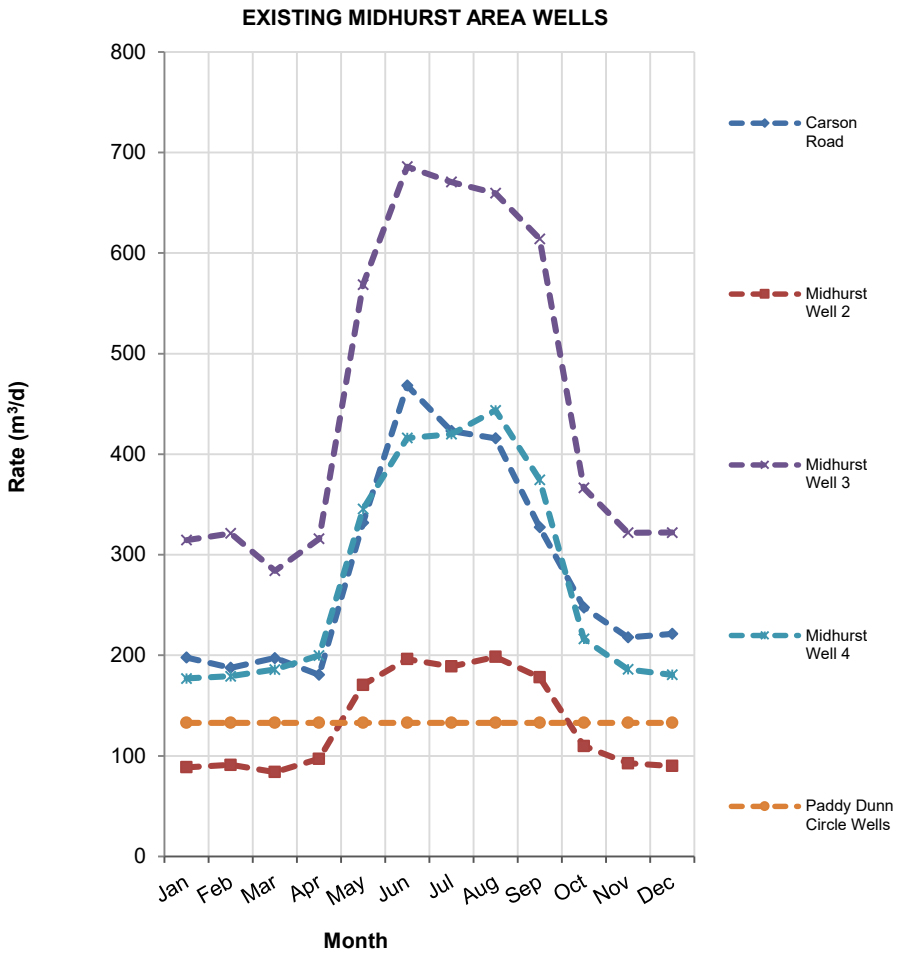
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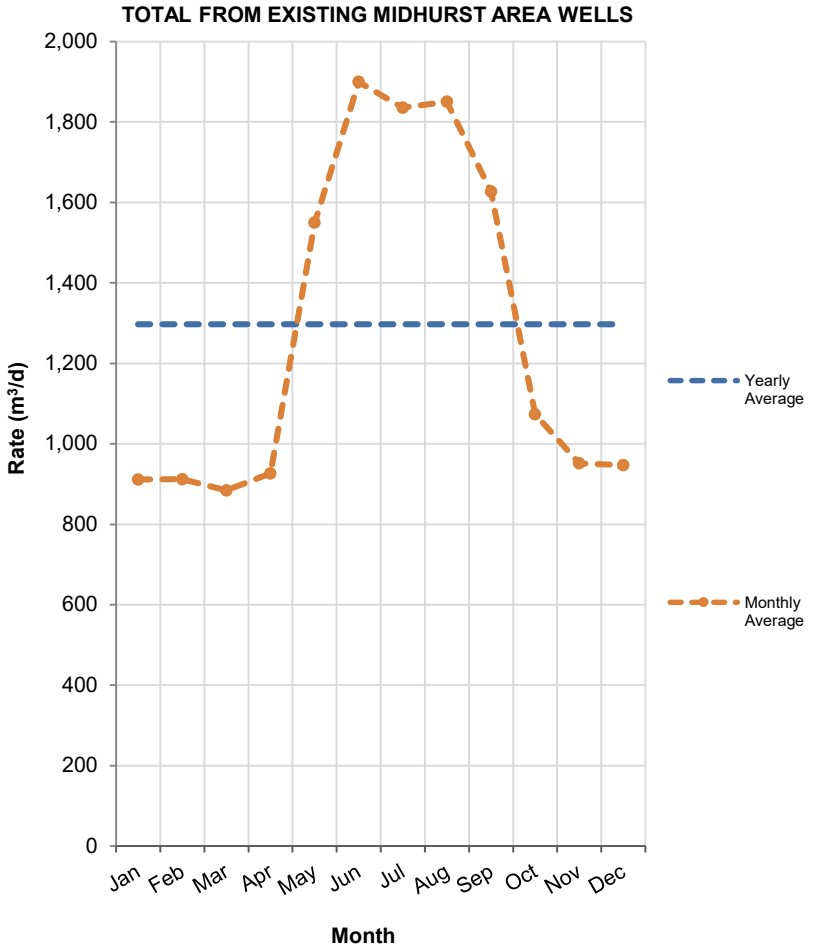
MODEL AREA

Golder Associates

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CHECK				
REVIEW	DH	2014-12-11		

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NOTE

- *Chart shows 2003 to 2010 monthly averages.*
- *Monthly averages for Paddy Dunn Circle wells not available, average rate for year applied equally every month.*

PROJECT

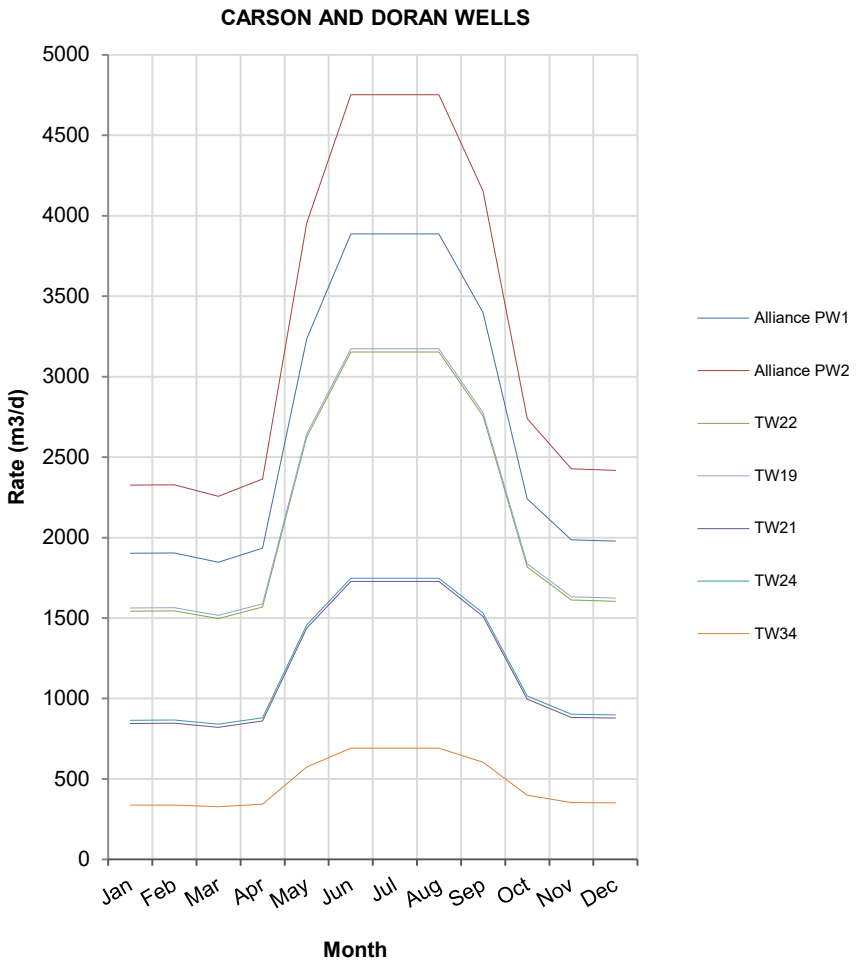
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GROUNDWATER MODELLING

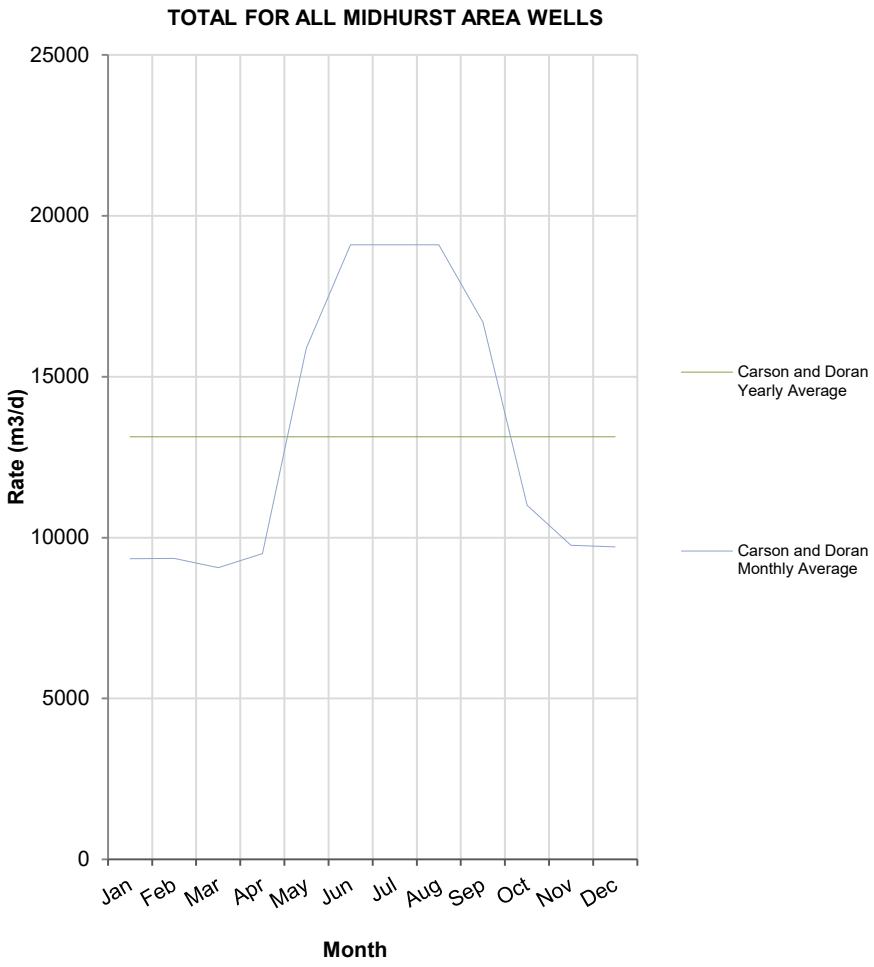
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EXISTING CONDITIONS
MIDHURST AREA PUMPING RATES

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			2
REVIEW			





NOTE

- *Projected total monthly demand at Carson and Doran wells calculated by prorating maximum demand (19,095 m^3/d) in accordance with Existing Conditions demand (Figure 2).*
- *Midhurst and Paddy Dunn's Circle rates for Future Conditions (not shown) are assumed to continue as per Existing Conditions (Figure 2).*

PROJECT

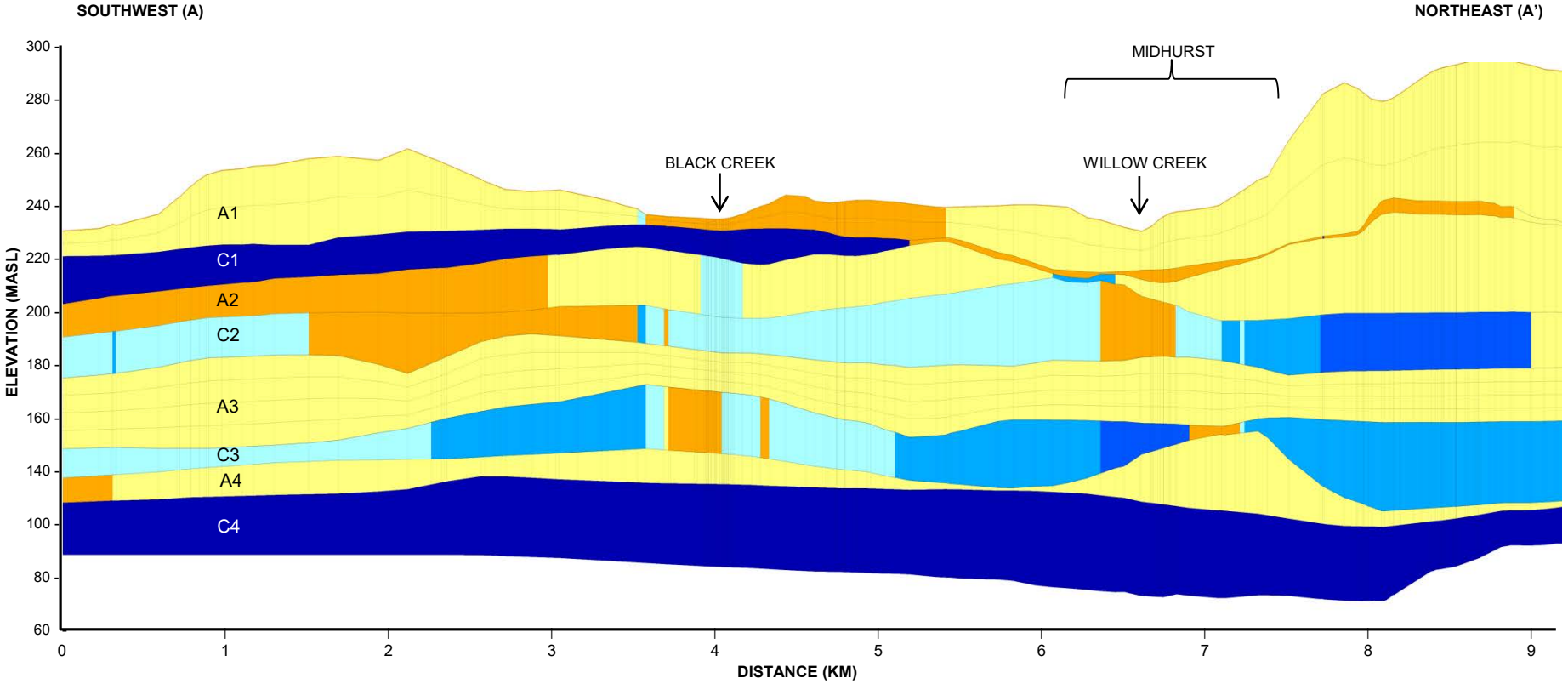
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

FUTURE CONDITIONS
CARSON AND DORAN PUMPING RATES

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	NOV 2015	REV. 1
CAD	AM	NOV 2015	FIGURE
CHECK			3
REVIEW			



NOTE:

- *See Figure 1 for plan view location of cross-section.*

LEGEND

HORIZONTAL HYDRAULIC CONDUCTIVITY (K_H) IN M/S:

- K_H >= 1E-4
- 1E-5 < K_H <= 1E-4
- 1E-6 < K_H <= 1E-5
- 1E-7 < K_H <= 1E-6
- 1E-8 < K_H <= 1E-7
- K_H = 1E-8

PROJECT

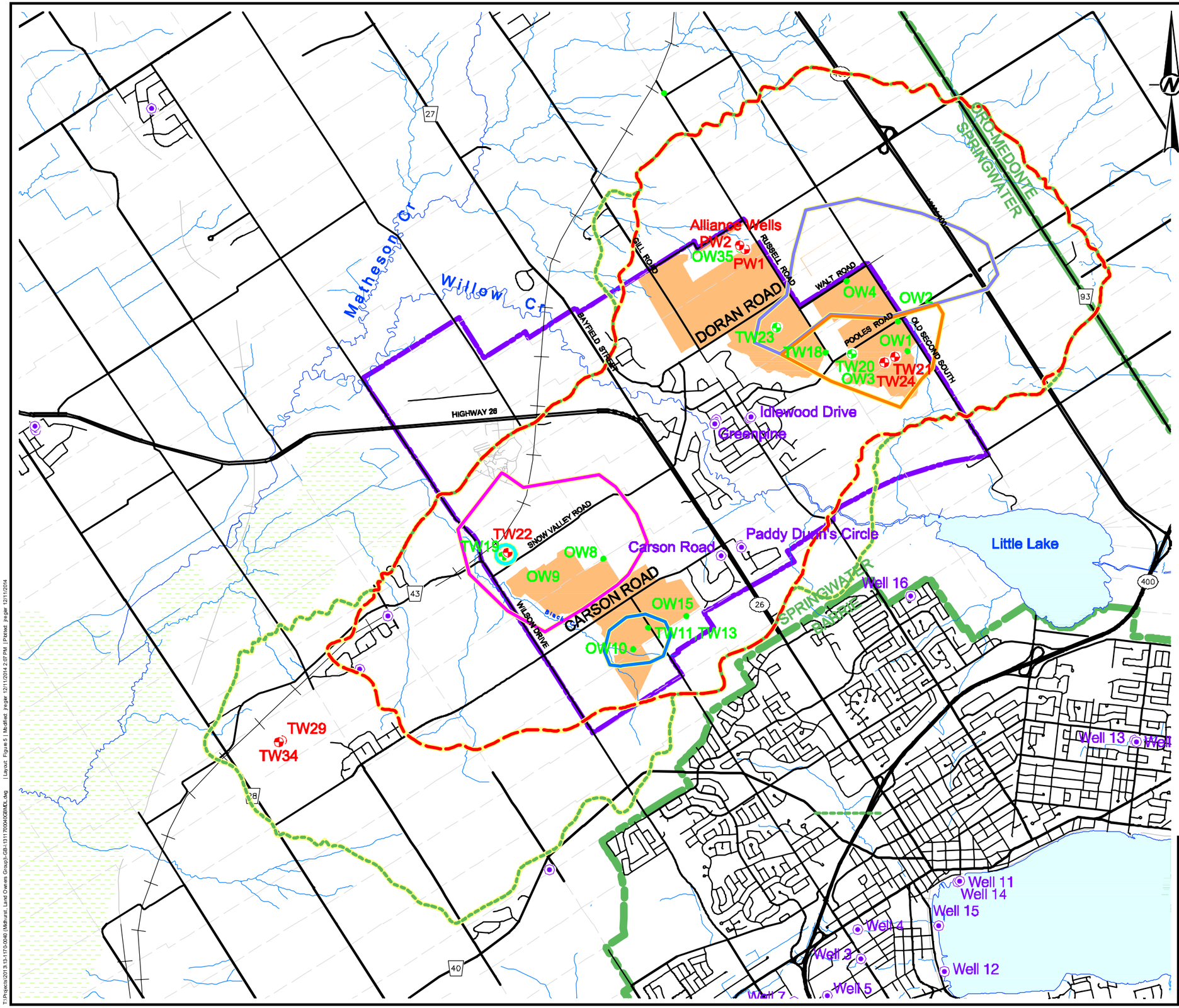
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

MODEL CROSS-SECTION

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			4
REVIEW			



PLAN LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Existing Municipal / Public Supply Well
- Test or Observation Well Site
- Municipal Well Water Supply Test Site

MODEL UPDATE ZONES

- A4 – K increased from 6E-5 m/s to 3E-4 m/s
- A3 – K increased from 2.3E-4 m/s to 3E-4 m/s
- UC (5E-6 m/s) changed to A1 (5E-5 m/s).
  Bottom of A1 raised from about 236 masl to 258 masl towards OW8
- C2 brought up through A2 to C1 (A2 locally thins out)
- Base elevation of A1 lowered from 243 masl to 237 masl
- Bottom of UC raised from ~260 masl to 274 masl.
  Bottom of A1 raised from ~235 masl to 252 masl.
  C1 introduced at 8 m thickness (previously not present)
- Bottom of A1 raised from 233 masl to 241 masl at TW18 to 247 masl TW21.
  C1 introduced at 5 m – 7 m thickness (previously N/P)
  A1 overwrites UC at TW24 and TW21

NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Wells are approximate to Accuracy of GPS and Measurement from known features.

This figure shows model updates that have been implemented as a result of recent drilling and aquifer testing data (Golder, 2014). For model updates resulting from the calibration refer to Section 5 of this report.

0 400 1000 2000 4000

SCALE 1:50000 metres

Plotted 11x17 Landscape

PROJECT

CARSON AND DORAN NEIGHBORHOODS
GROUNDWATER MODELLING

TITLE

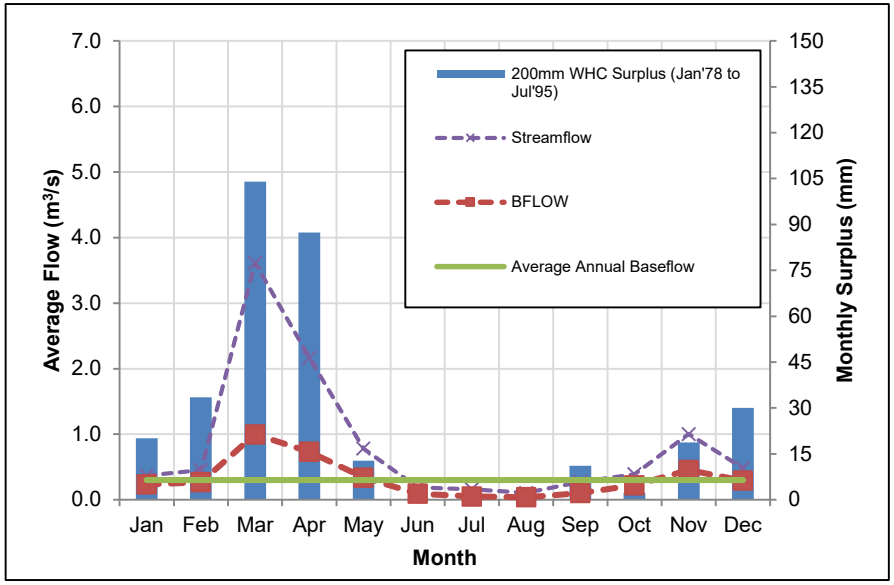
MODEL UPDATE AREAS

Golder Associates

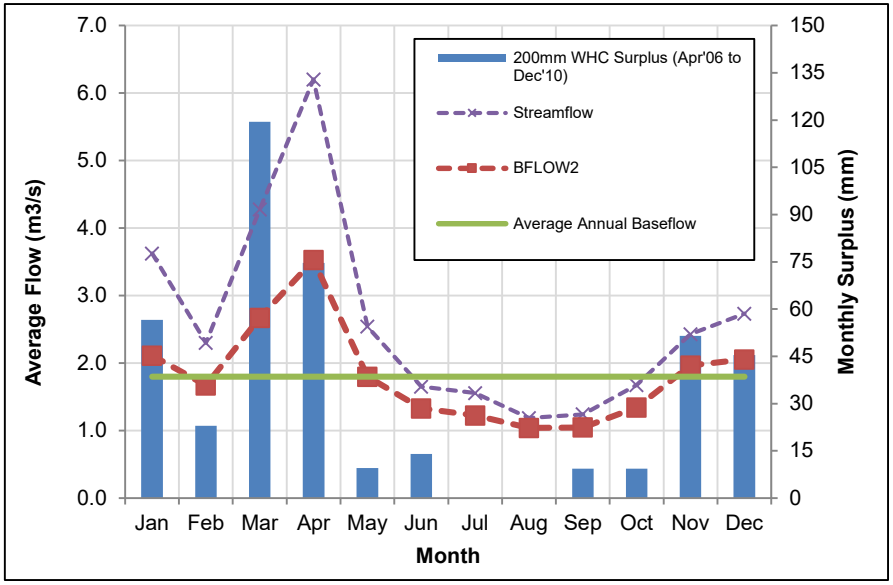
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DESIGN			SCALE	AS SHOWN
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CHECK				
REVIEW	DH	09 Dec 13		

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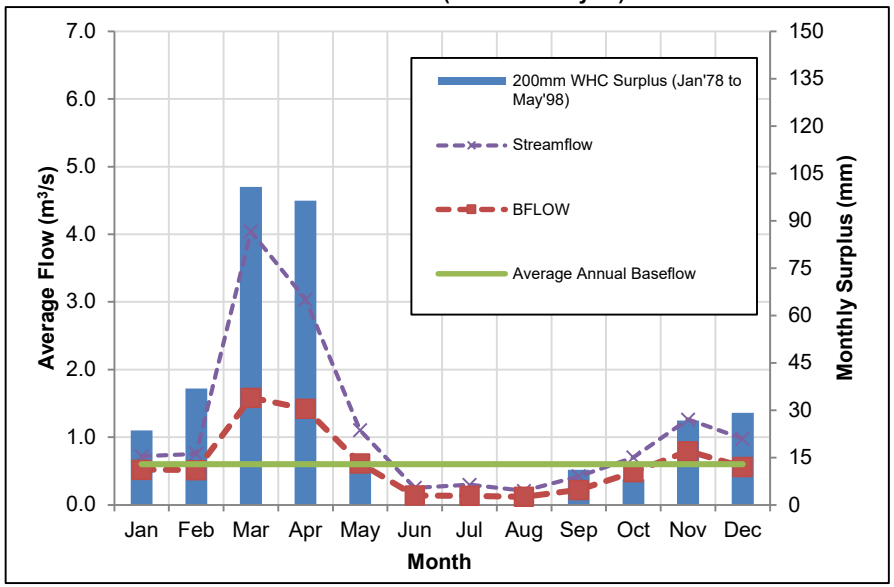
WILLOW CREEK ABOVE LITTLE LAKE (95 km²)
WSC Station 02ED009 (Feb'73 to Jul'95)

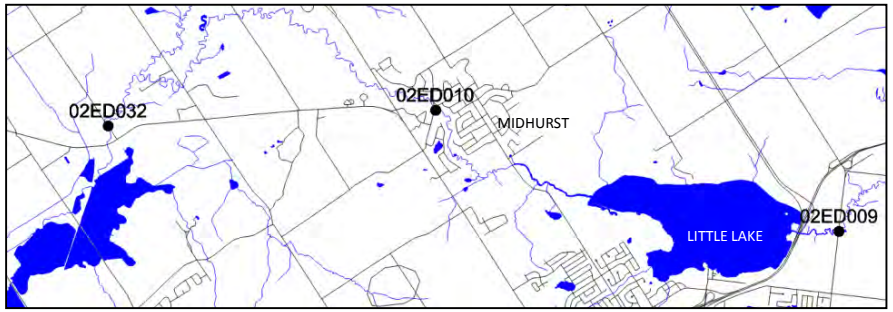


WILLOW CREEK AT MATHESON CREEK (231 km²)
WSC Station 02ED032 (Apr'06 to Dec'10)



WILLOW CREEK AT MIDHURST (127 km²)
WSC Station 02ED010 (Feb'73 to May'98)





PROJECT

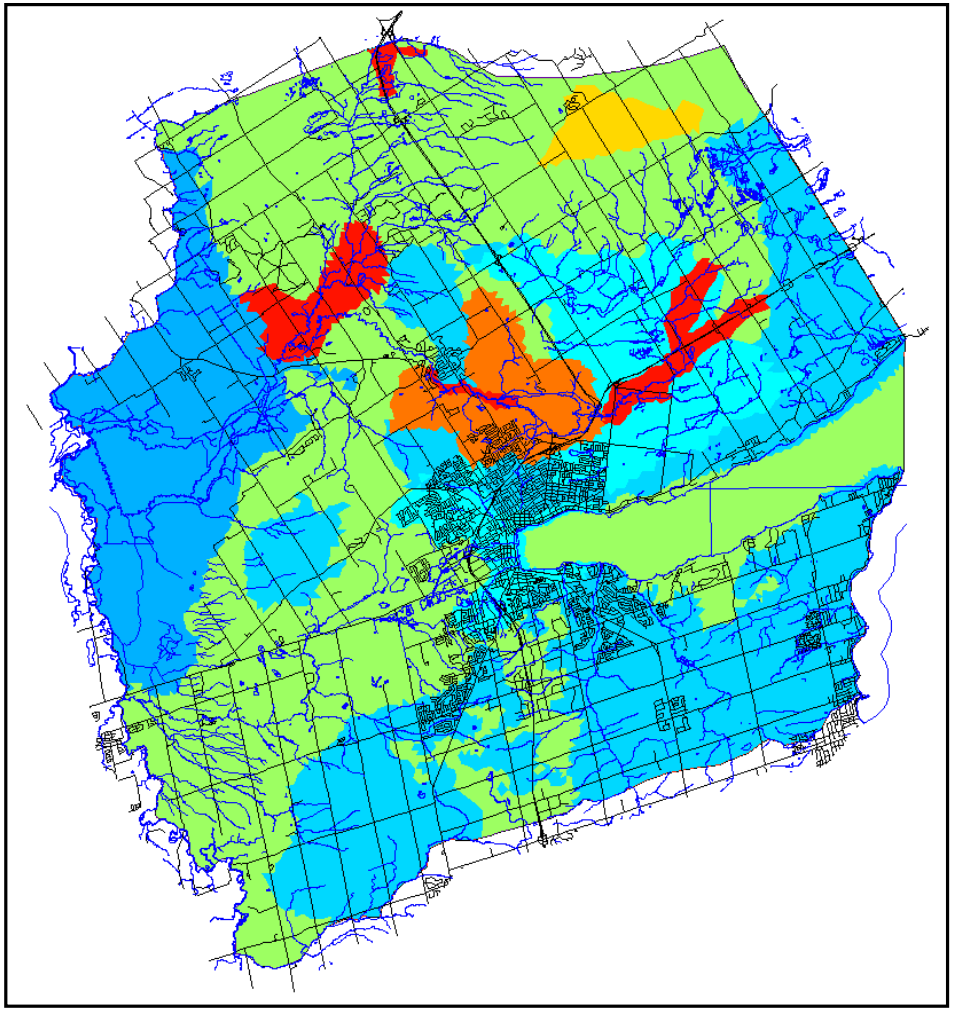
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

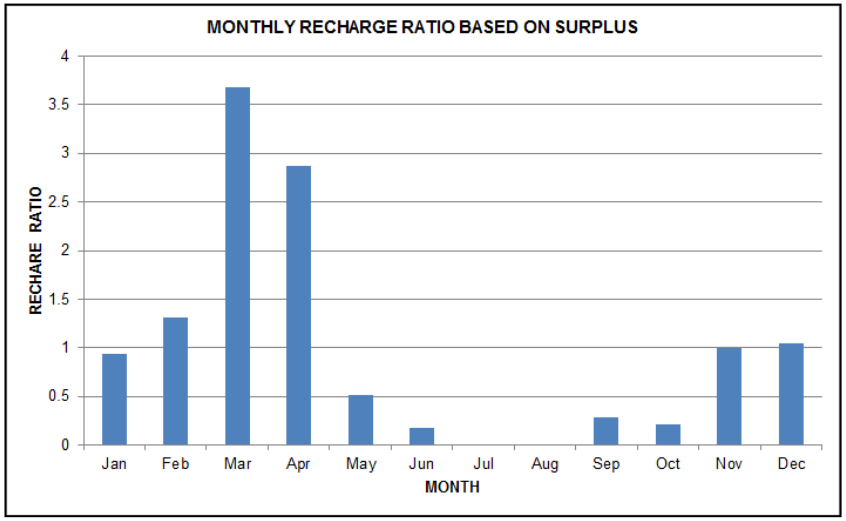
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WILLOW CREEK STREAM FLOW

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			6
REVIEW			





NOTES:

- *In transient simulation the recharge rate at each polygon for each month is determined by multiplying the average recharge rate (see Legend) by the monthly recharge ratio (see above).*
- *Surplus derived from Barrie WPCC monthly averages for period of 1978 – 2012.*

LEGEND

AVERAGE RECHARGE RATE (MM/YR):

- 110
- 140
- 170
- 250
- 390
- 450

PROJECT

CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

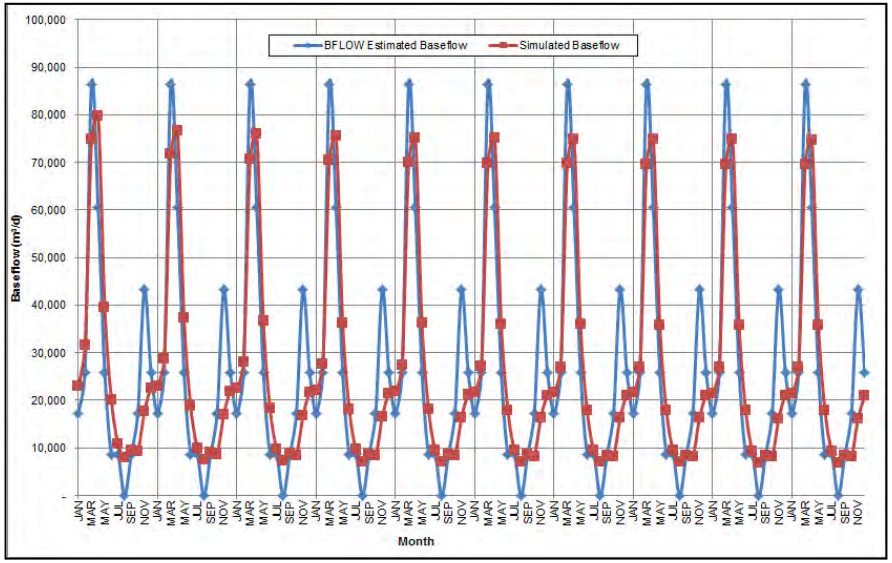
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MODEL RECHARGE DISTRIBUTION

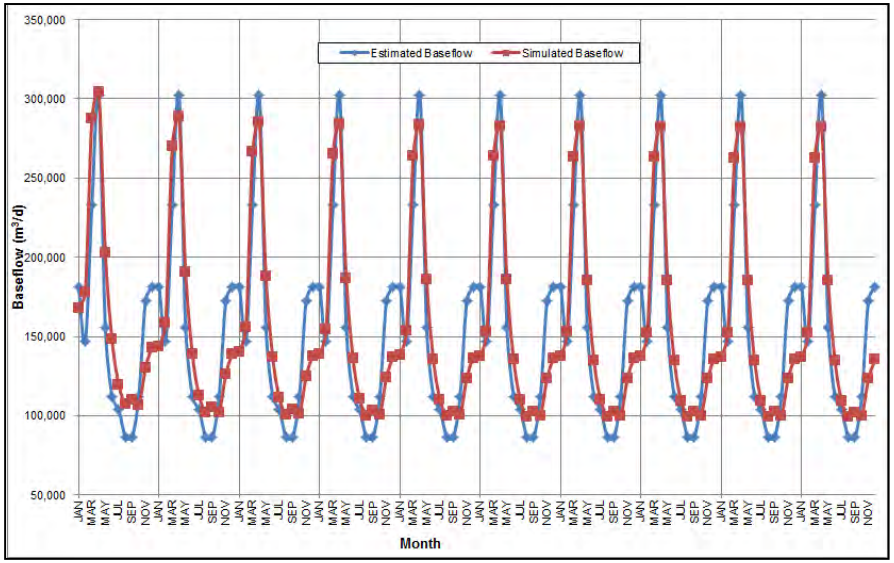
Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
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CAD	AM	MAR 2015	FIGURE
CHECK			7
REVIEW			

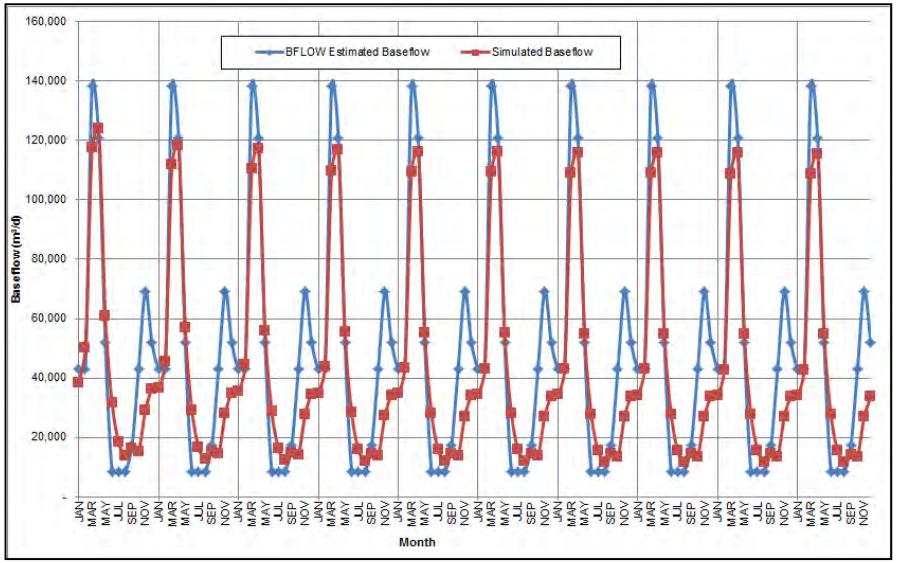
WILLOW ABOVE LITTLE LAKE (95 km²)
WSC Station 02ED009

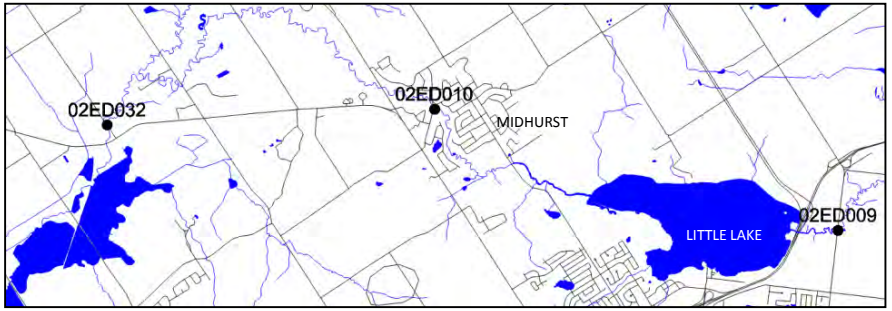


WILLOW AT MATHESON CRK (231 km²)
02ED032 Baseflow Results (Apr'06 to Dec'10)



WILLOW AT MIDHURST (127 km²)
WSC Station 02ED010





PROJECT

CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

EXISTING CONDITIONS
WILLOW CREEK
BASEFLOW CALIBRATION RESULTS

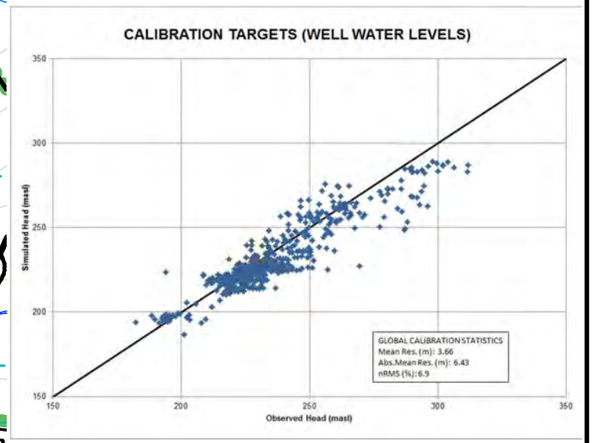
Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			8
REVIEW			

Alliance Wells
PW2
PW1
TW21
TW24
TW22
TW19
TW34
Idlewood Drive
Greentree
Carson Road
Paddy Dunn's Circle
Little Lake
Well 16
Well 13
Well 11
Well 14
Well 15
Well 4
Well 3
Well 12
Well 5
Well 7
Kemp
DORAN ROAD
CARSON ROAD
GILL ROAD
RUSSELL ROAD
WALT ROAD
FOOLES ROAD
OLD SECOND SOUTH
BAYFIELD STREET
SNOW VALLEY ROAD
WILSON DRIVE
HIGHWAY 26
Matheson Cr
Willow Cr
Black
ORO-MEDONTE SPRINGWATER
SPRINGWATER
BARRIE
400
27
43
26
93
28
40
220
225
230
235
240
245
215
210
205
200
195
190

PLAN LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Existing Municipal / Public Supply Well
- Municipal Well Test Site
- Existing Model Conditions Aquifer A3 Head Elevations (masl)



NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Wells are approximate to Accuracy of GPS and Measurement from known features.

This figure shows model updates that have been implemented as a result of recent drilling and aquifer testing data (Golder, 2014). For model updates resulting from the calibration refer to Section 5 of this report.

0 400 1000 2000 4000

SCALE 1:50000 metres

Plotted 11x17 Landscape

PROJECT

CARSON AND DORAN NEIGHBORHOODS
GROUNDWATER MODELLING

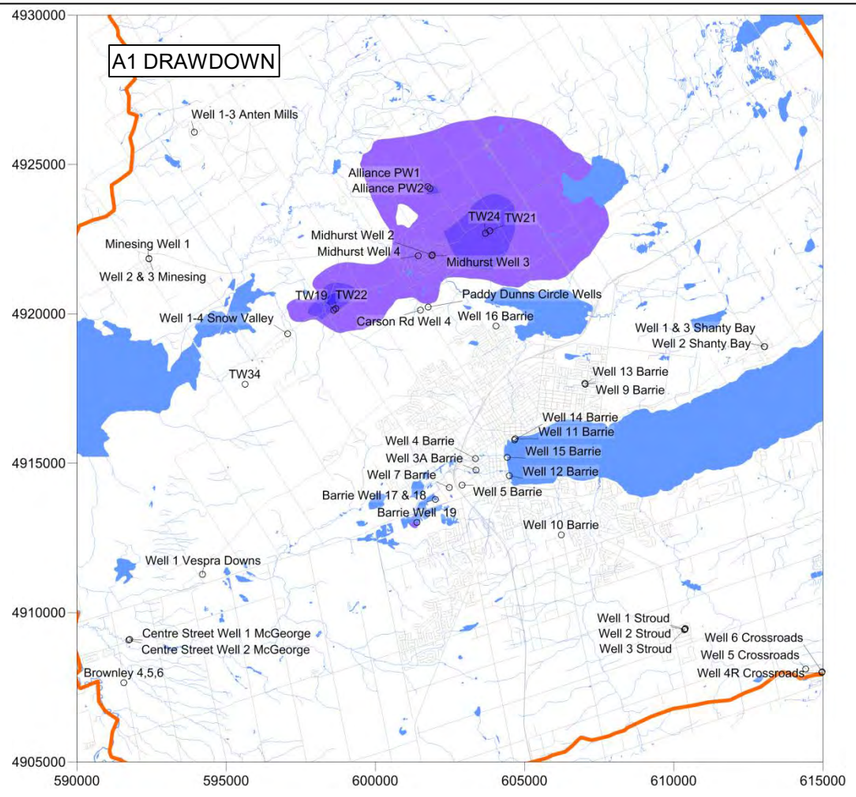
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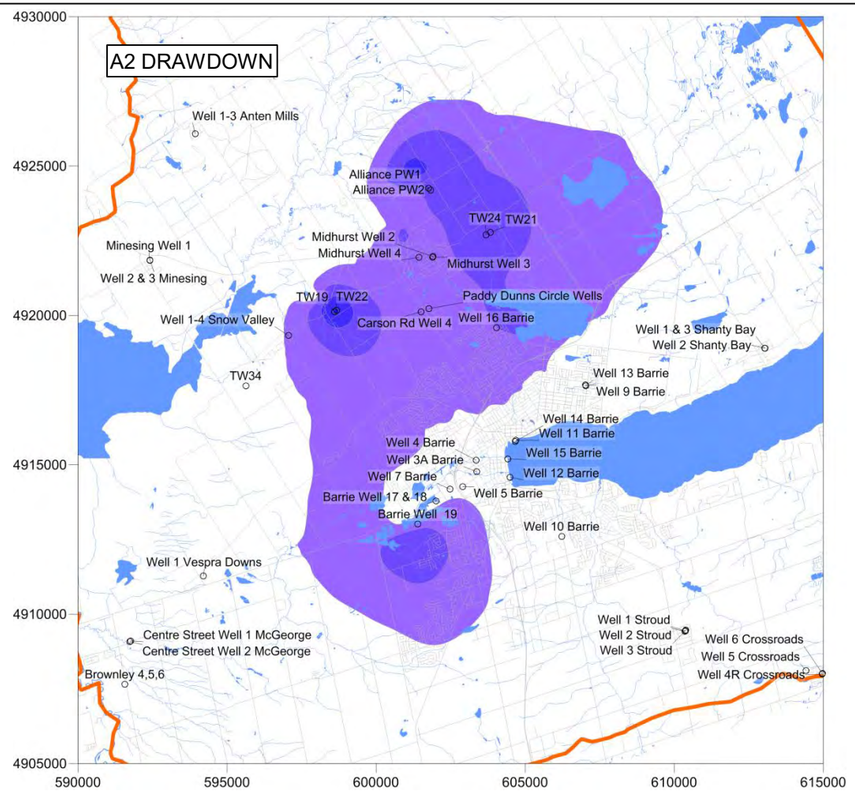
EXISTING CONDITIONS
SIMULATED GROUNDWATER HEAD ELEVATION
AQUIFER A3

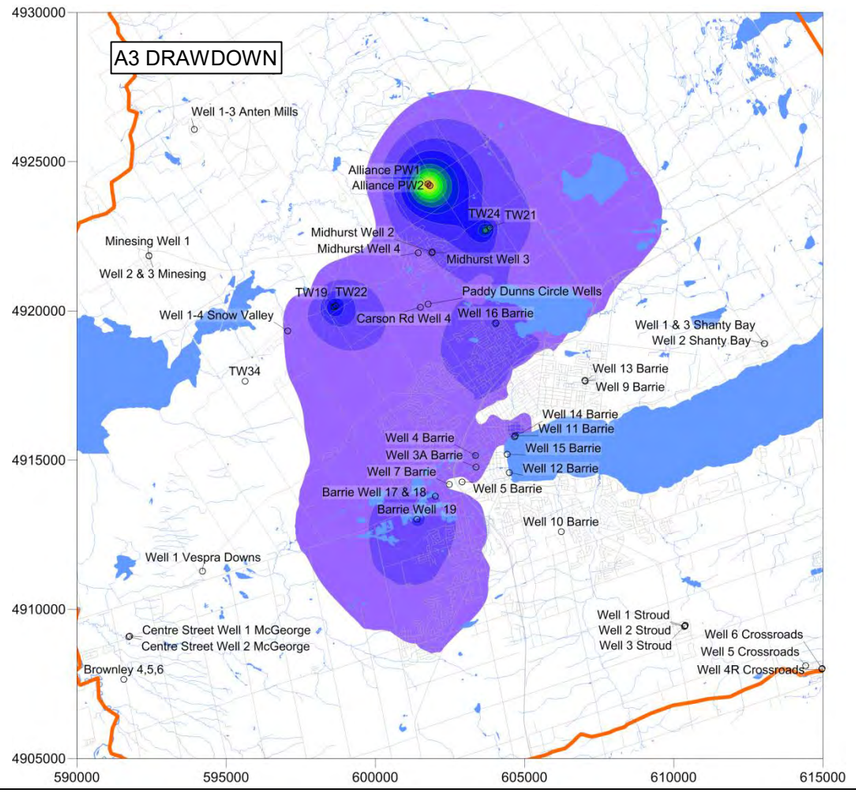
Golder Associates

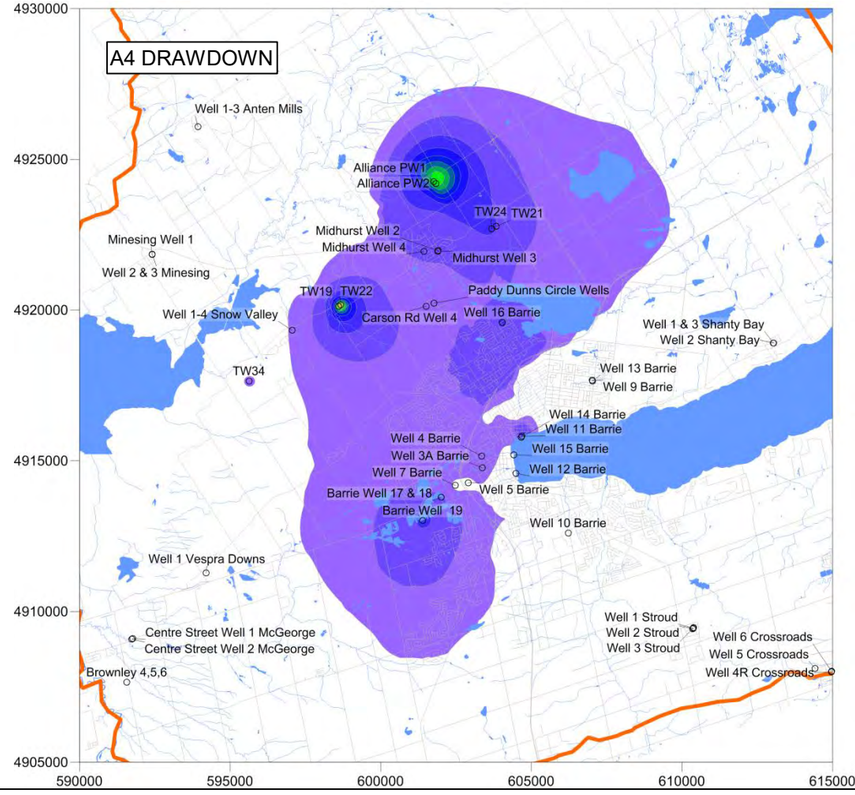
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REVIEW	DH	11 Dec 14			

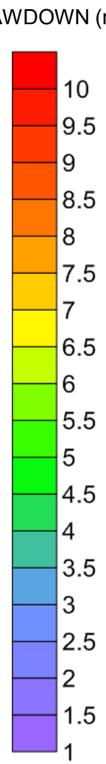
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PROJECT

CARSON AND DORAN NEIGHBOURHOODS GROUNDWATER MODELLING

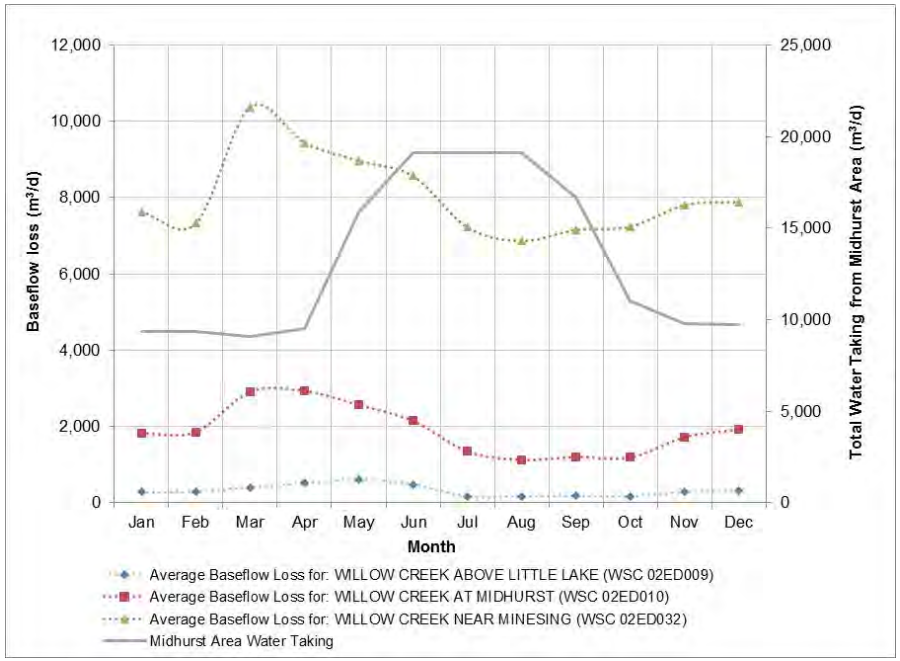
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FUTURE CONDITIONS SIMULATED DRAWDOWN

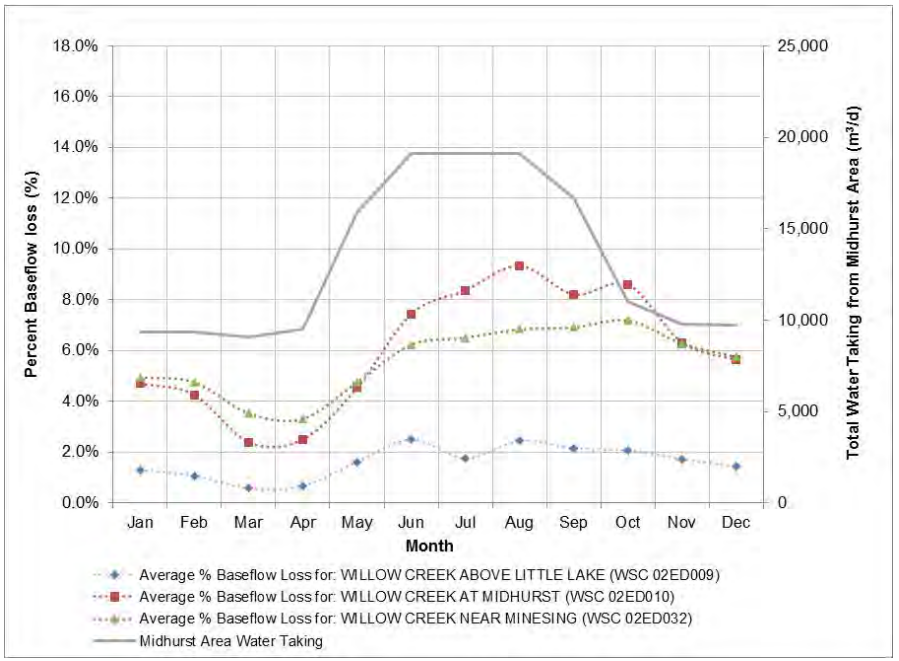
Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
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GIS	AM	NOV 2015	FIGURE
CHECK			**10**
REVIEW			

BASEFLOW LOSS EXPRESSED AS FLOW RATE



BASEFLOW LOSS EXPRESSED AS % OF TOTAL BASEFLOW FOR SUBCATCHMENT



NOTE

- *Monthly rates and percent changes reflect average result for 10-year simulation.*
- *Total Midhurst area pumping includes Carson and Doran Neighbourhoods and Midhurst and Paddy Dunn's Circle municipal well systems.*

PROJECT

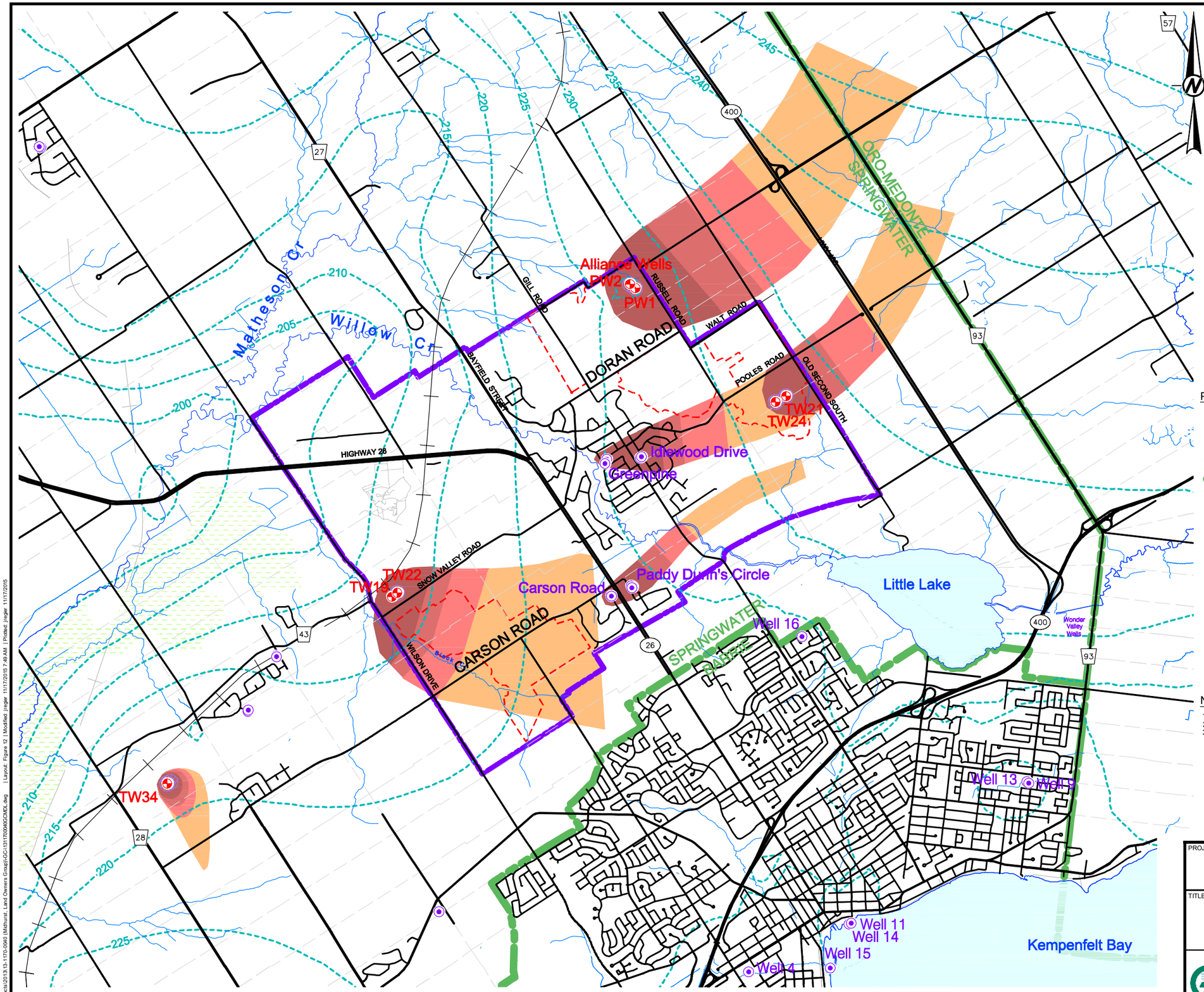
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

FUTURE CONDITIONS
WILLOW CREEK
SIMULATED BASEFLOW CHANGES

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
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CAD	AM	NOV 2015	FIGURE
CHECK			11
REVIEW			



PLAN LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Existing Municipal / Public Supply Well
- Municipal Well Test Site

100 m Radius Around Well
Model 2, 5, 10 & 25 Year Time of Travel Capture Zone
Gridded Model A3 Aquifer Equipotentials (masl)

NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Wells are approximate to Accuracy of GPS and Measurement from known features.

0 400 1000 2000 4000
SCALE 1:50000 metres
Plotted 11x17 Landscape

PROJECT
CARSON AND DORAN NEIGHBORHOODS
GROUNDWATER MODELLING

TITLE
CAPTURE ZONES

Golder Associates

PROJECT No.	13-1170-0040		FILE No.	1311700040GCMDL
DESIGN			SCALE	AS SHOWN
CADD	JPR	11 Nov 15	FIGURE	12
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REVIEW				

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TABLES

TABLE 1
Summary of Pumping Wells

Wellfield	Well ID	Easting	Northing	Aquifer	Existing Conditions Rate Range (m^3/d)	Future Conditions Rate Range (m^3/d)
Midhurst[1]	Greenpine Well 1	601,450	4,921,941	A3	0	0
	Greenpine Well 4	601,436	4,921,946	A3	177 - 443	177 - 443
	Idlewood Drive Well 2	601,908	4,921,972	A3	367 - 884	367 - 884
	Idlewood Drive Well 3	601,894	4,921,949	A3		
	Carson Rd Well 4	601,512	4,920,127	A3	180 - 468	180 - 468
Paddy Dunn's Circle[1]	Well 1	601,772	4,920,229	A3	133	133
	Well 2	601,784	4,920,233	A3		
	Well 3	601,764	4,920,253	A3		
Doran[2]	Alliance PW1	601,830	4,924,191	A3	-	1,846 - 3,888
	Alliance PW2	601,759	4,924,262	A3	-	2,256 - 4,752
	TW21	603,827	4,922,777	A3	-	821 - 1,728
	TW24	603,687	4,922,700	A3	-	821 - 1,728
Carson[2]	TW22	598,675	4,920,171	A4	-	1,497 - 3,154
	TW19	598,604	4,920,119	A4	-	1,497 - 3,154
	TW34	595,627	4,917,644	A4	-	328 - 691
Barrie	3A	603,374	4,914,759	A3	2,087	2,898
	4	603,331	4,915,148	A3	0	2,150
	5	602,927	4,914,267	A3	2,619	1,823
	7	603,533	4,913,835	A3	5,409	2,670
	11	604,690	4,915,816	A3	0	3,900
	12	604,499	4,914,593	A3	4,800	2,898
	14	604,661	4,915,782	A3	3,761	1,823
	15	604,412	4,915,199	A3	4,131	2,670
	17	602,045	4,913,788	A3	5,252	7,036
	18	602,047	4,913,781	A3		
	19	601,394	4,913,017	A3	0	4,178
	9	607,042	4,917,649	A3	3,766	4,589
	13	607,016	4,917,670	A3	4,130	3,012
	16	604,037	4,919,591	A3	4,253	5,095
Craighurst	Well 1	600,812	4,931,473	A1	0	0
	Well 2	600,813	4,931,476	A1	11	11
	Well 3	600,812	4,931,480	A2	21	21
Angus	Centre Street (McGeorge) Well 1	591,761	4,909,103	A3	306	306
	Centre Street (McGeorge) Well 2	591,729	4,909,078	A3	283	283
	Brownley Well 4	591,571	4,907,652	A3	0	0
	Brownley Well 5					
	Brownley Well 6					

TABLE 1
Summary of Pumping Wells

Wellfield	Well ID	Easting	Northing	Aquifer	Existing Conditions Rate Range (m^3/d)	Future Conditions Rate Range (m^3/d)
Stroud	Well 1	610,368	4,909,451	A3	166	166
	Well 2 (Standby)	610,358	4,909,422	A3	166	166
	Well 3	610,387	4,909,478	A3	166	166
Vespra Downs	Well 1 - 93	594,204	4,911,276	A3	39	39
	Well 1- 91	594,176	4,911,266	A3	0	0
Minesing	Well 1	592,409	4,921,843	A3	119	119
	Well 2	592,409	4,921,843	A2	119	119
	Well 3	592,377	4,921,822	A2	137	137
Anten Mills	Well 1	593,949	4,926,082	A3	1	1
	Well 2	593,935	4,926,073	A3	120	120
	Well 3	593,928	4,926,081	A3	151	151
Shanty Bay	Well 1	613,031	4,918,903	A3	43	43
	Well 2	613,046	4,918,902	A2	49	49
	Well 3	613,039	4,918,913	A3	55	55
Snow Valley	Well 3	597,054	4,919,329	A3	284	284
	Well 4					
	Well 1					
	Well 2					

1. See Figure 2 for monthly rates at Midhurst.
2. See Figure 3 for monthly rates at Carson and Doran Neighbourhoods wells.

TABLE 2
Summary of Model Construction Details

General Attributes	
Code	FEFLOW
Software	FEFLOW 6.2
Flow Type	Saturated
Simulation	Steady State & Transient
Dimension	Three-Dimensional (3D)

Domain (Figure 1)	
Area	746 km^2
Horizontal Extents	31 km wide x 24 km long
Vertical Extents	400 masl to 89 masl
Top of Model	Ground Surface
Bottom of Model	Bedrock Surface

Mesh Layout	
Element Type	Triangular Prism
Side Length	300 m to 10 m at wells
Total Elements	745,836

Numerical Layer and Hydrostratigraphic Unit Details

Layer	Nominal Unit	Average Recharge (mm/yr)	Description	Thickness (m)	Hydraulic Conductivity (m/s)	Specific Storage (1/m)
1 - 2	UC / A1	100 - 445	Till or Sand / Gravel	0.25 to 70	1E-6 to 3E-4	3E-04
3	A1	-	Sand	0.25 to 70	5E-6 to 3E-4	3E-04
4 - 6	C1	-	Clayey Silt to Clay	0.2 to 77	1E-08	1E-04
7	A2	-	Sand	0.5 to 44	5E-6 to 3E-4	2E-04
8 - 10	C2	-	Sandy Silt Till	0.2 to 65	5E-07	1E-04
11 - 16	A3	-	Sand/ Gravel	0.2 to 71	5E-5 to 1E-3	2E-04
17 - 19	C3	-	Sandy Silt to ClayTil	0.2 to 60	5E-8 to 3E-7	1E-04
20	A4	-	Sand / Gravel	0.5 to 33	5E-5 to 3E-4	2E-04
21	C4	-	Basal Till	0.5 to 37	1E-08	1E-04

Note:

1. Horizontal hydraulic conductivity listed. Vertical hydraulic conductivity is 1/10th horizontal.

TABLE 2
Summary of Model Construction Details

2. Effective porosity of 25% assumed for particle tracking / capture zone development.

Boundary Conditions			
Feature	**Type**	**Constraint**	**Head Value (masl)**
Willow Creek	Constant Head	Discharge only	DEM elevation
Little Lake	Constant Head	-	229
Matheson Creek	Constant Head	Discharge only	DEM elevation
Bear Creek	Constant Head	Discharge only	DEM elevation
Lake Simcoe	Constant Head	-	218.5
Minesing Wetland	Constant Head	-	186
Other Streams	Constant Head	-	DEM elevation
A3/A4 North	Constant Head	-	270
A3/A4 East	Constant Head	-	220
A3/A4 South	Constant Head	-	203 to 187

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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Golder Associates

[DHP 00480240]

May 2018

MIDHURST, ONTARIO
DRAFT REPORT ON CARSON AND DORAN NEIGHBOURHOODS PROPOSED WATER SUPPLY GROUNDWATER MODELLING

Submitted to:
The Township of Springwater c/o Ainley & Associates
2231 Nursery Road
Minesing ON L0L 1Y2



Report Number: 13-1170-0040 (4000)

REPORT

Golder Associates

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1.0 INTRODUCTION

Midhurst is a residential community located in Springwater Township, Ontario (Figure 1). The community has a population of about 3,100 people. The Midhurst Landowner's Group proposes to develop the Carson and Doran Neighbourhoods (Neighbourhoods) subdivisions north and south of the existing Midhurst residential area. The Neighbourhoods will be primarily residential and provide approximately 8,000 new dwellings for an estimated 29,000 additional people as specified in the Phase 1 and 2 Class Environmental Assessment (Ainley Group, 2009).

This report describes groundwater modelling undertaken to estimate the hydrogeological effects of the Neighbourhoods groundwater supply well pumping. The modelling is part of a larger hydrogeological study to be submitted as part of Phases 3 and 4 of the Midhurst Secondary Plan Class Environmental Assessment.

Modelling is conducted using the existing three-dimensional (3D) Kempenfelt Bay FEFLOW model with refinements in Midhurst and surrounding Willow Creek watershed areas. The use of regional scale models such as the Kempenfelt Bay FEFLOW model to assess groundwater impacts is an industry-accepted and commonly used approach in large water resource studies in Ontario. Groundwater models are an identified Source Water Protection assessment tool in the Ministry of Environment and Climate Change (MOECC) Technical Rules under the Clean Water Act. In addition, the original Kempenfelt Bay model formed the hydrogeologic basis of the City of Barrie Tier 3 Water Budget and Local Area Risk Assessment (AquaResource, 2013). The model was used to estimate impacts as a result of Barrie municipal well pumping and was a supporting tool for the MOECCs 2015 approval of the South Georgian Bay Lake Simcoe Source Protection Plan.

1.1 Scope of Work

The modelling scope of work involves two scenarios: 1) Existing Conditions; and 2) Future Conditions.

Existing Conditions

- Update model parameters in accordance with recent field activities including test well drilling and pumping tests; and
- Calibrate the model to transient (monthly) baseflow estimates along Willow Creek. "Baseflow" is the portion of stream flow supplied by groundwater discharge.

The Existing Conditions model forms the baseline for assessing the effects of Future Conditions pumping.

Future Conditions

- Input Future Conditions proposed wells and pumping rates;
- Estimate aquifer drawdown and potential well interference as a result of the additional water taking;
- Estimate monthly flow reductions at Willow Creek as a result of the additional water taking;
- Delineate capture zones for both existing Midhurst area wells and Carson and Doran Neighbourhood wells; and
- Assess the capture zones in the context of Aquifer Vulnerability Index (AVI).

The Future Conditions model considers the Carson and Doran Neighbourhoods at full build out. Note that this assessment also considers future takings at the City of Barrie municipal water supply system.

This report describes municipal supply pumping, original model construction, subsequent model updates, calibration, and future conditions assessment results.

2.0 MUNICIPAL WATER SUPPLY PUMPING

This section discusses municipal water supply well information as it pertains to the modelling. A summary of the pumping wells in the model and their rates for Existing and Future Conditions is provided in Table 1. In some instances proximate wells are grouped as a single "sink" in the model and share a combined rate.

2.1 Existing Conditions

Midhurst is entirely dependent on groundwater for its water supply. The community is currently serviced by eight wells in two wellfields (Figure 1):

1) Midhurst wellfield, consisting of Wells 1 and 4 (Greenpine wellfield), Wells 2 and 3 (Idlewood Drive wellfield) and Carson Road Well 4; and
2) Paddy Dunn's Circle wellfield, comprised of Wells 1, 2 and 3.

Water consumption ranges from about 880 m^3/d to 1,900 m^3/d (based on monthly data), with an average taking of 1,300 m^3/d during the course of a year (Figure 2). As is typical with municipal water supplies, the highest demand occurs during the summer months of June through August, where water demand is an average of 1.8 times greater than the remainder of the year. The varying demand shown in Figure 2 is simulated during transient calibration to baseflows in the Existing Conditions model.

Additional water takings occur around Midhurst, the most notable of these being the relatively large City of Barrie system. The City of Barrie Tier Three study (AquaResource, 2013) indicates that the total water taking at City of Barrie during 2010 was an average of 40,208 m^3/d. A 2012 water taking estimate, which accounts for the surface water plant being put online, is also listed in the study and predicts a lesser average groundwater demand of 32,465 m^3/d (although the actual rate may reach over 40,000 m^3/d during some months). For this analysis, the 2010 rates were used to reflect Existing Conditions as: 1) they better correlate with the surface water flow measurement period available for this study (the latest flow measurements are up to 2010); and 2) drawdown and baseflow impacts described in the Barrie Tier Three study were based on the 2010 condition as baseline; utilizing the same pumping regime allows comparison between the two studies, particularly with respect to Safe Additional Available Drawdown (SAAD). In addition, the 2010 rates provides a more conservative basis for assessing absolute impact as the lesser 2012 rates would allow for increased groundwater elevations and greater baseflows as a baseline.

For the smaller Snow Valley, Minesing and other systems, the Existing Conditions model uses the recent (circa 2009 to 2010) average water demands as listed in the Tier Three study (AquaResource, 2013).

2.2 Future Conditions

Approximately nine new water supply wells are proposed to supply the Carson and Doran Neighbourhoods (see TW-series and PW-series shown on Figure 1).

For Carson and Doran Neighbourhoods the planned maximum water taking is 221 L/s or approximately 19,094 m^3/d. This rate, if reached, would most likely occur during the June to August period. A pro-rating approach based on Existing Conditions demand ratios allows forecast of Future Conditions water takings for the remaining months of the year (Figure 3). The average water taking is thus anticipated to be approximately 13,134 m^3/d or 152 L/s.

Existing Midhurst and Paddy Dunn's Circle communities are currently near full build-out; as such, their Future Conditions pumping rates are assumed to continue as per Existing Conditions (Figure 2).

The City of Barrie Tier Three study provides an "Existing Plus Committed Plus Planned Demand" for the year 2031. These rates are used for City of Barrie wells in the Future Conditions modelling.

For the remainder of wells in the model, the Future Conditions rates continue as per recent average water demand (AquaResource, 2013).

3.0 MODEL BACKGROUND

The Kempenfelt Bay FEFLOW model was originally constructed in the early 2000s in support of the South Simcoe Groundwater Study. The model provides a computer-based, mathematical representation of the hydrogeologic system as understood through available physiographic mapping, borehole logs, well water levels, aquifer testing results, stream flow measurements and other field observations. A primary objective of the original model was the development of Wellhead Protection Areas (WHPAs) for South Simcoe municipal wells.

The model domain is regional in scale, encompassing an area of 746 km^2 (Figure 1). The Willow Creek watershed, wherein the proposed developments are located, lies almost entirely (>90%) within the model domain and comprises an area of 228 km^2.

An important feature of interest in the model is Willow Creek itself, which flows roughly centrally through the model domain from its source in the Oro uplands to its ultimate discharge location in the Minesing Swamp (Figure 1). The Creek demarcates topographic minima within the subwatershed and flows through granular soils for the majority of its length. As a result, Willow Creek is conceptualized and modelled as a major groundwater discharge zone along its entire reach (as opposed to discrete areas of upwelling).

Table 2 provides a summary of model attributes whereas Figure 4 illustrates an example model cross-section through the Midhurst area (see Figure 1 for plan view location of section).

This report focuses on model updates pertaining to the Midhurst area and encompassing the Willow Creek watershed. For a detailed description of the Midhurst area hydrogeology and prior model development the reader is referred to the following reports:

- *South Simcoe Municipal Groundwater Study* (Golder, WHI and Ainley, 2004);
- *South Simcoe Groundwater Study WHPA – Appendix E, City of Barrie* (Golder and WHI, 2004[1]);
- *South Simcoe Groundwater Study WHPA – Appendix L, Township of Springwater* (Golder and WHI, 2004[2]); and
- *Report On: Hydrogeological Study, Midhurst Water Supply Exploration Program Supporting Document, Midhurst Class EA, Township of Springwater, Ontario* (Golder, 2008).

In addition, the original Kempenfelt Bay model formed the hydrogeologic basis of the City of Barrie Tier 3 Water Budget and Local Area Risk Assessment (AquaResource, 2013). The model was used to estimate impacts as a result of Barrie municipal well pumping and was a supporting tool for the MOECCs 2015 approval of the South Georgian Bay Lake Simcoe Source Protection Plan.

4.0 MODEL UPDATES

Results of Golder's recent Midhurst-area water supply investigation guide the model updates described herein. The drilling and installation of 20 test wells and 13 observation well nests (21 observation wells total) has been completed. Subsequently, five aquifer tests (two in A3 and three in A4) have been conducted. The field study results and analysis allow for local-scale refinement of model parameters in the Midhurst area as follows:

- **Mesh Refinement:** The model mesh density is gradually increased around the new test wells to element dimensions of about 10 m to 15 m in order to better capture local-scale effects due to pumping.
- **Geologic Layering:** A review of borehole logs relative to model layering indicates that the field data is in good agreement with the pre-existing model elevations for deeper units A3, C3 and A4, with most unit "pick" elevations being within +/- 5 m of their model counterpart. No updates are deemed necessary for these layers. However, some minor updates to UC, A1, C1 and A2 are warranted in localized areas of Midhurst (Figure 5).
- **Hydraulic Conductivity:** Recent aquifer testing provides additional estimates of transmissivity for A3 and A4. This data is compared to the existing Midhurst and nearby Snow Valley pumping test results to determine a revised "average" for a sub-regional area encapsulating Midhurst (Figure 5).
  - **Aquifer A3:** The hydraulic conductivity of A3 is increased slightly from 2.3E-4 m/s to 3E-4 m/s.
  - **Aquifer A4:** Prior to the recent testing there were no local estimates of hydraulic conductivity for A4, hence the original value was assigned based on regional estimates. However, aquifer testing indicates that in Midhurst aquifer A4 is more transmissive than previously assumed and the hydraulic conductivity is increased from 6E-5 m/s to 3E-4 m/s.
- **Connection to Surface Water:** Aquifer testing did not reveal the potential for hydraulic connection between the pumping in deep Aquifers A3/A4 and surface water features. Water levels in Aquifer A1 did not decrease and gradients were not reversed as a result of the 72-hour pumping tests. This observation was considered when reviewing the modelled long-term impact of pumping at full build-out. Based on the field testing results, it was anticipated that any simulated potential impacts to surface water features from the deep pumping would take months or even years to propagate (this was later confirmed during the Future Conditions Assessment – Section 6.2).

5.0 MODEL CALIBRATION

The original (2004) Kempenfelt Bay model was calibrated to steady-state conditions. As such, the modelled stream baseflows reflected average yearly conditions. This was a reasonable approach as the goal of the 2004 modelling was to delineate WHPAs for wells screened in deep, confined aquifers; as such the behaviour of surficial aquifers and groundwater / surface water interaction was not a central focus.

For this current assessment it is important to more accurately depict seasonal stream flow fluctuations in order to understand how additional pumping may affect baseflow throughout the year. This is especially the case during the summer months when the dual effect of increased groundwater demand and decreased surface water discharge may accentuate baseflow losses.

As a result, the Existing Conditions model is calibrated in transient mode to Willow Creek monthly baseflow. In addition to improving the understanding of groundwater / surface water interaction in the Midhurst area, the transiently calibrated model serves as the "base case" to assess future effects due to increased pumping.

5.1 Calibration Dataset

The primary source of data for the calibration is continuous flow records for Water Survey of Canada (WSC) flow stations 02ED009, 02ED010, and 02ED032 (Environment Canada, 2012). All three stations are located on Willow Creek (Figure 1). These stations have varying period of records, with the most recent data being collected during 2010 at 02ED032 (Willow Creek at Matheson Creek).

The estimated watershed surplus, total measured stream flow and baseflow for each station is shown on Figure 6. The computer-based BFLOW algorithm (Arnold et al., 1995) is used to separate the baseflow (i.e., groundwater) portion of the total measured stream flow. The monthly baseflow estimates provide the targets for the transient model calibration.

5.2 Parameter Adjustment

Model parameters are refined in the areas of: 1) recharge rates; 2) surficial hydraulic conductivity assignments; 3) constant head constraints; and 4) storage parameters.

5.2.1 Recharge Rates

The 2004 model simulated average Willow Creek baseflow (110,000 m^3/d) is lower than the field-estimated average (156,000 m^3/d) at station 02ED032. This model under-prediction is in part due to the original calibration dataset being limited to low flows during summer, which would tend to bias baseflows to the low end of the measured range. Recharge rates in the original model range from 125 mm/yr to 230 mm/yr (see Figure 4.4 of Golder and WHI, 2004[1]); considerably lower than rates published in the more recent Barrie Tier Three study, which shows large areas of Willow Creek watershed with recharge in the 300 mm/yr to 600 mm/yr range (AquaResource, 2012).

Recharge rates are increased and a new recharge distribution is established to more accurately simulate measured baseflows (Figure 7). The revised distribution is refined through a concurrent review of surficial soil permeability and baseflow measurements at the three WSC stations. A satisfactory yearly average condition is first obtained; then, for monthly inputs, the yearly average recharge rate is pro-rated according to monthly surplus at the Barrie Water Pollution Control Centre (Environment Canada Climate Services, 2012) to approximate seasonal variation (Figure 7).

5.2.2 Hydraulic Conductivity

In tandem with increasing recharge rates, the surficial materials / hydraulic conductivity assignments (Layers 1 through 3) are reviewed. It is found that, in the original model, the surficial material within 500 m of Willow Creek from Little Lake westward to Minesing is typically assigned a hydraulic conductivity reflective of silty or clayey materials, whereas the majority (over 80%) of MOE WWIS logs indicate sand and/or gravel material at surface to

a depth of 3 m or greater. Thus the UC/A1 hydraulic conductivity within +/- 500 m along Willow Creek is increased locally up to 3E-4 m/s (the regional upper bound hydraulic conductivity for A1).

5.2.3 Constant Head Constraints

The original model has Willow Creek and Matheson Creek constant head nodes as unconstrained. This results in the streams being (potentially) both gaining and losing streams, depending on the surrounding groundwater elevation. In general, and as expected, the streams act primarily as discharge locations. However, in upland areas, streams defined as constant head could artificially sustain the water table at ground surface and recharge the system with unrepresentative volumes of groundwater.

For the current analysis, the Willow Creek and Matheson Creek constant head nodes are constrained to be "discharge only". This is consistent with the Creek's conceptual roles as groundwater discharge zones and improves the calibration to monthly baseflows, particularly at flow station 02ED009, which primarily reflects the upland catchment of Willow Creek.

5.2.4 Storage Parameters

The transient simulation requires input of groundwater system storage parameters. Table 2 lists the specific storage value applied for each hydrostratigraphic unit. The specific storage value of 2E-4/m for A2, A3 and A4 is consistent with aquifer test results. The specific storage value of 1E-4/m for C1, C2, C3 and C4 is an assumed input based on listed values for dense gravel to clayey materials that range from 4.9E-5/m to 2.6E-3/m (Batu, 1998). The specific storage value for UC and A1 (Layers 1 through 3) of 3E-4/m is developed through the calibration process.

An effective porosity of 0.25 is used for capture zone development.

5.3 Calibration Results

5.3.1 Transient Simulations

The final simulated versus field estimated (average) monthly baseflows are compared on Figure 8. The model captures the rise and fall of baseflow in accordance with seasonal climate patterns. Simulated discharge is typically within 10% of observed, indicating a reasonable match.

5.3.2 Steady-State Verification

The updated model is also run in steady-state (long term average conditions) to verify that the groundwater level calibration metrics are still satisfactory by comparing model output to 686 static water levels in the MOE WWIS (Figure 9).

Regional flow patterns (Figure 9) are consistent with past field inferences (see Figure 4.4.1 and Figure 4.4.2 of Golder, WHI, Ainley, 2004). Through the Midhurst area, groundwater flow in the A3 aquifer travels in a southwest direction from the uplands to the northeast, eventually moving in a more westerly direction as the influence of Willow Creek and Minesing Swamp discharge zones propagate to the deeper flow system.

A plot of simulated versus observed water levels and calibration statistics is provided on Figure 9 (see insert). For water levels below the 275 masl range, the model provides a good fit to measured data. Above 275 masl the model tends to underpredict water levels. Most of these higher water levels belong to shallow wells in the uplands northeast of Midhurst. At higher ground elevations (250 m up to 370 m) sub-regional, perched aquifers

(not directly related to aquifer A1) exist that are not explicitly captured in the regional-scale Kempenfelt Bay model and are difficult to calibrate to given the regionally continuous layer structure. However, the coarse representation of these upland areas is not considered an issue as the focus of this assessment is on baseflow changes at Willow Creek (lowland area) and drawdown in deep aquifer units (A3 / A4).

5.4 Calibration Summary

Through the calibration process the recharge rates, hydraulic properties of the geologic units and simulated flow patterns are found to be in satisfactory agreement with available field data. The Existing Conditions calibrated model input values are therefore considered to represent reasonable estimates for use in the assessment of Future Conditions. In particular, the calibrated model is considered sufficiently accurate for its ultimate purpose as an impact assessment tool given that:

- The focus of data collection and model refinement occurs in the area with the most pumping and potential for impact (Midhurst);
- Baseflow is evaluated at three “real world” stream gauges broadly positioned along Willow Creek upstream, adjacent to, and downstream of the proposed pumping;
- A high-degree of correspondence is demonstrated between average measured monthly baseflows and simulated monthly baseflows at these stream gauges during transient calibration.

6.0 FUTURE CONDITIONS ASSESSMENT

An assessment of the proposed Neighbourhoods water taking is undertaken for Future Conditions using the forecasted pumping rates listed in Table 1/Figure 3. The following measures are analyzed:

- Drawdown;
- Well interference; and
- Transient (monthly) changes to Willow Creek baseflow.

The Future Conditions model is simulated for a period of ten years. Note that the overall pattern of water level change in the model (including minimum and maximums) becomes reproducible year over year between five and ten years.

6.1 Drawdown

Figure 10 illustrates the simulated drawdown in Aquifers A1, A2, A3, and A4. The month of August during the tenth year of simulation time is used to illustrate drawdown, as this is related to an extended period of low recharge and high pumping (and thus greater drawdown). The 1 metre (m) drawdown contour is used to illustrate the lateral extent of drawdown.

The following is noted:

Aquifer A1

The drawdown in Aquifer A1 is relatively small (< 2.5 m). The lateral extent of response ranges from less than 1 km to approximately 4.5 km from the proposed development. A distant drawdown response is simulated east to northeast of the Doran area towards Oro-Medonte; this is in part a result of a relatively high transmissivity A1

overlain by low transmissivity (and hence lower recharge) UC material in this area. The greatest amount of vertical drawdown in Aquifer A1 emanates from the TW22 / TW19 area. Drawdown here appears to be accentuated by localized thinning of underlying aquitard units.

Aquifer A2

The drawdown in Aquifer A2 is also small (< 3 m), although the lateral drawdown extents have broadened as influence from the underlying municipal well pumping in A3 becomes more prominent.

Aquifer A3

The greatest drawdown occurs in Aquifer A3, where the majority of municipal pumping occurs. The high transmissivity of Aquifer A3 limits vertical drawdown in spite of high pumping rates; however, this same characteristic allows for a broad regional propagation of lateral drawdown. Drawdown reaches about 10 m at the Doran Neighbourhood whereas 3 m occurs at the Carson Neighbourhood. The zone of influence reaches a maximum extent of approximately 6 km from the proposed developments.

The zone of influence from City of Barrie pumping merges with that at Carson and Doran to produce a regionally continuous drawdown. The superposition results in a maximum drawdown of less than 2 m where the two responses merge.

Aquifer A4

Drawdown in Aquifer A4 is similar in extent to Aquifer A3. This is in part a reflection of the occasional absence or thinning of intermediary confining unit C3 throughout the Midhurst and Barrie areas (in other words, A3 and A4 combine into one aquifer). However, the maximum vertical magnitude of the drawdown is less than that in A3, with a maximum of about 7.5 m occurring at the Carson Neighbourhood. Local to TW34, an isolated 1.5 m of drawdown is simulated; the minor drawdown at this location is in part a result of its relatively low pumping rate.

6.1.1 Municipal Well Interference

Simulated well interference at surrounding municipal systems due to pumping at the Neighbourhoods is minimal and not anticipated to cause issues with well performance. The greatest amount of well interference occurs at the Midhurst and Paddy Dunn's Circle wells; where up to 1.7 m of additional drawdown is simulated. The remaining municipal well systems, including City of Barrie and Snow Valley, experience less than 1 m of additional drawdown as a result of Carson and Doran Neighbourhoods pumping, which is considered negligible from an operational standpoint.

6.1.2 Barrie Municipal Wells Safe Additional Available Drawdown (SAAD)

Safe additional available drawdown (SAAD) is defined as the additional drop in water level within a pumping well that could be sustained and still maintain that well's allocated pumping rate. A SAAD analysis was conducted for the Barrie municipal wells as part of the risk assessment portion of the Barrie Tier Three Study (AquaResource, 2013). The following is noted from that study:

- Under normal, current operating conditions the SAAD for Barrie pumping wells ranges from 17 m to 76 m.
- Under "diminished", current operating conditions – which may temporarily occur due to decreases in well efficiency from clogging of the well screen and aquifer materials – the SAAD for Barrie pumping wells ranges from 5 m (at Well 11) to 71 m. The Barrie well operators usually have sufficient time to temporarily

re-allocate pumping and shut a well down for rehabilitation; hence the SAAD for diminished conditions is not considered a strict limitation but rather a precautionary evaluation.

- The SAAD for the aquifer area adjacent to the wells – or the water level available above the top of the aquifer unit to maintain a confined response to pumping – ranges from 22 m to 56 m.
- Simulated drawdown that might occur under various *future* climate / demand risk assessment scenarios is presented. In each instance, the simulated drawdown still falls within the SAAD limits. Well 11 is the only well that exceeds the SAAD, and only under diminished well conditions. Note that this SAAD exceedance is simulated to occur prior to (or independent of) any additional drawdown imposed by Carson and Doran water takings.

Based on the findings above, the additional < 1 m of drawdown imposed by the Carson and Doran water takings at the City of Barrie municipal wells is considered acceptable and does not significantly add to water quantity risks.

6.2 Willow Creek Baseflow Changes

Figure 11 illustrates the Future Conditions simulated changes to monthly baseflows relative to Existing Conditions at the three Willow Creek flow stations. Also included in the chart is the Future Conditions total demand for the Midhurst area for reference.

The illustrated baseflow changes are a function of recharge and water demand. There is a seven month or longer day delay between pumping increase/decrease and associated baseflow response (see chart on left of Figure 11). Baseflow losses as a percent of Existing Conditions baseflow rates are amplified during summer months when recharge is lower and hence baseflow is minimized (see chart on right of Figure 11).

Geographically, the extent of baseflow losses occurs broadly from upstream of Little Lake downstream to Minesing Swamp; there are no highly localized areas of upwelling that are simulated as being discretely or uniquely impacted. The percentage baseflow loss is under 10% for all flow stations. The largest percent baseflow loss (about 9%) occurs at the Midhurst WSC station 02ED010 towards the end of summer; this is a result of the station's proximity to the source of pumping and the relative size of its catchment. The Willow Creek catchment in its entirety experiences within 3% to 7% baseflow loss depending on the time of year.

For context, the *Water Budget and Water Quantity Risk Assessment Guide* (MNR and MOE, 2011) defines an unacceptable impact to coldwater streams as a circumstance where groundwater discharge is reduced by more than 20% as compared to the average monthly baseflow of the watercourse, specifically the following is stated in this reference:

For coldwater streams, an unacceptable impact is defined by a circumstance where groundwater discharge is reduced by more than 20% as compared to the existing estimated monthly streamflow Qp80 (the flow that is exceeded 80 percent of the time) or the average monthly baseflow of the watercourse or another threshold that has already been defined as a condition in an existing permit. [Note: As described previously the modelling considers average monthly baseflow].

A discussion of the potential effect of these baseflow losses on natural environment receptors in the Willow Creek subwatershed is provided in the Hutchinson Environmental Sciences Report entitled *7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment*

(HESL, 2018). HESL concluded that "the predicted flow reductions in Willow Creek and its tributaries associated with the proposed water taking to supply the Midhurst Secondary Plan Area will have no adverse effects on habitat and water temperature in Matheson, Black and Willow Creeks." (HESL, 2018).

About 80% to 90% of the Midhurst area water taking is derived from the Willow Creek watershed. The remaining water taking is mostly sourced from the Nottawasaga River watershed (5% - 10%) or directly from Kempenfelt Bay (5% - 10%).

7.0 CAPTURE ZONES

Capture zones for the existing Midhurst and Paddy Dunn's Circle wells and the future Carson and Doran Neighbourhood wells are determined for the 2-year, 5-year, 10-year and 25-year time-of-travel using backward particle tracking in FEFLOW (Figure 12). Close proximity wells with similar capture zones are enveloped into a single capture zone in some cases. The capture zones are derived using Future Conditions average pumping rates and a steady-state (long-term yearly average) head distribution (Figure 12).

The capture zones reflect 2D projections to ground surface and do not necessarily account for vertical travel time. This conservative approach is frequently used to define capture zones for water supply systems in Ontario. The actual travel time for source water entering the groundwater table to reach the wells may be longer than illustrated as aquifers A3 and A4 are deep units residing beneath lower permeability aquitards.

The capture zones produced in this analysis provide the current best estimate of 2D well capture. After the water supply system design is finalized these capture zones may form the basis for Wellhead Protection Area (WHPA) delineation. At this time an uncertainty analysis may be incorporated into the results in order to provide an additional buffer for wellhead protection purposes.

7.1 Midhurst and Paddy Dunn's Circle Systems

Capture zones for Midhurst and Paddy Dunn's Circle wells are projected from Aquifer A3. The 25-year capture zones for the Midhurst Idlewood Drive and Greenpine wells extend about 3 km in an east to northeasterly direction, eventually bordering on the capture zone for TW21 / TW24. The Carson Road Well 4 and Paddy Dunn's Circle Wells 25-year capture zone travels approximately 3 km in a northeasterly direction.

7.2 Carson Neighbourhood

Capture zones for the Carson Neighbourhood are projected from Aquifer A4. The 25-year capture zone of TW22 extends about 3 km to the east. The 25-year capture zone for TW34 travels about 1 km south towards a groundwater high in the Snow Valley upland area.

7.3 Doran Neighbourhood

Capture zones for the Doran Neighbourhood are projected from Aquifer A3. The capture zones for the Doran Neighbourhood wells are oriented northeast as a result of the regional flow system emanating from the upland areas towards Oro-Medonte. The 25-year capture zone for the Alliance Wells extend approximately 4.5 km while the 25-year capture zone for TW21 / TW24 reaches about 3.5 km in length.

8.0 AQUIFER VULNERABILITY

The Aquifer Vulnerability Index (AVI) is a method for mapping the susceptibility of an aquifer to surficial contaminants. The AVI assigns a score based on two key parameters: 1) the thickness of each geologic unit above the aquifer; and 2) the hydraulic conductivity of each of these units.

An AVI analysis was completed by Golder for the South Georgian Bay Lake Simcoe Source Protection Region (Golder, 2010). A review of the mapping indicates that water supply aquifers A3 and A4 would remain classed as "low vulnerability" in the area of the capture zones described in Section 7. This classification is consistent with drilling observations recorded as part of Golder's recent water supply investigation that indicate substantial thicknesses of clayey materials overlying aquifer A3.

9.0 PERMIT TO TAKE WATER CONSIDERATIONS

All water takings in Ontario exceeding 50 m^3/day are required to obtain a Permit To Take Water (PTTW) from the MOECC. The Neighbourhood's future construction activities and proposed water supply will require PTTWs prior to operation, although the initial water supply permit request may be for significantly less water than reported herein as the subdivision will not be at full build-out. The groundwater model will be an important tool during the permitting review and approval process. In addition, and in consultation with the MOECC, a monitoring program may be instituted to ensure that private water supplies and surface water features are not adversely impacted by the water taking.

10.0 LIMITATIONS

10.1 Use of This Report

This report has been prepared by Golder Associates Ltd. (Golder) for use by The Midhurst Landowner's Group or its agents. The factual information, descriptions, interpretations, comments, results, conclusions and electronic files contained herein are specific to the project described in this report. Information used in this report should be restricted to that specified in the scope of work unless otherwise mutually agreed upon by The Midhurst Landowner's Group and Golder. This report should be read in its entirety as some sections could be falsely interpreted when taken individually or out-of-context. Golder is not responsible for any use of this report and its content by a third party, and/or for its use for purposes other than those intended.

Golder is not responsible for any damages that may result from unpredictable or unknown underground conditions, from erroneous information provided by and/or obtained from sources other than Golder, and from ulterior changes in the site conditions unless Golder has been notified of any occurrence, activity, information or discovery, past or future, susceptible of modifying the underground conditions described herein, and have had the opportunity of revising its interpretations. In addition, Golder is not responsible for any decrease of a property's value or any failure to complete a transaction as a consequence of this report.

10.2 Groundwater Modelling General Limitations

Hydrogeological investigations and groundwater modelling are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological system is changing with time and the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that field data provides a fraction of information for the site or model domain; as such a truly complete, comprehensive

characterization of the groundwater system is not possible. Therefore, every groundwater model is, by necessity, a simplification of a reality.

The professional groundwater modelling services described in this report are conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions. The results of previous or simultaneous work provided by sources other than Golder and quoted and/or used herein are considered as having been obtained according to recognized and accepted professional rules and practices, and therefore deemed valid.

The model presented herein provides a predictive scientific tool to evaluate the impacts of specified hydrological stressors on a real groundwater system and to compare various scenarios in support of a decision-making process. The model's accuracy is bound to the normal uncertainty associated to groundwater modelling and no warranty, express or implied, is made.

11.0 CLOSURE

A hydrogeological assessment of the proposed Carson and Doran Neighborhoods groundwater supply system is conducted using the Kempenfelt Bay FEFLOW model. An Existing Conditions model scenario is refined and further calibrated in Midhurst and greater Willow Creek watershed areas in accordance with recent drilling, aquifer testing, and stream flow data. Subsequently, a Future Conditions model simulates anticipated water taking at full build-out. Drawdown, well interference, baseflow changes, capture zones and Aquifer Vulnerability Index (AVI) status are assessed. A summary of the Future Conditions assessment results is provided below:

- The additional Carson and Doran water takings result in drawdowns of up to 10 m in Aquifer A3 in the area of the Doran Neighborhood, with a lateral zone of influence reaching 6 km from the proposed development. Well interference at surrounding municipal systems is minimal (1.5 metres or less) and not anticipated to impact well performance.
- Baseflow reductions at Willow Creek are highest during late summer period. The maximum reduction simulated is about 9% in the Midhurst area. The Willow Creek catchment experiences between about 3% to 7% baseflow loss depending on the time of year.
- Capture zones for the Midhurst and Paddy Dunn's Circle and Carson and Doran Neighbourhood wells are developed by delineating the 2 year, 5 year, 10 year and 25 year capture zones at each well. Most capture zones are directed east to northeast in conformance with regional flow patterns emanating from the Oro-Medonte uplands. The 25-year time of travel zones reach upgradient distances ranging from about 1 km to 4.5 km in length.
- Water supply aquifers A3 and A4 have a "low vulnerability" AVI in the areas of the capture zones.

Report Signature Page

GOLDER ASSOCIATES LTD.





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DAH/JAE/plc

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12.0 REFERENCES

Ainley Group (2009). *Township of Springwater, Class Environmental Assessment Study for the Midhurst Water, Wastewater and Transportation Master Plan, Phase 1 and 2 Report.* 208017. July 2009.

Arnold, J.G., P.M. Allen, R. Muttiah, and G. Bernhardt (1995). *Automated base flow separation and recession analysis techniques*. Ground Water 33(6): 1010-1018.

AquaResource (2013). *City of Barrie Tier Three Water Budget and Local Area Risk Assessment.* Prepared for Lake Simcoe Region Conservation Authority. BarrieT3_RA_15074-527 R-0412 Final. May 2013.

AquaResource (2012). *City of Barrie Tier Three Recharge Estimation Using MIKE SHE Technical Memorandum.* Prepared for Lake Simcoe Region Conservation Authority. 15074-527 Recharge LR-0612.docx. June 2012.

Batu, V., 1998. *Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis*. John Wiley & Sons, New York, 727p.

Environment Canada (2012). Environment Canada, Water Survey of Canada: *Environment Canada Data Explorer V1.2.30 using HYDAT Version 1.0.* November, 2012

Environment Canada Climate Services (2012). *Barrie WPCC Water Budget, 1978 – 2012.* Ordered by Golder in 2013.

Golder (2010). *City of Barrie Source Water Protection Threat Assessment.* 07-1170-0014 (1000). Submitted to City of Barrie. June 2010.

Golder (2008). *Report On Hydrogeological Study, Midhurst Water Supply Exploration Program, Supporting Document, Midhurst Class EA, Township of Springwater, Ontario.* 08-1170-0081. Submitted to: Midhurst Development Doran Road Inc. and Carson Road Development Inc. December 2008.

Golder, WHI and Ainley (2004). *South Simcoe Municipal Groundwater Study.* Prepared for South Simcoe Groundwater Partnership. S41W01. August 2004.

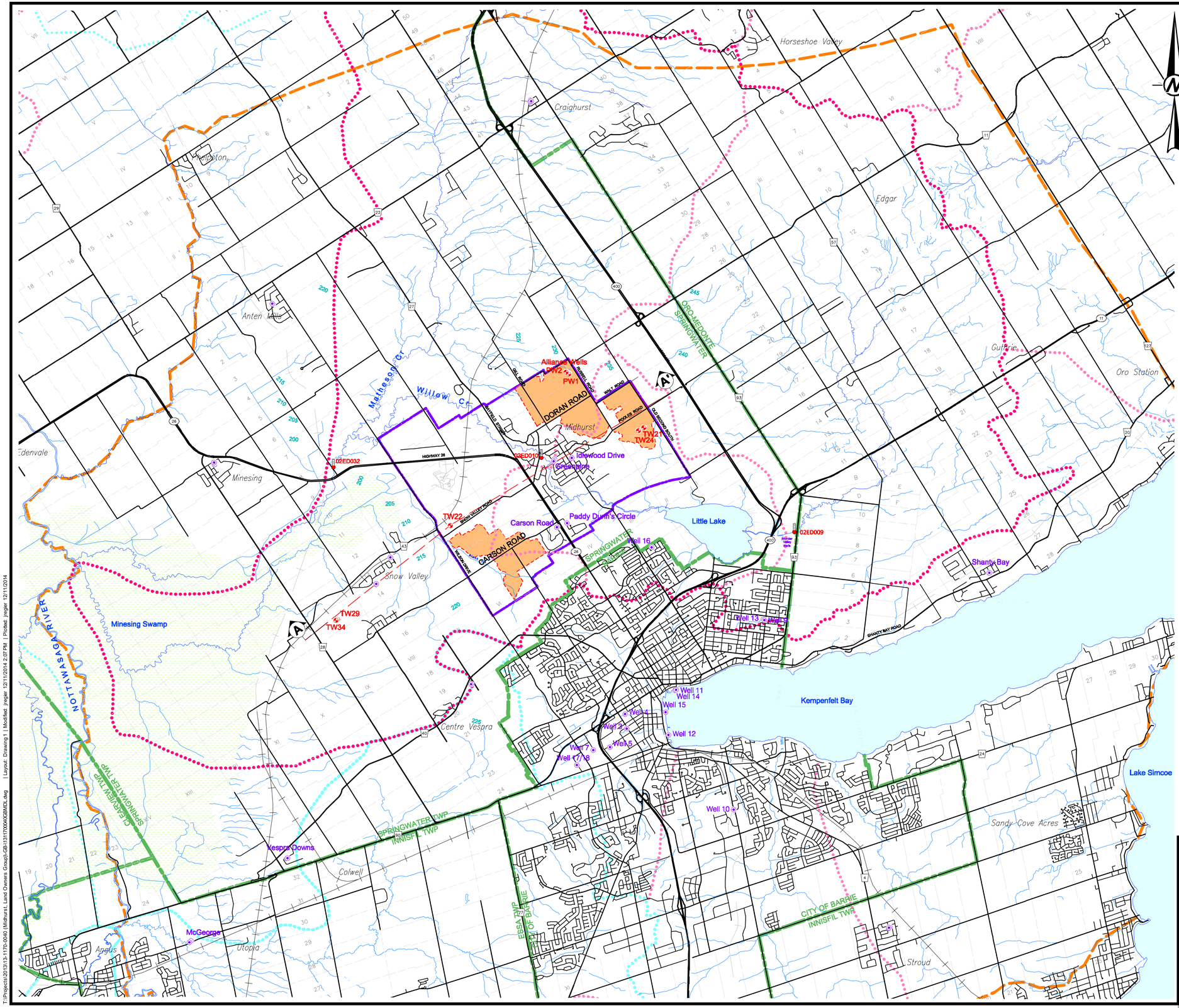
Golder and WHI (2004[1]). *South Simcoe Groundwater Study WHPA – City of Barrie Appendix E*. 04-1112-551. August 2004.

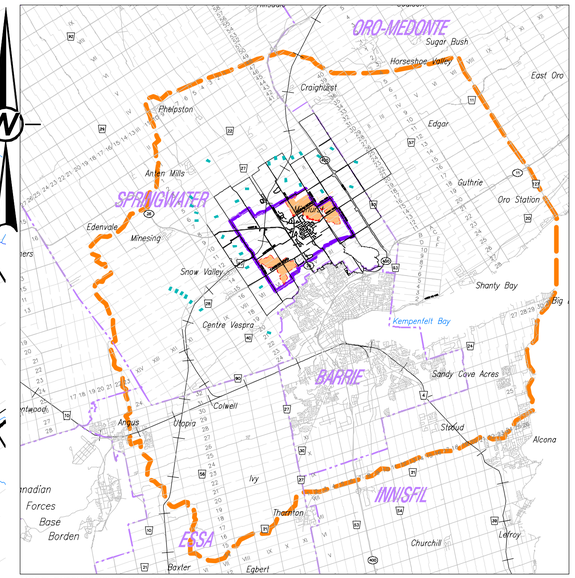
Golder and WHI (2004[2]). *South Simcoe Groundwater Study WHPA – Township of Springwater Appendix L.* 04-1112-551. August 2004.

Hutchinson Environmental Sciences Ltd. [HESL] (2018). *7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment Final Report*. J130030. Prepared for Ainley and Associates Ltd. May 2018.

Ministry of Natural Resources and Ministry of Environment (2011). *Water Budget & Water Quantity Risk Assessment Guide.* Prepared for the Ontario Ministries of Natural Resources and Environment by AquaResource Inc.. Drinking Water Source Protection Program.

FIGURES





MODEL EXTENTS KEY PLAN 1:200,000

LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Model Domain
- Willow Creek Watershed Boundary
- Nottawasaga River Watershed Boundary
- Watershed Sub-Basin
- Minesing Wetland Extents (Approximate)
- Existing Municipal / Public Supply Well
- 2014 Municipal Well Test Site
- 02ED009 WSC Flow Station

0 500 1000 2500 5000

SCALE 1:50000 metres

NOTES

1. Base Map from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013, SCS Consulting
3. Wells are approximate to Survey accuracy, GPS, and or measurement from mapped features.

PROJECT

CARSON AND DORAN NEIGHBOURHOODS GROUNDWATER MODELLING

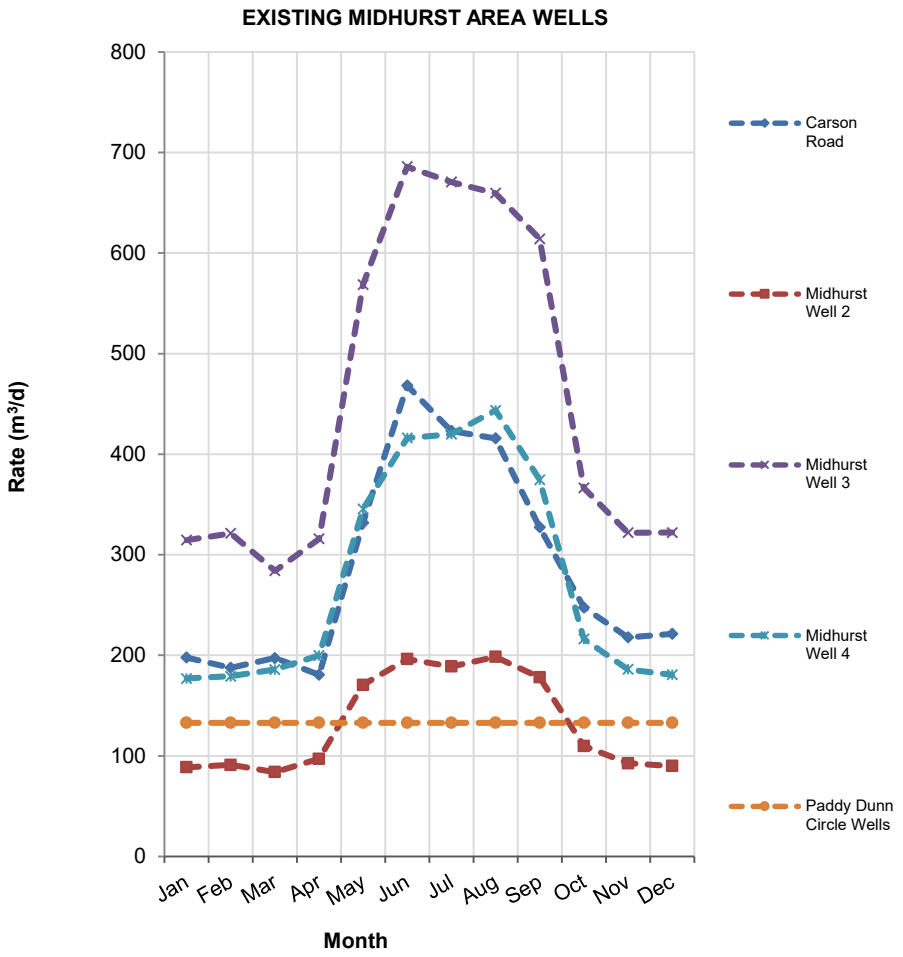
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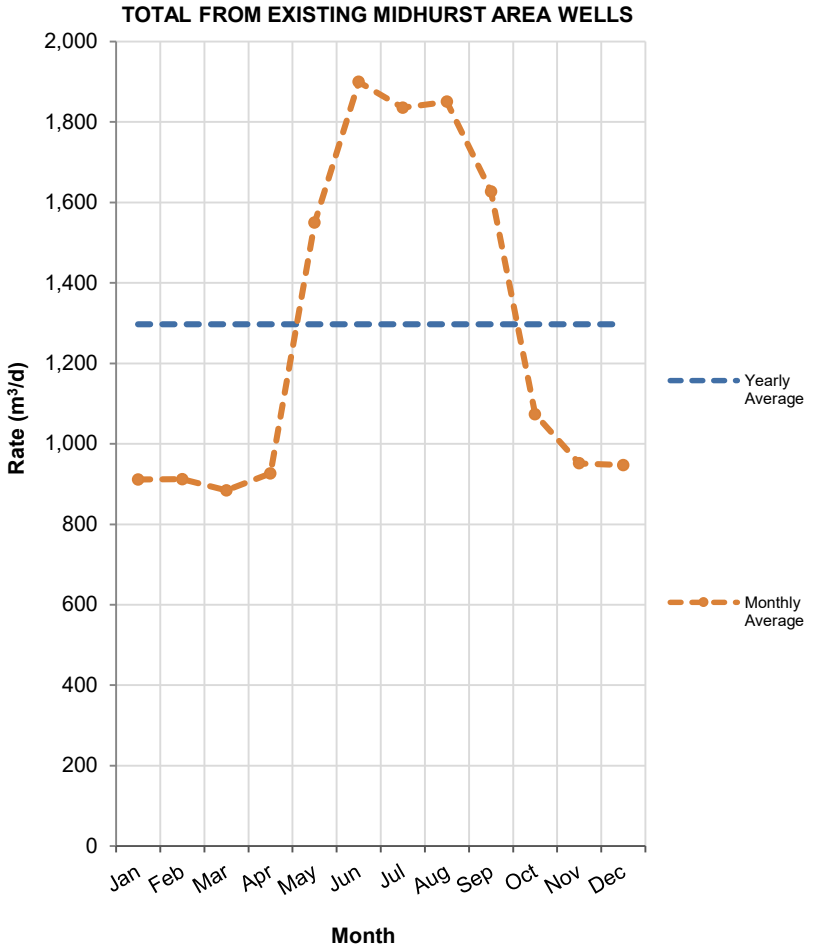
MODEL AREA

Golder Associates

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NOTE

- *Chart shows 2003 to 2010 monthly averages.*
- *Monthly averages for Paddy Dunn Circle wells not available, average rate for year applied equally every month.*

PROJECT

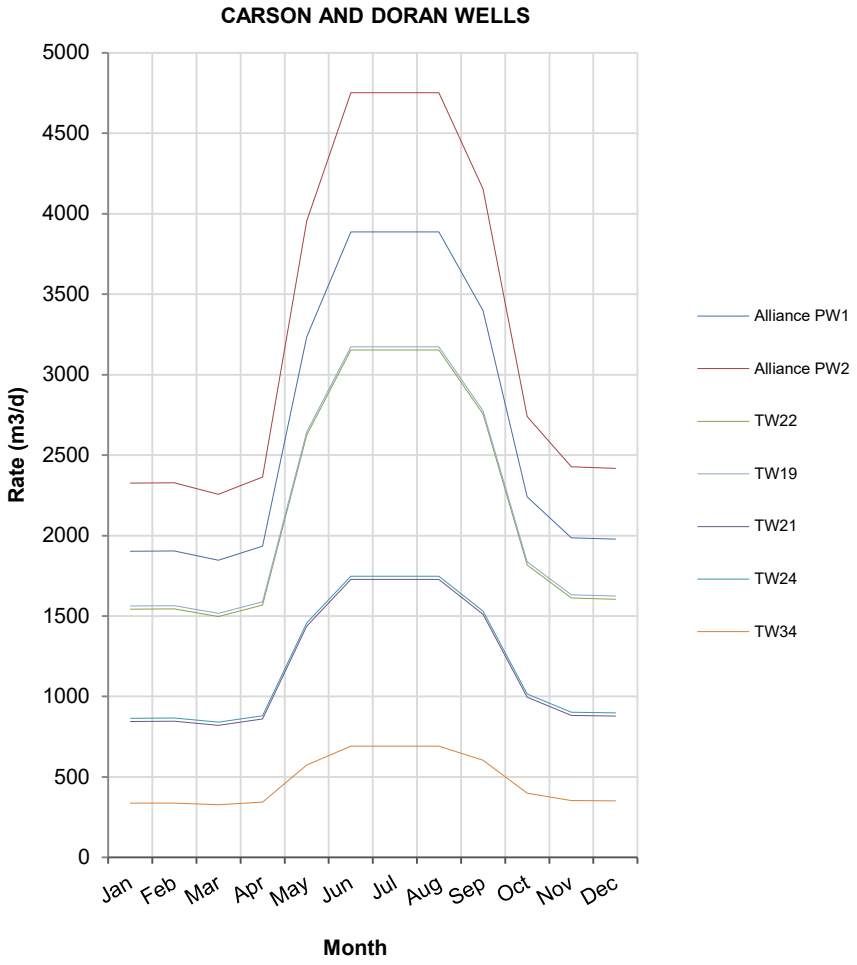
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

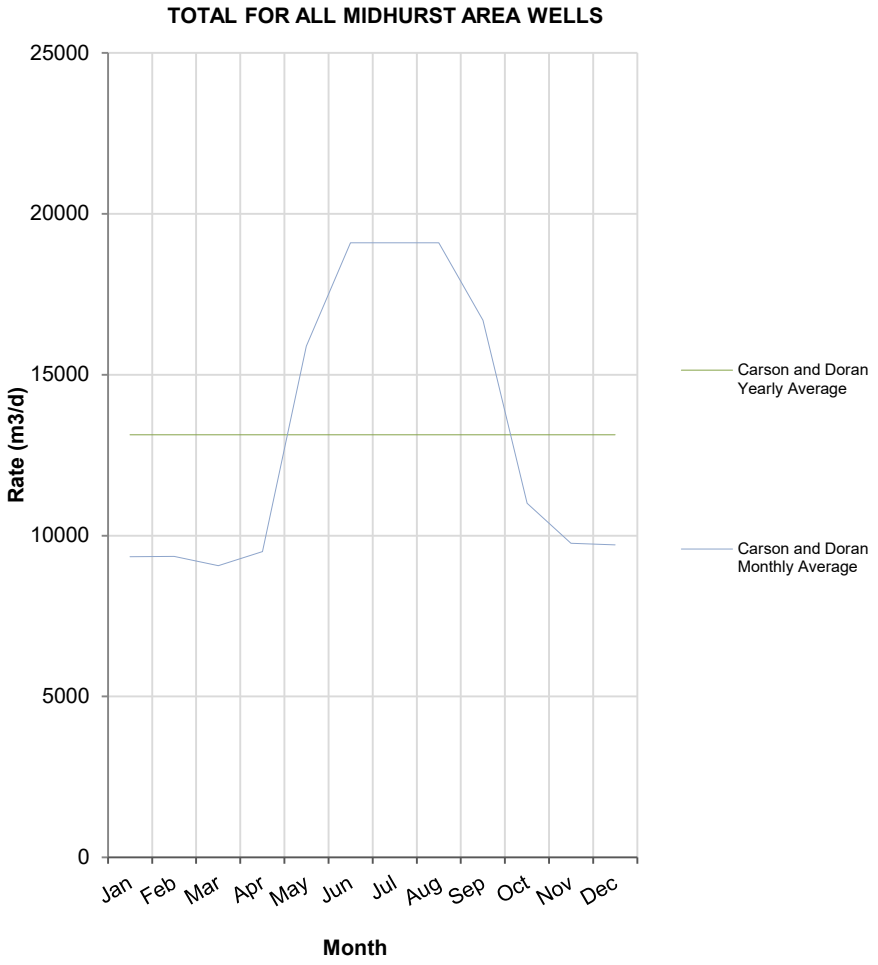
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EXISTING CONDITIONS
MIDHURST AREA PUMPING RATES

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			2
REVIEW			





NOTE

- *Projected total monthly demand at Carson and Doran wells calculated by prorating maximum demand (19,095 m^3/d) in accordance with Existing Conditions demand (Figure 2).*
- *Midhurst and Paddy Dunn's Circle rates for Future Conditions (not shown) are assumed to continue as per Existing Conditions (Figure 2).*

PROJECT

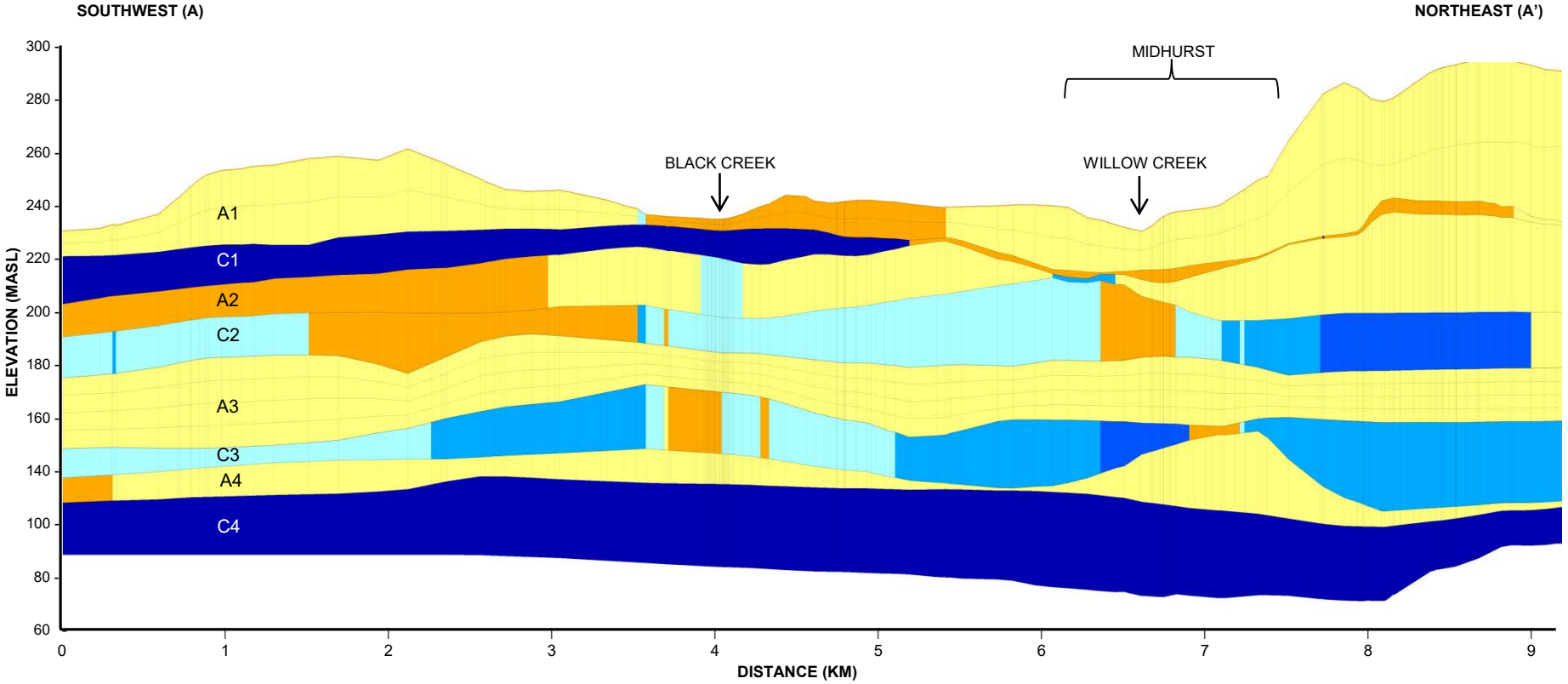
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

FUTURE CONDITIONS
CARSON AND DORAN PUMPING RATES

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	NOV 2015	REV. 1
CAD	AM	NOV 2015	FIGURE
CHECK			3
REVIEW			



NOTE:

- *See Figure 1 for plan view location of cross-section.*

LEGEND

HORIZONTAL HYDRAULIC CONDUCTIVITY (K_H) IN M/S:

- K_H >= 1E-4
- 1E-5 < K_H <= 1E-4
- 1E-6 < K_H <= 1E-5
- 1E-7 < K_H <= 1E-6
- 1E-8 < K_H <= 1E-7
- K_H = 1E-8

PROJECT

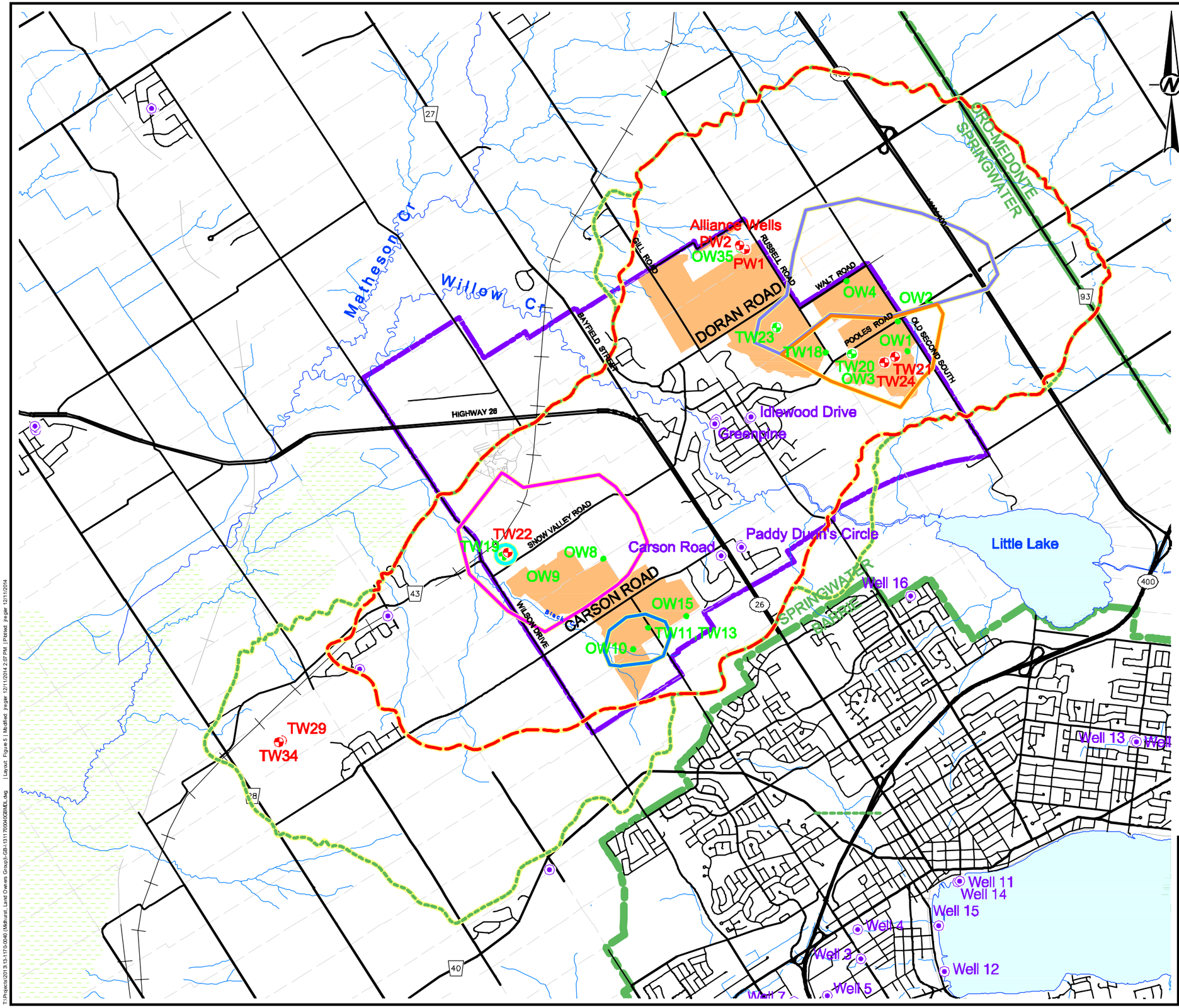
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

MODEL CROSS-SECTION

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			4
REVIEW			



PLAN LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Existing Municipal / Public Supply Well
- Test or Observation Well Site
- Municipal Well Water Supply Test Site

MODEL UPDATE ZONES

- A4 – K increased from 6E-5 m/s to 3E-4 m/s
- A3 – K increased from 2.3E-4 m/s to 3E-4 m/s
- UC (5E-6 m/s) changed to A1 (5E-5 m/s).
  Bottom of A1 raised from about 236 masl to 258 masl towards OW8
- C2 brought up through A2 to C1 (A2 locally thins out)
- Base elevation of A1 lowered from 243 masl to 237 masl
- Bottom of UC raised from ~260 masl to 274 masl.
  Bottom of A1 raised from ~235 masl to 252 masl.
  C1 introduced at 8 m thickness (previously not present)
- Bottom of A1 raised from 233 masl to 241 masl at TW18 to 247 masl TW21.
  C1 introduced at 5 m – 7 m thickness (previously N/P)
  A1 overwrites UC at TW24 and TW21

NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Wells are approximate to Accuracy of GPS and Measurement from known features.

This figure shows model updates that have been implemented as a result of recent drilling and aquifer testing data (Golder, 2014). For model updates resulting from the calibration refer to Section 5 of this report.

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SCALE 1:50000 metres

Plotted 11x17 Landscape

PROJECT

CARSON AND DORAN NEIGHBORHOODS
GROUNDWATER MODELLING

TITLE

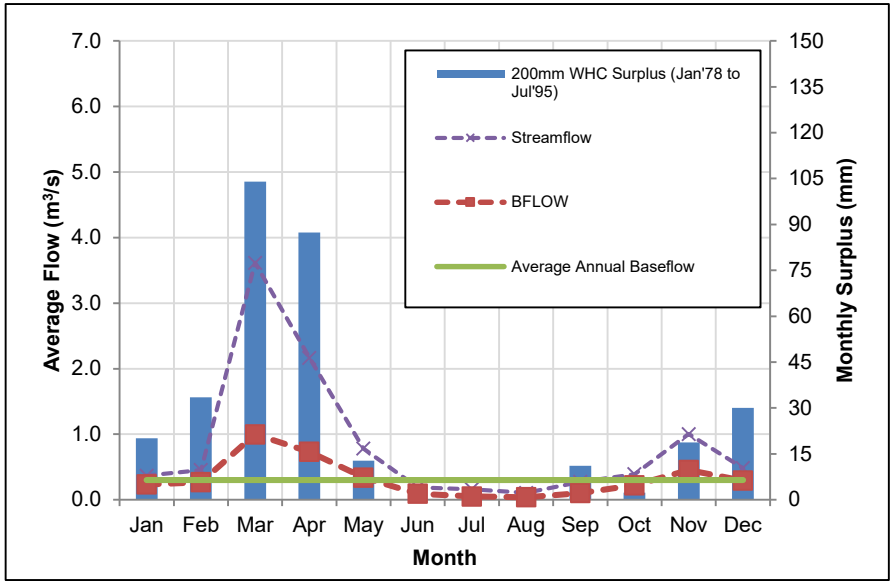
MODEL UPDATE AREAS

Golder Associates

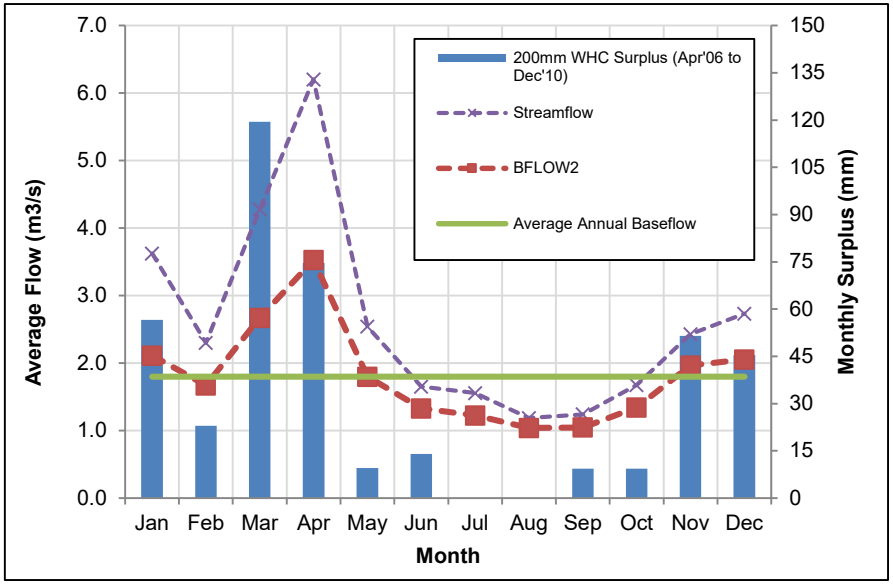
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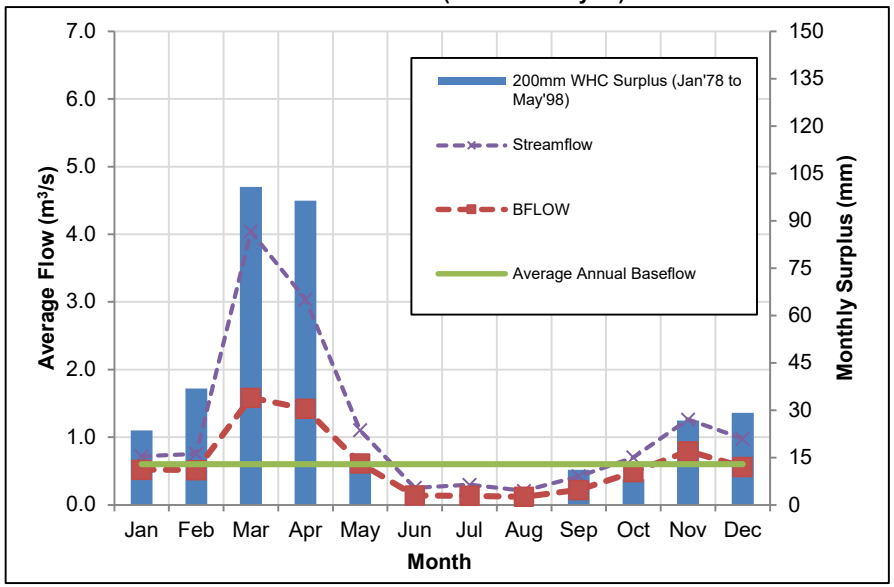
WILLOW CREEK ABOVE LITTLE LAKE (95 km²)
WSC Station 02ED009 (Feb'73 to Jul'95)

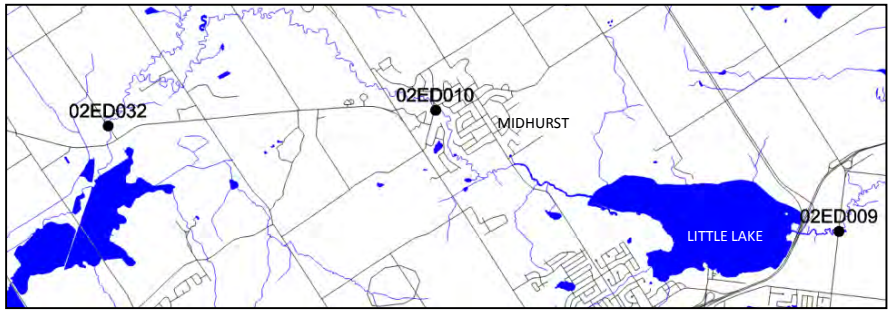


WILLOW CREEK AT MATHESON CREEK (231 km²)
WSC Station 02ED032 (Apr'06 to Dec'10)



WILLOW CREEK AT MIDHURST (127 km²)
WSC Station 02ED010 (Feb'73 to May'98)





PROJECT

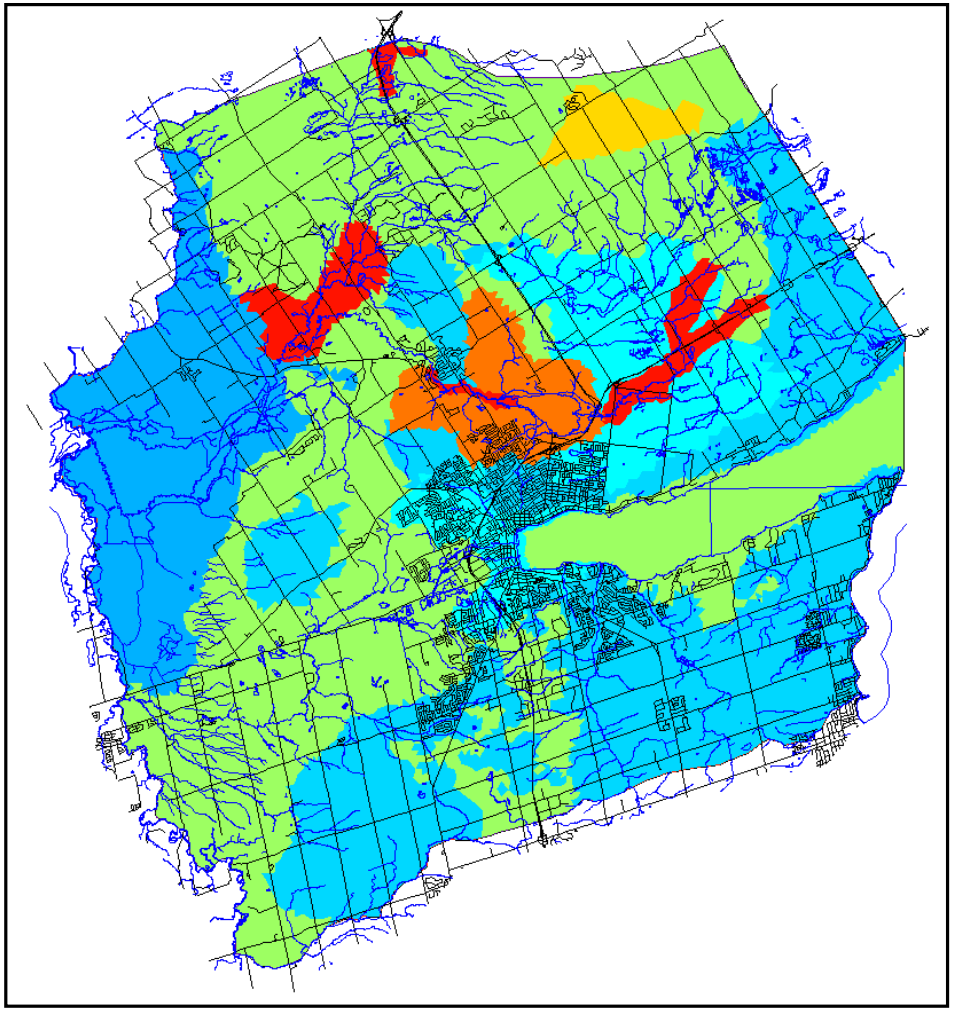
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

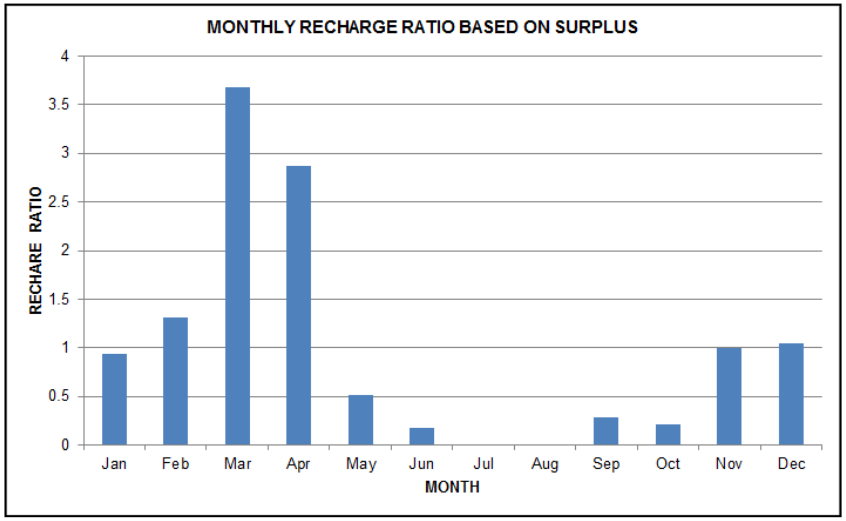
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WILLOW CREEK STREAM FLOW

Golder Associates

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DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			6
REVIEW			





NOTES:

- *In transient simulation the recharge rate at each polygon for each month is determined by multiplying the average recharge rate (see Legend) by the monthly recharge ratio (see above).*
- *Surplus derived from Barrie WPCC monthly averages for period of 1978 – 2012.*

LEGEND

AVERAGE RECHARGE RATE (MM/YR):

- 110
- 140
- 170
- 250
- 390
- 450

PROJECT

CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

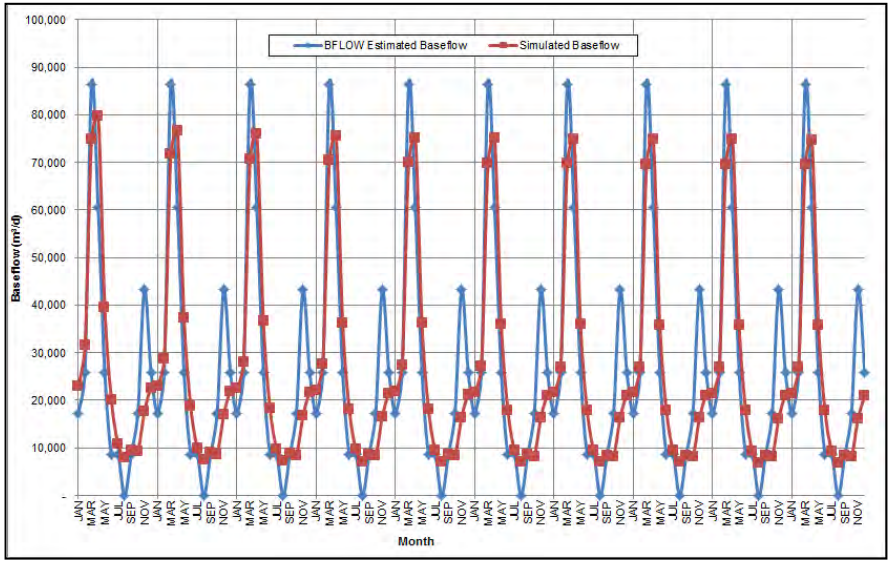
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MODEL RECHARGE DISTRIBUTION

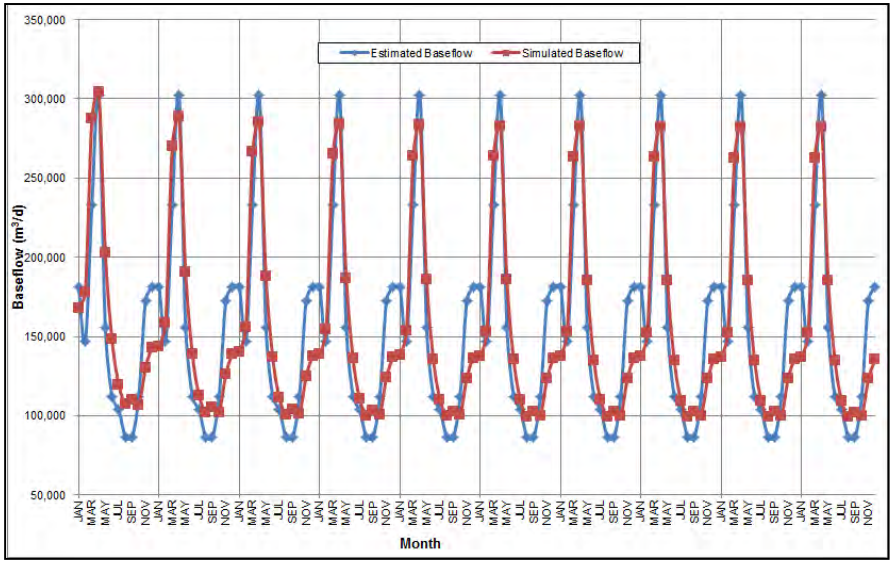
Golder Associates

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REVIEW			

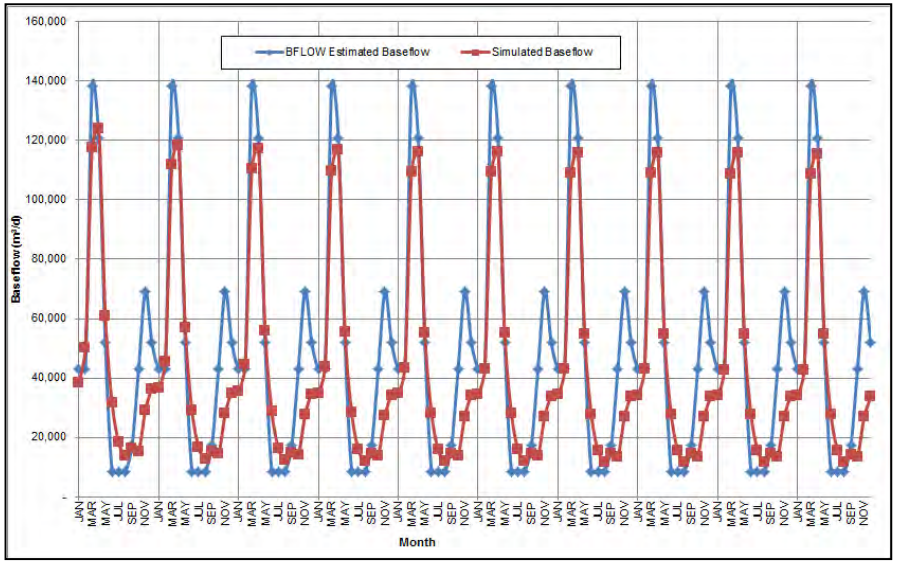
WILLOW ABOVE LITTLE LAKE (95 km²)
WSC Station 02ED009

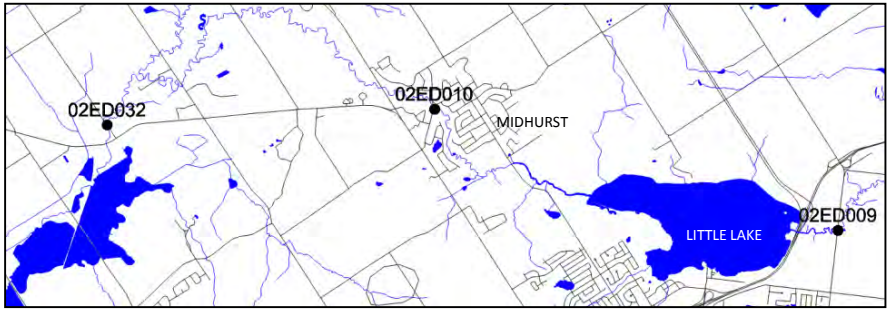


WILLOW AT MATHESON CRK (231 km²)
02ED032 Baseflow Results (Apr'06 to Dec'10)



WILLOW AT MIDHURST (127 km²)
WSC Station 02ED010





PROJECT

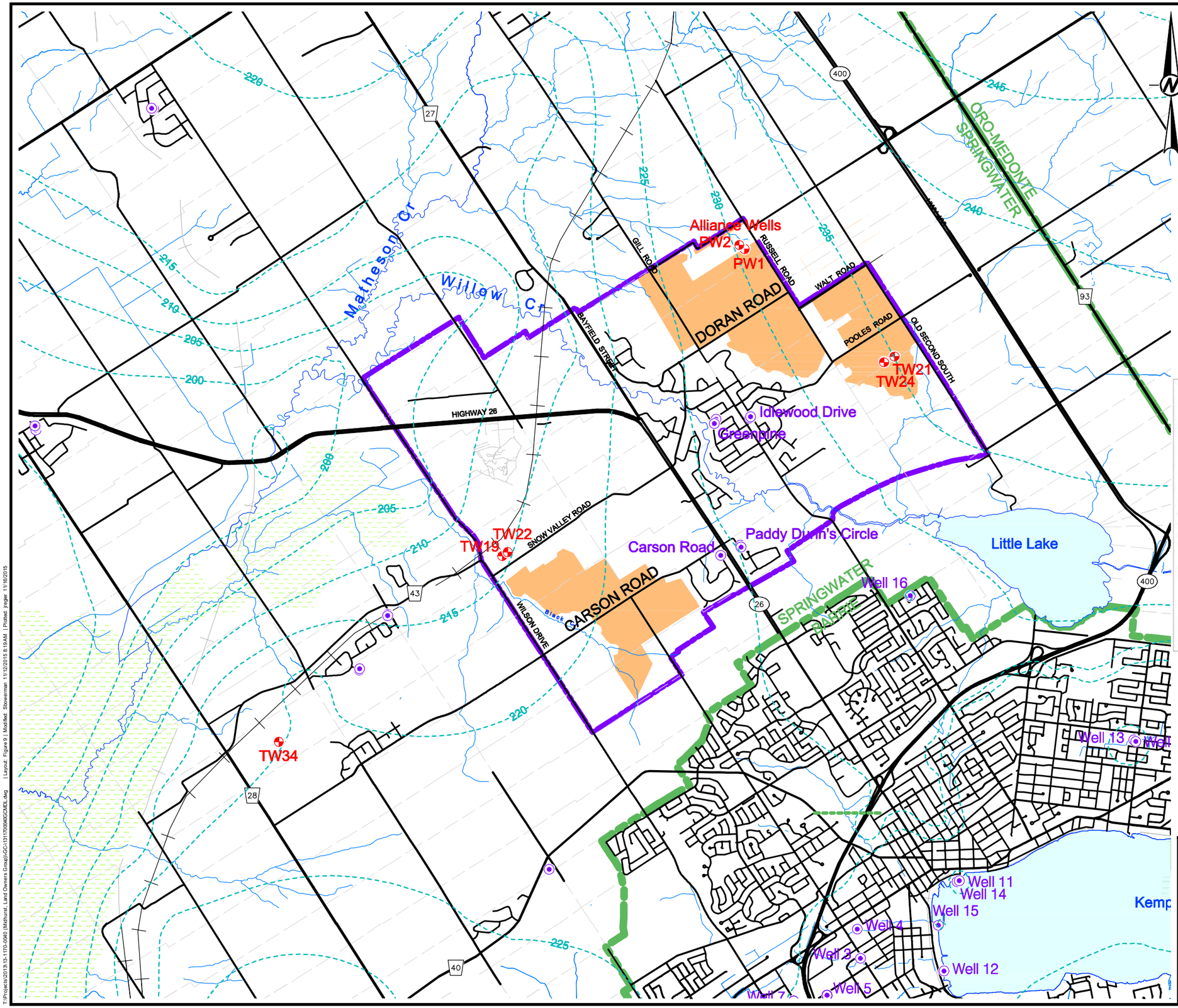
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

EXISTING CONDITIONS
WILLOW CREEK
BASEFLOW CALIBRATION RESULTS

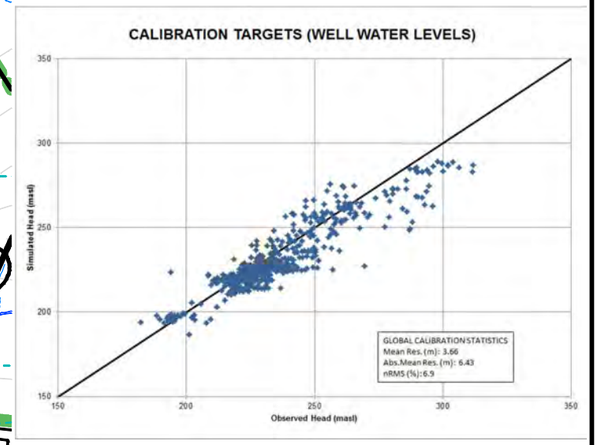
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DESIGN	AM	MAR 2015	REV. 1
CAD	AM	MAR 2015	FIGURE
CHECK			8
REVIEW			



PLAN LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Existing Municipal / Public Supply Well
- Municipal Well Test Site
- Existing Model Conditions Aquifer A3 Head Elevations (masl)



NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Wells are approximate to Accuracy of GPS and Measurement from known features.

This figure shows model updates that have been implemented as a result of recent drilling and aquifer testing data (Golder, 2014). For model updates resulting from the calibration refer to Section 5 of this report.

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SCALE 1:50000 metres

Plotted 11x17 Landscape

PROJECT

CARSON AND DORAN NEIGHBORHOODS
GROUNDWATER MODELLING

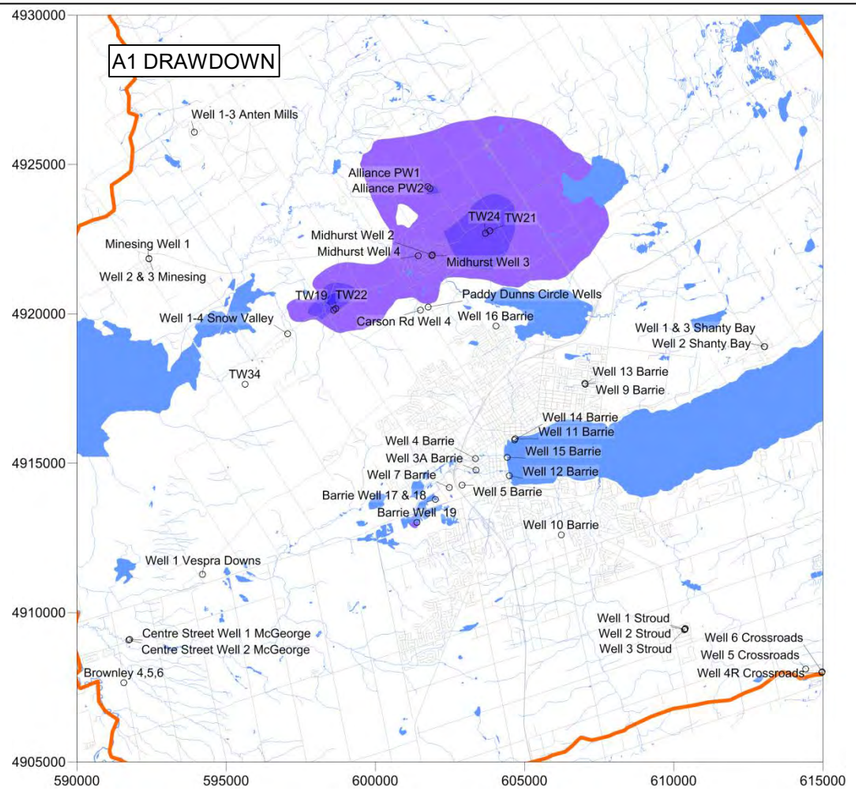
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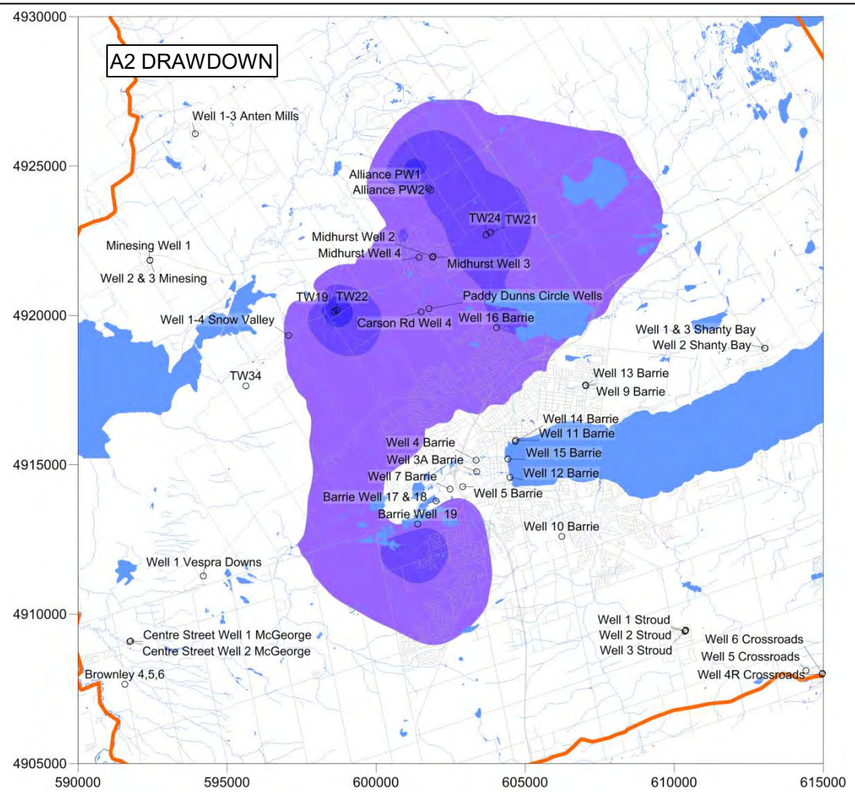
EXISTING CONDITIONS
SIMULATED GROUNDWATER HEAD ELEVATION
AQUIFER A3

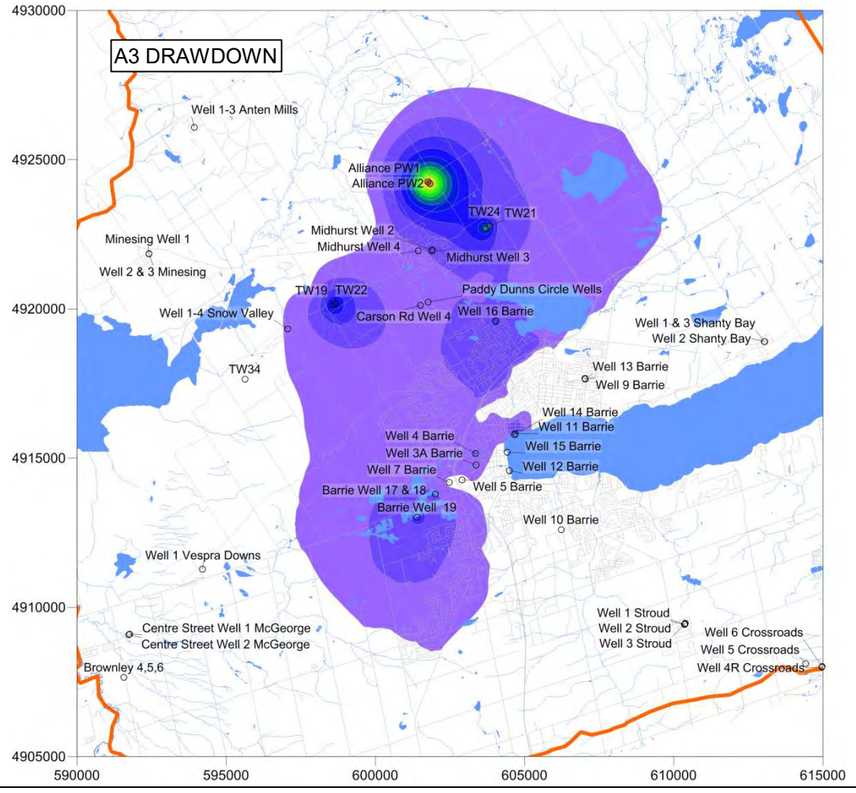
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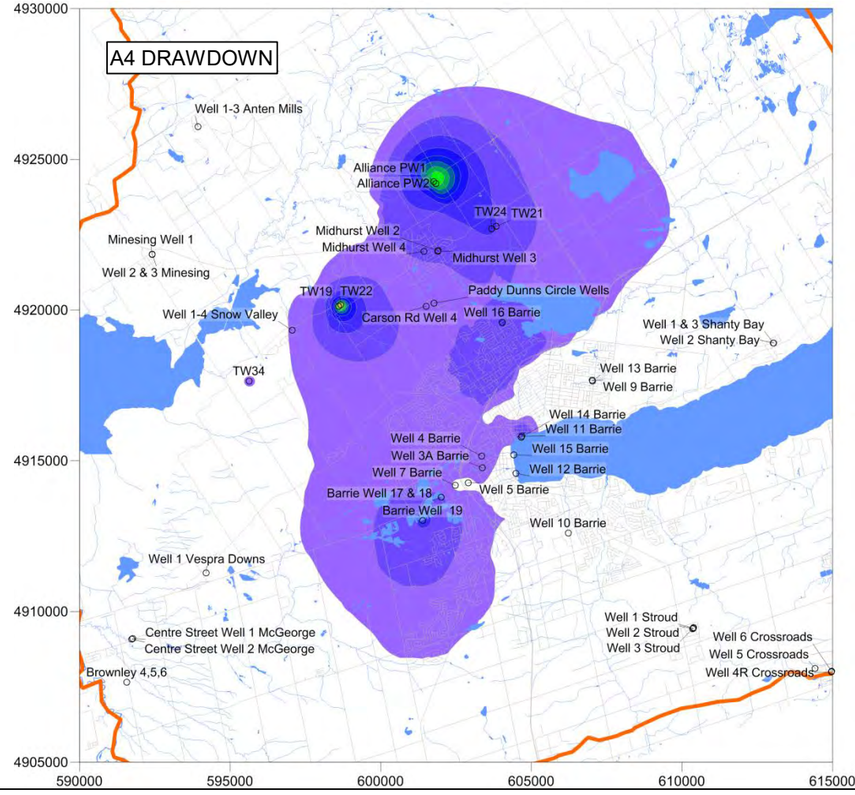
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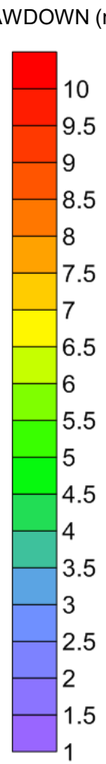
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PROJECT

CARSON AND DORAN NEIGHBOURHOODS GROUNDWATER MODELLING

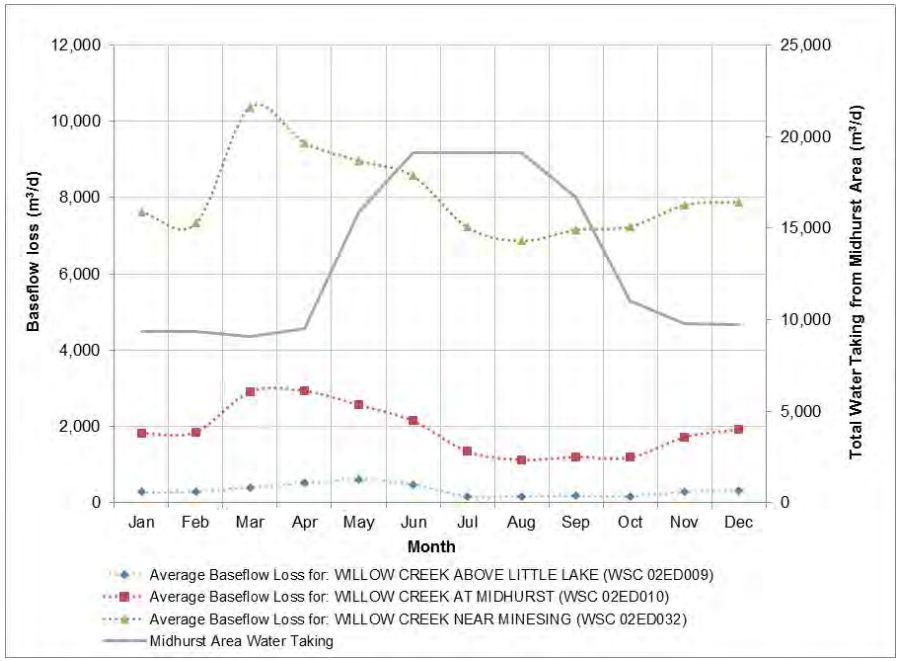
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FUTURE CONDITIONS SIMULATED DRAWDOWN

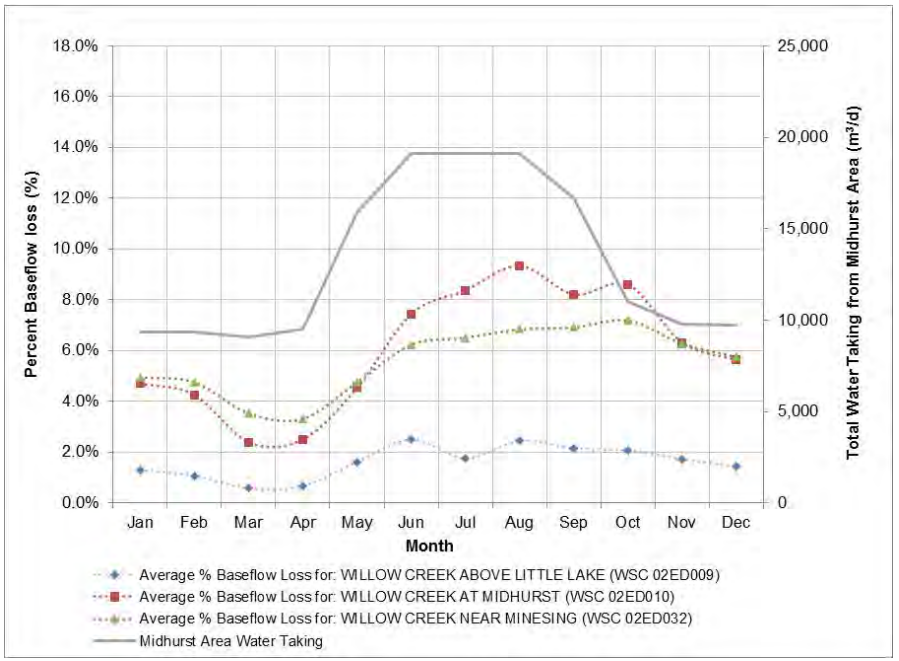
Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
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GIS	AM	NOV 2015	FIGURE
CHECK			**10**
REVIEW			

BASEFLOW LOSS EXPRESSED AS FLOW RATE



BASEFLOW LOSS EXPRESSED AS % OF TOTAL BASEFLOW FOR SUBCATCHMENT



NOTE

- *Monthly rates and percent changes reflect average result for 10-year simulation.*
- *Total Midhurst area pumping includes Carson and Doran Neighbourhoods and Midhurst and Paddy Dunn's Circle municipal well systems.*

PROJECT

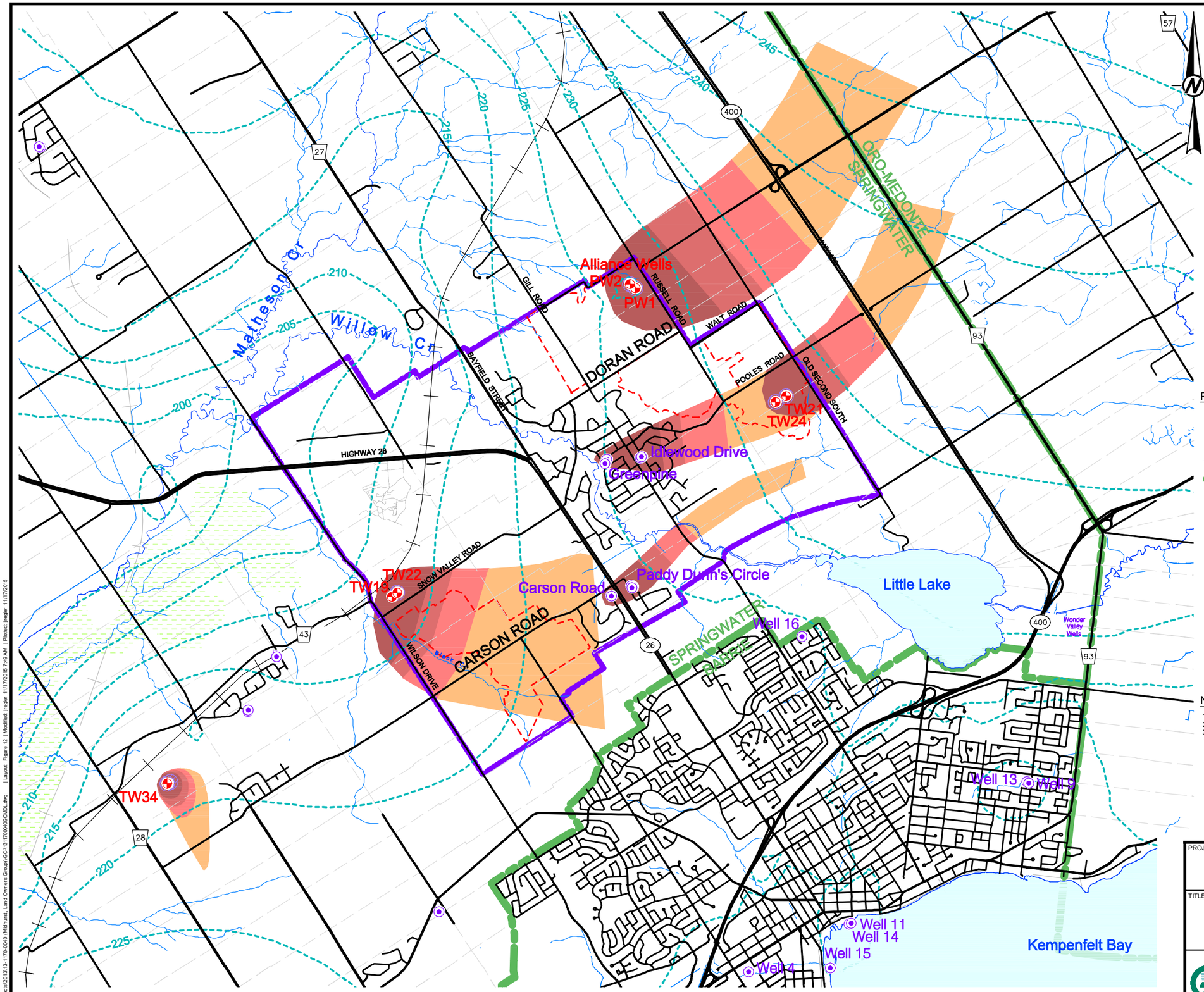
CARSON AND DORAN NEIGHBOURHOODS
GROUNDWATER MODELLING

TITLE

FUTURE CONDITIONS
WILLOW CREEK
SIMULATED BASEFLOW CHANGES

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	AM	NOV 2015	REV. 1
CAD	AM	NOV 2015	FIGURE
CHECK			11
REVIEW			



PLAN LEGEND

- Proposed Development
- Midhurst Growth Area Boundary
- Municipal Boundary
- Existing Municipal / Public Supply Well
- Municipal Well Test Site

100 m Radius Around Well
Model 2, 5, 10 & 25 Year Time of Travel Capture Zone
Gridded Model A3 Aquifer Equipotentials (masl)

NOTES:

1. Base Mapping from Terenet Mapping 2009
2. Development Plan Geranium Corporation 2013
3. Wells are approximate to Accuracy of GPS and Measurement from known features.

0 400 1000 2000 4000
SCALE 1:50000 metres
Plotted 11x17 Landscape

PROJECT
CARSON AND DORAN NEIGHBORHOODS
GROUNDWATER MODELLING

TITLE
CAPTURE ZONES

Golder Associates

PROJECT No.	13-1170-0040		FILE No.	1311700040GCMDL
DESIGN			SCALE	AS SHOWN
CADD	JPR	11 Nov 15	FIGURE	12
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TABLES

TABLE 1
Summary of Pumping Wells

Wellfield	Well ID	Easting	Northing	Aquifer	Existing Conditions Rate Range (m^3/d)	Future Conditions Rate Range (m^3/d)
Midhurst[1]	Greenpine Well 1	601,450	4,921,941	A3	0	0
	Greenpine Well 4	601,436	4,921,946	A3	177 - 443	177 - 443
	Idlewood Drive Well 2	601,908	4,921,972	A3	367 - 884	367 - 884
	Idlewood Drive Well 3	601,894	4,921,949	A3		
	Carson Rd Well 4	601,512	4,920,127	A3	180 - 468	180 - 468
Paddy Dunn's Circle[1]	Well 1	601,772	4,920,229	A3	133	133
	Well 2	601,784	4,920,233	A3		
	Well 3	601,764	4,920,253	A3		
Doran[2]	Alliance PW1	601,830	4,924,191	A3	-	1,846 - 3,888
	Alliance PW2	601,759	4,924,262	A3	-	2,256 - 4,752
	TW21	603,827	4,922,777	A3	-	821 - 1,728
	TW24	603,687	4,922,700	A3	-	821 - 1,728
Carson[2]	TW22	598,675	4,920,171	A4	-	1,497 - 3,154
	TW19	598,604	4,920,119	A4	-	1,497 - 3,154
	TW34	595,627	4,917,644	A4	-	328 - 691
Barrie	3A	603,374	4,914,759	A3	2,087	2,898
	4	603,331	4,915,148	A3	0	2,150
	5	602,927	4,914,267	A3	2,619	1,823
	7	603,533	4,913,835	A3	5,409	2,670
	11	604,690	4,915,816	A3	0	3,900
	12	604,499	4,914,593	A3	4,800	2,898
	14	604,661	4,915,782	A3	3,761	1,823
	15	604,412	4,915,199	A3	4,131	2,670
	17	602,045	4,913,788	A3	5,252	7,036
	18	602,047	4,913,781	A3		
	19	601,394	4,913,017	A3	0	4,178
	9	607,042	4,917,649	A3	3,766	4,589
	13	607,016	4,917,670	A3	4,130	3,012
	16	604,037	4,919,591	A3	4,253	5,095
Craighurst	Well 1	600,812	4,931,473	A1	0	0
	Well 2	600,813	4,931,476	A1	11	11
	Well 3	600,812	4,931,480	A2	21	21
Angus	Centre Street (McGeorge) Well 1	591,761	4,909,103	A3	306	306
	Centre Street (McGeorge) Well 2	591,729	4,909,078	A3	283	283
	Brownley Well 4	591,571	4,907,652	A3	0	0
	Brownley Well 5					
	Brownley Well 6					

TABLE 1
Summary of Pumping Wells

Wellfield	Well ID	Easting	Northing	Aquifer	Existing Conditions Rate Range (m^3/d)	Future Conditions Rate Range (m^3/d)
Stroud	Well 1	610,368	4,909,451	A3	166	166
	Well 2 (Standby)	610,358	4,909,422	A3	166	166
	Well 3	610,387	4,909,478	A3	166	166
Vespra Downs	Well 1 - 93	594,204	4,911,276	A3	39	39
	Well 1- 91	594,176	4,911,266	A3	0	0
Minesing	Well 1	592,409	4,921,843	A3	119	119
	Well 2	592,409	4,921,843	A2	119	119
	Well 3	592,377	4,921,822	A2	137	137
Anten Mills	Well 1	593,949	4,926,082	A3	1	1
	Well 2	593,935	4,926,073	A3	120	120
	Well 3	593,928	4,926,081	A3	151	151
Shanty Bay	Well 1	613,031	4,918,903	A3	43	43
	Well 2	613,046	4,918,902	A2	49	49
	Well 3	613,039	4,918,913	A3	55	55
Snow Valley	Well 3	597,054	4,919,329	A3	284	284
	Well 4					
	Well 1					
	Well 2					

1. See Figure 2 for monthly rates at Midhurst.
2. See Figure 3 for monthly rates at Carson and Doran Neighbourhoods wells.

TABLE 2
Summary of Model Construction Details

General Attributes	
Code	FEFLOW
Software	FEFLOW 6.2
Flow Type	Saturated
Simulation	Steady State & Transient
Dimension	Three-Dimensional (3D)

Domain (Figure 1)	
Area	746 km^2
Horizontal Extents	31 km wide x 24 km long
Vertical Extents	400 masl to 89 masl
Top of Model	Ground Surface
Bottom of Model	Bedrock Surface

Mesh Layout	
Element Type	Triangular Prism
Side Length	300 m to 10 m at wells
Total Elements	745,836

Numerical Layer and Hydrostratigraphic Unit Details

Layer	Nominal Unit	Average Recharge (mm/yr)	Description	Thickness (m)	Hydraulic Conductivity (m/s)	Specific Storage (1/m)
1 - 2	UC / A1	100 - 445	Till or Sand / Gravel	0.25 to 70	1E-6 to 3E-4	3E-04
3	A1	-	Sand	0.25 to 70	5E-6 to 3E-4	3E-04
4 - 6	C1	-	Clayey Silt to Clay	0.2 to 77	1E-08	1E-04
7	A2	-	Sand	0.5 to 44	5E-6 to 3E-4	2E-04
8 - 10	C2	-	Sandy Silt Till	0.2 to 65	5E-07	1E-04
11 - 16	A3	-	Sand/ Gravel	0.2 to 71	5E-5 to 1E-3	2E-04
17 - 19	C3	-	Sandy Silt to ClayTil	0.2 to 60	5E-8 to 3E-7	1E-04
20	A4	-	Sand / Gravel	0.5 to 33	5E-5 to 3E-4	2E-04
21	C4	-	Basal Till	0.5 to 37	1E-08	1E-04

Note:

1. Horizontal hydraulic conductivity listed. Vertical hydraulic conductivity is 1/10th horizontal.

TABLE 2
Summary of Model Construction Details

2. Effective porosity of 25% assumed for particle tracking / capture zone development.

Boundary Conditions			
Feature	**Type**	**Constraint**	**Head Value (masl)**
Willow Creek	Constant Head	Discharge only	DEM elevation
Little Lake	Constant Head	-	229
Matheson Creek	Constant Head	Discharge only	DEM elevation
Bear Creek	Constant Head	Discharge only	DEM elevation
Lake Simcoe	Constant Head	-	218.5
Minesing Wetland	Constant Head	-	186
Other Streams	Constant Head	-	DEM elevation
A3/A4 North	Constant Head	-	270
A3/A4 East	Constant Head	-	220
A3/A4 South	Constant Head	-	203 to 187

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[DHP 00480240]

January 2017

REPORT

SPRINGWATER, ONTARIO

REPORT ON CARSON AND DORAN NEIGHBOURHOODS WATER SUPPLY - MIDHURST SECONDARY PLAN: SUPPLEMENTARY HYDROLOGIC MODELLING

Submitted to:
The Township of Springwater c/o Ainley & Associates
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Report Number: 13-1170-0040 (4000)

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Executive Summary

The Midhurst Landowners' Group proposes to develop their lands within the Carson Road and Doran Road Neighbourhoods in the Midhurst Secondary Plan, in Springwater, Ontario (Figure 1). Nine new water supply wells are proposed to supply the Neighbourhoods. The estimated total maximum water taking is 221 litres per second (L/s) with an expected average annual water taking of approximately 152 L/s. The wells are situated within the Willow Creek watershed and draw water from a deep, regionally extensive confined sand and gravel aquifer.

Previous computer modelling was conducted to assess potential *groundwater* impacts due to water supply pumping at the proposed development (Golder, 2016[1]). A regional-scale FEFLOW groundwater model that included the Willow Creek watershed was employed. Using this prior model as a foundation, an integrated surface water / groundwater model has been developed to estimate the potential *surface water* impacts that may occur as a result of the future pumping. Particular focus is given to Willow Creek and its downstream discharge area the Minesing Wetland. The development and results of this recent integrated surface water / groundwater modelling analysis form the subject of this report.

HydroGeoSphere (HGS) is the computer program used to model the hydrologic system in this study. HGS is a three-dimensional numerical code that can dynamically consider all major components of the hydrologic cycle (Figure 2), including: precipitation, evapotranspiration, snowmelt, overland flow, infiltration, unsaturated zone flow, and saturated groundwater flow. This comprehensive assessment of the major processes in the hydrologic system allows for a robust simulation of streamflow and water level behaviour within the watershed.

Model construction and input parameter assignments are largely developed based on prior field studies and modelling (Golder, 2016[1], Golder, 2016[2], Beckers and Frind, 2001). The HGS model is calibrated to streamflows and water level data. Both long-term (steady-state) and monthly (transient) average conditions are considered. A reasonable match is obtained between simulated results and observed data, indicating that the model is appropriately parameterized and may be used to predict future impacts to the system.

Pre- to Post-Development pumping conditions are simulated and compared. At Willow Creek, an annual average streamflow reduction of 4% or less is estimated with a maximum decline of 6% occuring along certain reaches during summer. At Minesing Wetland, an annual average streamflow reduction of 3% is simulated with a maximum decline of 5% occuring during summer. However, when inflow from the Nottawasaga River upstream of the model domain and discharge from the proposed upstream wastewater treatment plant at Willow Creek and Highway 26 are considered, these losses comprise less than 1% of the wetland's total flow and are thus considered negligible. Simulated surface water level changes in the Minesing Wetland and Snow Valley area show a reduction of approximately 1 millimetre (mm) or less and are thus considered inconsequential.

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1.0 INTRODUCTION

The Midhurst Secondary Plan Area is located in Springwater Township, Ontario (Figure 1). The Midhurst Landowner's Group proposes to develop the Carson and Doran Neighbourhoods (Neighbourhoods) subdivisions (Figure 1). In accordance with the Phase 1 and 2 Class Environmental Assessment (Ainley Group, 2009), a future water supply is being assessed for approximately 8,208 new units (an estimated 28,638 additional people) in these Neighbourhoods. Nine new water supply wells are proposed to supply the Carson and Doran Neighbourhoods (Figure 1). The estimated maximum water taking is 221 L/s with an average water taking of approximately 152 L/s. The wells are situated within the Willow Creek watershed and draw water from a deep, regionally extensive confined sand and gravel aquifer. A new wastewater treatment plant will service the Neighbourhoods; treated effluent from the plant will be discharged into Willow Creek at Highway 26 at an average rate of 143 L/s at full build-out (Black and Veatch, 2016).

Recent computer modelling ultized a regional FEFLOW groundwater model to predict the impacts of the proposed future pumping on the groundwater system (Golder, 2016[1]). This model was used to estimate groundwater drawdown, well interference, baseflow changes and delineate well capture zones in relation to the proposed pumping.

This report describes additional hydrologic modelling undertaken to estimate the effects of the Neighbourhoods supply well pumping on the surface water system within the Willow Creek watershed and Minesing Wetland (Figure 1). The integrated surface water / groundwater computer program HGS is used. This work is an extension of, and companion report to, the aforementioned groundwater modelling (Golder, 2016[1]) and is part of a larger study submitted as part of Phases 3 and 4 of the Midhurst Secondary Plan Class Environmental Assessment (Golder, 2016[2]).

Two modelling scenarios are investigated in this study:

- **Pre-Development:** This scenario represents current conditions; the term 'Pre-Development' means pre-Neighbourhood development. The scenario incorporates coupled surface water/groundwater flow, Kempenfelt Bay and Nottawasaga River surface flow outlet boundary conditions and average monthly water surplus. Both steady-state (annual average) and 10-year transient (monthly) simulations are undertaken. Pre-Development annual average and monthly pumping rates at existing wells are applied for steady-state and transient simulations, respectively (Table 1 and Figure 6). This scenario provides the initial condition for the Post-Development scenario.
- **Post-Development:** This scenario investigates the impact of pumping under Post-Development conditions with the Neighbourhoods at full build-out. The same boundary conditions are applied as the Pre-Development scenario. Both steady-state (annual average) and 10-year transient (monthly) simulations are undertaken. Post-Development annual average and monthly pumping rates at existing and proposed wells are applied for steady-state and transient simulations, respectively (Table 1 and Figure 7). Additional flow inputs from the wastewater treatment plant into Willow Creek are considered external to the model.

Simulated changes to surface water flow rates and water levels at Willow Creek and Minesing Wetland are evaluated from Pre- to Post-Development scenarios and presented herein.

1.1 Scope of Work

The scope of work consists of the following tasks.

1. **Background Data:** Amass and analyze publicly available climate and surface water studies and data for Minesing Wetland and Willow Creek watershed. The groundwater parameterization herein continues to rely on the hydrogeologic data and inputs derived in the recent groundwater investigation (Golder, 2016[2]) and supporting modelling analysis (Golder, 2016[1]). These data include 686 static water levels in the Ministry of Environment and Climate Change Water Well Information System (WWIS) and continuous flow records for Water Survey of Canada (WSC) Willow Creek flow stations 02ED009, 02ED010, and 02ED032 (Environment Canada, 2012 – locations shown on Figure 1). The latter of these stations is immediately upstream of the Minesing Wetland. To our knowledge, there are no flow records immediately downstream of the Minesing Wetland; however, this location is addressed in the model simulations. A previous hydrology study of the Oro Moraine conducted by others (Beckers and Frind, 2001) provides an estimate of the long-term average surplus water distribution over the study area.

2. **Model Construction, Groundwater**: Import the pre-existing FEFLOW model into HGS. This process effectively parameterizes the subsurface domain in HGS. The entire model domain (Figure 1) is incorporated to allow for regional boundary condition assignments and to encapsulate the entirety of pumping withdrawal influence; however, the primary focus of the model effort is Willow Creek and its downstream discharge area the Minesing Wetland.

3. **Model Construction, Surface Water**: Parameterize surface water model inputs in accordance with information obtained in Task 1.

4. **Calibration**: Calibrate the model to surface water and groundwater data obtained in Task 1. The successfully calibrated model forms the Pre-Development, "baseline" current condition.

5. **Predictive Simulation**: Add Neighbourhoods pumping wells at average annual rates (steady-state simulation) and monthly rates (transient simulation) to establish Post-Development surface water effects including flow and water level changes.

1.2 Code Description – HydroGeoSphere

The HGS model (Therrien et al., 2012) is a three-dimensional control volume finite element simulator designed to represent the entire terrestrial portion of the hydrologic cycle (Figure 2). It uses a globally-implicit approach to simultaneously solve the 2D diffusive wave equation and the 3D form of Richards' equation. It also dynamically integrates key components of the hydrologic cycle such as evaporation from bare soil and water bodies; vegetation-dependent transpiration with root uptake; snowmelt and soil freeze/thaw. Features such as macropores, fractures and tile drains can either be incorporated discretely or by using a dual-porosity, dual permeability formulation. The HGS platform uses a Newton iteration to handle nonlinearities in the governing flow equations, a robust and efficient iterative sparse matrix solver, which has been parallelized to utilize high performance computing facilities for addressing large-scale problems.

University researchers and industry professionals have utilized HGS to carry out a variety of modelling projects. One of the first large-scale watershed studies to use the integrated groundwater/surface water flow capabilities of HGS was carried out by Li et al. (2008). HGS was one of several codes considered by the Ontario Ministry of Natural Resources and Forestry for watershed scale, integrated water-budget modelling applications in Ontario (AquaResource, 2011); the code received a favourable review for its strong theoretical basis and advanced formulation. A third-party review of the HGS computer program was published recently by Brunner and Simmons (2012). A list of publications that have utilized HGS can be found at http://www.aquanty.com/recent-publications/.

HGS provides four distinct advantages for this modelling application. First, it can seamlessly and efficiently adopt the pre-existing calibrated FEFLOW groundwater model inputs into its construction, which results in significant time and cost savings when compared to building a numerical model "from scratch". Second, HGS uses a rigorous, mass conservative approach that fully couples surface and variably saturated subsurface flow equations – this method is more robust than other models that rely on a separate (and often numerically unstable) linkage of surface and subsurface modeling codes. Third, including the surface flow equations reduces the complexity of the boundary condition assigned to the top surface of the model – which is now just the observed or net precipitation. This simplifies calibration of streamflows because surplus water, the sole source of water in the model, is based on observed long term average runoff for the catchment area. Therefore, total runoff from the model will always be correct for steady-state conditions, in that it will equal the input (surplus water) as long as there are no other sources in the model domain. Fourth, HGS eliminates the requirement that the location of surface water bodies be defined as part of the top boundary condition – they arise naturally as a consequence of the topography, surface and subsurface characteristics and the applied precipitation.

2.0 CONCEPTUAL HYDROLOGICAL/HYDROGEOLOGICAL MODEL

2.1 General Considerations

HGS incorporates all of the major processes in the hydrologic cycle (Figure 2). In the integrated modelling approach, a surface flow domain consisting of a 2D finite-element mesh is defined coincident with the top of the groundwater flow domain 3D finite-element mesh. Water can move freely between the two domains with the direction of flow determined by the dynamic local hydraulic gradient. Flow in the surface domain is governed by geometry (in this case the surface topography) and the properties of the surface (principally Manning's coefficient of friction). Similarly, flow in the groundwater domain is governed by hydrostratigraphic layer geometry (such as layer thickness and elevation) and soil properties (such as hydraulic conductivity and storage).

When water, in the form of surplus water (precipitation - evapotranspiration), is applied to the surface flow domain, it can either pond and move laterally as surface flow or vertically into the subsurface as infiltration. Whether or not either of these flows occurs depends on factors such as:

- Hydraulic conductivity of the shallow subsurface - e.g., low permeability materials such as clay can inhibit infiltration;
- Depression storage – i.e. a depression must fill with water before lateral surface flow can occur; and

- Hydraulic gradient – e.g., in a discharge area, upwelling groundwater (upward hydraulic gradient) prevents infiltration.

2.2 Specific Considerations

For information on the details of Midhurst area conceptual hydrogeology and prior model development, the reader is referred to the following reports:

- *South Simcoe Municipal Groundwater Study* (Golder, WHI and Ainley, 2004);
- *South Simcoe Groundwater Study WHPA – Appendix E, City of Barrie* (Golder and WHI, 2004[1]);
- *South Simcoe Groundwater Study WHPA – Appendix L, Township of Springwater* (Golder and WHI, 2004[2]); and
- *Report On: Hydrogeological Study, Midhurst Water Supply Exploration Program Supporting Document, Midhurst Class EA, Township of Springwater, Ontario* (Golder, 2008).
- *Report On: Carson and Duran Neighbourhoods Proposed Water Supply Groundwater Modelling* (Golder, 2016[1]). This modelling was part of a larger hydrogeological study submitted as part of Phases 3 and 4 of the Midhurst Secondary Plan Class Environmental Assessment (Golder, 2016[2]). This modelling was conducted based on the existing three-dimensional (3D) Kempenfelt Bay FEFLOW model with refinements in Midhurst and surrounding Willow Creek watershed areas. It is strongly recommended that the reader consult this report given the foundational role it plays in the current work.
- *Report On: Hydrogeological Study, Midhurst Water Supply Exploration Program, Township of Springwater, Ontario* (Golder, 2016[2]). The hydrogeological characterization developed as part of this assessment formed the basis of several updates incorporated into the groundwater model (Golder, 2016[1]).

The HGS model is constructed by importing the existing FEFLOW model (Golder, 2016[1]) into the HGS framework and so it inherits most of the subsurface characteristics of that model including:

- 3D model domain extents and topography;
- Subsurface material distributions and properties (saturated hydraulic conductivity, specific storage, porosity);
- Lateral boundary conditions (no-flow, fixed heads - e.g. at Kempenfelt Bay); and
- Pumping well boundary conditions.

The following data that are not included in the FEFLOW model analysis was required specifically for the HGS model:

- The long-term, average, water surplus (precipitation – evapotranspiration) distribution (Figure 3) is applied to the surface flow domain in the HGS model. The surplus is obtained from Beckers and Frind (2001), and is calculated using 1951–1990 climate normals for 11 meteorological stations. Average annual precipitation estimates ranged from 800 to 930 mm/yr, while average annual evapotranspiration is estimated to be about 500 mm/yr, based on water budget calculations for the Oro Moraine Upland (Dixon Hydrogeology Limited, 1992). Precipitation minus evapotranspiration provides surplus depth; this is water available for overland

flow or infiltration. The total yearly water surplus over the 696 km^2 study area of Beckers and Frind (2001) was 8.53 m^3/s, which will be similar to the HGS modelled value except for a small discrepancy due to the larger HGS model domain.

- Monthly surplus ratios relative to annual surplus (Figure 4) are based on observed monthly surplus water (Golder, 2016[1]). These ratios are used to prorate the average annual water surplus distribution obtained from Beckers and Frind (2001) shown in Figure 3 to produce 12 monthly water surplus distributions.
- Soil retention properties, required for all subsurface materials as the HGS model solves Richard's equation for variably-saturated flow in the subsurface, are also obtained from Beckers and Frind (2001). The authors subdivided their domain into two materials: aquifers and aquitards, for which they supplied soil retention characteristic curves.
- Surface flow characteristics (Manning coefficient of friction or roughness factor): a value of 0.03 s/m$^{1/3}$ is assumed to apply over the entire surface flow domain. Streeter and Wylie (1985) list average values for this parameter and this value falls within the range of what they classify as 'earth' to 'earth, with stones or weeds'.

3.0 MODEL CONSTRUCTION

Constructing the HGS model from the existing FEFLOW model requires the following two basic steps:

1. Import the existing updated FEFLOW groundwater model into HGS and modify the material properties and boundary condition inputs as required; and
2. Define the surface flow domain and surface material properties.

The details of each step as they pertain to the groundwater and surface water domains are discussed separately below.

3.1 Groundwater Domain

3.1.1 Model Area

The HGS model adopts the same area as the FEFLOW model (Figure 1). The total model area is 746 km^2. The Willow Creek watershed, wherein the proposed developments are located, lies almost entirely (>90%) within the model domain and comprises an area of 228 km^2.

3.1.2 Boundary Conditions

HGS utilizes a surplus distribution as the majority source of water to the model (surplus is precipitation minus evapotranspiration). Figure 3 illustrates the steady-state annual average surplus; this distribution was first developed by Beckers and Frind (2001). From the surplus input, the proportion of overland flow versus infiltration is calculated within HGS. For the transient model, monthly surplus is derived by prorating the annual surplus by the monthly recharge ratios shown in Figure 4 (Golder, 2016[1]).

In the FEFLOW model, a large number of constant head nodes are defined on the top of the model domain (see Figure 5), although in some areas along the outer boundary of the model they are carried down into the

subsurface. HGS constant head and critical depth boundary conditions are applied to the top surface of the model domain, in this case specifically to the surface flow domain (Figure 5). In the HGS model, and unlike the prior FEFLOW model, constant head nodes do not need to be defined along potential streams in order to constrain heads, as the surface flow domain acts as a pathway for excess water to flow laterally should ponding occur. Therefore the only area where constant head nodes are defined is along the outer boundary at Kempenfelt Bay, which are assigned a head of 219 masl. Although this boundary could potentially allow water to flow into the model domain, it is located at a downstream point in the flow system so this is unlikely to happen.

The critical depth boundary condition defined at the outlet of the Nottawasaga River is of a type unique to surface flow models; it is not a fixed head or flux boundary, but merely allows water to freely exit the model domain should ponding occur. The resulting surface water elevation is largely controlled by the elevation of the lowest surface domain node along the boundary, which in this case is 179.7 masl.

By default, any other nodes on the outer model boundary, which are not explicitly assigned boundary conditions for either the surface or subsurface domains, act as no-flow boundaries.

3.1.3 Pumping Rates

The model includes existing municipal wells in Midhurst, City of Barrie wells, and other regional water takings as summarized in Table 1. Most wells draw from deep, regionally extensive confined aquifers A3 or A4, including the proposed wells at the Neighbourhoods. In both Pre- and Post-Development scenarios, singular average annual rates are used for steady-state simulations whereas variable monthly rates are used for transient simulations (Figure 6 and Figure 7). The steady-state simulations reflect long-term, average conditions whereas the transient simulations allow for a more refined understanding of the seasonal nature of potential hydrologic impacts.

The Carson and Doran Neighbourhoods maximum taking is modelled at 221 litres per second (L/s) with a modelled average annual water taking of approximately 152 L/s. As is typical with most municipal water takings in Ontario, the greatest consumption occurs during the summer months. For the proposed Midhurst Neighbourhood wells, the permitted maximum is applied for June, July and August with pro-rated rates calculated for the remaining months (Figure 7) based on existing water usage trends in Midhurst (Figure 6).

3.1.4 Material Properties

Hydraulic conductivity and specific storage values for each element are inherited from the FEFLOW model. An X-direction hydraulic conductivity distribution is presented in Figure 8 for illustration.

Porosity values of 0.3 and 0.5 are assumed for aquifer and aquitard elements respectively and are the same as those used in Beckers and Frind (2001).

HGS solves Richard's equation for variably-saturated soil, which requires that soil retention relationships (pressure head versus saturation and saturation versus relative permeability) be defined for all subsurface materials. These relationships are defined for aquifer and aquitard materials by Beckers and Frind (2001) and are adopted for use here. The 3D model domain is first subdivided into zones of aquifer and aquitard materials based on the X-direction hydraulic conductivity (see Figure 9). These two zones are then assigned the appropriate soil retention properties (Figure 10).

3.2 Surface Water Domain

In HGS, the surface water flow domain is defined to be coincident with the top of the 3D subsurface domain (Figure 1), and, in this case, is composed of 2D triangular elements which are the top faces of the 3D subsurface prism elements.

The main parameter that controls flow in the surface domain, besides the surface slope which is inherited from the geometry of the 3D domain top surface (i.e. the topography), is the Manning coefficient of friction. As described earlier, a value of 0.03 $s/m^{1/3}$ is assumed to apply over the entire surface flow domain.

There is an option in HGS, used in the current model, to create unique surface flow nodes that are coincident with the subsurface nodes on the top of the 3D domain. In this case, the surface flow node has a hydraulic head that can be unique from the subsurface node, and a simple relationship has been defined that controls fluid flux between the two nodes as a function of the head gradient between them. This relationship uses a coupling length parameter, representative of a characteristic length separating the two domains, to control fluid flow between the two domains, with larger values inhibiting flow. Initially, a coupling length value of 0.1 m was assumed to apply to the entire surface flow domain. Delfs et. al. (2012) experimented with this value in simulations of field studies of overland flow and stream generation, and found that HGS was insensitive to small changes in coupling length below a value of 0.1 m.

The final surface flow parameter to be assigned is the depression (or rill) storage height. This is the depth of water that must be attained before surface flow will occur. It represents small depressions in the ground surface that cannot be captured in the finite-element mesh defining the surface flow domain, mainly due to element size constraints. Larger values of depression storage height tend to promote infiltration. A value of 2 mm is assigned for the depression storage height for the entire surface flow domain, mainly to prevent numerical instability.

4.0 MODEL CALIBRATION

Model calibration involves adjusting Pre-Development model input parameters within a reasonable range until simulated results satisfactorily correspond to observed data (calibration targets). The principle calibration targets in this study are annual and monthly streamflows and baseflows (the groundwater portion of streamflows) at Willow Creek and measured static groundwater levels (presumed to provide average water levels) throughout the model domain as supplied by the WWIS. Average annual conditions are considered in the steady-state model whereas monthly conditions are considered in the transient model.

A satisfactory calibration within the groundwater domain has been previously achieved in the FEFLOW model (Golder, 2016[1]); the outcome of that endeavour is primarily inherited in the HGS model. As such, the current calibration mainly focuses on surface parameters affecting calibration to flow; nonetheless, comparison to groundwater targets is also undertaken as a check.

4.1 Parameter Adjustment

4.1.1 Surface Topography

The computer-based BFLOW algorithm (Arnold et al., 1995) is used to separate the baseflow (i.e., groundwater) portion of the total measured stream flow at the three WSC stations (Figure 6, Golder 2016[1]). It was found that steady-state baseflow values predicted by HGS at gauge locations give consistently lower values than the

BFLOW annual average. This could in part be due to how HGS handles surplus water in the surface flow domain, where, depending on local conditions, it can either infiltrate (and become groundwater flow and potential baseflow) or flow overland as surface water. If regions of groundwater discharge are widespread, they can prevent infiltration and cause surplus water to flow overland until it eventually reaches a stream. Such water does not contribute to baseflow in HGS but instead reports as overland flow, another portion of total streamflow.

In order to more accurately reflect physical conditions at Willow Creek and also increase baseflow the following adjustments are made:

- Within areas of coarser grid resolution the localized creek channel depression may be obscured in the interpolated digital topography. Hence the elevation of the stream channels upstream of Little Lake are reduced by 2 m in order to lower stream channel and related water table elevation near the streams. The resulting baseflow increase is on the order of 3%.
- The main stream channels comprising Willow and Matheson Creeks are hydraulically corrected so that they slope continuously downstream to reduce ponding. The resulting baseflow increase is approximately 3%.

4.1.2 Surface Flow Parameters

The following surface flow parameters are adjusted during calibration to baseflows:

- The coupling length is reduced by one order of magnitude from 0.1 m to 0.01 m. This enhances fluid exchange between the surface and subsurface domains and result in a 35% increase in baseflow, however, the absolute value of baseflow is still significantly less than that calculated by BFLOW.
- Depression storage height is increased from 2 mm to 2 cm. This had a negligible effect on the simulated HGS baseflow.
- Although not a calibration parameter, the post-processing baseflow calculation approach is also considered. In HGS, baseflows are calculated for a chosen area (m^2) by integrating the positive exchange flux (m/s) to produce a volumetric flux (m^3/s). The exchange flux represents the rate of fluid flow between the surface and subsurface domains, and positive values represent flow from the subsurface to the surface domain (i.e., exfiltration). If baseflow is restricted to groundwater discharging directly to a surface water body, then we must first specify a surface water depth as a cutoff value for determining what is or is not a surface water body. In this case, a relatively small value of surface water cutoff depth of 0.003 m is chosen, which increases the baseflow estimated from HGS.

4.1.3 Snow Valley Area Hydraulic Conductivity

Recent site investigations (Golder, 2010b) indicate that there are numerous seeps and springs along the flanks of the moraine in the Snow Valley area. Figure 11 (right upper image) shows the observed water surface contours in the area.

The lower image in Figure 11 also shows the boundaries of two regions where hydraulic conductivity adjustments are made. In the first region (blue line) the hydraulic conductivity of the upper 3 model layers is decreased to 10^{-7} m/s while in the second region (orange line) the thickness of the C1 aquitard is increased by extending it upwards one model layer.

The combined effect of these two changes is illustrated in the upper left image in Figure 11, which shows the head contours (at ground surface) from the HGS steady-state flow simulations both before (solid blue lines) and after (dashed blue lines) the local adjustments were made to the hydraulic conductivity of the selected layers.

4.2 Calibration Results

4.2.1 Steady-State Simulation

A Pre-Development steady-state simulation is run and simulated flows are compared to average flows derived from WSC flow stations 02ED009, 02ED010, and 02ED032 (Environment Canada, 2012) (Table 2). Note that there is no flow gauge at the outlet of Minesing Wetland. Simulated steady-state streamflows are somewhat greater than the WSC flow stations averages, ranging from a maximum of 20% greater at Midhurst (02ED010) to 8% greater at Little Lake (02ED009). A simulated streamflow within 20% of observed is considered satisfactory given the potential measurement error at the flow stations (Beckers and Frind, 2001).

Steady-state simulated baseflows are also compared to average baseflows (derived using the BFLOW algorithm) at the WSC flow stations (Table 2). Baseflows derived from the HGS model are lower than those derived from BFLOW, as mentioned earlier. There are several possible explanations for this. Firstly, BFLOW-derived baseflows, like all automated separation methods, are simplified mathematical inferences that inherently result in some departure (including potential overestimation) from true baseflow (Partington et.al., 2012). Secondly, the aforementioned 'surface water cutoff value' may, in some areas close to Willow Creek where the water table is near-surface, result in the 'exiting' of groundwater into the surface water system just prior to reaching the Creek itself. In the post-processing routine, this water is not counted as baseflow; but, in a practical sense, it is. Nonetheless, in the context of overall streamflow, conservation of total flow in the model is maintained.

In the Pre-Development model, the steady-state head solution is compared to 686 static water levels in the WWIS to verify that the groundwater level calibration metrics are satisfactory (Figure 12). The head comparison result and associated statistical measures (Figure 12 insert) indicates a reasonable match to observed water levels and are similar to that provided in the prior FEFLOW model (Golder, 2016[1]).

Finally, the overall fluid balance errors (inflow versus outflow) in the HGS simulation are less than 1%.

4.2.2 Transient Simulation

A Pre-Development transient simulation is run and compared to average monthly flows at the WSC flow stations (Figure 13). A 10-year simulation period is chosen to allow the flow system time to equilibrate with average monthly water surplus and average monthly pumping. The HGS modelled streamflows match the average monthly streamflows trends closely.

5.0 PREDICTIVE SIMULATIONS

Post-Development steady-state and transient predictive simulations are carried out and streamflow and water levels compared relative to Pre-Development conditions. The Neighbourhoods are modelled using full-build out pumping rates (see Table 1 and Figure 7). Flow contributions from the future wastewater treatment plant, which will discharge treated water into Willow Creek at Highway 26, are considered post-simulation.

5.1 Steady-State Simulation

Steady-state annual Pre- to Post-Development flow changes are evaluated for the three WSC flow station locations and Minesing Wetland to provide for an estimate of long-term, average annual flow impacts (Table 2). Flow rates and relative (%) reductions are presented. Prior to a discussion on specific values listed in Table 2, it is important to note the following while reviewing potential impact to Minesing Wetland:

As may be inferred from Table 2, all flow losses incurred in *total streamflow* are derived from a reduction in groundwater baseflow; in other words the volume of water lost from streamflow and baseflow are the same. Willow Creek streamflow reduction increases as we move downstream, with the highest relative reduction of 3.8% at WSC 02ED032 (Table 2). Meanwhile, the Minesing Wetland outlet experiences a streamflow reduction of 3.0% (0.18 m^3/s). However, given the upstream input of the treatment plant (0.143 m^3/s), and the unaccounted for upstream input from the Nottawasaga River outside of the model domain, the actual % flow loss at Minesing Wetland would be less than 1% thus is negligible relative to the total flow reporting to the wetland.

The wetland receives flow from several surface water sources. The largest of these is the Nottawasaga River, which drains a catchment area of over 3,300 km^2; the majority of which lies upstream of the wetland. However, only a fraction of this catchment area (508 km^2) is accounted for in the model. Furthermore, treated water from the Neighbourhoods wastewater treatment plant will be discharged into Willow Creek near Highway 26 (upstream of Minesing Wetland). It is anticipated that the average annual discharge rate of the wastewater treatement plant will be 143 L/s (or 0.143 m^3/s) (Black and Veatch, 2016). These wetland flow contributions, external to the model, would in reality serve to offset any Minesing Wetland potential impacts as described below.

Baseflow changes are also evaluated for the three WSC flow station locations and Minesing Wetland (Table 2). Owing to the underestimation of Pre-Development baseflow (Section 4), the relative (%) loss in Post-Development conditions is overestimated, with reductions reaching up to 17% at Midhurst. However, when the simulated volumetric flow loss is subtracted from the *observed* baseflow, the losses at each station are under 10%. It is important to note that the prior FEFLOW groundwater model provided better correspondence to observed baseflows and indicated Post-Development losses were less than 10% along Willow Creek (Golder, 2016[1]). For context, the Water Budget and Water Quantity Risk Assessment Guide (MNR and MOE, 2011) defines an unacceptable impact to coldwater streams as a circumstance where groundwater discharge is reduced by more than 20% as compared to the average monthly baseflow of the watercourse.

5.2 Transient Simulation

Transient monthly Pre- to Post-Development streamflow changes are evaluated for Willow Creek and Minesing Wetland (Figure 14). The reduction in streamflow is seasonally variable and is affected by both varying pumping rates and, in the case of relative (%) reductions, is sensitive to changing surplus throughout the year. The smallest % streamflow reductions occur at Willow Creek above Little Lake (WSC 02ED009) with losses less than 1.5% for most of the year. The largest % streamflow reduction occurs at Willow Creek at Midhurst (WSC 02ED032) with losses reaching almost 6% during summer months. Similar patterns were predicted for baseflow impacts in the FEFLOW groundwater model (see Figure 11 of Golder, 2016[1]). Losses at Minesing Wetland range between 1% to 5% during the year, with largest % losses incurred during late summer and early fall. However, given the upstream input of the treatment plant (0.143 m^3/s), and the unaccounted for upstream input

from the Nottawasaga River outside of the model domain, the actual % flow loss at Minesing Wetland would be less than 1% and is thus negligible relative to the total flow reporting to the wetland.

Post-Development surface water level changes are tracked for locations in Minesing Wetland and adjacent to Snow Valley Road (Figure 15). Surface water depth in the Minesing Wetland naturally varies from approximately 30 mm over the course of the year and shows less than 1 mm of decline due to the proposed water taking in the Post-Development scenario. Meanwhile, surface water depth at Snow Valley Road is less (~ 2.5 mm), fluctuates by less than 1 mm over the course of the year, and shows negligible water level impact due to the proposed water taking in the Post-Development scenario. The small Post-Development change in water level in these areas is expected for several reasons. Firstly, estimated *groundwater* drawdown is minor in this area owing, in part, to the majority of the pumping occurring closer to Midhurst and the area being underlain by significant aquitard thickness (drawdown maps are provided in Golder, 2016[1]). Secondly, the area receives a considerable influx of surface water which would tend to offset impacts emanating from the underlying groundwater system.

6.0 CONCLUSIONS

Hydrologic modelling using the HydrogGeoSphere code is undertaken to estimate the effects of the operation of deep groundwater wells servicing the proposed Carson and Doran Neighbourhoods on surface water resources within the Willow Creek watershed and Minesing Wetland. The modelling indicates the following surface water changes may occur from Pre- to Post-Development as a result of the proposed well operation:

- Willow Creek may experience an average annual streamflow loss of approximately 4% or less. Seasonally, streamflow losses may reach up to 6% during summer.
- Minesing Wetland has a *simulated* average annual streamflow loss of 3% and a maximum loss of 5% during late-summer to early fall. However, upstream contributions to the wetland from: 1) the Nottwasaga River (upstream of the model domain); and 2) future wastewater treatment plant discharge will offset these losses and result in a negligible change to total wetland flow rates.
- Surface water level changes in Minesing Wetland and the nearby Snow Valley Road area are expected to be less than 1 mm and are thus considered negligible.

7.0 LIMITATIONS

7.1 Use of This Report

This report has been prepared by Golder Associates Ltd. (Golder) for use by The Midhurst Landowners' Group or its agents. The factual information, descriptions, interpretations, comments, results, conclusions and electronic files contained herein are specific to the project described in this report. Information used in this report should be restricted to that specified in the scope of work unless otherwise mutually agreed upon by The Midhurst Landowners' Group and Golder. This report should be read in its entirety as some sections could be improperly interpreted when taken individually or out-of-context. Golder is not responsible for any use of this report and its content by a third party, and/or for its use for purposes other than those intended.

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7.2 Modelling General Limitations

Hydrological investigations and modelling are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological system is changing with time and the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that field data provides a fraction of information for the site or model domain; as such a truly complete, comprehensive characterization of the groundwater system is not possible. Therefore, every groundwater model is, by necessity, a simplification of a reality.

The professional modelling services described in this report are conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions. The results of previous or simultaneous work provided by sources other than Golder and quoted and/or used herein are considered as having been obtained according to recognized and accepted professional rules and practices, and therefore deemed valid.

The model presented herein provides a predictive scientific tool to evaluate the impacts of specified hydrological stressors on a real system and to compare various scenarios in connection with a decision-making process. The model's accuracy is bound to the normal uncertainty associated to modelling and no warranty, express or implied, is made.

Report Signature Page

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REFERENCES

Ainley Group (2009). Township of Springwater, Class Environmental Assessment Study for the Midhurst Water, Wastewater and Transportation Master Plan, Phase 1 and 2 Report. 208017. July 2009.

Arnold, J.G., P.M. Allen, R. Muttiah, and G. Bernhardt (1995). Automated base flow separation and recession analysis techniques. Ground Water 33(6): 1010-1018.

AquaResource (2013). City of Barrie Tier Three Water Budget and Local Area Risk Assessment. Prepared for Lake Simcoe Region Conservation Authority. BarrieT3_RA_15074-527 R-0412 Final. May 2013.

AquaResource (2012). City of Barrie Tier Three Recharge Estimation Using MIKE SHE Technical Memorandum. Prepared for Lake Simcoe Region Conservation Authority. 15074-527 Recharge LR-0612.docx. June 2012.

AquaResource (2011). Integrated Surface and Groundwater Model Review and Technical Guide. Prepared for the Ontario Ministry of Natural Resources.

Batu, V., 1998. Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. John Wiley & Sons, New York, 727p.

Beckers, J. and E.O. Frind (2001). Simulating Groundwater Flow and Runoff for the Oro Moraine Aquifer System. Part II. Automated Calibration and Mass Balance Calculations. Journal of Hydrology 243 (2001) 73-90.

Black and Veatch (2016). Evaluation of Treatment Alternatives for Midhurst Wastewater Treatment Plant (Draft). March 2016.

Brunner, P., and C. T. Simmons (2012), HydroGeoSphere: A Fully Integrated, Physically Based Hydrological Model. Ground Water, 50(2), 170-176.

Delfs, J-O., E.A. Sudicky, Y-J. Park, R.G. McLaren, T. Kalbacher and O. Kolditz (2012). An Inter-Comparison Of Two Coupled Hydrogeological Models. XIX International Conference on Water Resources, CMWR 2012, University of Illinois at Urbana-Champaign, June 17-22 2012.

Dixon Hydrogeology Limited, 1992. Oro seventh line Aggregate pits hydrogeology study, P.O. Box 1354, Barrie, Ontario, Canada L4M 5R4.

Environment Canada (2012). Environment Canada, Water Survey of Canada: Environment Canada Data Explorer V1.2.30 using HYDAT Version 1.0. November, 2012

Environment Canada Climate Services (2012). Barrie WPCC Water Budget, 1978 – 2012. Ordered by Golder in 2013.

Golder (2016[1]). Midhurst Ontario: Report On Carson And Doran Neighbourhoods Proposed Water Supply Groundwater Modelling. [Appendix M of Hydrogeological Study. Midhurst Water Supply Exploration Program, Township of Springwater, Ontario, Golder 2016[2].] 13-1170-0040 (4000). Submitted to Township of Springwater c/o Ainley and Associates. June 2016.

Golder (2016[2]). Hydrogeological Study. Midhurst Water Supply Exploration Program, Township of Springwater, Ontario. 13-1170-0040 (4000). Submitted to Township of Springwater c/o Ainley and Associates. June 2016.

Golder (2010). City of Barrie Source Water Protection Threat Assessment. 07-1170-0014 (1000). Submitted to City of Barrie. June 2010.

Golder (2010b). Proposed Miller and Patterson Subdivisions, Snow Valley Road, Simcoe County – Attenuation of Phosphorus from Final Effluent. 08-1170-0231. Technical memorandum submitted to Barrie Welding and Machine. September 2010.

Golder (2008). Report On Hydrogeological Study, Midhurst Water Supply Exploration Program, Supporting Document, Midhurst Class EA, Township of Springwater, Ontario. 08-1170-0081. Submitted to: Midhurst Development Doran Road Inc. and Carson Road Development Inc. December 2008.

Golder, WHI and Ainley (2004). South Simcoe Municipal Groundwater Study. Prepared for South Simcoe Groundwater Partnership. S41W01. August 2004.

Golder and WHI (2004[1]). South Simcoe Groundwater Study WHPA – City of Barrie Appendix E. 04-1112-551. August 2004.

Golder and WHI (2004[2]). South Simcoe Groundwater Study WHPA – Township of Springwater Appendix L. 04-1112-551. August 2004.

Jyrkama, M., (2003). A Methodology for Estimating Groundwater Recharge, Ph.D. thesis, University of Waterloo, Waterloo, Ontario, Canada.

Li, Q., A.J.A. Unger, E.A. Sudicky, D. Kassenaar, E.J. Wexler, and S. Shikaze (2008). Simulating the multi-seasonal response of a large-scale watershed with a 3D physically-based hydrologic model. Journal of Hydrology (2008), Vol. 357, Pages 317-336.

Ministry of Natural Resources and Ministry of Environment (2011). Water Budget & Water Quantity Risk Assessment Guide. Prepared for the Ontario Ministries of Natural Resources and Environment by AquaResource Inc. Drinking Water Source Protection Program.

Partington, D., P. Brunner, C.T. Simmons, A.D. Werner, R. Therrien, H.R. Maier and G.C. Dandya (2012). Evaluation of outputs from automated baseflow separation methods against simulated baseflow from a physically based, surface water-groundwater flow model. Journal of Hydrology, Vols. 458-459. 21 August 2012. Pages 28-39.

Streeter, V.L., and E.B. Wylie (1985). Fluid Mechanics. Eighth Edition. McGraw-Hill Book Company. New York.

Therrien, R., et al., (2012). HydroGeoSphere: A Three-Dimensional Numerical Model Describing Fully-Integrated Subsurface and Surface Flow and Transport, User Guide. Aquanty Inc., Waterloo, Ontario, Canada.

TABLES

TABLE 1
Summary of Pumping Wells

Wellfield	Well ID	Easting	Northing	Aquifer	Existing Conditions Rate Range (m^3/d)	Future Conditions Average Yearly Rate (Steady State Model) (m^3/d)	Future Conditions Rate Range (Monthly Transient Model) (m^3/d)
Midhurst[1]	Greenpine Well 1	601,450	4,921,941	A3	0	0	0
	Greenpine Well 4	601,436	4,921,946	A3	177 - 443	277	177 - 443
	Idlewood Drive Well 2	601,908	4,921,972	A3	367 - 884	585	367 - 884
	Idlewood Drive Well 3	601,894	4,921,949	A3			
	Carson Rd Well 4	601,512	4,920,127	A3	180 - 468	285	180 - 468
Paddy Dunn's Circle[1]	Well 1	601,772	4,920,229	A3	133	133	133
	Well 2	601,784	4,920,233	A3			
	Well 3	601,764	4,920,253	A3			
Doran[2]	Alliance PW1	601,830	4,924,191	A3	-	2,674	1,846 - 3,888
	Alliance PW2	601,759	4,924,262	A3	-	3,269	2,256 - 4,752
	TW21	603,827	4,922,777	A3	-	1,189	821 - 1,728
	TW24	603,687	4,922,700	A3	-	1,189	821 - 1,728
Carson[2]	TW22	598,675	4,920,171	A4	-	2,169	1,497 - 3,154
	TW29	598,604	4,920,119	A4	-	2,169	1,497 - 3,154
	TW34	595,627	4,917,644	A4	-	476	328 - 691
Barrie	3A	603,374	4,914,759	A3	2,087	2,898	2,898
	4	603,331	4,915,148	A3	0	2,150	2,150
	5	602,927	4,914,267	A3	2,619	1,823	1,823
	7	603,533	4,913,835	A3	5,409	2,670	2,670
	11	604,690	4,915,816	A3	0	3,900	3,900
	12	604,499	4,914,593	A3	4,800	2,898	2,898
	14	604,661	4,915,782	A3	3,761	1,823	1,823
	15	604,412	4,915,199	A3	4,131	2,670	2,670
	17	602,045	4,913,788	A3	5,252	7,036	7,036
	18	602,047	4,913,781	A3			
	19	601,394	4,913,017	A3	0	4,178	4,178
	9	607,042	4,917,649	A3	3,766	4,589	4,589
	13	607,016	4,917,670	A3	4,130	3,012	3,012
	16	604,037	4,919,591	A3	4,253	5,095	5,095
Craighurst	Well 1	600,812	4,931,473	A1	0	0	0
	Well 2	600,813	4,931,476	A1	11	11	11
	Well 3	600,812	4,931,480	A2	21	21	21
Angus	Centre Street (McGeorge) Well 1	591,761	4,909,103	A3	306	306	306
	Centre Street (McGeorge) Well 2	591,729	4,909,078	A3	283	283	283
	Brownley Well 4	591,571	4,907,652	A3	0	0	0
	Brownley Well 5						
	Brownley Well 6						

TABLE 1
Summary of Pumping Wells

Wellfield	Well ID	Easting	Northing	Aquifer	Existing Conditions Rate Range (m^3/d)	Future Conditions Average Yearly Rate (Steady State Model) (m^3/d)	Future Conditions Rate Range (Monthly Transient Model) (m^3/d)
Stroud	Well 1	610,368	4,909,451	A3	166	166	166
	Well 2 (Standby)	610,358	4,909,422	A3	166	166	166
	Well 3	610,387	4,909,478	A3	166	166	166
Vespra Downs	Well 1 - 93	594,204	4,911,276	A3	39	39	39
	Well 1- 91	594,176	4,911,266	A3	0	0	0
Minesing	Well 1	592,409	4,921,843	A3	119	119	119
	Well 2	592,409	4,921,843	A2	119	119	119
	Well 3	592,377	4,921,822	A2	137	137	137
Anten Mills	Well 1	593,949	4,926,082	A3	1	1	1
	Well 2	593,935	4,926,073	A3	120	120	120
	Well 3	593,928	4,926,081	A3	151	151	151
Shanty Bay	Well 1	613,031	4,918,903	A3	43	43	43
	Well 2	613,046	4,918,902	A2	49	49	49
	Well 3	613,039	4,918,913	A3	55	55	55
Snow Valley	Well 3	597,054	4,919,329	A3	284	284	284
	Well 4						
	Well 1						
	Well 2						

1. See Figure 6 for monthly rates at Midhurst.
2. See Figure 7 for monthly rates at Carson and Doran Neighbourhoods wells.

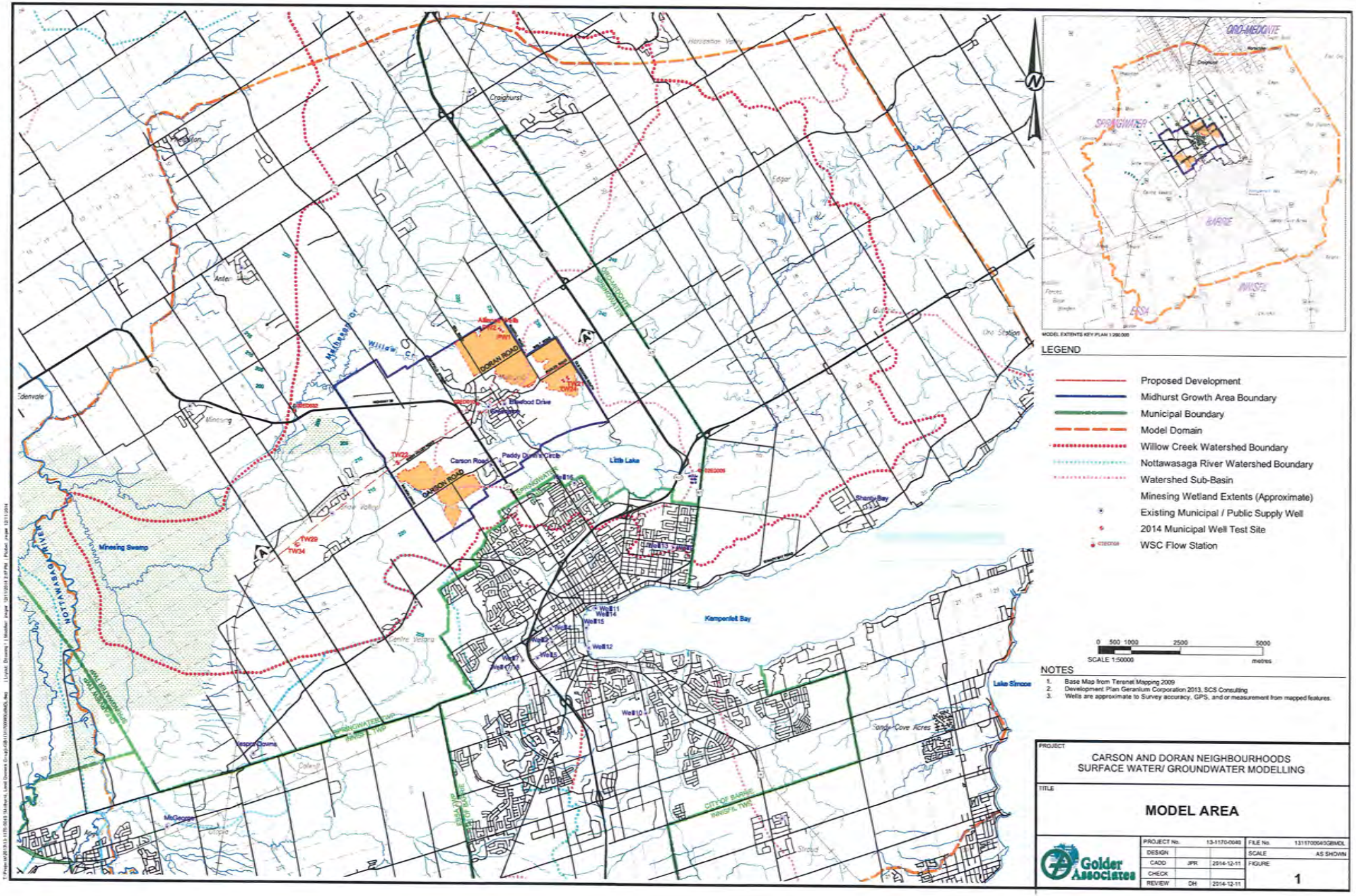
TABLE 2
Average Annual Flows

	Observed		Pre-Development Steady-State Simulation		Post-Development Steady-State Simulation			
Flow Station[1]	Streamflow (m^3/s)	Baseflow (m^3/s)	Streamflow (m^3/s)	Baseflow (m^3/s)	Streamflow (m^3/s)	Baseflow (m^3/s)	% Loss in Streamflow	% Loss in Baseflow[2]
02ED009 (Little Lake)	0.85	0.32	0.92	0.18	0.90	0.16	1.6%	8.5%
02ED010 (Midhurst)	1.15	0.58	1.38	0.28	1.33	0.23	3.5%	17.3%
02ED032 (Minesing)	2.62	1.81	2.98	1.32	2.86	1.21	3.8%	8.6%
Minesing Wetland Outlet	N/A	N/A	6.01	3.15	5.83	2.98	3.0%	5.7%

Notes:

1. See Figure 1 for station locations. Minesing Wetland Outlet includes contributions from upstream Willow Creek, Nottawasga River, and Wetland itself.
2. % baseflow loss is likely overestimated owing to the initial underprediction of baseflow in the Pre-Development scenario.

FIGURES

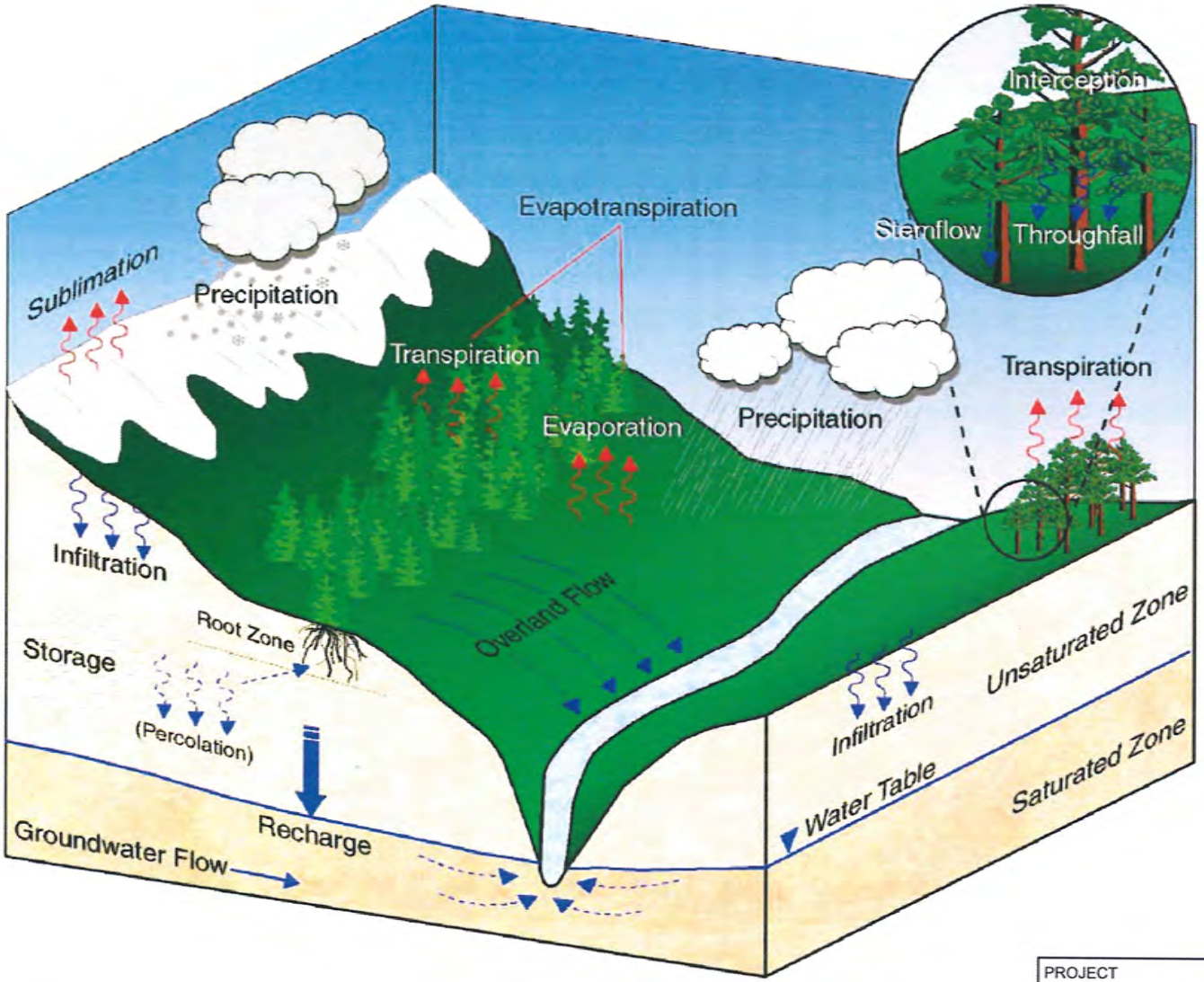


PROJECT
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/ GROUNDWATER MODELLING

TITLE
MODEL AREA

Golder Associates

PROJECT No.		13-1170-0048	FILE No.	13117004803BMDL
DESIGN			SCALE	AS SHOWN
CADD	JPR	2014-12-11	FIGURE	1
CHECK				
REVIEW	DH	2014-12-11		



NOTE

- *Reference: Jyrkama (2003)*

PROJECT

CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

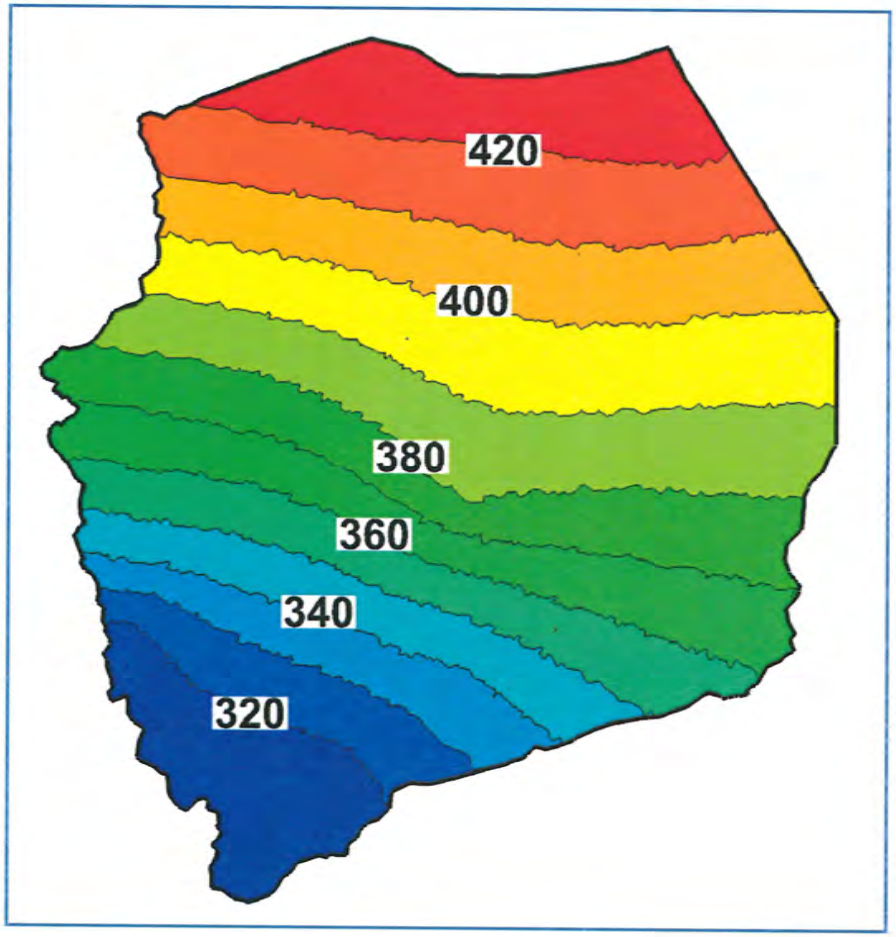
TITLE

HYDROLOGIC CYCLE

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DESIGN	RM	MAR 2016	REV. 1
CAD	RM	MAR 2016	FIGURE
CHECK			2
REVIEW			

HGS MODEL SURPLUS WATER DISTRIBUTION (mm/year)



NOTES:

- *HGS model surplus water distribution derived from Beckers and Frind (2001) Figure 7.*

PROJECT

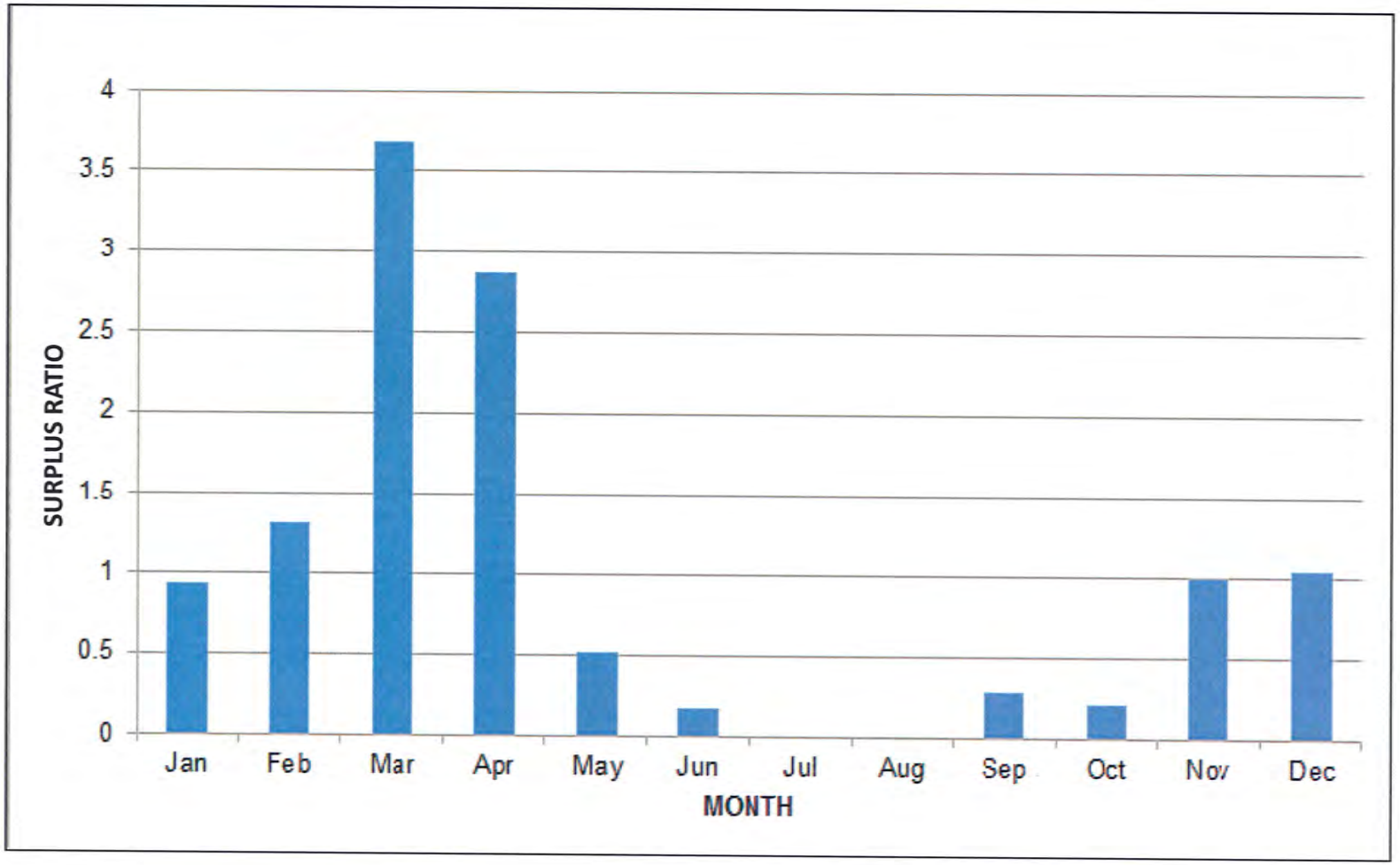
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

TITLE

MODEL SURPLUS WATER DISTRIBUTION

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DESIGN	RM	JAN 2017	REV. 1
CAD	RM	JAN 2017	FIGURE
CHECK			3
REVIEW			



NOTES:

- *In transient simulations the HGS model surplus water distribution for each month is determined by multiplying the surplus water distribution derived from Beckers and Frind (2001) (Figure 3) by the monthly surplus ratio (see above).*

PROJECT

CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

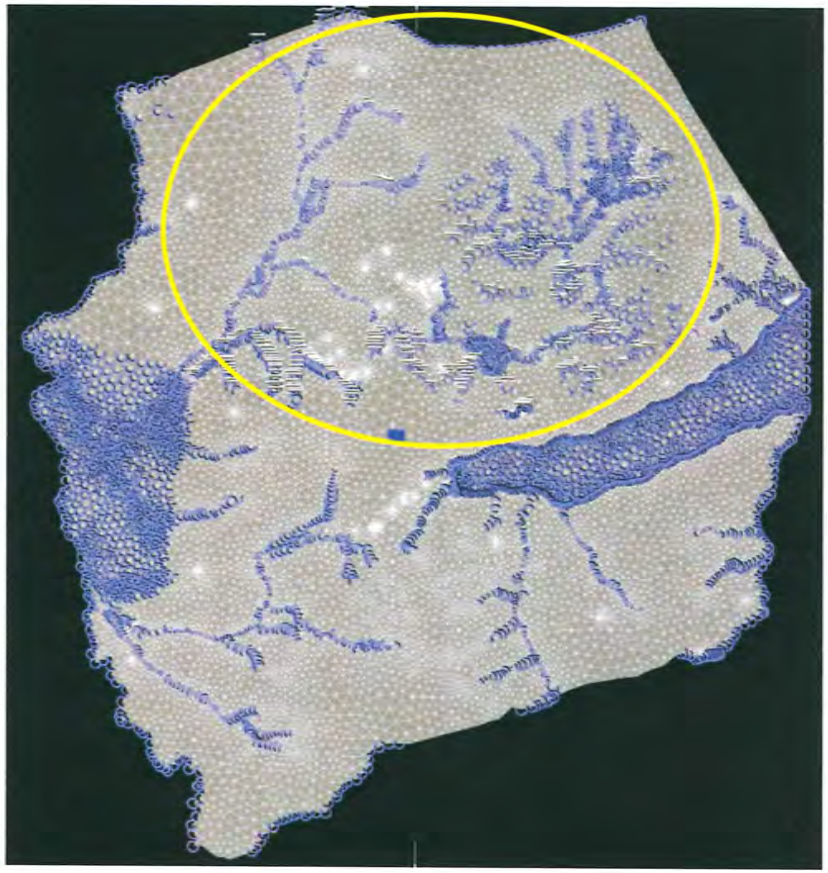
TITLE

MONTHLY SURPLUS RATIO

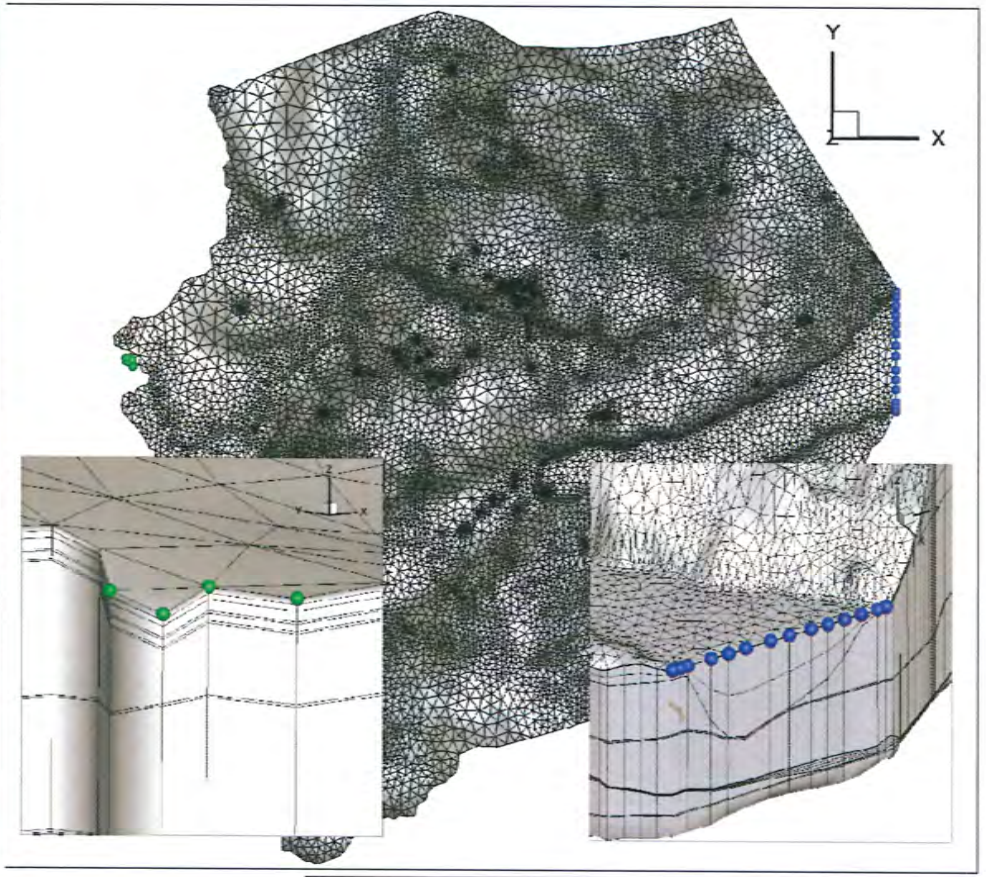
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CAD	RM	JAN 2017	FIGURE
CHECK			4
REVIEW			

FEFLOW MODEL



HGS MODEL



NOTE

- *FEFLOW model – blue circles indicate constant head nodes, yellow ellipse indicates region of constrained 'discharge only' constant head nodes.*
- *HGS model – green spheres indicate critical depth boundary condition, blue spheres indicate constant head boundary condition. Also shown are oblique views of the critical depth boundary condition at the outlet of the Nottawasaga River (lower left inset, viewed from the west) and the constant head boundary condition at Kempenfelt Bay (lower right inset, viewed from the southeast)*

PROJECT

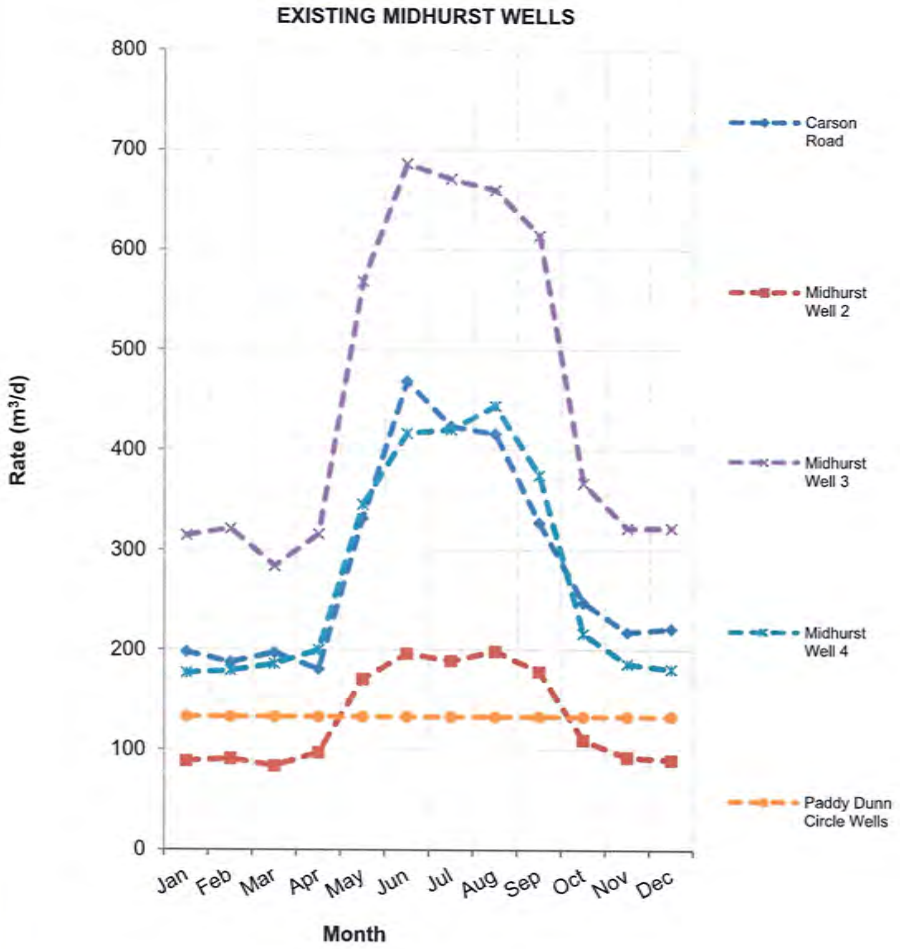
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

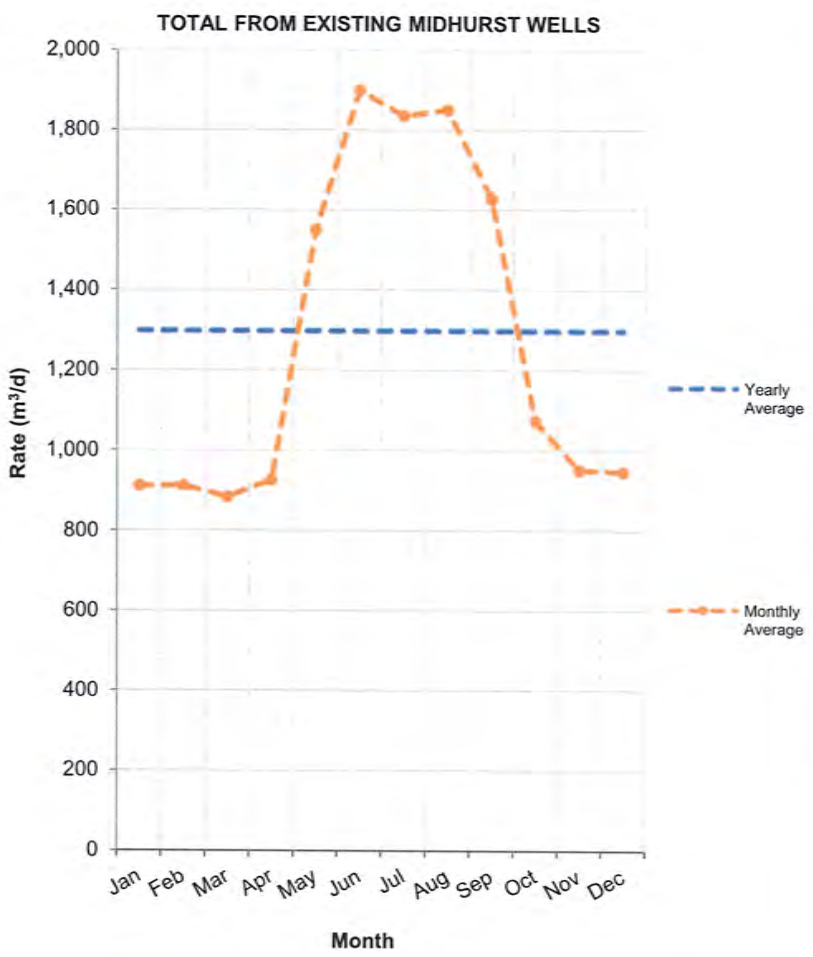
TITLE

BOUNDARY CONDITIONS

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PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	JAN 2017	REV. 1
CAD	RM	JAN 2017	FIGURE
CHECK			5
REVIEW			





NOTE

- *Chart shows 2003 to 2010 monthly averages.*
- *Monthly averages for Paddy Dunn Circle wells not available, average rate for year applied equally every month.*

PROJECT

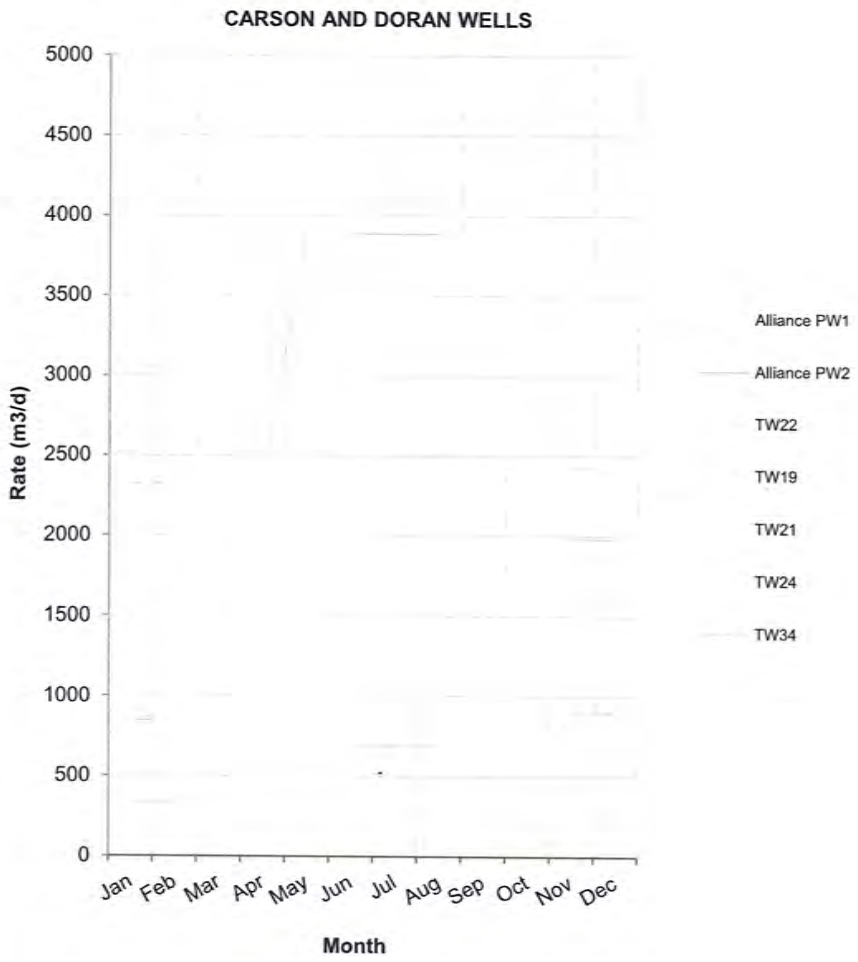
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

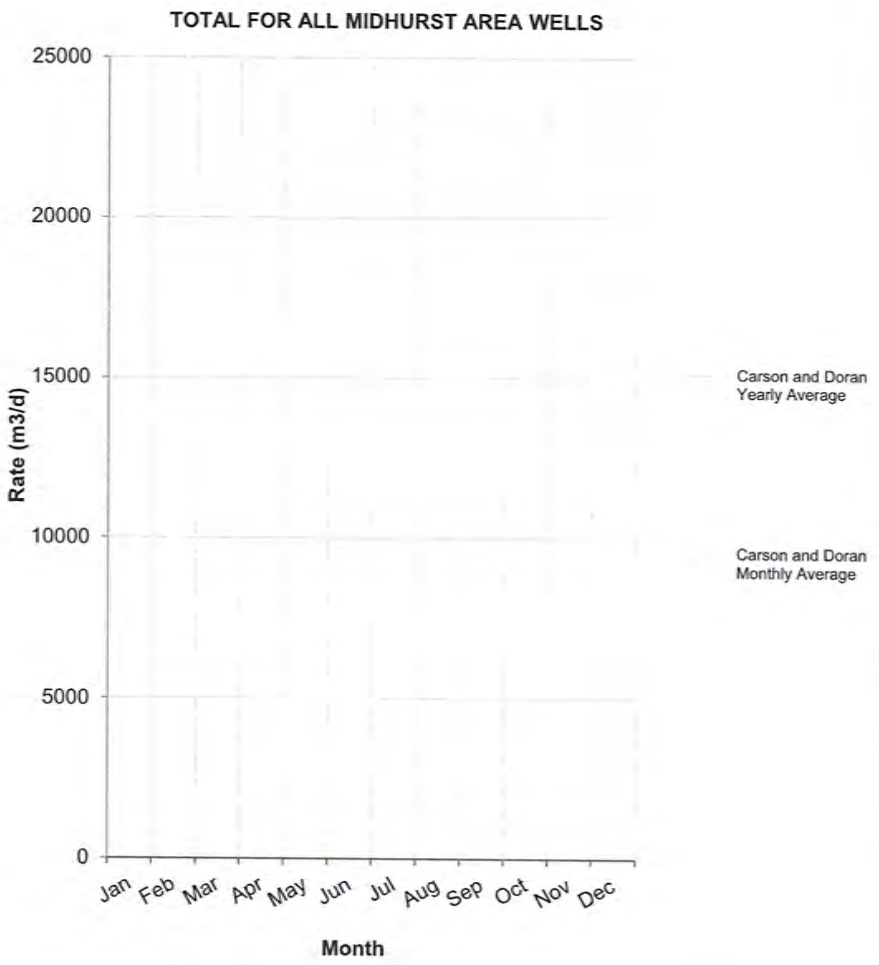
TITLE

PRE-DEVELOPMENT
MIDHURST PUMPING RATES

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DESIGN	RM	JAN 2017	REV. 1
CAD	RM	JAN 2017	FIGURE
CHECK			6
REVIEW			





NOTE

- *Projected total monthly demand at Carson and Doran wells calculated by prorating maximum demand (19,095 m³/d) in accordance with Existing Conditions demand (Figure 6).*
- *Midhurst and Paddy Dunn's Circle rates for Future Conditions (not shown) are assumed to continue as per Existing Conditions (Figure 6).*

PROJECT

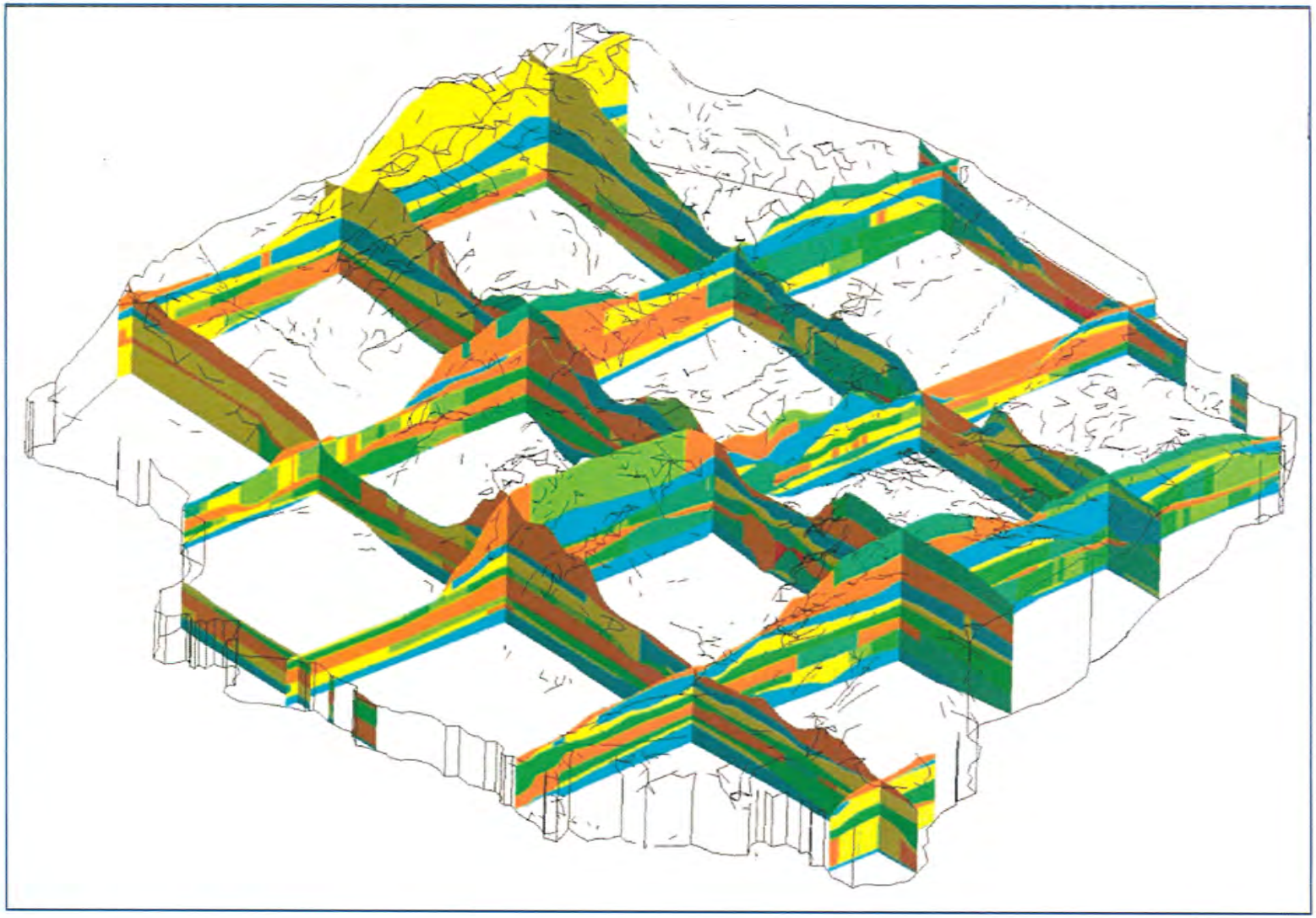
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

TITLE

POST-DEVELOPMENT
CARSON AND DORAN PUMPING RATES

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DESIGN	RM	JAN 2017	REV. 1
CAD	RM	JAN 2017	FIGURE
CHECK			7
REVIEW			



LEGEND

HYDRAULIC CONDUCTIVITY IN X-DIRECTION (M/D)

- 100
- 10
- 1
- 0.1
- 0.01
- 0.001
- 0.0001
- 1E-05

PROJECT

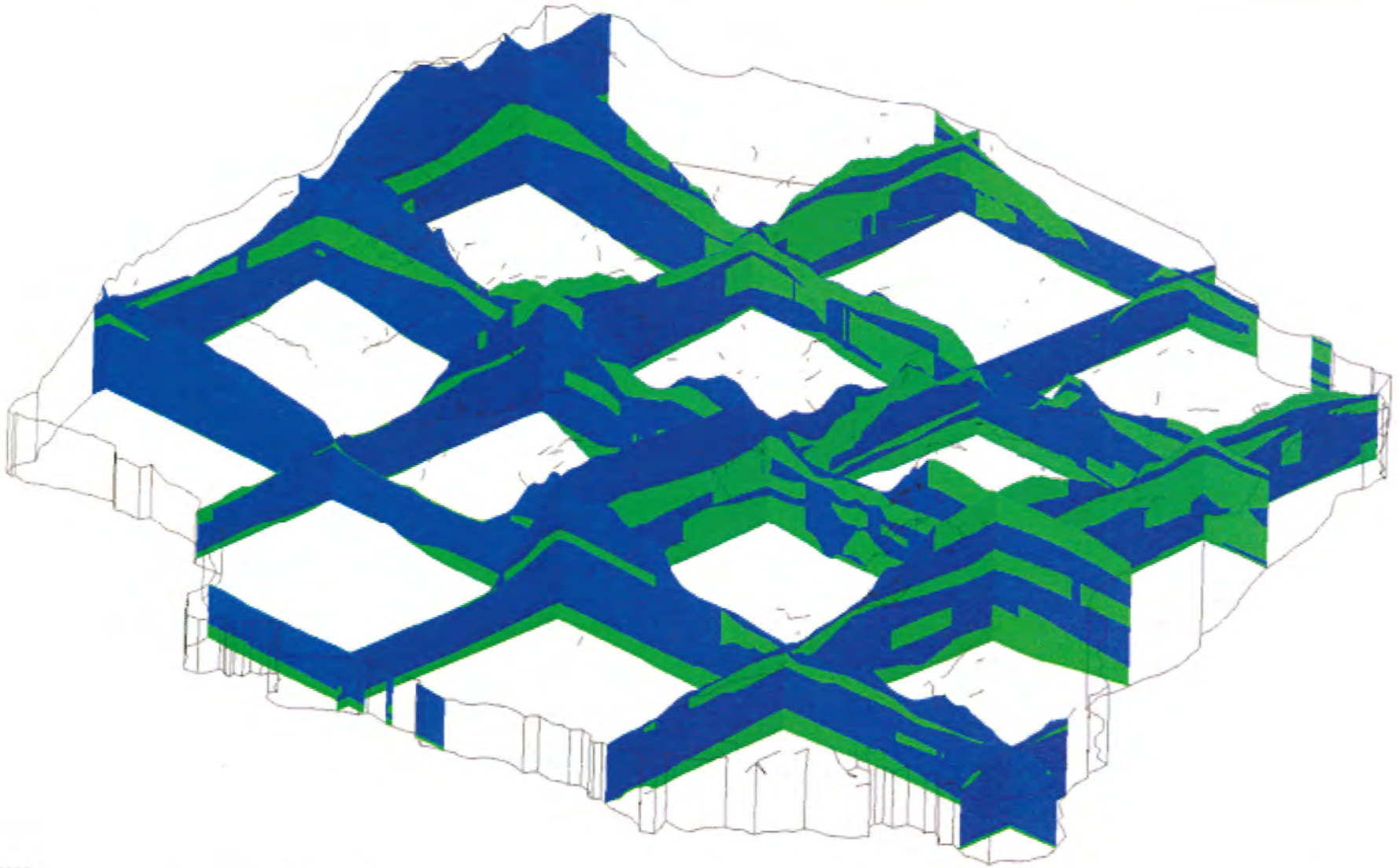
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

TITLE

HYDRAULIC CONDUCTIVITY DISTRIBUTION

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	MAR 2016	REV. 1
CAD	RM	MAR 2016	FIGURE
CHECK			8
REVIEW			



LEGEND

- Aquitard
- Aquifer

NOTES:

- Elements were grouped as aquifer or aquitard depending on the X-direction hydraulic conductivity (Kxx) as follows:
  Aquifer: Kxx >= 0.01 m/day
  Aquitard: Kxx < 0.01 m/day

PROJECT

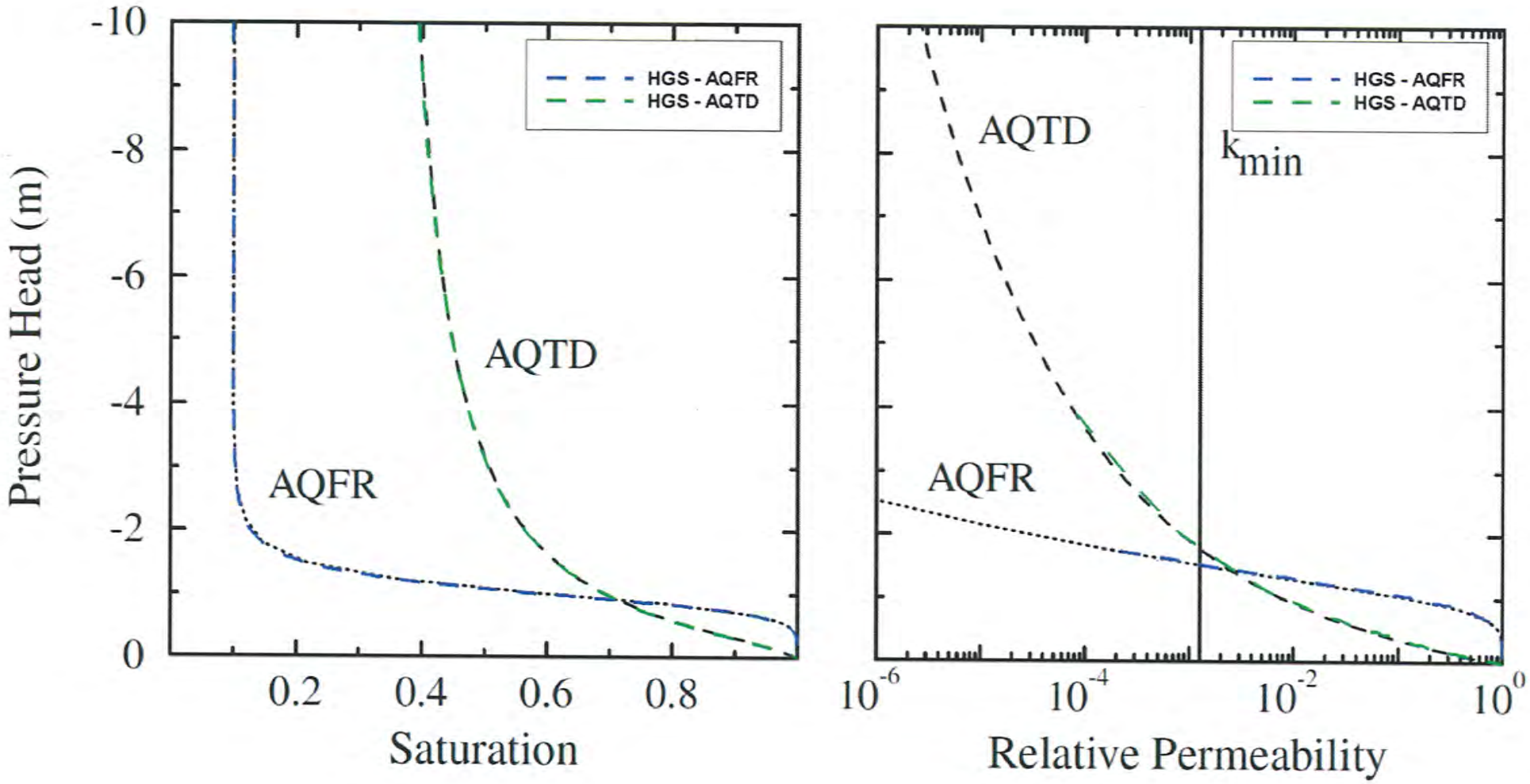
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

TITLE

AQUIFER/AQUITARD DISTRIBUTION

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	MAR 2016	REV. 1
CAD	RM	MAR 2016	FIGURE
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REVIEW			



NOTES:

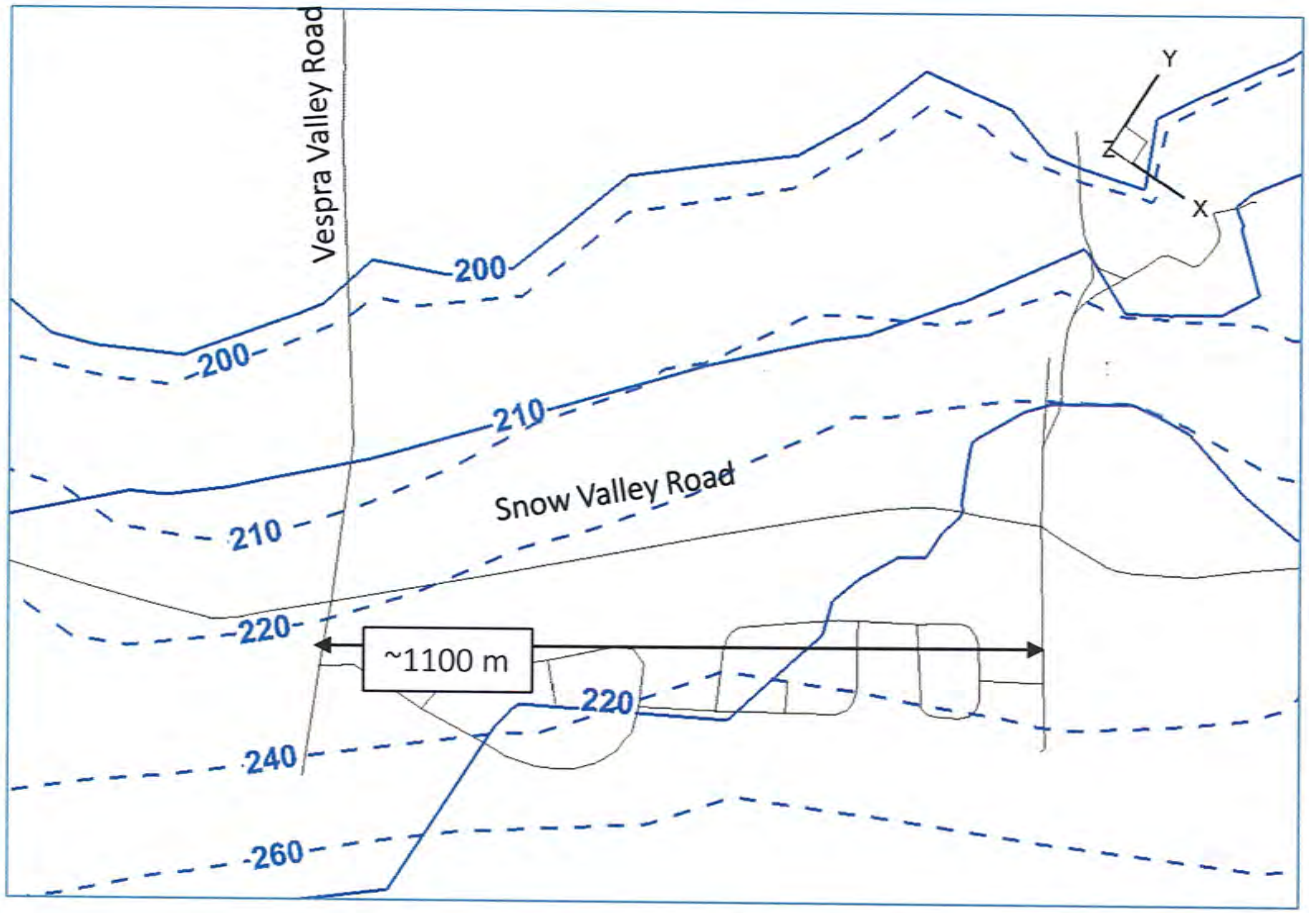
- Reference: Beckers and Frind (2001).
- Blue (AQFR) and green (AQRD) dashed lines are HGS soil retention properties derived from Beckers and Frind (2001) (black dotted and dashed lines).

PROJECT	CARSON AND DORAN NEIGHBOURHOODS SURFACE WATER/GROUNDWATER MODELLING
TITLE	**SOIL RETENTION PROPERTIES**

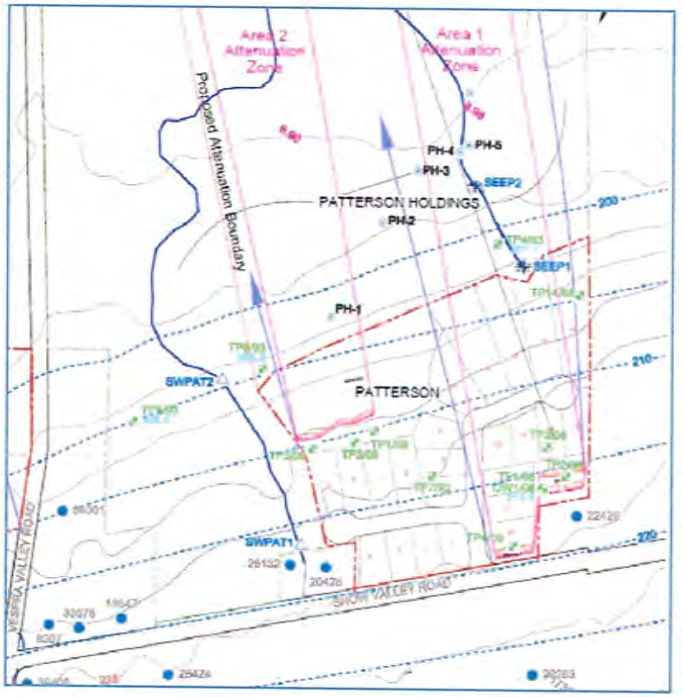
Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	MAR 2016	REV. 1
CAD	RM	MAR 2016	FIGURE
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REVIEW			

HGS MODEL



OBSERVED

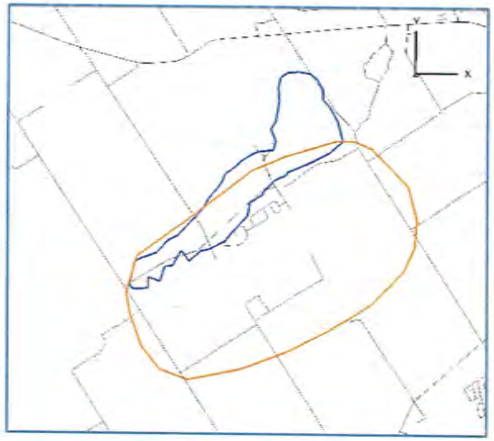


NOTES:

- In image above from Golder (2010b), dashed blue lines are water surface elevation.

NOTES:

- Image above shows hydraulic head contours at ground surface from initial HGS steady-state flow simulation (blue solid lines) and after hydraulic conductivity adjustments (blue dashed lines).
- Image to left shows first (blue line) and second (orange line) areas of hydraulic conductivity adjustments



PROJECT

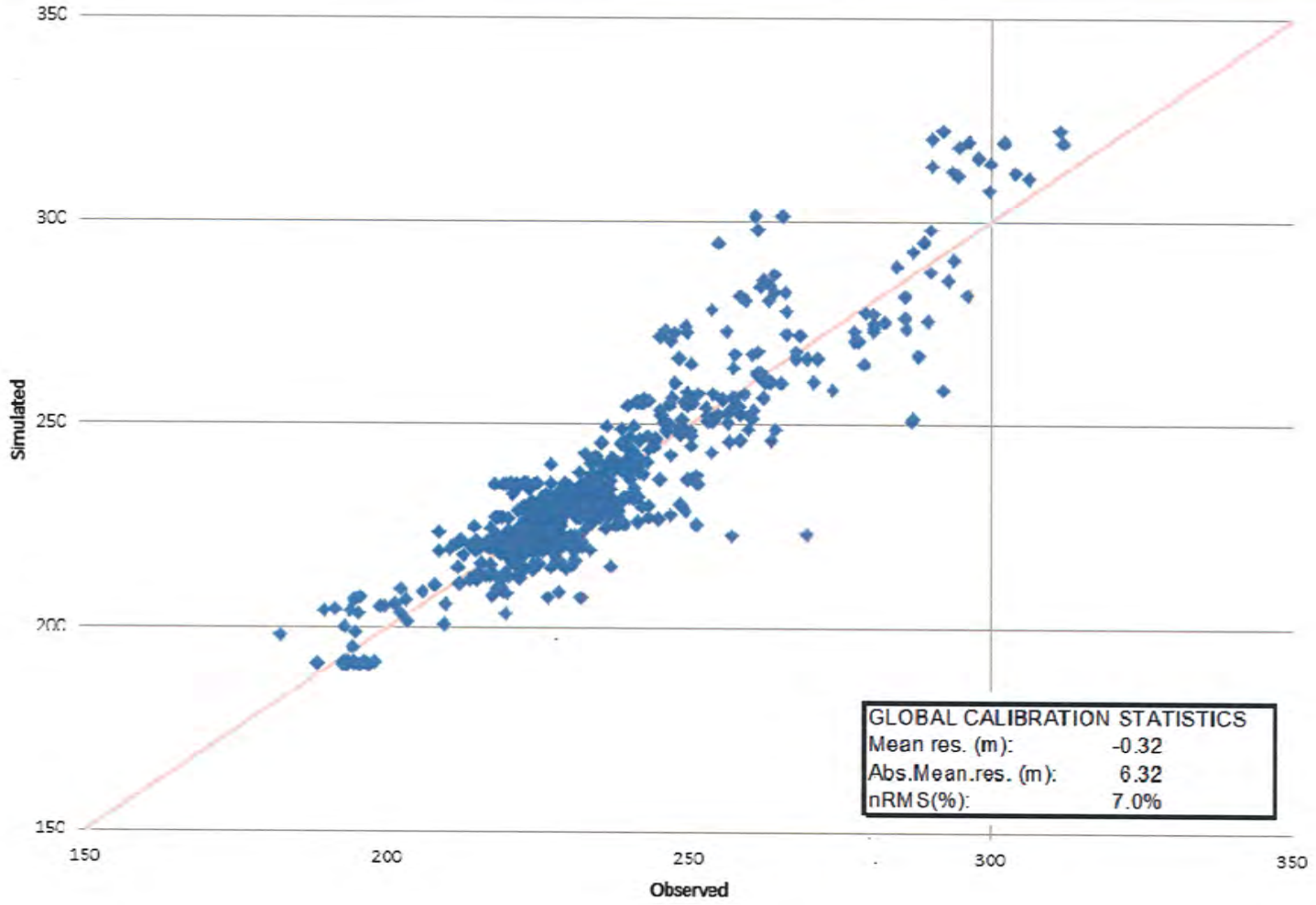
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

TITLE

STEADY-STATE HYDRAULIC HEAD IN VICINITY OF SNOW VALLEY

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	MAR 2016	REV. 1
CAD	RM	MAR 2016	FIGURE
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REVIEW			



PROJECT

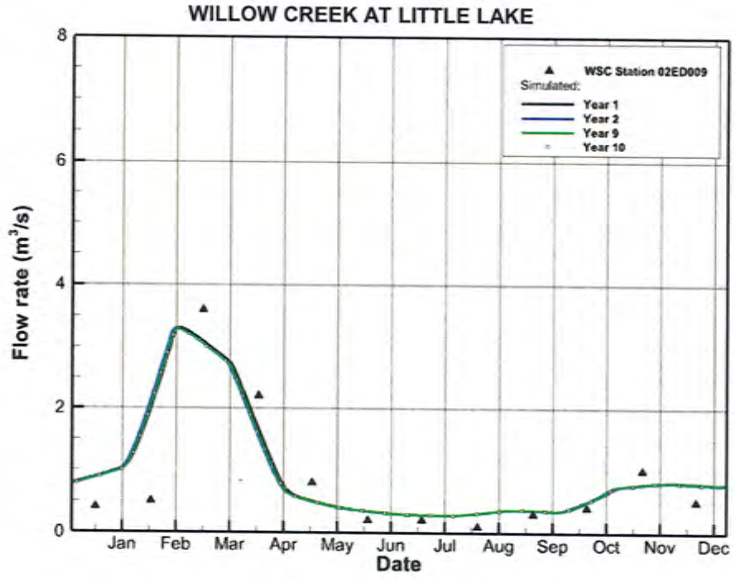
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

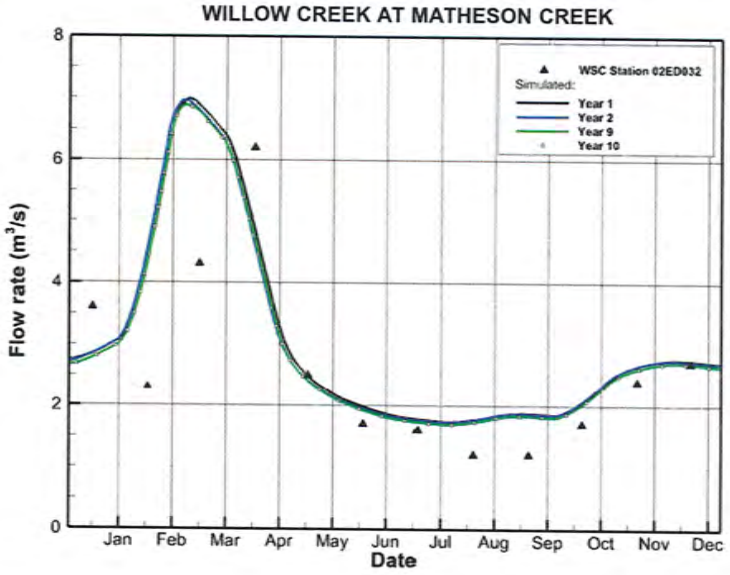
TITLE

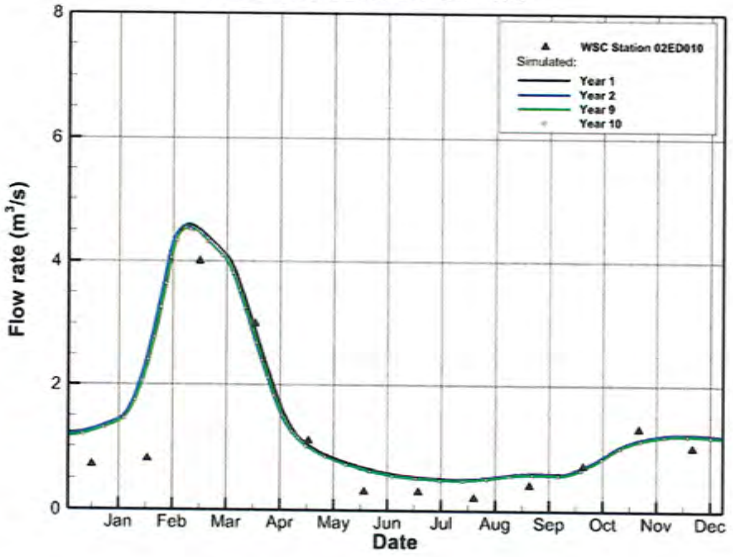
GROUNDWATER LEVEL CALIBRATION (MOECC WWIS WELLS)

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	JAN 2017	REV. 1
CAD	RM	JAN 2017	FIGURE
CHECK			12
REVIEW			







NOTES:

- *Observed (long-term average) stream flow data (black triangles) from WSC stations (April '06 to Dec'10)*

PROJECT

CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

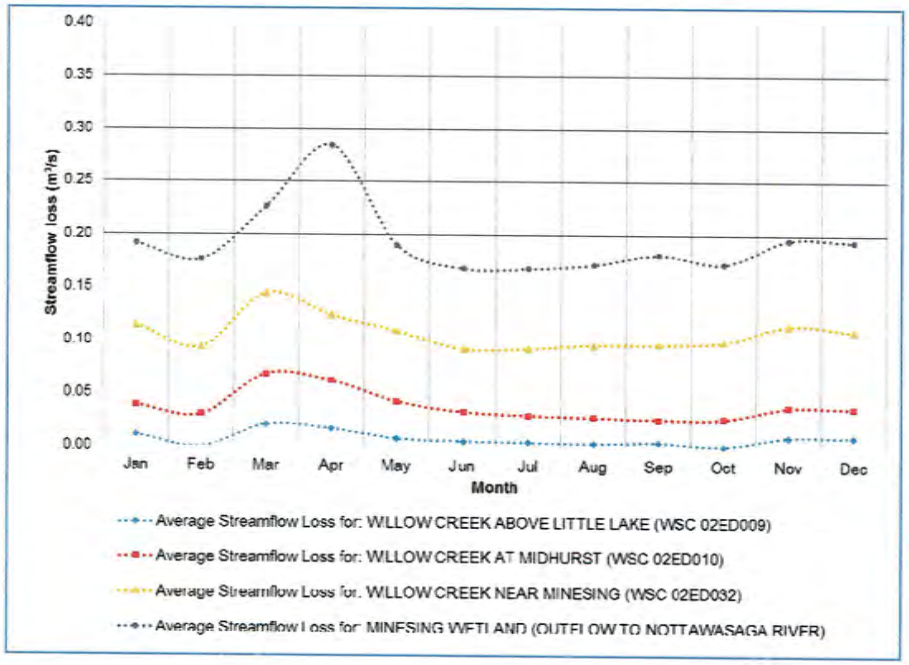
TITLE

PRE-DEVELOPMENT
SIMULATED MONTHLY STREAMFLOWS

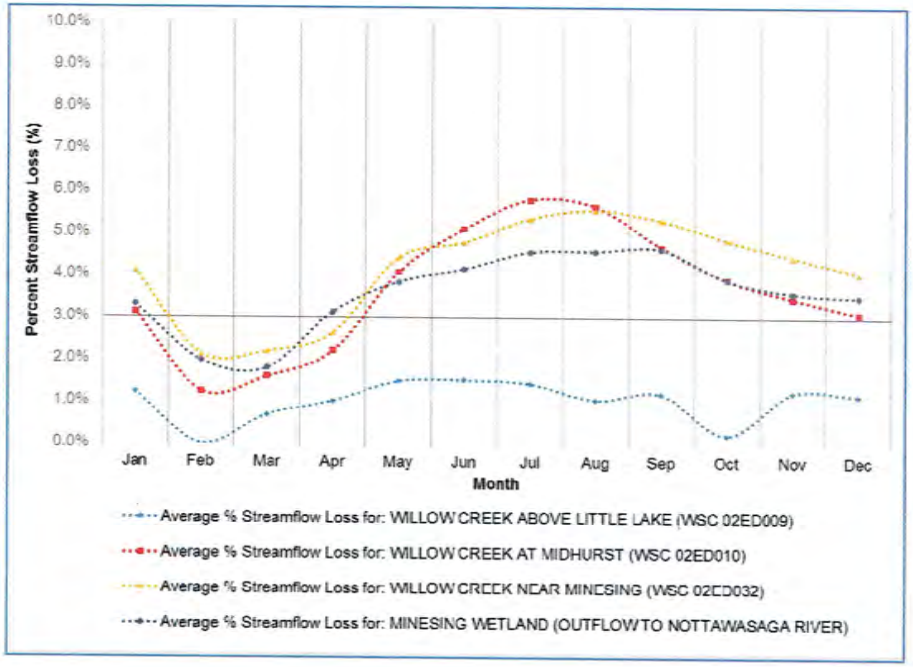
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CAD	RM	JAN 2017	FIGURE
CHECK			13
REVIEW			

STREAMFLOW LOSS EXPRESSED AS FLOW RATE



STREAMFLOW LOSS EXPRESSED AS % OF TOTAL STREAMFLOW FOR SUBCATCHMENT



NOTE

- *Monthly rates and percent changes reflect result for 10th year of simulation.*

PROJECT

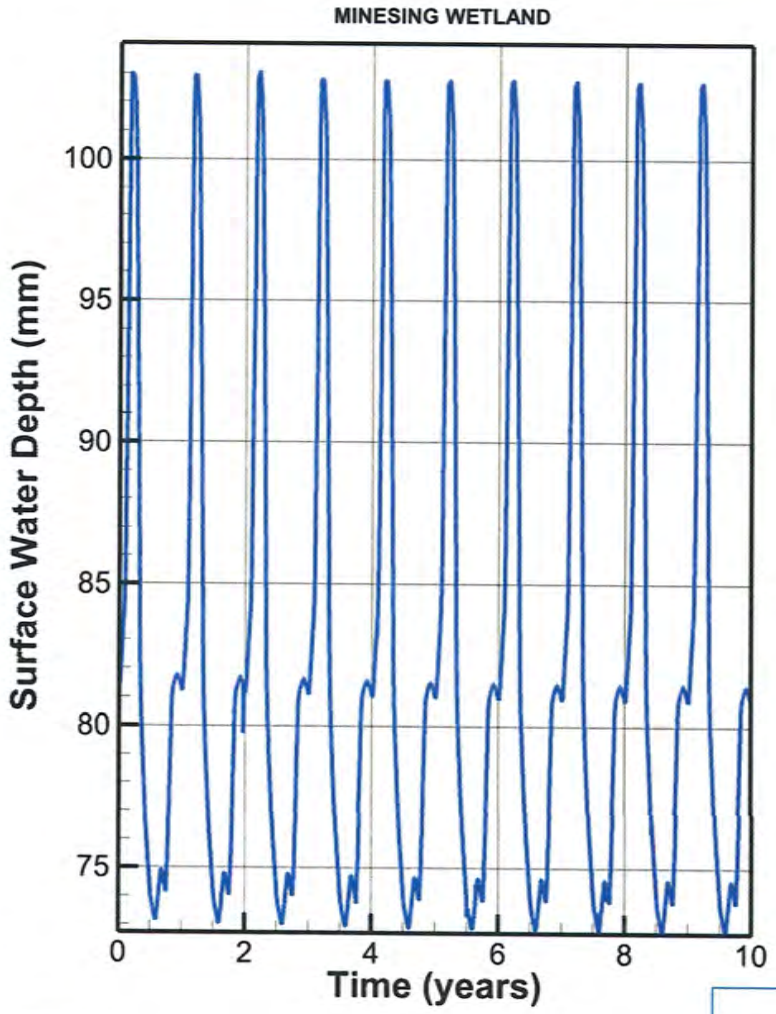
CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

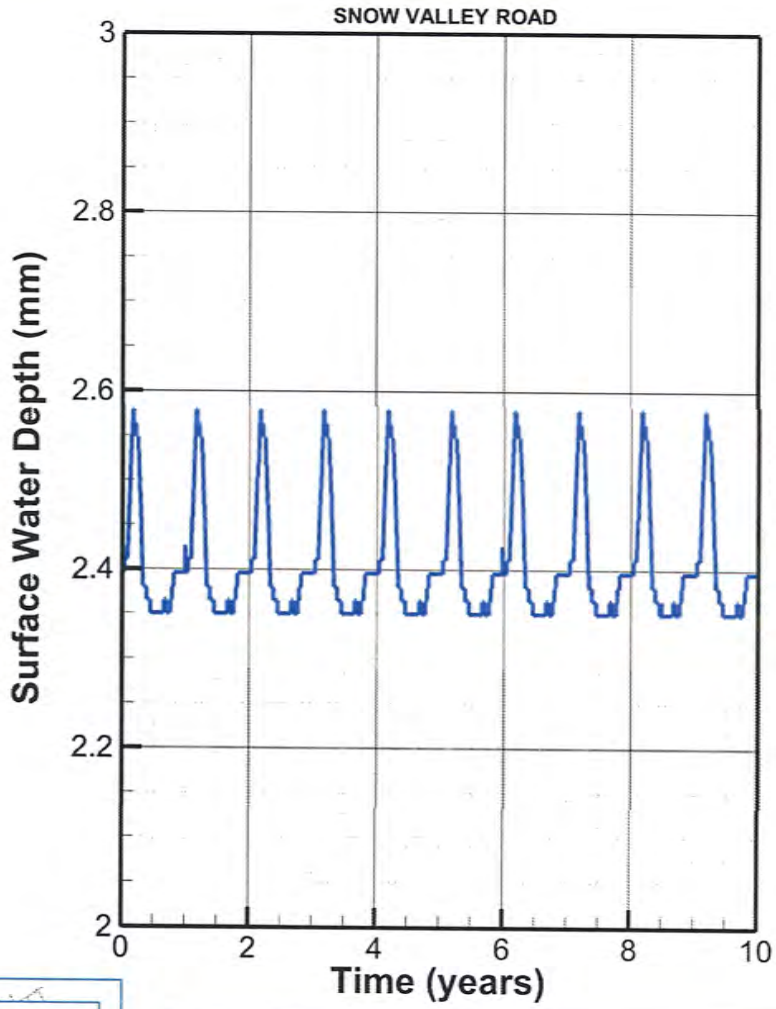
TITLE

POST-DEVELOPMENT
SIMULATED MONTHLY STREAMFLOW CHANGES

Golder Associates

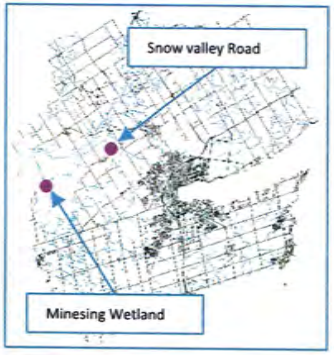
PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	APR 2016	REV. 1
CAD	RM	APR 2016	FIGURE
CHECK			14
REVIEW			





NOTES:

- *Simulated surface water depth at Minesing Wetland (left panel) and Snow Valley Road (right panel)*
- *Model output locations shown in panel to right*



PROJECT

CARSON AND DORAN NEIGHBOURHOODS
SURFACE WATER/GROUNDWATER MODELLING

TITLE

POST-DEVELOPMENT SURFACE WATER LEVEL RESPONSE MINESING WETLAND AREA

Golder Associates

PROJECT No. 13-1170-0040(4000)			SCALE AS SHOWN
DESIGN	RM	JAN 2017	REV. 1
CAD	RM	JAN 2017	FIGURE
CHECK			15
REVIEW			

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[DHP 00734293 2]

APPENDIX 'K'

Evaluation of Midhurst Water Supply and Water Treatment Alternatives – Black & Veatch, May 2016

EVALUATION OF MIDHURST WATER SUPPLY AND WATER TREATMENT ALTERNATIVES - DRAFT

Class EA Phase 3 & 4 for the Midhurst Secondary Plan

B&V PROJECT NO. 180261

PREPARED FOR

The Township of Springwater

C/O AINLEY & ASSOCIATES LIMITED

MAY, 2016

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APPENDICES

Appendix A – Water Supply Alternative Review – Draft Report

Appendix B – Fire Flow Calculation Table

Appendix C – Sand and Gravel Site Plan

Appendix D – Doran Area WTP and Reservoir Site Plan

1. Background

The infrastructure requirements to accommodate future growth planned within the Midhurst Secondary Plan were considered in accordance with Phases 1 and 2 of the Municipal Class Environmental Assessment (EA) Process (Municipal Class Environmental Assessment Manual, 2000, as amended in 2007 and 2011) and documented in the "Class EA Study for Midhurst Water, Wastewater and Transportation Master Plan – Phases 1 & 2 Report, Ainley, July 2009" (Phase 1 &2 Report). The report determined that the Township of Springwater could construct a new water supply system to service growth within the Midhurst Secondary Plan area, including a water treatment plant (WTP), reservoirs, a booster station, transmission mains, and watermains.

Growth within the Midhurst Secondary Plan Area would occur in both the Carson Road and Doran Road areas. It was noted in the Phases 1 & 2 Report that the WTP would be located in the Doran Road Neighbourhood closer to the water supply wells that were proposed to be located in the Doran area at that time. However, subsequent to completion of the Phases 1 & 2 Report, the Midhurst Landowner's Group c/o Carson Road Development Inc. successfully completed the acquisition of a parcel of land north of Snow Valley Road; referred to as the "Sand and Gravel site". As the Sand and Gravel site is separated from the residential communities it can be considered a better location for siting both the water and the wastewater treatment plants. Impact to the residential roads and community from the truck traffic (which will be delivering chemicals to the plants), as well as noise arising from operations of the facilities, would be comparatively less than the previously proposed locations.

A water supply exploration study was initiated as part of Phases 3 & 4 of the Municipal Class EA process and was carried out by Golder Associates Ltd. In addition to the well supply in the Doran Road Area, the exploration program showed promising water supply results at the Sand and Gravel site. This meant that there would be sufficient ground water supply available in the Carson and Doran areas to meet their respective needs. Therefore, it became apparent that the option of having a dedicated WTP in each area should be reconsidered as an alternative, based on the results of the well drilling investigation.

The Draft Report "Water Supply System Alternatives Review" (Appendix A) considered three alternatives for the water supply system:

- *Alternative 1- Construct a single WTP in the Carson Road Neighbourhood and connect to Doran*
- *Alternative 2- Construct a single WTP in the Doran Road Neighbourhood and connect to Carson*
- *Alternative 3- Construct two separate WTPs; One in Carson and One in Daron*

Based on the evaluation documented in Report called "Water Supply System Alternatives Review", Alternative 3 was identified as the preferred strategy due to the availability of sufficient water supply in both Carson and Doran neighbourhoods. This would remove the need to transfer raw water and treated distribution water from one neighbourhood to the other, thereby reducing both capital and operating costs.

2. Purpose of This Report

As indicated above and presented inTable 1, the previous studies concluded that there will be two WTPs located with one in each area of the development (steps from 1 to 3). Based on the preferred alternative solution for water supply systems as presented in a Report (Appendix A), viable

alternatives for water treatment process for the proposed WTP and water distribution are presented and evaluated in this report.

This report presents design basis assumptions which were used to develop design concepts for treatment and supply for each water system. In order to formulate a list of viable treatment alternatives for the WTP, available raw water quality data was reviewed, as well as both present and anticipated future drinking water quality objectives to identify treatment systems for this project. Preliminary preferred design concepts for treatment and water supply systems are presented with rationale.

Table 1 - Decision Making Steps

STEPS	DELIVERABLE	TASKS
1	Midhurst Water, Wastewater and Transportation Master Plan (Phase 1 & 2 Report)	• One WTP at Doran Area Site to supply water to both areas
2	Groundwater Supply Investigation	• Groundwater Investigation included field work at 10 different sites • Identified potential water supply capacity and water quality • 4 well sites were recommended to be developed as potential production wells (2 sites in Doran Area and 2 in Carson Area)
3	Identification and Evaluation Water Supply Alternative Solutions (Re-evaluation of Phase 1& 2 Decision)	• 3 water supply alternatives developed and evaluated (Single WTP in Carson; single WTP in Doran; two WTPs) • Supply, storage and distribution requirements identified • Evaluated based on capital and operating costs • Selection of preferred supply strategy to construct 2 Separate WTPs (1 in Doran; 1 in Carson)
4	**Evaluation of Midhurst Water Supply and Water Treatment Alternatives** **(This Report)**	• **Identification and evaluation of water supply and treatment alternatives for Carson and Doran Areas** • **Preliminary preferred Water Supply and Treatment for Carson Area** • **Preliminary preferred Water Supply and Treatment for Doran Area**

3. Design Basis

The following section summarizes the design basis for the preferred water supply strategy which includes constructing two separate WTPs.

3.1 Population and Water Demand

3.1.1 Projected Units and Population

The proposed infrastructure is expected to serve the following new developments in the Midhurst Settlement Area:

- Doran Road Neighbourhoods 1 and 2
- Carson Road Neighbourhood 3
- Future Employment Lands (north of the Carson Road Neighbourhood)

The Carson Road and Doran Road Neighbourhoods will grow in phases over a number of years. As identified in the Phase 1 & 2 Report, Phase 1 of the development will include the development of 5,000 equivalent units. Subsequently, the development will reach a buildout of 8,208 units.

In accordance with the Master Plan, one unit is equivalent to 3 persons (Ainley Group, 2009). The projected units and population count are shown in Table 2.

Table 2 - Total Projected Units and Population

	UNITS	POPULATION
Doran Road Neighbourhoods 1 and 2	5,299	15,897
Carson Road Neighbourhood 3	2,559	7,677
Future Employment Lands - Carson	350	1,050
Total Future Households/Equivalent Population	8,208	24,624

Source: (Ainley Group, 2009)

3.1.2 Phasing

For the purposes of this assessment, it is assumed that the water supply system will be built in two phases; Phase 1 and Full Build Out, as shown in Table 3.

Table 3 - Units and Population per Phase

	CARSON ROAD NEIGHBOURHOOD (+ COMMERCIAL)		DORAN ROAD NEIGHBOURHOOD		TOTAL	
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT
Units	2,650	2,909	2,350	5,299	5,000	8,208

	CARSON ROAD NEIGHBOURHOOD (+ COMMERCIAL)		DORAN ROAD NEIGHBOURHOOD		TOTAL	
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT
Population	7,950	8,727	7,050	15,897	15,000	24,624

3.1.3 Projected Treated Water Demands

Projected water demands to be supplied by the new WTPs in Doran and Carson for both Phase 1 and Build Out conditions are summarized in Table 4. It should be noted that well supply and WTP capacities will need to provide an additional 5% of the above noted maximum day demands to account for in plant uses such as backwashing requirements.

Table 4 - Projected Treated Water Demands

	CARSON ROAD NEIGHBOURHOOD (+ COMMERCIAL)		DORAN ROAD NEIGHBOURHOOD		TOTAL	
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT
Population	7,950	8,727	7,050	15,897	15,000	24,624
Average Day Demand (ADD) (L/s) [1]	35.0	38.4	31.0	69.9	66.0	108.3
Maximum Day Demand (MDD) (L/s) [2]	69.9	76.8	62.0	132.8	131.9	209.6
Peak Hour Demand (PHD) (L/s) [2]	104.9	115.1	93.0	199.3	197.9	314.4

[1]Values on table based on average per capita demand of 380 L/day as per Phase 1 & 2 of Class EA Report

[2]Peaking factors are based on the MOECC Water System Design Guidelines (Table 3.1)

3.2 Process Design Basis

3.2.1 Well Water Supply and Pumping

The raw water supply required by the new development in Midhurst would be obtained from wells located within the Carson and Doran Neighbourhoods. The number of wells required is based on the latest Water Supply Exploration Program, prepared by Golder Associates Ltd memorandum dated October 15, 2015.

The well supply system would be designed to meet the projected water treatment plant capacities for Phase 1 and Full Build Out. Each well would be equipped with a deep well submersible pump, which would be designed with sufficient hydraulic head capabilities to convey the raw water from the wells to their respective water treatment plants in Doran and Carson. Table 5 summarizes the design basis for well pumping.

Table 5 - Well Water Supply and Pumping Design Basis

PARAMETER	VALUE
No. of Well Sites	The following four sites (Two in Doran and Two in the Carson Area) were recommended to provide water to the Secondary Plan Area. Each site will have a minimum of one standby well at a minimum capacity of 50% of the total site capacity. • Sand and Gravel Site near the potential Carson Road WTP site • West Snow Valley Site; west of the Carson area • Doran Road Alliance Site • Old Second Road Site, south of Pooles Road
Well depth (m)	Penetration of aquifer to be determined as per the geotechnical conditions and groundwater exploration study.
Well pump type	Submersible well pump, multistage to suit the required pressure
Piping	Complete with isolation and check valves, flowmeter, air release-vacuum valve, pump-to-waste and surge protection
Well Capacities	Available capacities at each well site based on the latest Water Supply Exploration Program Report (October 15, 2015) • Doran: Road Alliance Site (TW35/ PW1) – 100 L/s • Doran: Old Second Road Site (TW21/OW24) – 40 L/s • Carson: Sand and Gravel Site (OW19 / TW22) – 73 L/s • Carson: West Snow Valley Site (OW29 / TW34) – 20 L/s

3.2.2 Plant Capacity

For the purposes of this analysis, the growth in the Midhurst Secondary Plan Area is assumed to gradually increase up to the Phase 1 level (5000 units) over a period of 15 years and the subsequent 10 years would see a gradual increase to Full Build Out. The proposed WTP will be sized to meet the maximum day demand as well as in plant use requirements. Once maximum day demand reaches 90% of the WTP rated capacity for Phase 1, the next expansion of the plant will be added to accommodate for population growth to Full Build Out conditions.

3.2.3 Water Treatment Goals

The Safe Drinking Water Act prescribes a treatment goal of 2-log removal/inactivation of viruses for all groundwater systems not under the influence of surface water. Therefore, all of the water from the Carson and Doran area wells will be disinfected to achieve 2-log inactivation of viruses.

The CT method is used to determine disinfection credits achieved during treatment for chemical disinfection. In this method, CT is defined as the product of C, the residual disinfectant concentration in mg/L, and T_{10}, the detention time in minutes corresponding to the time for which 90 percent of the water has been in contact with at least the residual concentration. The Ministry of the Environment and Climate Change (MOECC) provides guidelines for T_{10}/T ratios, where T is the

hydraulic detention time, based on the extent of baffling, and this T_{10}/T ratio is often referred to as a baffling factor.

Disinfection requirements are correlated to CT values in the *Procedure for Disinfection of Drinking Water in Ontario.* Table 6 presents the design basis for the disinfection requirements.

Table 6 - Design Basis for Disinfection

PARAMETER	VALUE	
	PHASE 1	BUILD OUT
Log removal/inactivation of viruses required	2 (99%)	2 (99%)
Minimum water temperature (°C)	5	5
pH	6 - 9	6 – 9
Minimum free chlorine residual to be maintained at end of CT cells (mg/L)	0.3	0.3
Minimum CT required (mg-min/L)	4.0	4.0

Secondary disinfection requirements will also be designed in compliance with the MEOCC *Procedure for Disinfection of Drinking Water in Ontario*.

It is recommended that additional treatment be provided to ensure that the finished water meets the health based standards described in O.Reg 169/03 and to satisfy aesthetic water quality objectives in accordance with MOECC Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines.

The ground water investigation completed to date shows that the water quality varies noticeably in each well site. Therefore each WTP will need to be designed to target specific water quality issues as described in the following sections.

3.3 Water Distribution System

3.3.1 Overview

Based on the preferred water supply system alternative, as presented in Appendix A, the water supply system for the Midhurst Secondary Plan Neighbourhood areas will consist of reservoirs, pumping systems, transmission mains and distribution water mains as shown in Figure 1 and Figure 2. The Carson and Doran Neighbourhoods will operate as separate pressure zones.

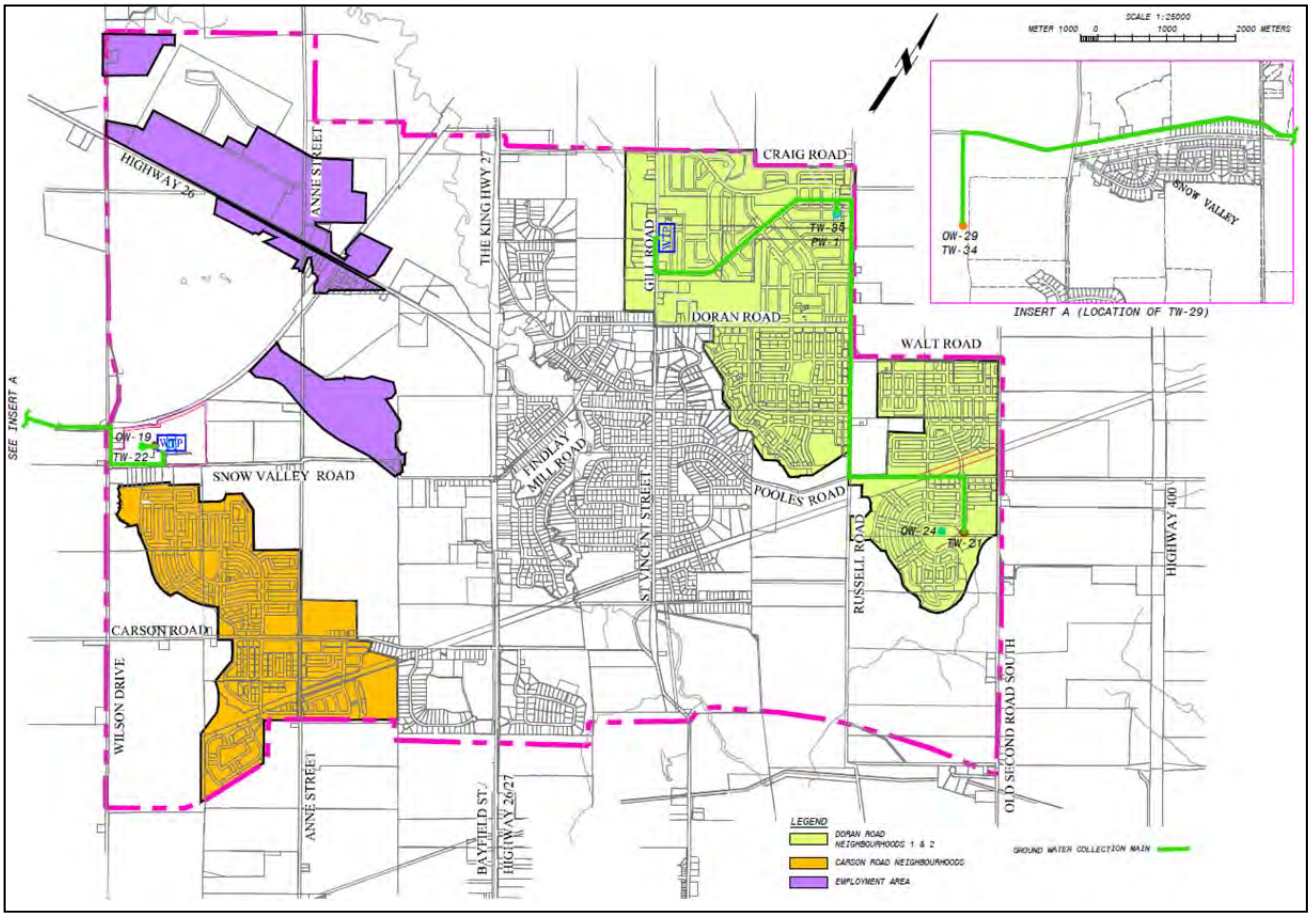


Figure 1- Two WTPs (One Carson; One Doran) – Ground Water Supply System

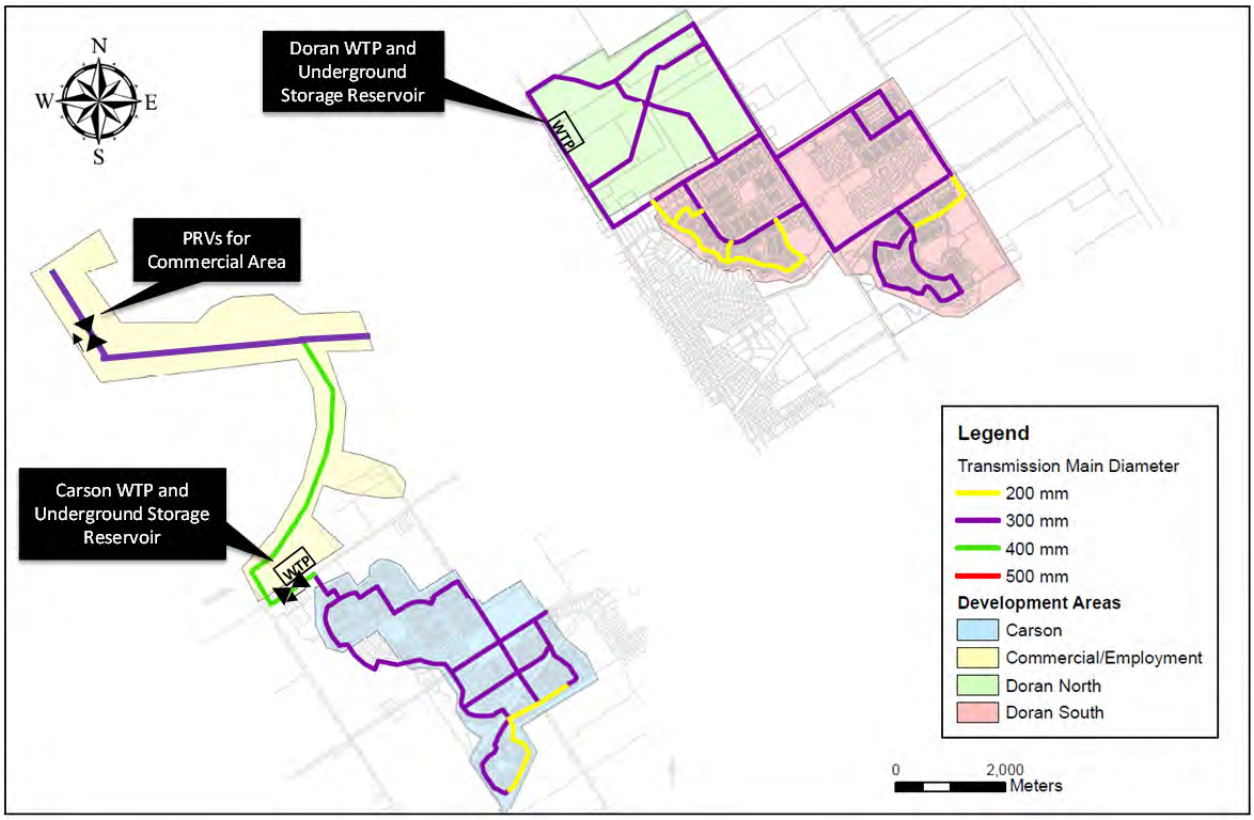


Figure 2 - Two WTPs in (One Carson; One Doran) – Treated Water Distribution System

3.3.2 Fire Flow Demand and Volume

Fire flow is defined as the volume of water that a system must be capable of providing, above and beyond the usual demands of a community for the purpose of fighting fires. Numerous methods exist for the calculation of fire flow requirements.

The MOECC Guidelines provide fire flow demands based on historical data for small municipalities in Ontario. These guidelines are generic to all types of housing, and do not take into consideration the types of dwellings to be constructed. Any industrial and commercial users are treated as 'equivalent' populations. The fire flow requirements of these equivalent populations are recommended to be included in the total fire flow required for the community.

The fire flow rates and durations for each area based on MOECC Guidelines are summarized in Table 7.

Table 7 - Fire Flow Calculations Based on MOECC Guidelines

	CARSON AREA		DORAN AREA	
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT
Population	8,025	8,727	6,975	15,897
Fire Flow (L/s)	167	182	174	235
Fire Flow Duration (hours)	3	3	3	3
Fire Flow Volume (m^3)	1,800	1,960	1,880	2,540

The MOECC Guidelines further state that the *Manual of Water Supply Practices (M31)* by AWWA and Fire Underwriters Survey (FUS) document *Water Supply for Public Fire Protection* (CGI Group, 2007) should be referred to for establishing fire flow requirements.

The *Manual of Water Supply Practices (M31)* describes four different fire calculation methodologies from following organizations;

- Insurance Services Office (ISO),
- Iowa State University (ISU),
- National Fire Academy (NFA), and
- Illinois Institute of Technology Research Institute (IITI).

These methodologies require careful assessment of building construction type, construction materials, occupancy, exposure and fire communications. The smaller residential buildings can also be classified based on the distance that separates them from their neighbours.

Details of the residential and commercial structures in the Midhurst Secondary Plan are under review and have not been confirmed yet. However, based on initial review of the planning documents, five types of residential structures are identified. In addition to the residential

structures, schools and small retail stores are also being planned within the residential areas. There is also dedicated land for commercial and industrial development north of the Carson Road Neighbourhood.

Based on the information available at this time, fire flow rates were calculated for these types of developments using calculation methodologies mentioned above and presented in Appendix B.

Sizing pipeline and storage infrastructure to provide sufficient fire flows when required could have a detrimental impact on the water quality in the distribution system. In order to prevent any water quality issues especially during the initial years of development, it is suggested that fire flow be rated at 133 L/s based on the FUS methodology for the townhouses listed in Appendix B.

As presented in Manual of Water Supply Practices (M31), recommended fire flow duration used in the four methods listed above (based on the National Fire Protection Association's Fire Protection Handbook) would be 2 hours up to 158 L/s.

Following further review of the type of residential and commercial development as well as consultation with the Township and Fire Officers, fire flow rates and duration were chosen to be 133 L/s for 3 hours as per FUS Methodology as confirmed by Ainley in February 2016. This will provide sufficient fire flow for the development whilst limiting the water quality issues that can arise when sizing distribution infrastructure to meet high fire flows.

3.3.3 Storage Volume

The reservoirs will provide flow equalization to reduce the need for frequent changes in plant production rates to meet system demands, and to meet distribution system peak, fire and emergency demand requirements. As the distribution system will be operated as a "closed system", the reservoirs will be in-ground storages and will be pumped to the distribution system.

The peak hourly demand of each area will be met by means of a storage tank that will operate on a fill/empty mode (Fill during night, and empty during peak hourly demand), with a pump station which will provide peak demand.

Storage sizing is based on the MOECC's Design Guideline for Drinking Water Systems. This means that storage capacity is required for three key components:

- Fire Storage
- Equalization Storage
- Emergency Storage

As mentioned in Section 3.3.2, fire storage is based on a flow rate of 133 L/s with a three hour duration. This storage capacity is dedicated to meet fire flow demands.

Equalization storage is designed to meet the water demands that exceed the daily water supply capacity. Since the proposed wells and water treatment plant will be designed to meet maximum daily demands, the equalization storage must be sufficient to meet the difference between maximum daily demand and peak hour demand. Current MOECC guidelines suggest that equalization storage be equal to 25% of the maximum day demand.

Emergency storage is dedicated storage to meet water demands in case of an emergency, such as a power outage. Current MOECC standards state that the emergency storage should be calculated as 25% of fire and equalization storage.

The combination of fire, equalization and emergency storage is the minimum recommended storage volume required.

3.3.4 Distribution System Pumping

In order to provide an optimized system, Doran and Carson will have separate Hydraulic Grade Lines (HGL) to ensure adequate pressure. A high level hydraulic analysis was conducted in order to confirm the suitability of each system's HGL based on the distribution system and ground elevations. Under normal operating conditions, the desired pressure range for the Doran and Carson development areas is between 50 and 90psi. This is the basis that guides the required HGL for each system.

There will be a pumping system at each water treatment plant. Each pumping station will be dedicated to their respective neighbourhoods (Carson Road Neighbourhood and Doran Road Neighbourhood).

4. Carson Area Water Treatment and Water Supply

4.1 Plant Capacity

For the purposes of this analysis, the growth in Carson is assumed to gradually increase up to the Phase 1 level (2,650 units) over a period of 15 years and the subsequent 10 years would see a gradual increase to Full Build Out (2,909 units). Figure 3 illustrates the maximum day water demands from the start of Phase 1 until the completion of Full Build Out for the Carson Area.

The Carson WTP will be rated at 73 L/s to match to the well capacity of the Sand and Gravel well site. The plant's rated capacity would provide the maximum day demand up to 69.6 L/ and additional 5% in plant uses which would be allocated for backwashes and other requirements for the plant. This is slightly less than the projected demand for Phase 1 of 69.9 L/s. However, the detailed design phase of this project will confirm the in plant water demand and available capacity from the wells as well as water demand from the development areas. As indicated previously, when the demand reaches to 90% of the rated plant capacity the next plant capacity expansion will be commence.

As shown in Figure 4, the Carson Area does not have significant growth between the end of Phase 1 and Full Build out. However, this additional growth means that the West Snow Valley well site is required because demand exceeds the Sand and Gravel site capacity of 73 L/s. Once the West Snow Valley site is connected, additional treatment processes will be required to treat the West Snow Valley well supply.

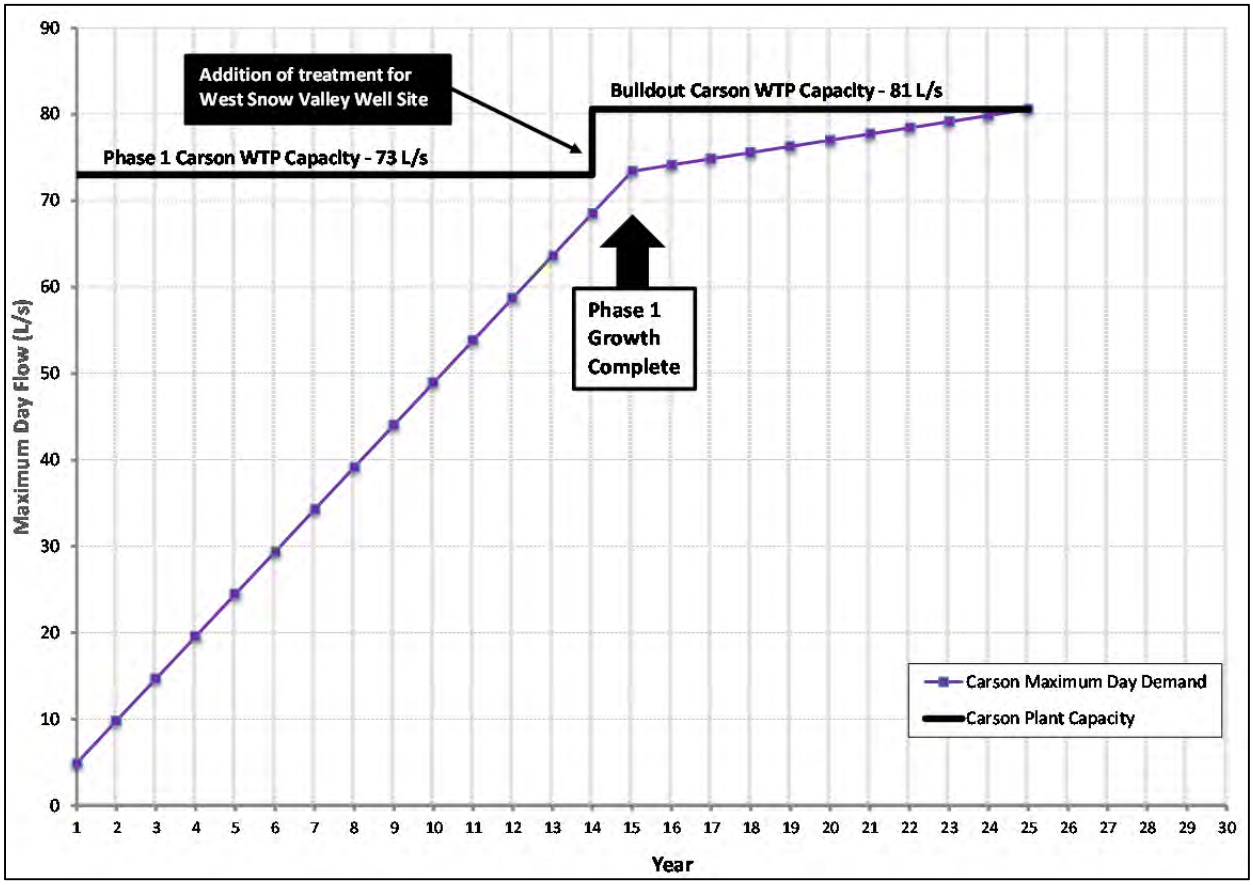


Figure 3 - Carson WTP Capacity Expansions and Water Demand

4.2 Raw Water Quality and Quantity

4.2.1 Sand and Gravel Well Site

The Water Supply Exploration Study documented that the well TW-22 at the Sand and Gravel Site has a tested yield of 36.5 L/s. A number of test wells were drilled at this site and it was concluded that the TW22 well is proposed to be twinned at the same site, increasing the total well capacity to 73 L/s. The site will have an additional standby well to support at least 50 percent capacity of site capacity. The total capacity of the site will be sufficient to meet the required plant capacity (maximum day demand and in plant loses) until near the end of Phase 1 growth period.

The well site including observation and production wells will be protected by a boundary fence and provided with good access. The site is in close proximity to the proposed location of the Carson WTP. These wells will be the main water supply source to the Carson Area, therefore an emergency power supply to the well pumps from the WTP facility is proposed.

4.2.2 West Snow Valley Well Site

The well in the Snow Valley West Site (TW-34) has a tested yield of 20 L/s, and it was noted that the site is capable of yielding 40 L/s with a twinned well at or near the location of OW29. The required

capacity from this site to meet the Build Out demand is only 8 L/s in addition to the available well capacity at the Sand and Gravel Site.

The well is located approximately 4.5 km west of the proposed location for the WTP. A transmission main will be built on Snow Valley Road to transfer ground water to the proposed WTP site. Figure 4 presents the location of the wells.

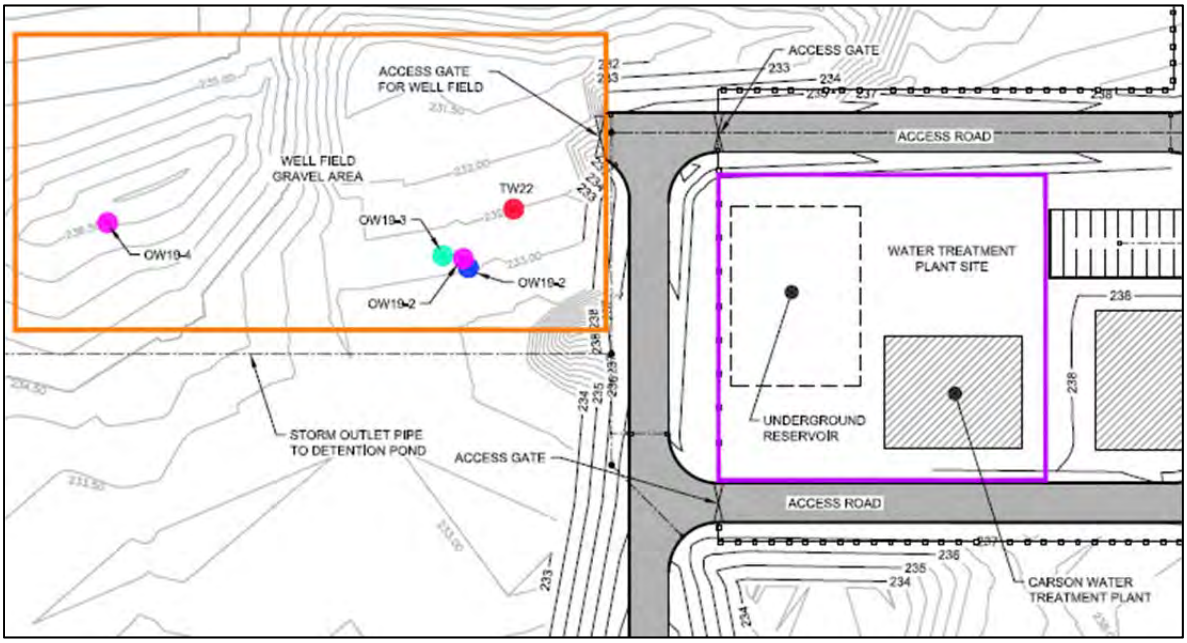


Figure 4 - Sand and Gravel Site Well Field

4.2.3 Raw Water Quality

Water quality data for the Carson Area wells is shown in Table 8. The TW-22 samples were collected on September 12, 2014, and the TW-34 samples were collected on April 16, 2014.

The ground water investigation completed to date shows that water quality varies between the two sites. The TW-22 sample had higher concentrations of nitrate (7.7 mg/L), but iron and manganese were not detected. The TW-34 samples had iron and manganese levels that exceed Ontario drinking water standards for aesthetic objectives (AOs). The water from this site also had a slight sulphur odour and gas bubbles, presumed to be methane.

Table 8 - Raw Water Analysis Results at OW19/TW22 and OW29/TW34 in Carson Area

PARAMETERS	UNITS	OW19/ TW22	OW29/ TW34	ONTARIO DRINKING WATER QUALITY STANDARDS, OBJECTIVES AND GUIDELINES
Hardness ($CaCO_3$)	mg/L	311	211	80 – 100 (OG)
Dissolved Organic Carbon	mg/L	1.7	1.6	5 (AO)
Turbidity	NTU	0.4	13.9	5
Nitrite (N)	mg/L	< 0.1	< 0.1	1.0

PARAMETERS	UNITS	OW19/ TW22	OW29/ TW34	ONTARIO DRINKING WATER QUALITY STANDARDS, OBJECTIVES AND GUIDELINES
Nitrate (N)	mg/L	7.7	< 0.1	10
Iron (Fe)	mg/L	< 0.005	1.27	0.3 (AO)
Manganese (Mn)	mg/L	< 0.001	0.294	0.050 (AO)
pH	pH	7.9	8.05	6.5 – 8.5 (OG)
Alkalinity (Total as $CaCO_3$)	mg/L	238	234	30-500 (OG)
Total Ammonia-N	mg/L	< 0.01	0.14	Not defined

4.2.4 Treatment Goals for Wells at Sand and Gravel Site

The maximum acceptable concentration (MAC) for nitrate is 10 mg/L as nitrogen (mg/L-N). The TW-22 sample tested had a nitrate concentration of 7.7 mg/L-N. Although the sample concentration was less than the MAC, and the levels are anticipated to drop, planning for nitrate removal is recommended at this phase in the project in the event the nitrate concentrations increase over time or higher concentrations are discovered when further sampling is conducted. A nitrate treatment goal of reducing nitrate by half is proposed for these wells.

4.2.5 Treatment Goals for Wells at West Snow Valley Site

Iron and manganese are nuisance contaminants that can cause discoloration of drinking water and staining of fixtures and clothing. The Ontario Drinking Water Standards prescribe an aesthetic objective (AO) for iron of 0.3 mg/L, and an AO for manganese of 0.05 mg/L. Although the AO for manganese is 0.05 mg/L, manganese can cause staining at concentrations as low as 0.02 mg/L. The treatment goals will be 0.2 mg/L for iron and 0.015 mg/L for manganese. There is anecdotal evidence that the water may contain hydrogen sulfide and methane gases. These gases are readily removed to below detection limits by aeration.

4.3 Water Treatment Alternatives

Because wells at the Sand and Gravel site and the West Snow Valley site have different treatment requirements, the treatment alternatives are reviewed separately, even though the systems will be located at the same WTP. Disinfection for the entire flow is also discussed in the following sections.

4.3.1 Sand and Gravel Site Well Water Treatment

The treatment goal at the Sand and Gravel well water is to reduce nitrate concentrations by approximately 50 percent. The best available technologies for removing nitrate are as follows:

- Ion exchange (IX) with strong base anion (SBA) resin.
- Reverse osmosis (RO)
- Electrodialysis reversal (EDR)

IX is extentively used in cases where nitrate removal is the only treatment goal because IX is less expensive than RO or EDR and because it generates approximately five times less brine waste by-product.

RO and EDR use membranes to remove high percentage of all dissolved contaminants, including nitrate, and therefore RO and EDR are appropriate technologies for desalinating water to reduce the concentration of total dissolved solids (TDS) or in some cases where treatment is required to remove multiple contaminants. In treatment with RO or EDR, typically 75 to 85 percent of the water treated is recovered as product water and the remainder is discharged from the systems as brine waste by-product that must be managed. Consequently, well pumping rates would have to be higher to compensate for the water lost as brine. Furthermore, the capital costs for RO or EDR would be three to four times the cost for IX. In contrast to RO and EDR, IX is used to remove specific target ions, and recovery of product water is around 98 percent.

A schematic of treatment with IX is shown in Figure 5. IX resin is contained in pressure vessels, and as water flows through the resin, nitrate is exchanged for chloride on the IX resin. If the treatment goal is 50 percent removal of nitrate, approximately 50 percent of the well flow can be bypassed around IX treatment, thus reducing capital and operating costs. When the resin exchange capacity is exhausted, the resin is regenerated with a solution of sodium chloride (NaCl) drawn from a NaCl saturation tank. During regeneration, nitrate is eluted from the resin and replaced by chloride, readying the resin for another treatment cycle.

The regeneration waste is a brine solution containing sodium, chloride, and nitrate. The preferred disposal method for this brine would be discharge to a sanitary sewer which leads to the wastewater treatment plant (WWTP). The Midhurst WWTP is proposed to be located within the same site as this WTP. The brine will be pumped to the headworks together with other wastes; however, in order mitigate the impact to the wastewater treatment process, a careful review will need to be undertaken during detailed design.

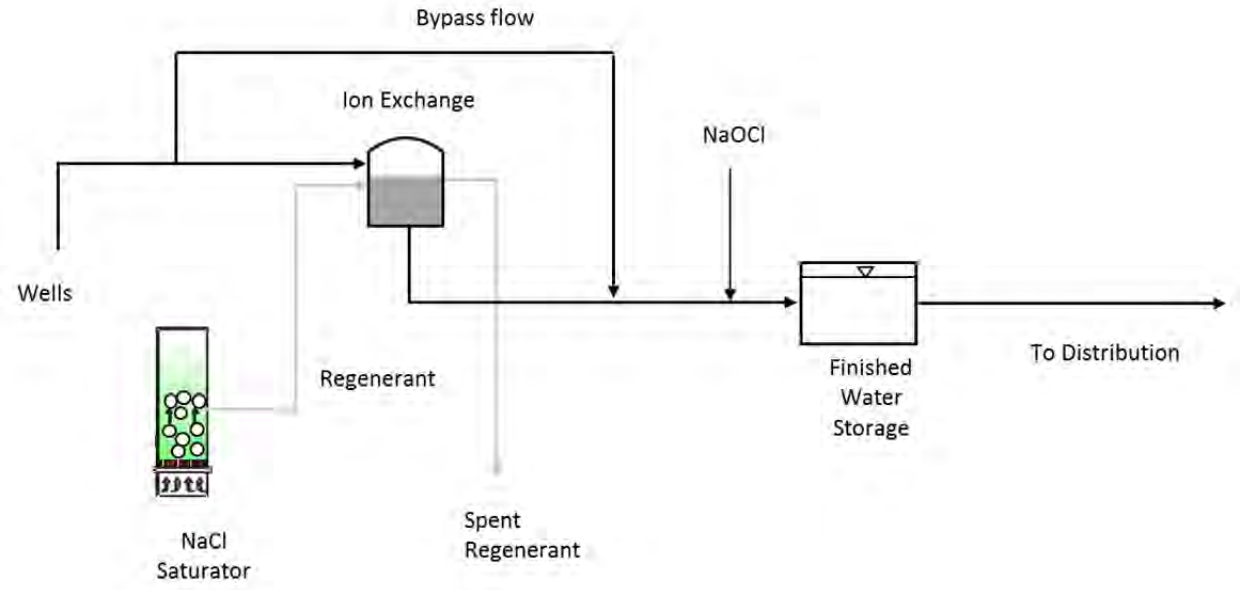


Figure 5 - Sand and Gravel Site Well Water Treatment System

4.3.2 West Snow Valley Site Well Water Treatment

The standard method for removing iron and manganese from groundwater is oxidation followed by filtration. The media used in the filter is either coated with manganese dioxide (such as greensand or induced greensand) or it is a specialty media such as Pyrosulite (naturally occurring manganese dioxide).

A schematic of the treatment system is shown in Figure 6. Groundwater collected from the wells will be dosed with sodium hypochlorite (NaOCl). In this option, NaOCl has two treatment functions, disinfection and oxidation of iron and manganese. Treatment with an oxidant such as chlorine, changes the species of iron and manganese from soluble forms that are not removed during filtration to insoluble forms that are removed. Depending on the media type, the media is regenerated with NaOCl or with NaOCl and a periodic dose of potassium permanganate ($KMnO_4$). The filter will be backwashed periodically to remove solids that accumulate. The backwash waste will be discharged to an equalization basin and from there pumped to a settler for washwater recovery. The recovered water will be pumped back to the beginning of treatment, and sludge from the settler will be pumped to the wastewater treatment plant which would be within the same site.

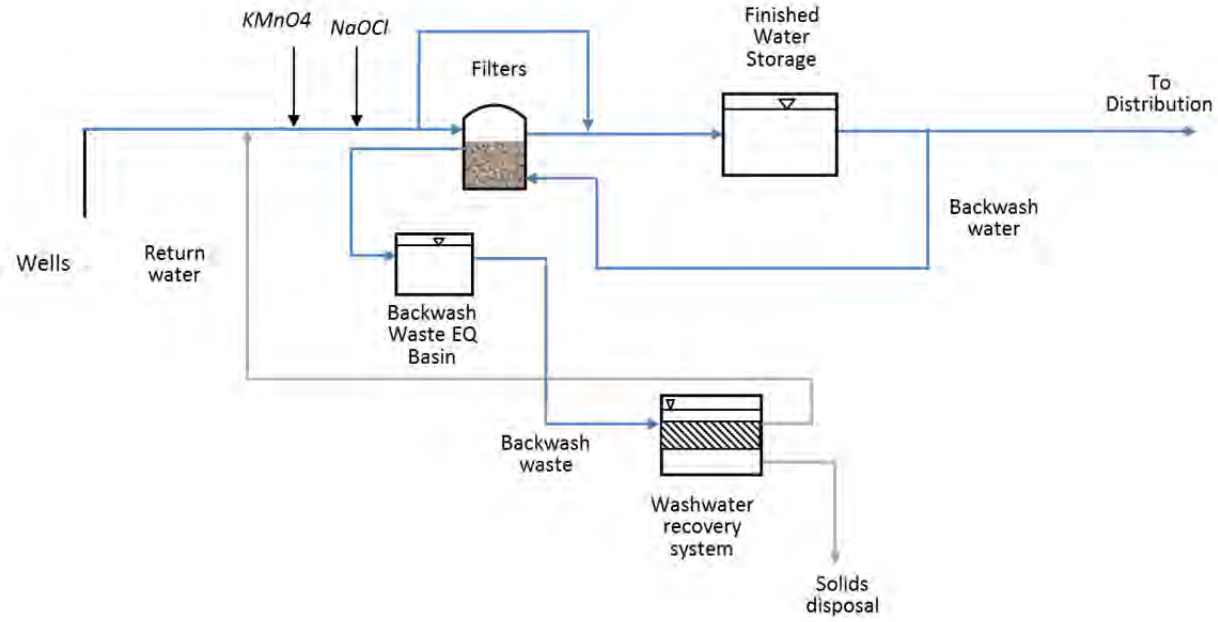


Figure 6 - Treatment at the West Snow Valley Site

In lieu of treatment to remove iron and manganese, some systems dose sequestering agents such as sodium silicate or polyphosphates to prevent aesthetic problems caused by iron and manganese. These sequestering agents bind iron and manganese and thus prevent them from precipitating and causing discoloration. There are, however, disadvantages compared with treatment to remove iron and manganese. First the correct dose must be applied for the sequestering agent to be effective. Second, the effectiveness of sequestering agents can dissipate with time. Water demand will be low in the initial phases of the project that will result in longer water ages in the distribution system. Aged water enhances the potential for iron and manganese to cause discoloration if present in the water. Therefore, the use of sequestering agents to control iron and manganese is not recommended for this project.

4.3.3 Disinfection

There are two viable options for disinfection to meet the MOECC requirement; chemical disinfection and Ultraviolet (UV) radiation.

For ground water which is not under the direct influence of surface water, UV light is acceptable as a primary disinfection process, provided that the UV reactors are designed to dose at least 40 mJ/cm^2 and is maintained throughout the life time of the lamp. However, it does not provide a disinfectant residual which is required for the distribution system. According to the *Procedure for Disinfection of Drinking Water in Ontario* by MOECC, the primary disinfection must be followed by another process, normally chlorination, which introduces and maintains a persistent disinfectant residual throughout the distribution system. Therefore, a chemical disinfection has to be operated and maintained for secondary disinfection.

A chemical disinfection system will require a contact tank where sufficient contact time is provided to all of the water. The CT method is used to determine disinfection credits achieved during the disinfection process in a contact tank. The contact tank would have to be designed with sufficient baffling as classified in the MOE *Procedure for Disinfection of Drinking Water in Ontario.*

Chlorine in the form of liquid sodium hypochlorite (NaOCl) would be added to the water for disinfection to achieve 2-log inactivation of viruses. Contact time to achieve the required CT would occur in the finished water storage tank. It is preferred to have a common disinfection method for both of the WTPs to achieve efficiency of operation.

4.4 Treated Water Distribution System

4.4.1 Storage Volume

The Carson Road Neighbourhoods will have a local storage reservoir at the water treatment plant site in Carson, which will store treated water so that it can be pumped to the distribution system. Distribution system feed pumps at the WTP will be capable of providing flow during peak hours and during emergency conditions (fire flows, etc.).

The water storage facilities will each provide water storage for the respective areas in which they are located. The Carson storage requirements are summarized in Table 9.

Table 9 - Carson Road Area: Storage Reservoir Volume requirements (includes Employment Area)

PARAMETER	STORAGE VOLUME (m^3)	
	PHASE 1	BUILD OUT
Equalization Storage (25% of Max Day Demand)	1,511	1,658
Fire Storage (133 L/s for a duration of 3 hours)	1,436	1,436
Emergency Storage (25% of Equalization Storage + Fire Storage)	737	774
Carson Total Storage Requirement	3,684	3,868

4.4.2 Distribution System Pumping

In order to provide an optimized system, Carson and Doran will have separate Hydraulic Grade Lines (HGL). Table 10 presents the basis of the HGL for the Carson area.

Table 10 - Carson Road Area: Hydraulic Grade Line Design Basis

PARAMETER	DATA
Preferred Operating Pressure Range	345 to 620 kPa (50 to 90 psi)
Minimum Ground Elevation	240m
Maximum Ground Elevation	280m
Provided Hydraulic Grade Line	321m (280m for Employment Area)
Provided Pressure ranges	347-737 kPa (50.3 to 106.8 psi)

Based on the hydraulic analysis completed, the Carson area is shown to have a wide range of elevations (240-280m) that would make it impossible to maintain the desired pressure range (50 to 90 psi) in a single pressure district without the implementation of pressure control valves. For example, an area in the north-west corner of the Carson Road Neighbourhood would slightly exceeds the upper limit of the preferred operating pressure range of 90 psi. Due to this, a pressure reducing valve (or individual pressure reducing valves at service connections) would be required to service this area.

Additionally, due to the topography of the Carson employment area, the dedicated land for commercial and industrial development north of the Carson Road Neighbourhood would have a lower hydraulic grade line. It is suggested that this sector be fed through a Pressure Reducing Valve in order to maintain the preferred operating pressure range for the area.

The Carson water treatment plant would include a high lift pumping station which would be dedicated to supplying treated water to the Carson Road Neighbourhood. Table 11 presents the design basis for the Carson Area distribution pumps.

Table 11 - Carson Road Area: Distribution Pumping Design Basis

PUMPING SYSTEM	DESIGN BASIS FOR CAPACITY	DISTRIBUTION PUMPING CAPACITY (L/S)	
		PHASE 1	BUILD OUT
Carson Road Neighbourhood Pumps	Peak Hour Demand of Carson Area	100 (HGL = 321m)	104 (HGL = 321m)
Fire Flow Pump	As per FUS	133	133

Since there would be no floating storage (elevated tank) in the Carson area, the Carson high lift pumps would need to include a range of pumps which could supply all demand conditions from minimum hour demands to peak hour demands. In order to operate the large range of flows, variable frequency drive (VFD) pumps are expected to be required for the distribution pumping. Additionally, a fire flow pump would be required in order to provide fire flow demands during an emergency.

4.5 Preferred Solution for Carson Area

4.5.1 Description of Preferred Design Concept

The preferred design concept recommended for implementation of the Carson Area Water Supply and WTP includes the following components;

- Construction of 3 equally sized production wells at the Sand and Gravel site with any 2 being capable of providing a total of 73 L/s to provide Phase 1 water demand,
- Construction of production wells at West Snow Valley Site with a minimum of 2 wells rated at a minimum 8 L/s, complete with a raw water transmission main to the Sand and Gravel site,

- A WTP is to be built at the Sand and Gravel Site to treat ground water from two sites. An IX system is recommended for nitrate removal for the Sand Gravel Site wells. The WTP will also include a treatment system for the West Snow Valley site wells including a filter system with special filter media for removal of iron and manganese. The disinfection system will include chlorine storage tank and a feed system complete with a contact tank. The process waste from the water treatment systems would be pumped to the WWTP at the site. The facility will be equipped with emergency power supply to sustain entire operation including well pumps,
- An underground storage tank will be built to provide a minimum 3,868 m^3 storage to provide emergency, fire storage and equalisation volume for peak hours,
- A pumping station will be built as part of the WTP to provide the peak hourly demand of the Carson Area and to maintain the pressure range between 50 and 90 psi throughout the area; the station will also house fire pumps to provide required fire flow of 133 L/s. Pressure reducing valves (or individual pressure reducing valves at service connections) will be required to service some of the small areas in the Carson Area.

Appendix C presents the location of preferred Sand and Gravel site wells and WTP.

4.5.2 Opinion of Probable Capital Costs

The estimated capital cost of the project based on the scope of work outlined in this report is summarized in Table 12.

The following general assumptions were made in preparation of the cost estimates:

- Estimates of probable a Class 4 capital costs have been developed based on prices obtained from suppliers and from data in Black & Veatch's possession from projects of similar nature and scope. The cost estimates presented in this report may be significantly affected by a number of factors which cannot be readily forecast which include amongst others, volume of work in hand or in prospect for contractors or suppliers at the time of the tender calls, future labour contract settlements, inflation and market escalation. For this reason, the cost estimate has an expected accuracy of +35 percent to -20 percent of the actual construction cost.
- All taxes have been excluded.

Table 12 - Probable Opinion of Cost Estimate For Carson Area WTP and Supply

COMPONENTS	PHASE 1	ADDITIONAL COST FOR BUILD OUT
Raw water supply (drilling well casing, screens, pumps, wellhead, piping and transmission main)	$870,000	$3,138,000
Carson WTP including distribution and fire pumping systems	$3,535,000	$701,000
Carson Water Storage Tank	$2,638,000	

Other costs (General requirements, Approvals, Permits, Engineering (15%), and Contingency 25%)	$3,825,000	$2,098,000
Total Current Year	**$10,868,000**	**$5,937,000**

5. Doran Area Treatment and Water Supply

5.1 Plant Capacity

For the purposes of this analysis, growth in the Doran Area is assumed to gradually increase up to the Phase 1 level (2,350 units) over a period of 15 years and the subsequent 10 years would see a gradual increase to Full Build Out (5,299 units). Figure 7 illustrates the maximum day water demands from the start of Phase 1 until the completion of Full Build Out for the Doran Area. Additionally, it displays the proposed WTP capacity over time.

For the Doran area, the WTP construction will be phased in two parts. Initially, Doran can be built to meet the Phase 1 demand requirements. Once the maximum day demand reaches 90% of the WTP rated capacity for Phase 1, the next expansion of the plant would be required to accommodate for population growth at to full Build Out conditions. It is envisioned that the treatment plant building will be built to accommodate the ultimate size and the expansion will simply involve additional filter and pumps to increase the treatment capacity.

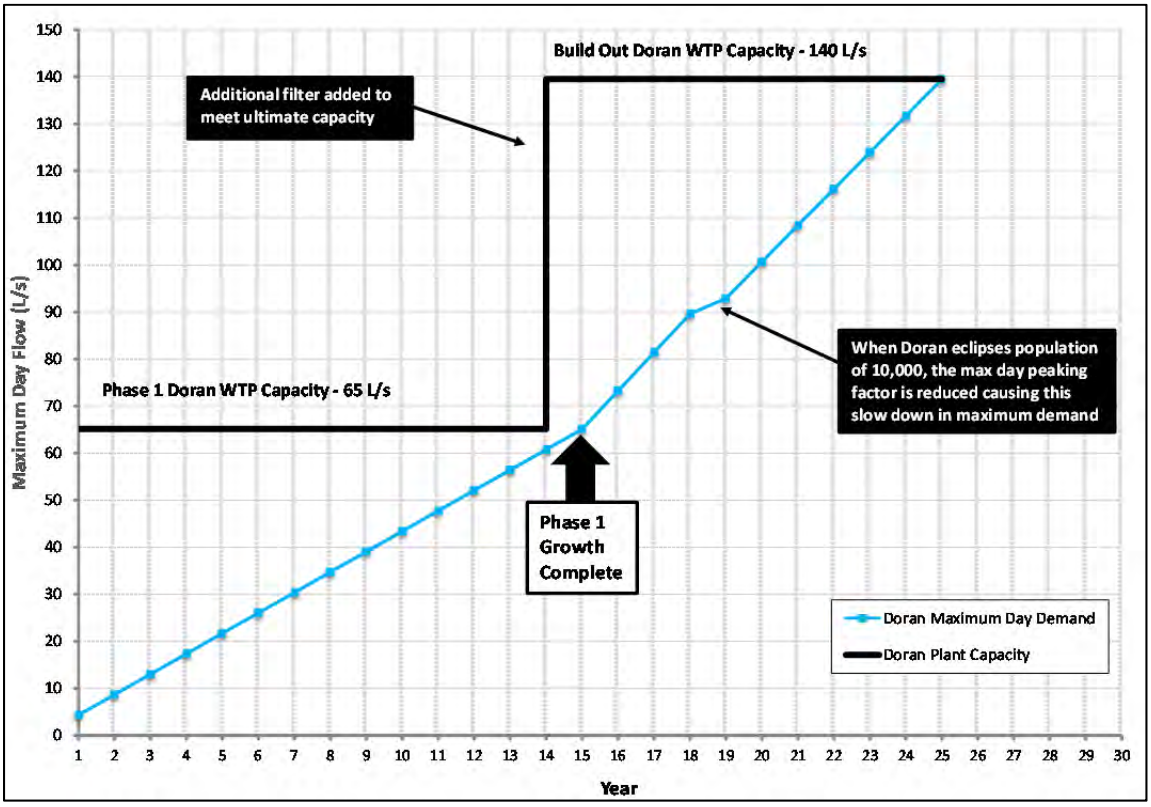


Figure 7 - Doran WTP Capacity Expansions and Water Demand

5.2 Raw Water Quality and Quantity

5.2.1 Alliance Well Site

The Water Supply Exploration Study documented that well PW1 at the Alliance Site has a tested yield of 45 L/s. This well is proposed to be twinned reaching a combined capacity of 100 L/s, with the twin operating at 55 L/s. The site will have an additional standby well to support at least 50 percent of site capacity.

The Alliance well site is located north east end of the development area in Doran Area within the residential development area. The allocated site is approximately 9.3 m by 30 m.

5.2.2 Old School Road Site

The wells in the Old School Road Site (TW-21) had a tested yield of 27.8 L/s, but it was noted that the site is capable of yielding 40 L/s with a twinned well at OW24, where both wells could operate at 20 L/s.

5.2.3 Raw Water Quality

Water quality data for the wells is shown in Table 13. The test sample for well PW1, located at the Alliance site, was collected on July 24, 2014. The test sample for well TW-21, located at the Old School Road site, was collected on August 5, 2014. The water from PW1 showed levels of iron and

manganese that exceeded AOs for these contaminants. There were no contaminants at levels of concern in the TW-21 sample.

Table 13 - Raw Water Analysis Results at TW35 / PW1 and TW21 / OW24 in the Doran Area

PARAMETERS	UNITS	Alliance Site (TW35 / PW1)	Old School Road Well (TW21/ OW24)	ONTARIO DRINKING WATER QUALITY STANDARDS, OBJECTIVES AND GUIDELINES
Hardness ($CaCO_3$)	mg/L	208	274	80 – 100 (OG)
Dissolved Organic Carbon	mg/L	1.2	1.2	5 (AO)
Turbidity	NTU	1.4	0.3	5
Nitrite (N)	mg/L	< 0.1	< 0.1	1.0
Nitrate (N)	mg/L	< 0.1	3.1	10
Iron (Fe)	mg/L	0.298	0.015	0.3 (AO)
Manganese (Mn)	mg/L	0.074	0.002	0.050 (AO)
pH	pH	8.06	7.99	6.5 – 8.5 (OG)
Alkalinity (Total as $CaCO_3$)	mg/L	201	203	30-500 (OG)
Total Ammonia-N	mg/L	0.22	< 0.01	Not defined

5.2.4 Treatment Goals for Wells at Alliance and Old School Well Sites

The water from PW1 wells will require treatment to remove iron and manganese and disinfection. The water from TW-21 wells will only require disinfection.

5.3 Water Treatment Alternatives

5.3.1 Alliance Site Well Water Treatment

A schematic of the treatment system is shown in Figure 8. The treatment process would be the same as at the West Snow Valley site. Groundwater collected from the wells would be dosed with sodium hypochlorite (NaOCl) for disinfection and oxidation of iron and manganese. Depending on the media type, the media would be regenerated with NaOCl or with NaOCl and a periodic dose of potassium permanganate ($KMnO_4$). The filter would be backwashed periodically to remove solids that accumulate. The backwash waste would be discharged to an equalization basin and from there pumped to a settler for washwater recovery. The recovered water would be pumped back to the beginning of treatment, and sludge from the settler would be drained to the Sewage Pumping Station on site. The treatment system would be sized to match to the capacity of the well site.

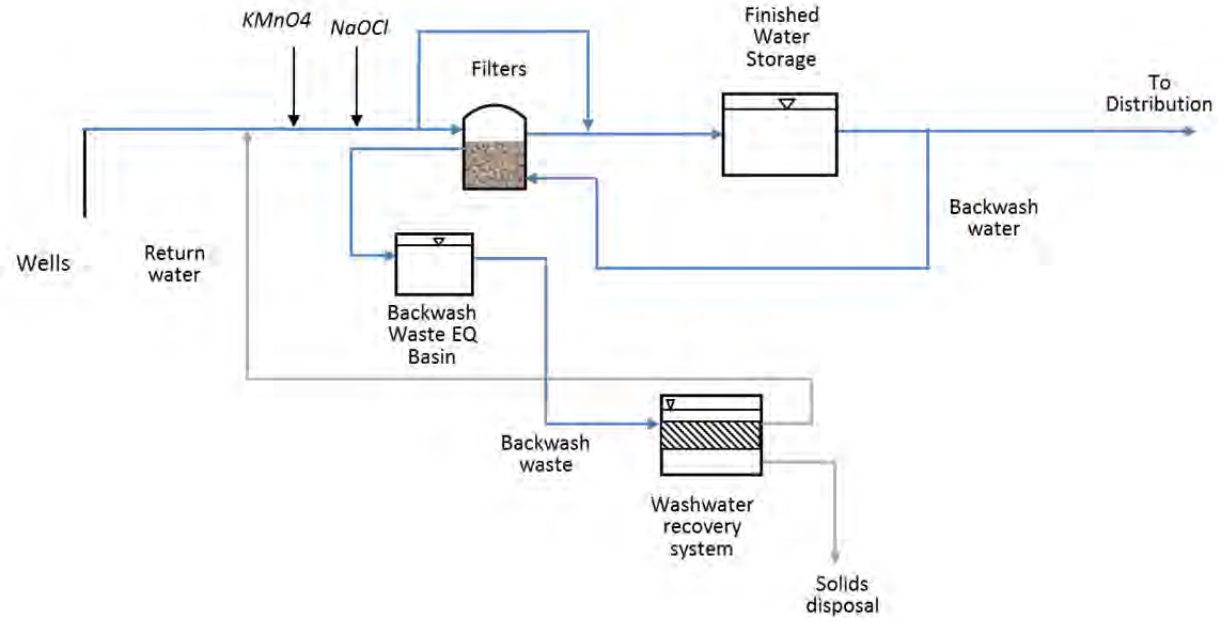


Figure 8 - Treatment at the Alliance Site

5.3.2 Old School Road Site Well Water Treatment

The only treatment required at the Old School Road site is disinfection to achieve 2-log virus inactivation. Water from the Old School Road site would be pumped to the Alliance site where it would be blended with water from the Alliance wells before Sodium Hypochlorite is added to the water. CT contact time would occur in the finished water storage tank.

5.4 Water Supply

5.4.1 Storage Volume

The Doran Road Neighbourhoods would have a local storage reservoir at the water treatment plant site in Doran, which would store treated water so that it could be pumped to the distribution system. The high lift pumps at the WTP would be capable of providing flow during peak hours and during emergency conditions (fire flows, etc.).

The water storage facilities would each provide water storage for the respective areas in which they would be located. The Doran storage requirements are summarized in Table 14.

Table 14 - Doran Road Area: Storage Reservoir Volume

PARAMETER	STORAGE VOLUME (m^3)	
	PHASE 1	BUILD OUT
Equalization Storage (25% of Max Day Demand)	1,340	2,869
Fire Storage (133 L/s for a duration of 3 hours)	1,436	1,436
Emergency Storage (25% of Equalization Storage + Fire Storage)	694	1076
Doran Total Storage Requirement	3,470	5,382

5.4.2 Distribution System Pumping

In order to provide an optimized system, Carson and Doran would have separate Hydraulic Grade Lines (HGL). Table 15 presents the basis of the HGL for the Doran area.

Table 15 - Doran Road Area: Hydraulic Grade Line Design Basis

PARAMETER	HYDRAULIC GRADE LINE
Preferred Operating Pressure Range	345 to 620 kPa (50 to 90 psi)
Minimum Ground Elevation	265m
Maximum Ground Elevation	295m
Provided Hydraulic Grade Line	335m
Provided Pressure ranges	375-600 kPa (54.4 to 87 psi)

Based on the hydraulic analysis completed, the Doran area is shown to have a reasonable range of elevations (265-295m) for servicing. Typically, 30m is the perfect range of elevations to be serviced by a single pressure district since 30m is approximately equivalent to 40psi. This makes it possible to maintain the desired operating pressure range (50 to 90psi) across the entire area without the implementation of any pressure control valves. Hydraulic modeling confirmed that adequate system pressure can be maintained throughout Doran at the design hydraulic grade line (335m).

The Doran water treatment plant will include a high lift pumping station which will be dedicated to supplying treated water to the Doran Road Neighbourhood. Table 16 presents the design basis for the Doran high life pumps.

Table 16 - Doran Road Area: Distribution Pumping Design Basis

PUMPING SYSTEM	DESIGN BASIS FOR CAPACITY	DISTRIBUTION PUMPING CAPACITY (L/S)	
		PHASE 1	BUILD OUT
Doran Road Neighbourhood Pumps	Peak Hour Demand of Doran Area	89 (HGL = 335m)	189 (HGL = 335m)
Fire Flow Pump	As per FUS	133	133

Since there would be no floating storage (elevated tank) planned in the Doran area, the Doran distribution feed pumps would need to include a range of pumps which are able to supply all demand conditions from minimum hour demands to peak hour demands. In order to operate the large range of flows, variable frequency drive (VFD) pumps would be expected to be required for the distribution pumping. Additionally, fire flow pumps are required in order to provide fire flow of 133 L/s during an emergency.

5.5 Preferred Solution for Doran Area

5.5.1 Description of Preferred Design Concept

The preferred design concept recommended for implementation of the Doran Area Water Supply and WTP includes the following components;

- Construction of 3 equally sized production wells at the Alliance Well Site, with any 2 being capable of providing a total of 100 L/s complete with a raw water transmission main to the WTP site,
- Construction of production wells at the Old School Road Well Site with, minimum of 2 wells rated at total of 40 L/s complete with a raw water transmission main to the WTP site,
- A WTP would be built at the Doran WTP site to treat ground water from two well sites. The WTP would include the treatment system for the Alliance site wells including filter system with special filter media for removal of iron and manganese. The disinfection system would include chlorine storage and, feed system complete with a contact tank. The process waste from the water treatment systems would be pumped to the Sewage Pumping Station at the same site. The facility will be equipped with emergency power supply to sustain entire operation. Appendix D presents the site plan for the proposed Doran WTP,
- An underground storage tank would be built to provide a minimum 3,500 m^3 for Phase 1 to provide emergency, fire storage and equalisation volume for peak hours, and after Phase 1 the storage volume would be expanded to 5,400 m^3,
- A pumping station would be built a part of the WTP to provide peak hourly demand of the Doran Area and to maintain the pressure range to between 50 and 90 psi throughout the area; the station would also house fire pumps. Opinion of Probable Capital Cost

The estimated capital cost of the project based on the scope of work outlined in this report is presented in Table 17.

Table 17 - Probable Opinion of Cost Estimate for the Doran Area WTP and Supply

COMPONENTS	PHASE 1	ADDITIONAL COST FOR BUILD OUT
Raw water supply (drilling well casing, screens, pumps, wellhead, piping and transmission main)	$1,410,000	$3,100,000
Doran WTP including distribution and fire pumping systems	$3,659,000	$380,000
Doran Water Storage Tank	$2,474,000	$1,724,000
Other costs (General requirements, Approvals, Permits, Engineering (15%), and Contingency 25%)	$4,098,000	$2,835,000
Total Current Year	**$11,641,000**	**$8,039,000**

APPENDIX A

WATER SUPPLY SYSTEM ALTERNATIVES TECHNICAL MEMORANDUM

B&V PROJECT NO. 180261

PRIVILEDGED AND CONFIDENTIAL

WATER SUPPLY SYSTEM ALTERNATIVES REVIEW – DRAFT REPORT

Class EA Phase 3 & 4 for the Midhurst Secondary Plan

B&V PROJECT NO. 180261

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PREPARED FOR

The Township of Springwater

C/O AINLEY & ASSOCIATES LIMITED

MAY 2016

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APPENDICES

Appendix A – Detailed Cost Estimates

1 Background

The infrastructure requirements to accommodate growth planned within the Midhurst Secondary Plan were considered in accordance with Phases 1 & 2 of the Municipal Class Environmental Assessment (EA) Process (Municipal Class Environmental Assessment Manual, 2000, as amended in 2007 and 2011) and documented in the "Class EA Study for Midhurst Water, Wastewater and Transportation Master Plan – Phases 1 & 2 Report, Ainley, July 2009" (Phase 1 &2 Report). The report determined that the Township of Springwater could construct a new water supply system to service growth within the Midhurst Secondary Plan area, including a water treatment plant (WTP), reservoirs, a booster station, transmission mains, and watermains.

Growth within the Midhurst Secondary Plan Area would occur in both the Carson Road and Doran Road areas. It was noted in the Phases 1 & 2 Report that the WTP would be located in the Doran Road Neighbourhood close to the water supply wells that were originally proposed to be located in the Doran area.

Subsequent to completion of the Phases 1 & 2 Report, the Midhurst Landowner's Group c/o Carson Road Development Inc. successfully completed the acquisition of a parcel of land north of Snow Valley Road; referred to as the "Sand and Gravel site". Separated from the residential communities, the Sand and Gravel site suggests an ideal location for consolidating the proposed water and wastewater treatment plants. Impact to the residential roads and community from the truck traffic (which will be delivering chemicals to the plants), as well as noise arising from operations of the facilities, would be comparatively less at the Sand and Gravel site than at the previously proposed locations.

A water supply exploration study was initiated as part of Phases 3 & 4 of the Municipal Class EA process and was carried out by Golder Associates Ltd. In addition to the well supply in the Doran Road Area, the exploration program showed promising water supply results at the Sand and Gravel site and at a site west of Snow Valley. This meant that there would be sufficient ground water supply available in the Carson and Doran areas to meet their respective needs. Therefore, it became apparent that the option of having a dedicated WTP in each area should be reconsidered as an alternative, based on the results of the well drilling investigation

2 Purpose of this Report

The purpose of this report is to identify and present the key differences between the following three alternatives and provide an economic comparison based on operating and capital costs as well as whole life costs of the project;

- *Alternative 1- Construct the WTP in the Carson Road Neighbourhood:* Locate the WTP at the Sand and Gravel site, and build a pumping station and reservoir to service the area in the Doran Road Neighbourhood. Wells in both Doran and Carson supply raw water to the WTP.
- *Alternative 2- Construct the WTP in the Doran Road Neighbourhood:* Locate the WTP on Doran Road, and build a pumping station and reservoir to service the area in the Carson Road Neighbourhood. Wells in both Doran and Carson supply raw water to the WTP.
- *Alternative 3- Construct two WTPs:* Locate a WTP in both the Carson Road and Doran Road Neighbourhoods with no connection between the neighbourhoods. Wells in Doran and Carson supply raw water to their respective WTPs.

3 Design Basis

The Carson Road and Doran Road Neighbourhoods will grow in phases over a number of years. As identified in the Phase 1 & 2 Report, Phase 1 of the development will include the development of 5,000 equivalent units.

Table 1 summarizes the design basis for Phase 1 and Build Out conditions if the Carson and Doran Neighbourhoods are hydraulically connected with a single WTP serving both areas. Table 2 summarizes the design basis if the Carson and Doran Neighbourhoods are hydraulically separate with individual WTPs. *Note: Tables 1 and 2 do not include 5% water supply requirement for filter backwashing.*

Table 1 – Design Basis for a Single Water Treatment Plant (Alternatives 1 and 2)

DATA	CARSON ROAD NEIGHBOURHOOD (INCLUDING COMMERCIAL)		DORAN ROAD NEIGHBOURHOOD		TOTAL	
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT
Units	2,650	2,909	2,350	5,299	**5,000**	**8,208**
Design Population	7,950	8,727	7,050	15,897	**15,000**	**24,624**
Average Day Demand (L/s) [Based on 380L/capita/day]	35.0	38.4	31.0	69.9	**66.0**	**108.3**
Maximum Day (L/s)	66.4	69.1	58.9	125.9	**125.3**	**194.9**
Peak Hour Demand (L/s)	99.7	103.6	88.4	188.8	**188.0**	**292.4**

Table 2 – Design Basis for Separate Water Treatment Plants in Carson and Doran Neighbourhoods (Alternative 3)

DATA	CARSON ROAD NEIGHBOURHOOD (INCLUDING COMMERCIAL)		DORAN ROAD NEIGHBOURHOOD		TOTAL	
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT
Units	2,650	2,909	2,350	5,299	**5,000**	**8,208**
Design Population	7,950	8,727	7,050	15,897	**15,000**	**24,624**
Average Day Demand (L/s) [Based on 380L/capita/day]	35.0	38.4	31.0	69.9	**66.0**	**108.3**
Maximum Day (L/s)	69.9	76.8	62.0	132.8	**131.9**	**209.6**
Peak Hour Demand (L/s)	104.9	115.1	93.0	199.3	**197.9**	**314.4**

It is important to note that the design basis would vary slightly depending on if the Doran and Carson Road Neighbourhoods are hydraulically connected (as per Alternatives 1 and 2) or hydraulically separate (as per Alternative 3). When the areas are hydraulically connected the population can be combined and considered as one water supply system, which allows for a lower peaking factor to be used. When the areas are separate, the populations have to be considered separately which leads to a higher peaking factor. This means that although average day demands are consistent for all

alternatives; the maximum and peak hour demands are slightly different depending on the alternative. However, based on the hydrogeological report, the proposed wells will meet the maximum day demands in Carson and Doran for each alternative. Peak hour demand, fire flows and emergency water supply will be provided from storage.

4 Description of Alternatives

4.1 GENERAL

4.1.1 Ground Water Supply System

The ground water supply required by the new development in Midhurst will be obtained from wells located within the Carson and Doran Neighbourhoods. The number of wells, and their respective yields, required to meet the ultimate demands were confirmed through Water Supply Exploration Program. Based on the investigations, the wells would be located in four areas. Table 3 presents the details of the wells identified.

Table 3 – Ground Water Wells

WELL SITE	WELL TAG NAME	NAME	SITE PRODUCTION CAPACITY
Sand and Gravel Site near the potential Carson Road WTP site	TW22	Carson Well #1	73 L/s.
	OW19	Carson Well #2	
	Future	Carson Well #3	
West Snow Valley Site; west of the Carson area	TW34	Carson Well #4	20 L/s.
	OW29	Carson Well #5	
	Future	Carson Well #6 (at site west of Snow Valley)	
Doran Road Alliance Site near the potential Doran WTP	PW1	Doran Well #1	100 L/s.
	TW35	Doran Well #2	
	Future	Doran Well #3 (in Alliance Development)	
Old Second Road Site, south of Pooles	TW21	Doran Well #4	40 L/s.
	OW24	Doran Well #5	
	Future	Doran Well #6 (south of Pooles Rd)	

The combined well capacity (233 L/s) means that the wells could meet the combined maximum day demands in Carson and Doran for each alternative including a 5% allowance for filter backwashing.

In Alternatives 1 and 2, there is sufficient well capacity to meet maximum day demands without using the West Snow Valley Site in Carson. However, for Alternative 3, the West Snow Valley Well Site is ultimately required to supplement the Sand and Gravel Site since the maximum day demand in Carson would be 76.8 L/s (80.6 L/s with 5% in-plant use (backwashing)).

Each well would be equipped with a deep well submersible pump, which would be designed with sufficient hydraulic head capabilities to convey the raw water from the wells to the WTP. For the purpose of this evaluation, static water and drawdown levels have been established based on the information available from test holes and pump tests. Additional raw water transmission mains would be required under Alternatives 1 and 2.

Figures 1, 3 and 5, provided in the upcoming sections, illustrate the locations of these wells, as well as the proposed collection mains connecting each well with the WTP, for each alternative.

4.1.2 Water Treatment Plant

The Water Supply Exploration Program completed to date shows that water quality varies noticeably at each well.

Table 4 summarizes the particular water quality results for each well site.

Table 4 – Highlights of Water Quality Test Results

WELL SITE	WELL #	HIGHLIGHTS OF WATER QUALITY TEST RESULTS
Carson: Sand and Gravel Site	OW19 / TW22	Low iron and manganese concentrations and elevated nitrate concentration
Carson: West Snow Valley Site	OW29 / TW34	High iron and manganese concentrations with observed bubbles of gas and a slight sulphurous odour
Doran: Road Alliance Site	TW35 / PW1	High manganese concentration and slightly elevated iron concentrations
Doran: Old Second Road Site	TW21 / OW24	No detectable issue

For the purpose of this evaluation, to consistently meet Ontario Drinking Water Objectives it was assumed that WTPs would include treatment systems to deal with specific issues as well as provide disinfection with chlorine, tanks for chlorine contact and backwash process waste handling systems to meet maximum water demand.

Based on the above table it is noticeable that:

- A single Water Treatment Plant, as considered in Alternatives 1 and 2, would include green sand filtration system to lower Iron and Manganese levels and an Ion Exchange system to lower the elevated nitrate levels from the Sand and Gravel site.
- The Carson WTP, in Alternative 3, would require Ion Exchange system for the elevated nitrates from the Sand and Gravel site, but would also need air stripping for volatile organic compounds and green sand filtration for iron and manganese treatment from the West Snow Valley Site.

- The Doran WTP, in Alternative 3, would only require treatment to reduce the elevated iron and manganese concentrations.

4.1.3 Treated Water Distribution System

Black & Veatch developed a high level distribution system hydraulic model for each of the alternatives in order to confirm the operating strategies and size the major transmission mains and pumping systems. The Hydraulic Grade Line (HGL) for both neighbourhoods was determined to provide water pressure to both neighbourhoods in the most efficient way possible. Figures 2, 4 and 6 illustrate the treated water distribution system for each alternative.

The Carson Road Neighbourhood is at a lower ground elevation than the Doran Road Neighbourhood. As a result, it was determined that each area would be in a different HGL: Carson Road at 321 m and Doran Road at 335 m. These areas would be operated as "closed systems": the reservoirs in each area would be in-ground storages and the water would be pumped to the distribution system.

Storage requirements based on equalization, fire and emergency, as approved by the Township, were calculated for each alternative. There is minimal difference in storage requirement sizing between the alternatives. Both Carson and Doran would be sized to meet the needs of their individual areas.

A description of each alternative solution and their respective technical analyses and figures are presented in the following sections.

4.2 ALTERNATIVE 1 – WTP IN CARSON ROAD NEIGHBOURHOOD

For this alternative, the WTP would be located at the Sand and Gravel site and sized to serve the residential and commercial development growth related to the Secondary Plan Area. The WTP would be connected to the Doran Road Neighbourhood through transmission mains (both raw water and treated water).

4.2.1 Ground Water Supply System

Figure 1 presents the location of the facilities for this alternative, along with well locations and ground water supply mains.

It is assumed that the wells at the Sand and Gravel Site, OW19/TW22 (potential capacity of 73 L/s), would be used as primary supply for the system. This facility would be capable of supplying the entire average day demands of Phase 1 (66 L/s, as shown in Table 1; 69 L/s with 5% in-plant use). Well TW35 /PW1 at the Doran Alliance site would supplement the system to meet the average day demands including in-plant use during Build Out (114 L/s). In order to reach the maximum day flow requirements including in-plant use (205 L/s) at Build Out, production well TW21 would be added to the system.

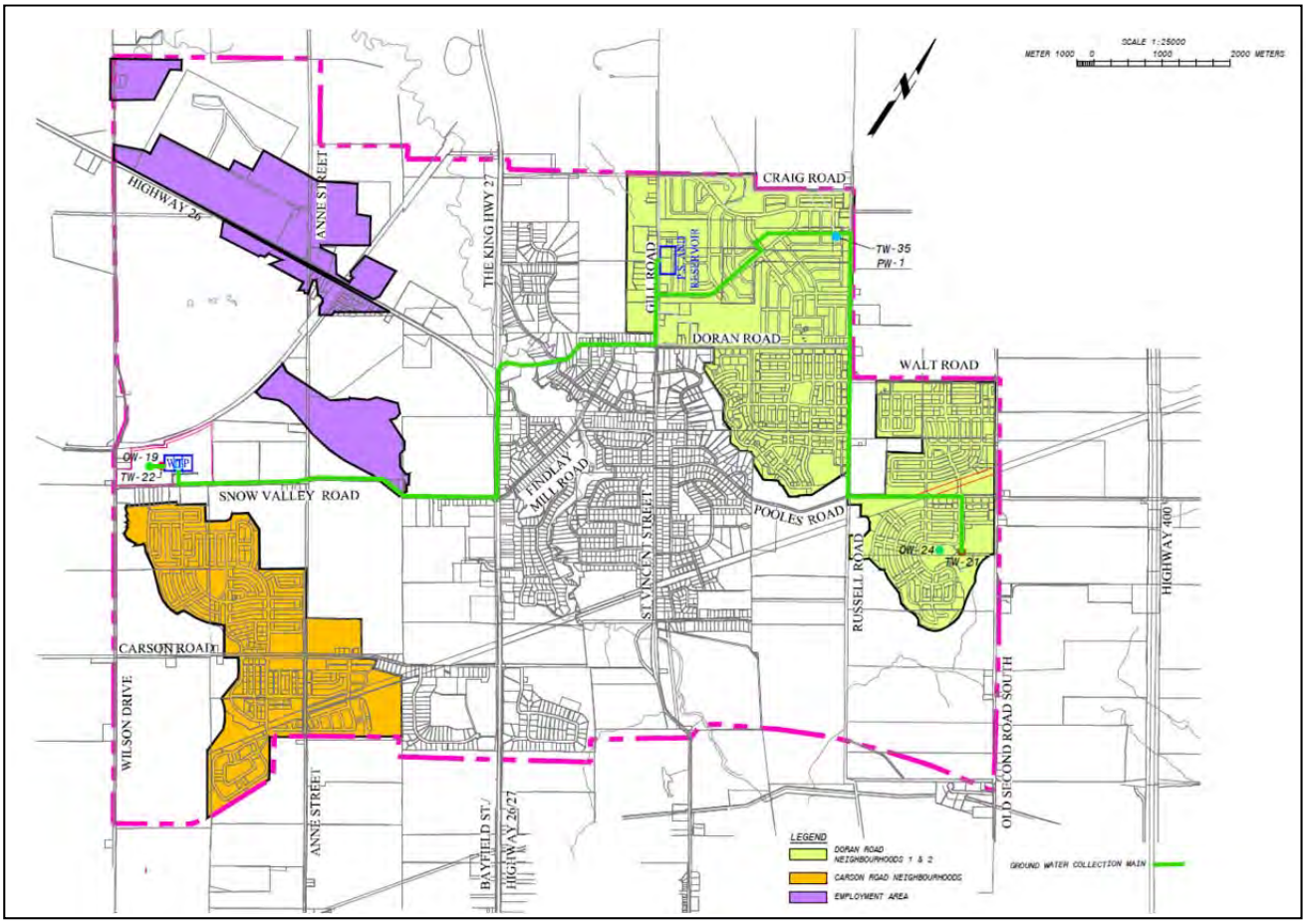


Figure 1 – Alternative 1 - WTP in Carson Road Neighbourhood – Ground Water Supply System

4.2.2 Treated Water Distribution System

The pumping station at the Carson Road WTP site would be designed with two separate sets of high service pumps; Carson High Service PS and Doran High Service PS. The Carson High Service PS would supply the peak hour demand of the Carson Road Neighbourhood and the commercial/employment area located north of Carson.

The Doran High Service PS at the Carson WTP site would supply the maximum day demand of the Doran Road Neighbourhood, via a 400mm diameter transmission main. The local PS and Reservoir site in Doran would provide additional flow to Doran during peak hour and fire flow conditions. Figure 2 illustrates the treated water distribution system for Alternative 1.

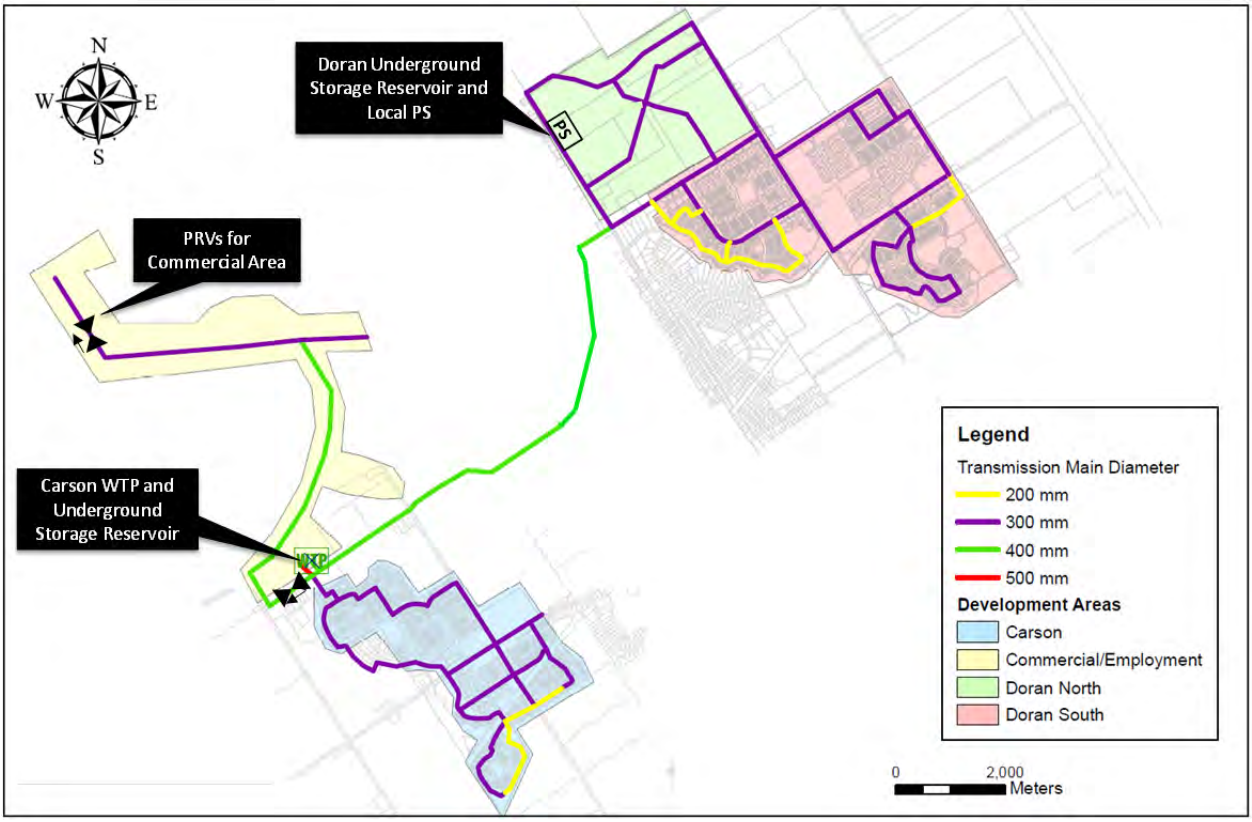


Figure 2 – Alternative 1 - WTP in Carson Road Neighbourhood – Treated Water Distribution System

4.3 ALTERNATIVE 2 – WTP IN DORAN ROAD NEIGHBOURHOOD

For this alternative, the WTP would be located in the Doran Road neighborhood within the new development area and sized to serve the residential and commercial development growth related to the Secondary Plan Area. The WTP would be connected to the Carson Road Neighbourhood through transmission mains (both raw water and treated water).

4.3.1 Ground Water Supply System

Figure 3 presents the location of the facilities for this alternative, along with well locations and ground water supply mains. It is assumed that the primary supply for the system would be TW35/PW1 (ultimate capacity of 100 L/s), which is the production well at the Doran Road Neighbourhood located closest to the proposed WTP location. This facility would be capable of supplying the entire average day demand of Phase 1 (66 L/s, as shown in Table 1; 69L/s with additional 5% in-plant use). Well TW21 at the Old Second Road South Site would supplement the system to meet the average day demands including in-plant use during Build Out (114L/s). In order to reach the maximum day flow requirements including in-plant use (205L/s) at Build Out, production well OW19/TW22 at the Sand and Gravel site would be added to the system.

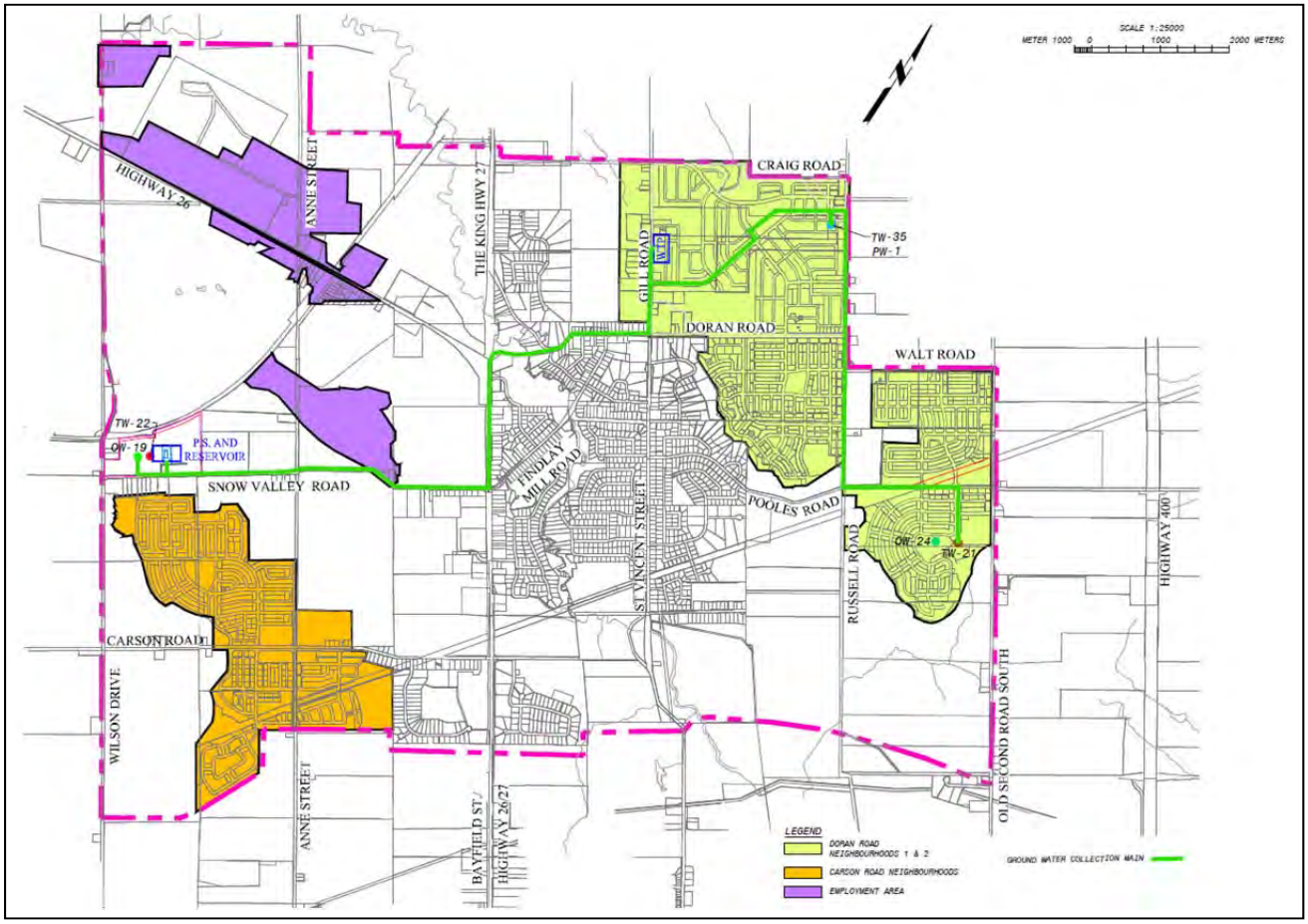


Figure 3 – Alternative 2 - WTP in Doran Road Neighbourhood – Ground Water Supply System

4.3.2 Treated Water Distribution System

The Doran WTP site would include the Doran High Service PS, which would be sized to meet both the Doran Road Neighborhood peak hour demand, as well as the maximum day demand of the Carson Road Neighbourhood and the industrial and commercial area to the north.

The Doran Road Neighbourhood peak hour demand would be pumped from the high service pumps in the Doran Road WTP site. The maximum day demand of the Carson Road Neighbourhood would be pumped by the Doran High Service PS via a 300mm diameter transmission main. Pressure from the Doran High Service PS would be reduced at the entrance of the Carson Road area to match the required pressure. A pressure-reducing valve would be added at a suitable location along the transmission main to maintain system pressure within the preferred range (50-90psi). The local PS and Reservoir site in Carson would provide additional flow to Carson during peak hour and fire flow conditions. Figure 4 illustrates the treated water distribution system for Alternative 2.

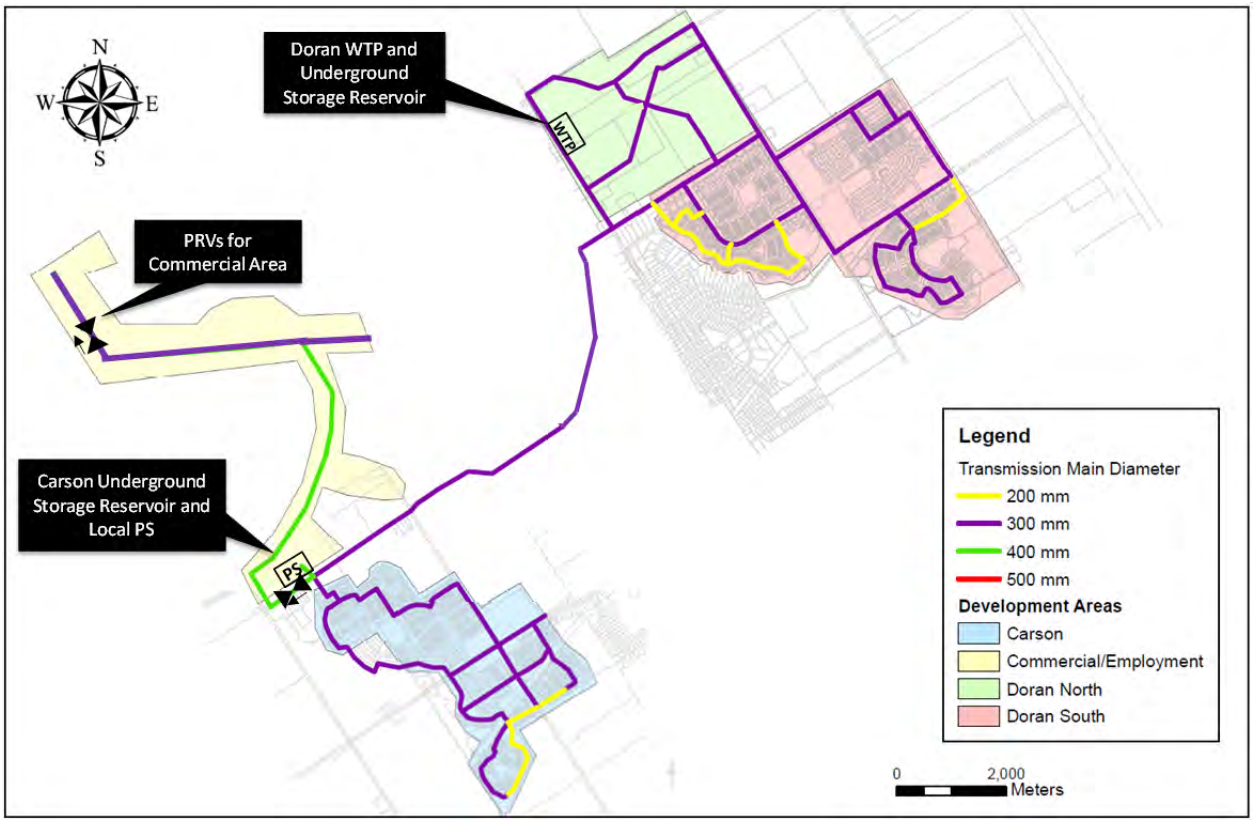


Figure 4 – Alternative 2 - WTP in Doran Road Neighbourhood – Treated Water Distribution System

4.4 ALTERNATIVE 3 – TWO WTPS

For this alternative, there would be a WTP located in the Doran Road neighborhood and another in the Carson Road Neighbourhood. The water supply areas would have no connecting transmission main between them for either the ground water supply system or the treated water distribution system. Each neighbourhood would have its own dedicated WTP sized to supply water for the area's demands.

4.4.1 Ground Water Supply System

Figure 5 presents the location of the facilities for this alternative, along with well locations and ground water supply mains. It is assumed that the primary supply for the Carson Road Neighbourhood system for Phase 1 would be wells OW19/TW22, located next to the proposed WTP location, which have an ultimate well capacity of 73 L/s. In order to reach the maximum day demands including in-plant use at Build Out of 81 L/s, wells OW19/TW22 would be supplemented by the West Snow Valley well site (OW29/TW34).

For the Doran Road Neighbourhood system, it is assumed that production well TW35 / PW1, with an ultimate capacity of 100 L/s, would provide the maximum demands of Phase 1. In order to reach the maximum day demands including in-plant use at Build Out of 139 L/s, TW35 would be supplemented by the Old Second Road Site (TW21), which has an ultimate capacity of 40 L/s.

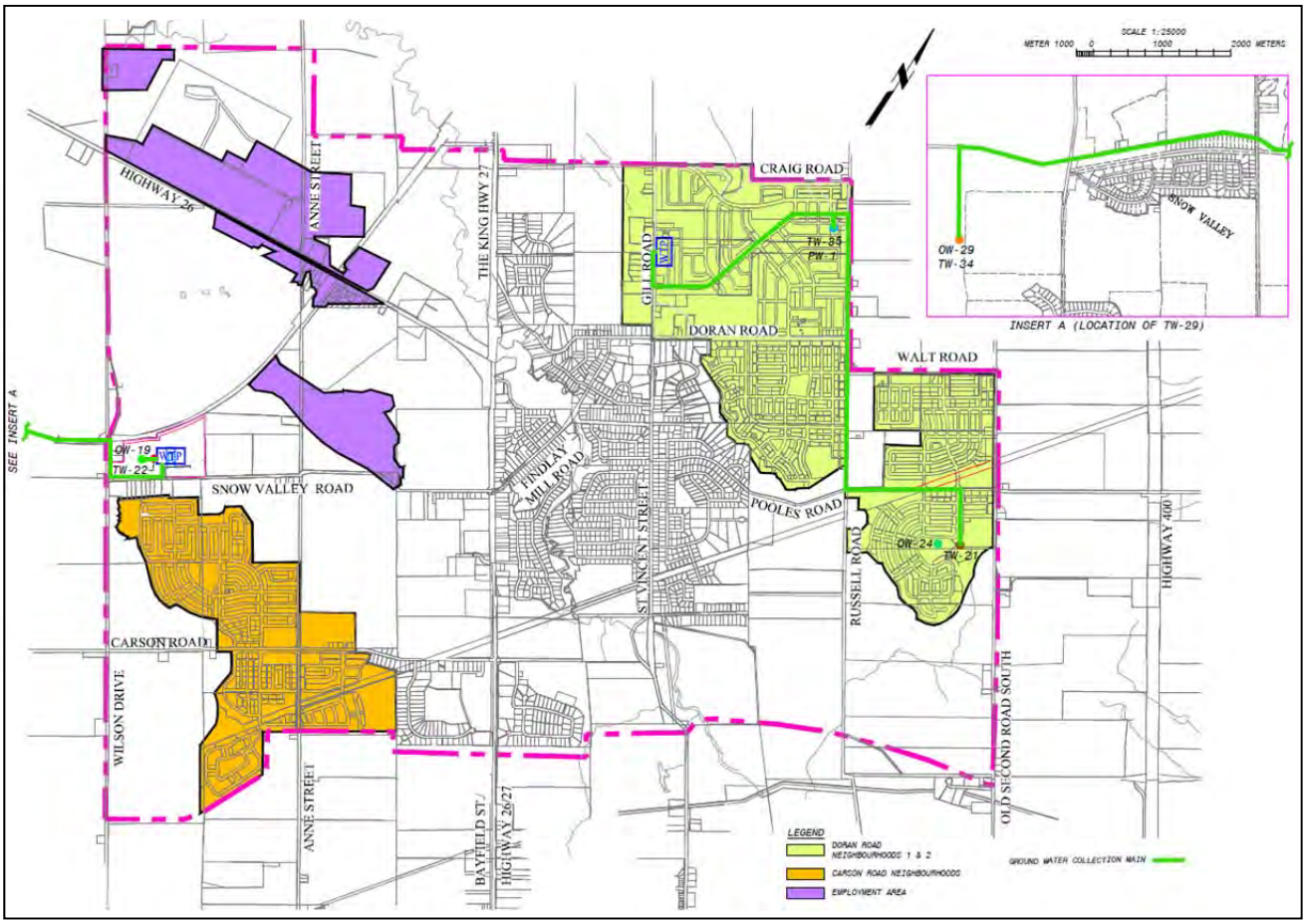


Figure 5 – Alternative 3 – Two WTPs (One Carson; One Doran) – Ground Water Supply System

4.4.2 Treated Water Distribution System

The treated water distribution system in each Neighbourhood would be controlled by a dedicated WTP and High Service PS. The WTP located in the Carson Road Neighbourhood would supply the maximum day demand and peak hour demand for both the industrial and commercial area and the Carson Road Neighbourhood. Similarly, the WTP in the Doran Road Neighbourhood would supply the maximum day demand and peak hour demand for the Doran Road Neighbourhood. The WTPs would have no connecting transmission main between them. Figure 6 illustrates the treated water distribution system for Alternative 3.

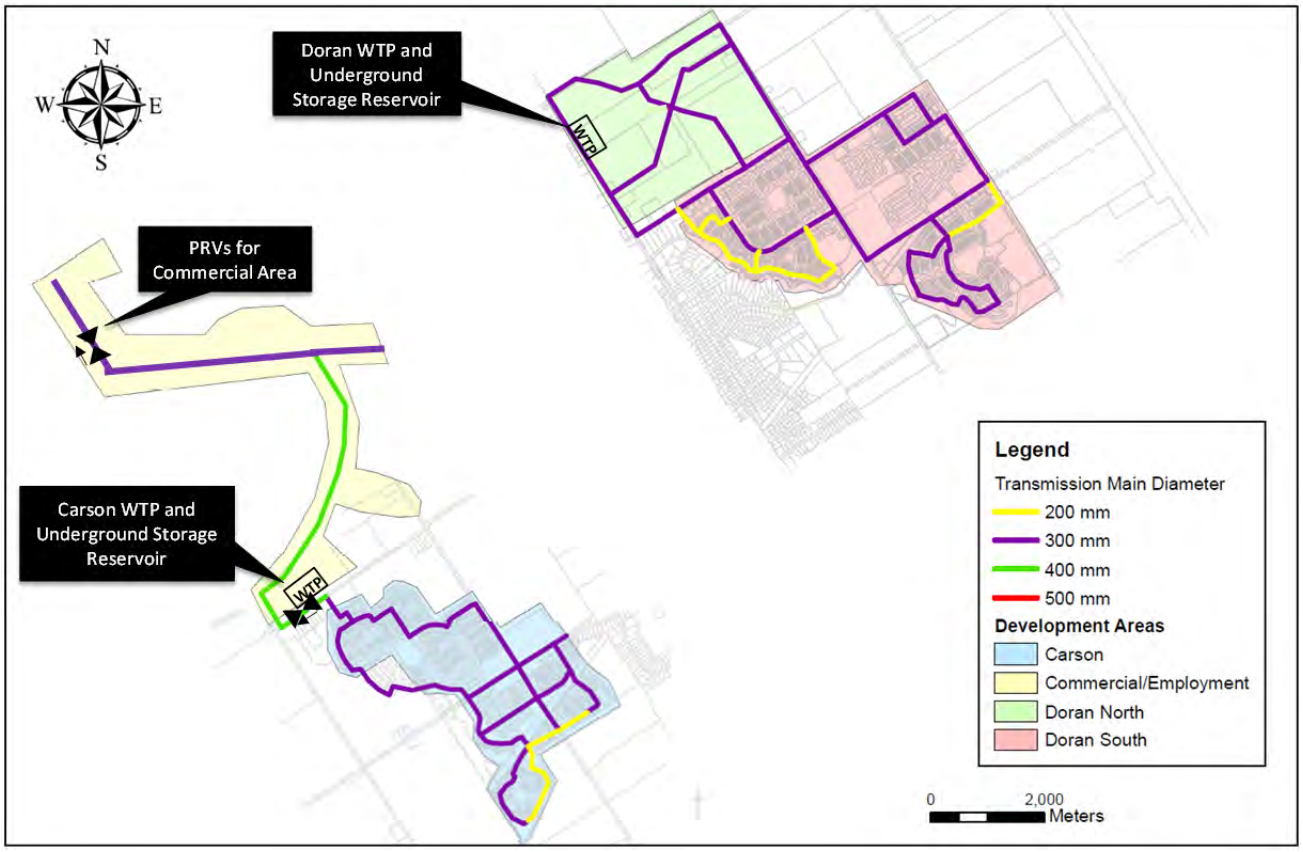


Figure 6 – WTP in Doran Road Neighbourhood and Carson Road Neighbourhood – Treated Water Distribution System

5 Opinion of Probable Cost Comparison

5.1 METHODOLOGY

The economic assessment of each of the three alternatives for the Midhurst Secondary Plan Area future servicing strategy is based on an Opinion of Probable Cost (OPC) for each alternative. The OPC includes capital cost estimates for each alternative and whole life costs (WLC). For comparative purposes between the 3 scenarios, the reference period of operation for the whole life analysis was taken as 25 years, which includes gradually increasing demand to reach Phase 1 demand in 15 years and to reach Buildout demands over an additional 10 years.

In general, existing financial sources of information were reviewed to develop a Class 5 cost estimate in accordance with the Recommended Practice No. 17R-97 and No. 18R-97 developed by the Association for the Advancement of Costing International (AACE). These levels of estimates are based on preliminary information/concepts and are used for strategic-level decision-making purposes.

The methodology uses financial information from cost estimation manuals (RS Means), other similar projects in scope/nature and size, professional judgment and experience based on conceptual-level defined parameters, and applied allowances for local market conditions and variability.

5.1.1 Capital Cost

The capital cost estimates include overheads on material, equipment, and general conditions, but exclude tax, engineering, legal, administration, and field services fees. All costs are in Year 2016 Canadian dollars. A 25% general contingency cost has been included in the capital cost.

The detailed cost estimates are available in Appendix A.

5.1.2 Operation Cost

Staff time allocation would be similar for all of the alternatives, as none of these facilities would need full time staff. Time allocation for maintenance personnel attendance to these facilities may likely be higher for Alternative 3 due to the second WTP and likely be lower for Alternative 1 as the site is in the same parcel as wastewater treatment.

It is assumed that each alternative would have a similar amount of chemicals required for disinfection and for treatment. Due to the two WTPs, Alternative 3 would require slightly higher replacement costs for filters, instruments, etc. However, no major differences are identified in operation costs between alternatives other than the power cost associated with the raw water and distribution pumping. Therefore, the operating cost calculations only include these two items at this time.

The pumping costs are calculated for average day demand and $0.1 per kWh is used.

5.1.3 Whole Life Costs

Whole life costs calculations are based on 25 years and a 2% discount rate.

5.2 COST COMPARISON OF THE ALTERNATIVES

Table 5 shows the economic assessment for each of the three alternatives.

Table 5 – Summary of Economic Assessment of Alternatives

ALTERNATIVE	CAPITAL COSTS (IN 2016 $)		WHOLE LIFE OPERATION COSTS (IN 2016 $)		WHOLE LIFE COSTS
	PHASE 1	BUILD OUT	PHASE 1	BUILD OUT	
ALTERNATIVE 1: WTP in Carson	$55,120,000	$3,870,000	$813,000	$1,753,000	$61,550,000
ALTERNATIVE 2: WTP in Doran	$53,930,000	$3,880,000	$825,000	$1,808,000	$60,440,000
ALTERNATIVE 3: Two WTPs	$48,140,000	$7,860,000	$782,000	$1,669,000	$58,440,000

As seen above, the whole life cost for Alternative 3 is the lowest. Of the whole life cost, both capital and operations costs are lowest for Alternative 3. However, Alternative 3 would require a higher capital cost after Phase 1 due to the addition of the West Snow Valley Site well facility including new wells, transmission main and treatment.

6 Evaluation of Alternatives

The advantages and disadvantages of the three alternatives are provided in Table 6. However, it should be noted that all three alternatives can be implemented without any impact to the existing Midhurst distribution system.

Table 6 – Evaluation of Alternatives

	ALTERNATIVE 1 WTP IN CARSON ROAD	ALTERNATIVE 2 WTP IN DORAN ROAD	ALTERNATIVE 3 TWO WTPS
Advantages	• Located on the same parcel as the WWTP, which would be more advantageous in terms of plant operations and maintenance. • Parcel is separated from the existing residential development; less noise and traffic impacts.	• WTP is located in the higher demand area where a larger population is located.	• No need to transfer ground water and treated water between the neighbourhoods. No impact to the town center of Midhurst for construction. • No need for a secondary pumping system as in the other alternatives. The total number of pumps would be less than other alternatives. • Lower initial capital cost due to reduction in raw and treated water transmission mains required.
Disadvantages	• Requires two sets of distribution pumping systems at the WTP site. • Requires more raw water and treated water transmission main. • Requires second pump system for peak hour and Fire.	• Requires a pressure-reducing valve at the entrance to the Carson Road area which will require maintenance. • Requires more raw water and treated water transmission main. • Requires second pump system for peak hour and Fire.	• Redundancy of the well supply system will be reduced; there must be sufficient wells in quantity and number to satisfy individual area demands. • WTP maintenance and operations effort will be marginally higher than Alternatives 1 and 2.

7 Summary

The following summarizes the key differences between each alternative:

- Each alternative is operationally viable with no significant disadvantage for any one of them.
- There is little practical difference in daily operation and maintenance demands between the alternatives. For each alternative, there will be two facilities to maintain (either the WTP or pumping station in each area).
- The whole life cost for a 25 year project period shows minimal difference between the alternatives; however, at this stage, Alternative 3 shows a marginally lower whole life cost. Additionally, Alternative 3 also has the lowest upfront cost (cost for the Phase 1 development).

Based on the evaluation, Alternative 3 "Two WTPs" is the preferred supply strategy and will be carried forward into the next stage, the treatment process alternatives evaluation.

APPENDIX A

DETAILED COST ESTIMATES

B&V PROJECT NO. 180261

BLACK & VEATCH
Building a world of difference.

3/22/2016
c:\pw_working\cngpw\d1550054\2016-03-14 Water Supply Review with 3 options

Midhurst Class EA Phases 3 & 4
Midhurst WTP - Cost Estimation Summary
Alternative 1: WTP in Carson Road Neighborhood

Design Basis for WTP and PS	Phase 1	Build Out
Well Production Flow Rates		
Average Demand + 5% Backwash - Carson (L/s)	36.7	40.3
Average Demand + 5% Backwash - Doran (L/s)	32.6	73.4
Total Average Demand + 5% Backwash (L/s)	69.3	113.7
Total Maximum Demand + 5% Backwash (L/s)	131.6	204.7
Carson Road WTP Pumping		
Peak Hour Demand - Carson Area (L/s)	99.7	103.6
Max Day Demand Transfer - Doran Area (L/s)	58.9	125.9
Ave Day Demand Transfer - Doran Area (L/s)	31.0	69.9
Doran Road Pumping Station		
Peak Hour Demand - Doran Area (L/s)	88.4	188.8
Peak Hour minus Max Day - Doran Area (L/s)	29.5	62.9
Fire Flow Demand - Doran Area (L/s)	133	133

Economic Factors	Phase 1	Build Out
Interest (%)	5%	5%
Inflation (%)	3%	3%
Contingency (%SUM Capital Costs)	25%	
Year to Begin	2018	
Duration of Construction is 12 mo (Mid point 0.5 yr)	0.5	0.5
Cost per kW ($/kW)	0.1	0.1

Well Summary	Carson - Sand & Gravel Site: TW19 / TW22	Doran - Alliance Site: TW-E / PW1	Doran - Old Second Road South: TW21
Ground Elevation at Well Site (m)	232.0	286.0	289.5
Ground Water Elevation with Drawdown (m)	187.0	198.0	195.0
Available Flow Capacity (Permit to Take Water Capacity) (L/s)	73	100	40
Vertical Distance from Drawdown to Well Elevation (m)	45	88	95

Distribution Pumping Summary	Phase 1	Build Out	
Hydraulic Grade Line for Carson Area (m)	321.0	321.0	
Hydraulic Grade Line for Doran Area (m)	335.0	335.0	
Assumed Pump Efficiency (wire to water)	80%	80%	
WTP - Pumps to Carson: Pump Static Head (m)	86	86	*Assumed 3m below ground (LWL)*
WTP - Pumps to Carson: Pump Friction Head (m)	8	8	
Annual Power Consumption Carson Pumps (kWh)	353,623	388,185	
WTP - Pumps to Doran: Pump Static Head (m)	100	100	*Assumed 3m below ground (LWL)*
WTP - Pumps to Doran: Pump Friction Head (m) (Transmission)	10	15	
Annual Power Consumption Transfer Pumps (kWh)	366,882	861,077	
Doran PS - Pumps to Doran: Pump Static Head (m)	55	55	*Assumed 3m below ground (LWL)*
Doran PS - Pumps to Doran: Pump Friction Head (m)	8	8	
Annual Power Consumption Doran Peak Pumps (kWh)	24,918	53,231	*Assumed pumping peak difference 3 hours/day*
Combined Power Consumption (kWh)	745,423	1,302,493	

Well not needed when single WTP is used

Well not needed when single WTP is used

	Phase 1			Buildout		
Raw Water Pumping (Well to WTP)	Carson - Sand & Gravel Site: TW19 / TW22	Doran - Alliance Site: TW-E / PW1	Doran - Old Second Road South: TW21	Carson - Sand & Gravel Site: TW19 / TW22	Doran - Alliance Site: TW-E / PW1	Doran - Old Second Road South: TW21
Well to **Carson** WTP Distance (m)	245	7,503	n/a	245	7,503	n/a
Ground Elevation of WTP (m)	238	238	238	238	238	238
Assumed % Supply by Well	50%	0%	65%	35%	0%	
Average Day Demand Flow Rate (L/s)	34.6	34.6	0	73.9	39.8	0
Well Pump Static Head (m)	50.9	39.9	42.85	50.9	39.9	42.9
Well Pump Friction Head (m)	3.4	18.3	2	7.7	23.1	2
Well Total Dynamic Head Required (m)	54.3	58.2	44.9	58.6	63.0	44.9
Power Consumption (kW)	23.0	24.7	0.0	53.1	30.7	0.0
Annual Power Consumption (kWh)	201,874	216,449	0	465,116	269,194	0

Assumed 140 roughness constant, plus 2m headloss through the filter

C-factor 140
Pipe Diameter 200 mm
300 mm

CAPITAL COST

Construction, Equipment, etc.	Phase 1 Units	# of Units	Unit Cost	Cost	Total Cost	Build Out Addition Units	# of Units	Unit Cost	Cost	Total Cost
CARSON WTP SITE (WTP Process Building: 27m x 15m x 5m; Chlorine Contact Tank; Backwash Tank)										
Earthwork	-	-	-	$ -	**$ 141,456**	-	-	-	$ -	**$ -**
Excavation	m^3	2688	$ 30	$ 80,640		m^3		$ 30	$ -	
Backfill	m^3	1584	$ 35	$ 55,440		m^3		$ 35	$ -	
Granular Fill	m^3	89.6	$ 60	$ 5,376		m^3		$ 60	$ -	
Concrete	-	-	-	$ -	**$ 861,696**	-	-	-	$ -	**$ -**
Slab on grade	m^3	224	$ 750	$ 168,000		m^3		$ 750	$ -	
Wall	m^3	336	$ 1,300	$ 436,800		m^3		$ 1,300	$ -	
Suspended slab	m^3	134	$ 1,500	$ 201,600		m^3		$ 1,500	$ -	
Columns	m^3	35	$ 1,600	$ 55,296		m^3		$ 1,600	$ -	
Embedded accessories	-	-	-	-		-	-	-	-	
Superstructure	-	-	-	$ -	**$ 351,970**	-	-	-	$ -	**$ -**
Exterior wall, brick & block system	m^2	560	$ 350	$ 196,000		m^2		$ 350	$ -	
Structural post and frame	TN	3.1	$ 4,200	$ 13,020		TN		$ 4,200	$ -	
Internal masonry wall system	m^2	53	$ 150	$ 7,950		m^2		$ 150	$ -	
Roof system	m^2	405	$ 200	$ 81,000		m^2		$ 200	$ -	
Doors - Hollow Metal	each	10	$ 2,100	$ 21,000		each		$ 2,100	$ -	
Doors - Overhead	each	2	$ 12,000	$ 24,000		each		$ 12,000	$ -	
Windows	each	10	$ 900	$ 9,000		each		$ 900	$ -	
Equipment	-	-	-	$ -	**$ 1,384,000**	-	-	-	$ -	**$ 579,500**
Filters	each	2	$ 350,000	$ 700,000		each	1	$ 350,000	$ 350,000	
Pumps	each	12	$ 20,000	$ 240,000		each	4	$ 20,000	$ 80,000	
Chemical feed systems - Chlorine Gas	Lump sum			$ 100,000		Lump sum			$ 50,000	
Chemical feed systems - Sodium bisulphate for dechlorination			$ 33,000	$ 49,500				$ 33,000	$ 49,500	
Chemical feed systems - Other Chemicals	Lump sum			$ 150,000		Lump sum			$ 50,000	
Chlorine gas Scrubber	each	1	$ 83,000	$ 124,500		each	0	$ 83,000	$ -	
Blowers	each	1	$ 20,000	$ 20,000		each	0	$ 20,000	$ -	
Mechanical	-	-	-	$ -	**$ 299,850**	-	-	-	$ -	**$ -**
HVAC	Lump sum			$ 89,100		Lump sum			$ -	
Plumbing	Lump sum			$ 60,750		Lump sum			$ -	
Process piping & valves	Lump sum			$ 150,000		Lump sum			$ -	
Instrumentation	-	-	-	$ -	**$ 300,000**	-	-	-	$ -	**$ 150,000**
Electrical	-	-	-	$ -	**$ 1,200,000**	-	-	-	$ -	**$ -**
Process Building Cost					**$ 4,538,972**					**$ 729,500**
CARSON WTP SITE (Underground Storage Tank, 3,700 m3, built once for ultimate - 37m x 20m x 6m)										
Sheeting	m^2	740	$2,300	$1,702,000	**$1,702,000**	m^2	-	-	$ -	**$ -**
Earthwork	-	-	-	$ -	**$ 227,556**					**$ -**
Excavation	m^3	4788	$ 30	$ 143,640		m^3	-	-	-	
Backfill	m^3	2124	$ 35	$ 74,340		m^3	-	-	-	
Granular Fill	m^3	159.6	$ 60	$ 9,576		m^3	-	-	-	
Concrete	-	-	-	$ -	**$ 1,618,014**					**$ -**
Slab on grade	m^2	380	$ 750	$ 285,000		m^2	-	-	-	
Footing for columns	m^3	32	$ 750	$ 24,300		m^3	-	-	-	
Wall	m^3	384	$ 1,300	$ 499,200		m^3	-	-	-	
Suspended slab	m^3	389	$ 1,500	$ 582,750		m^3	-	-	-	
Beam cap for columns	m^3	14	$ 1,500	$ 21,600		m^3	-	-	-	
Columns	m^3	128	$ 1,600	$ 205,164		m^3	-	-	-	
Embedded accessories	-	-	-	-		-	-	-	-	
Masonry: Block wall, 8" (Seismic)	m^2	27	$ 140	$ 3,840	**$ 3,840**	m^2	-	-	-	**$ -**
Metal: Access Hatches	each	4	$ 3,000	$ 12,000	**$ 12,000**	each	-	-	-	**$ -**
Thermo & Moisture Protection - Storage Tank Liner	m^2	1789	$ 45	$ 80,496	**$ 80,496**	m^2	-	-	-	**$ -**
Mechanical - Process Piping & Valves	Lump sum				**$ 30,000**	Lump sum			-	**$ -**
Instrumentation	Lump sum				**$ -**	Lump sum			-	**$ -**
Electrical	Lump sum				**$ -**	Lump sum			-	**$ -**
Underground Storage Tank Cost					**$ 3,673,906**					**$ -**
Sitework (10% of storage)					$ 367,391					$ -
General Requirements (10% of process, storage and sitework; 7% Phase 2					$ 858,027					$ 51,065
Sub-total					$ 9,438,295					$ 780,565
Contingencies (25% of sub-total)					$ 2,359,574					$ 195,141
Mid-Point of Construction (S=P(1+i)n)					$ 175,660					$ 14,527 assumed 12 mo
Total Probable Construction Cost					**$11,973,529**					**$990,233**

CAPITAL COST

Construction, Equipment, etc.	Phase 1 Units	# of Units	Unit Cost	Cost	Total Cost	Build Out Addition Units	# of Units	Unit Cost	Cost	Total Cost
DORAN PS AND STORAGE SITE (Pumping Station Building, 15m x 12m x 5m)										
Earthwork	-	-	-	$ -	**$ 76,476**	-	-	-	$ -	**$ -**
Excavation	m^3	1248	$ 30	$ 37,440		m^3	-	-	-	
Backfill	m^3	1044	$ 35	$ 36,540		m^3	-	-	-	
Granular Fill	m^3	41.6	$ 60	$ 2,496		m^3	-	-	-	
Concrete	-	-	-	$ -	**$ 465,771**	-	-	-	$ -	**$ -**
Slab on grade	m^3	97.5	$ 750	$ 73,125		m^3	-	-	-	
Wall	m^3	192	$ 1,300	$ 249,600		m^3	-	-	-	
Suspended slab	m^3	59	$ 1,500	$ 87,750		m^3	-	-	-	
Columns	m^3	34.6	$ 1,600	$ 55,296		m^3	-	-	-	
Embedded accessories	-	-	-	-		-	-	-	-	
Superstructure	-	-	-	$ -	**$ 326,520**	-	-	-	$ -	**$ -**
Exterior wall, brick & block system	m^2	480	$ 350	$ 168,000		m^2	-	-	-	
Structural post and frame	TN	3.1	$ 4,200	$ 13,020		TN	-	-	-	
Internal masonry wall system	m^2	42	$ 150	$ 6,300		m^2	-	-	-	
Roof system	m^2	576	$ 200	$ 115,200		m^2	-	-	-	
Doors - Hollow Metal	each	4	$ 2,100	$ 8,400		each	-	-	-	
Doors - Overhead	each	1	$ 12,000	$ 12,000		each	-	-	-	
Windows	each	4	$ 900	$ 3,600		each	-	-	-	
Equipment	-	-	-	$ -	**$ 300,000**	-	-	-	$ -	**$ 120,000**
Pumps	each	5	$ 60,000	$ 300,000		each	2	$ 60,000	$ 120,000	
Mechanical	-	-	-	$ -	**$ 309,320**	-	-	-	$ -	**$ 60,000**
HVAC	Lump sum			$ 115,200		Lump sum			-	
Plumbing	Lump sum			$ 69,120		Lump sum			-	
Process piping & valves	Lump sum			$ 125,000		Lump sum			$ 60,000	
Instrumentation	-	-	-	$ -	**$ 200,000**	-	-	-	$ -	**$ -**
Electrical	-	-	-	$ -	**$ 800,000**	-	-	-	$ -	**$ 50,000**
Pumping Station Building Cost					**$ 2,478,087**					**$ 230,000**
DORAN PS AND STORAGE SITE (Underground Storage Tank, 3,400 m3 phase 1 (36m x 19m x 6m) and 1,800 m3 addition in build out (36m x 10 m x 6m)										
Sheeting	m^2	210	2300	$ 483,000	**$ 483,000**	m^2	138	2300	$ 317,400	**$ 317,400**
Earthwork	-	-	-	$ -	**$ 232,680**	-	-	-	$ -	**$ 113,873**
Excavation	m^3	5016	$ 30	$ 150,480		m^3	2160	$ 26	$ 56,160	
Backfill	m^3	2088	$ 35	$ 73,080		m^3	1656	$ 32	$ 52,992	
Granular Fill	m^3	152	$ 60	$ 9,120		m^3	81.4	$ 58	$ 4,721	
Concrete					**$ 1,577,539**					**$ 1,184,566**
Slab on grade	m^2	380	$ 750	$ 285,000		m^2	180	$ 730	$ 131,400	
Footing for columns	m^3	32.4	$ 750	$ 24,300		m^3	32.4	$ 730	$ 23,652	
Wall	m^2	384	$ 1,300	$ 499,200		m^2	384	$ 1,235	$ 474,240	
Suspended slab	m^3	380	$ 1,500	$ 570,000		m^3	250	$ 1,450	$ 362,500	
Beam cap for columns		14.4	$ 1,500	$ 21,600			14.4	$ 1,450	$ 20,880	
Columns	m^3	110.9	$ 1,600	$ 177,439		m^3	110.9	$ 1,550	$ 171,894	
Embedded accessories	-	-	-	-		-	-	-	-	
Masonry: Block wall, 8" (Seismic)	m^2	27	$ 136	$ 3,731	**$ 3,731**	m^2	27	$ 136	$ 3,731	**$ 3,731**
Metal: Access Hatches	each	4	$ 3,000	$ 12,000	**$ 12,000**	each	2	$ 3,000	$ 6,000	**$ 6,000**
Thermo & Moisture Protection - Storage Tank Liner	m^2	2040	$ 45	$ 91,786	**$ 91,786**	m^2	1624	$ 45	$ 73,066	**$ 73,066**
Mechanical - Process Piping & Valves	Lump sum				**$ 50,000**	Lump sum				**$ 15,000**
Instrumentation	Lump sum				**$ -**	Lump sum				**$ 10,000**
Electrical	Lump sum				**$ -**	Lump sum				**$ -**
Underground Storage Tank Cost					**$ 2,450,735**					**$ 1,723,635**
Sitework (10% of storage)					$ 245,074					$ 172,364
General Requirements (10% of process, storage and sitework; 7% Phase 2					$ 517,389.56					$ 148,819.92
Sub-total					$ 5,691,285					$ 2,274,819
Contingencies (25% of sub-total)					$ 1,422,821					$ 568,705
Mid-Point of Construction (S=P(1+i)n)					$ 105,923					$ 42,338
Total Probable Construction Cost					**$7,220,029**					**$2,885,861**

Watermain Length (m)	
Diameter (mm)	1-Carson WTP
Raw Water Supply	
200	5,882
300	5,091
Distribution System	
200	4,259
300	27,475
400	7,671
500	127

Transmission Main Capital Costs (m)		
Diameter (in)	RATE $/m	1-Carson WTP
Raw Water Supply		
200	$ 600	$ 3,529,200
300	$ 700	$ 3,563,700
Total		**$ 7,092,900**
Distribution System		
200	$ 600	$ 2,555,364.00
300	$ 700	$ 19,232,843
400	$ 900	$ 6,903,783
500	$ 1,045	$ 133,196
	Total	**$ 28,825,186**
TOTAL		**$ 35,918,086**

Phase 1 is reached

Buildout is reached

Calculating NPV																												
Item					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Capital Costs	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	
Water Treatment Plant and Pumping Stations			$19,193,559																$3,876,095											
Transmission Mains			$35,918,086																											
Capital Costs	$0	$0	**$55,111,644**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$3,876,095**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$58,987,739**
Capital Costs (Year n)	$0	$0	**$55,111,644**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$3,894,742**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$59,006,386**
Net Present Value (2016)	$0	$0	**$55,111,644**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$3,863,716**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$58,975,360**
Operating Costs																														
Distribution System Pumping					$4,969	$9,939	$14,908	$19,878	$24,847	$29,817	$34,786	$39,756	$44,725	$49,695	$54,664	$59,634	$64,603	$69,573	$74,542	$80,113	$85,684	$91,254	$96,825	$102,396	$107,966	$113,537	$119,108	$124,679	$130,249	
Raw Water Pumping					$2,789	$5,578	$8,366	$11,155	$13,944	$16,733	$19,522	$22,311	$25,099	$27,888	$30,677	$33,466	$36,255	$39,043	$41,832	$44,992	$48,152	$51,312	$54,472	$57,632	$60,791	$63,951	$67,111	$70,271	$73,431	
Operation Costs (2016)					**$7,758**	**$15,517**	**$23,275**	**$31,033**	**$38,792**	**$46,550**	**$54,308**	**$62,066**	**$69,825**	**$77,583**	**$85,341**	**$93,100**	**$100,858**	**$108,616**	**$116,375**	**$125,105**	**$133,836**	**$142,566**	**$151,297**	**$160,027**	**$168,758**	**$177,489**	**$186,219**	**$194,950**	**$203,680**	**$2,574,923**
Operation Costs (Year n)					**$7,763**	**$15,531**	**$23,303**	**$31,080**	**$38,861**	**$46,648**	**$54,439**	**$62,234**	**$70,034**	**$77,839**	**$85,649**	**$93,463**	**$101,282**	**$109,106**	**$116,934**	**$125,745**	**$134,560**	**$143,381**	**$152,207**	**$161,039**	**$169,875**	**$178,717**	**$187,565**	**$196,417**	**$205,275**	**$2,588,948**
Net Present Value (2016)					**$7,755**	**$15,507**	**$23,256**	**$31,002**	**$38,745**	**$46,485**	**$54,221**	**$61,955**	**$69,685**	**$77,413**	**$85,137**	**$92,858**	**$100,576**	**$108,291**	**$116,003**	**$124,681**	**$133,355**	**$142,026**	**$150,693**	**$159,357**	**$168,017**	**$176,674**	**$185,328**	**$193,978**	**$202,624**	**$2,565,623**

Net Present Value	
Capital Costs (2016)	**$58,975,360**
Operation Costs (2016)	**$2,565,623**
Net Present Value (2016)	**$61,540,983**

# of Units	0	0	328	657	985	1313	1642	1970	2298	2627	2955	3283	3612	3940	4268	4596	4925	5253	5581	5910	6238	6566	6895	7223	7551	7880	8208

Midhurst Class EA Phases 3 & 4
Midhurst WTP - Cost Estimation Summary
Alternative 2: WTP in Doran Road Neighborhood

Design Basis for WTP and PS	Phase 1	Build Out
Well Production Flow Rates		
Average Demand + 5% Backwash - Carson (L/s)	36.7	40.3
Average Demand + 5% Backwash - Doran (L/s)	32.6	73.4
Total Average Demand + 5% Backwash (L/s)	69.3	113.7
Total Maximum Demand + 5% Backwash (L/s)	131.6	204.7
Doran Road WTP Pumping		
Peak Hour Demand - Doran Area (L/s)	88.4	188.8
Max Day Demand Transfer - Carson Area (L/s)	66.4	69.1
Ave Day Demand Transfer - Carson Area (L/s)	35.0	38.4
Carson Road Pumping Station		
Peak Hour Demand - Carson Area (L/s)	99.7	103.6
Peak Hour minus Max Day - Carson Area (L/s)	33.2	34.5
Fire Flow Demand - Carson Area (L/s)	133	133

Economic Factors	Phase 1	Build Out
Interest (%)	5%	5%
Inflation (%)	3%	3%
Contingency (%SUM Capital Costs)	25%	
Year to Begin	2018	
Duration of Construction is 12 mo (Mid point 0.5 yr)	0.5	0.5
Cost per kW ($/kW)	0.1	0.1

	Carson - Sand & Gravel Site		Doran - Alliance Site	Doran - Old Second Road South
Well Summary	**TW19 / TW22**		**TW-E / PW1**	**TW21**
Ground Elevation at Well Site (m)	232.0		286.0	289.5
Ground Water Elevation with Drawdown (m)	187.0		198.0	195.0
Available Flow Capacity (Permit to Take Water Capacity) (L/s)	73		100	40
Vertical Distance from Drawdown to Well Elevation (m)	45		88	95

Distribution Pumping Summary	Phase 1	Build Out	
Hydraulic Grade Line for Carson Area (m)	321.0	321.0	
Hydraulic Grade Line for Doran Area (m)	335.0	335.0	
Assumed Pump Efficiency (wire to water)	80%	80%	
WTP - Pumps to Carson: Pump Static Head (m)	41	41	*Assumed 3m below ground (LWL)*
WTP - Pumps to Carson: Pump Friction Head (m) (Transmission)	13	14	
Annual Power Consumption Carson Pumps (kWh)	200,943	224,706	
WTP - Pumps to Doran: Pump Static Head (m)	55	55	*Assumed 3m below ground (LWL)*
WTP - Pumps to Doran: Pump Friction Head (m)	8	8	
Annual Power Consumption Transfer Pumps (kWh)	209,837	473,161	
Carson PS - Pumps to Carson: Pump Static Head (m)	86	86	*Assumed 3m below ground (LWL)*
Carson PS - Pumps to Carson: Pump Friction Head (m)	8	8	
Annual Power Consumption Carson Peak Pumps (kWh)	41,993	43,671	*Assumed pumping peak difference 3 hours/day*
Combined Power Consumption (kWh)	452,773	741,537	

Well not needed when single WTP is used

Well not needed when single WTP is used

	Phase 1				Buildout				
Raw Water Pumping (Well to WTP)	Carson - Sand & Gravel Site **TW19 / TW22**		Doran - Alliance Site **TW-E / PW1**	Doran - Old Second Road South **TW21**	Carson - Sand & Gravel Site **TW19 / TW22**		Doran - Alliance Site **TW-E / PW1**	Doran - Old Second Road South **TW21**	
									Assumed 140 roughness constant, plus 2m headloss through the filter
									C-factor 140
									Pipe Diameter 200 mm
									300 mm
Well to **Doran** WTP Distance (m)	6,591		1,000	3,682	6,591		1,000	3,682	
Ground Elevation of WTP (m)	283		283	283	283		283	283	
Assumed % Supply by Well	0%		70%	30%	0%		70%	30%	
Average Day Demand Flow Rate (L/s)	0		48	21	0		80	34	
Well Pump Static Head (m)	96.0		85.0	88.0	96.0		85.0	88.0	*Assumed 140 roughness constant, plus 2m headloss through the filter*
Well Pump Friction Head (m)	2.0		12.7	10.2	2.0		28.8	22.6	
Well Total Dynamic Head Required (m)	98.0		97.7	98.2	98.0		113.8	110.6	
Power Consumption (kW)	0		58	25	0		111	46	
Annual Power Consumption (kWh)	0		509,005	219,288	0		973,259	405,295	

CAPITAL COST

Construction, Equipment, etc.	Phase 1					Build Out Addition				
	Units	# of Units	Unit Cost	Cost	Total Cost	Units	# of Units	Unit Cost	Cost	Total Cost
DORAN WTP SITE (WTP Process Building: 27m x 15m x 5m; Chlorine Contact Tank; Backwash Tank)										
Earthwork	-	-	-	$ -	**$ 141,456**	-	-	-	$ -	**$ -**
Excavation	m^3	2688	$ 30	$ 80,640		m^3		$ 30	$ -	
Backfill	m^3	1584	$ 35	$ 55,440		m^3		$ 35	$ -	
Granular Fill	m^3	89.6	$ 60	$ 5,376		m^3		$ 60	$ -	
Concrete	-	-	-	$ -	**$ 861,696**	-	-	-	$ -	**$ -**
Slab on grade	m^3	224	$ 750	$ 168,000		m^3		$ 750	$ -	
Wall	m^3	336	$ 1,300	$ 436,800		m^3		$ 1,300	$ -	
Suspended slab	m^3	134	$ 1,500	$ 201,600		m^3		$ 1,500	$ -	
Columns	m^3	35	$ 1,600	$ 55,296		m^3		$ 1,600	$ -	
Embedded accessories	-	-	-	-		-	-	-	-	
Superstructure	-	-	-	$ -	**$ 351,970**	-	-	-	$ -	**$ -**
Exterior wall, brick & block system	m^2	560	$ 350	$ 196,000		m^2		$ 350	$ -	
Structural post and frame	TN	3.1	$ 4,200	$ 13,020		TN		$ 4,200	$ -	
Internal masonry wall system	m^2	53	$ 150	$ 7,950		m^2		$ 150	$ -	
Roof system	m^2	405	$ 200	$ 81,000		m^2		$ 200	$ -	
Doors - Hollow Metal	each	10	$ 2,100	$ 21,000		each		$ 2,100	$ -	
Doors - Overhead	each	2	$ 12,000	$ 24,000		each		$ 12,000	$ -	
Windows	each	10	$ 900	$ 9,000		each		$ 900	$ -	
Equipment	-	-	-	$ -	**$ 1,384,000**	-	-	-	$ -	**$ 579,500**
Filters	each	2	$ 350,000	$ 700,000		each	1	$ 350,000	$ 350,000	
Pumps	each	12	$ 20,000	$ 240,000		each	4	$ 20,000	$ 80,000	
Chemical feed systems - Chlorine Gas	Lump sum			$ 100,000		Lump sum			$ 50,000	
Chemical feed systems - Sodium bisulphate for dechlorination			$ 33,000	$ 49,500				$ 33,000	$ 49,500	
Chemical feed systems - Other Chemicals	Lump sum			$ 150,000		Lump sum			$ 50,000	
Chlorine gas Scrubber	each	1	$ 83,000	$ 124,500		each	0	$ 83,000	$ -	
Blowers	each	1	$ 20,000	$ 20,000		each	0	$ 20,000	$ -	
Mechanical	-	-	-	$ -	**$ 299,850**	-	-	-	$ -	**$ -**
HVAC	Lump sum			$ 89,100		Lump sum			$ -	
Plumbing	Lump sum			$ 60,750		Lump sum			$ -	
Process piping & valves	Lump sum			$ 150,000		Lump sum			$ -	
Instrumentation	-	-	-	$ -	**$ 300,000**	-	-	-	$ -	**$ 150,000**
Electrical	-	-	-	$ -	**$ 1,200,000**	-	-	-	$ -	**$ -**
Process Building Cost					**$ 4,538,972**					**$ 729,500**
DORAN WTP SITE (Underground Storage Tank, 3,400 m3 phase 1 (36m x 19m x 6m) and 1,800 m3 addition in build out (36m x 10 m x 6m)										
Sheeting	m2	210	$ 2,300	$ 483,000	**$ 483,000**	m2	138	2300	$ 317,400	**$ 317,400**
Earthwork	-	-	-	$ -	**$ 232,680**	-	-	-	$ -	**$ 113,873**
Excavation	m^3	5016	$ 30	$ 150,480		m^3	2160	$ 26	$ 56,160	
Backfill	m^3	2088	$ 35	$ 73,080		m^3	1656	$ 32	$ 52,992	
Granular Fill	m^3	152	$ 60	$ 9,120		m^3	81.4	$ 58	$ 4,721	
Concrete	-	-	-	$ -	**$ 1,577,539**	-	-	-	$ -	**$ 1,184,566**
Slab on grade	m^3	380	$ 750	$ 285,000		m^3	180	$ 730	$ 131,400	
Footing for columns	m^3	32	$ 750	$ 24,300		m^3	32	$ 730	$ 23,652	
Wall	m^3	384	$ 1,300	$ 499,200		m^3	384	$ 1,235	$ 474,240	
Suspended slab	m^3	380	$ 1,500	$ 570,000		m^3	250	$ 1,450	$ 362,500	
Beam cap for columns	m^3	14	$ 1,500	$ 21,600		m^3	14	$ 1,450	$ 20,880	
Columns	m^3	111	$ 1,600	$ 177,439		m^3	111	$ 1,550	$ 171,894	
Embedded accessories	-	-	-	-		-	-	-	-	
Masonry: Block wall, 8" (Seismic)	m^3	27	$ 136	$ 3,731	**$ 3,731**	m^3	27	$ 136	$ 3,731	**$ 3,731**
Metal: Access Hatches	each	4	$ 3,000	$ 12,000	**$ 12,000**	each	2	$ 3,000	$ 6,000	**$ 6,000**
Thermo & Moisture Protection - Storage Tank Liner	m^2	2040	$ 45	$ 91,786	**$ 91,786**	m^2	1624	$ 45	$ 73,066	**$ 73,066**
Mechanical - Process Piping & Valves	Lump sum				**$ 50,000**	Lump sum			-	**$ 15,000**
Instrumentation	Lump sum				**$ -**	Lump sum			-	**$ 10,000**
Electrical	Lump sum				**$ -**	Lump sum			-	**$ -**
Underground Storage Tank Cost					**$ 2,450,735**					**$ 1,723,635**
Sitework (10% of storage)					$ 245,074					$ 172,364
General Requirements (10% of process, storage and sitework; 7% Phase 2)					$ 723,478.06					$ 183,784.92
Sub-total					$ 7,958,259					$ 2,809,284
Contingencies (25% of sub-total)					$ 1,989,565					$ 702,321
Mid-Point of Construction (S=P(1+i)n)					$ 148,115					$ 52,285 assumed 12 mo
Total Probable Construction Cost					**$10,095,938**					**$3,563,890**

CAPITAL COST

Construction, Equipment, etc.	Phase 1					Build Out Addition				
	Units	# of Units	Unit Cost	Cost	Total Cost	Units	# of Units	Unit Cost	Cost	Total Cost
CARSON PS AND STORAGE SITE (Pumping Station Building, 15m x 12m x 5m)										
Earthwork	-	-	-	$ -	**$ 76,476**	-	-	-	$ -	**$ -**
Excavation	m^3	1248	$ 30	$ 37,440		m^3	-	-	-	
Backfill	m^3	1044	$ 35	$ 36,540		m^3	-	-	-	
Granular Fill	m^3	41.6	$ 60	$ 2,496		m^3	-	-	-	
Concrete	-	-	-	$ -	**$ 465,771**	-	-	-	$ -	**$ -**
Slab on grade	m^3	97.5	$ 750	$ 73,125		m^3	-	-	-	
Wall	m^3	192	$ 1,300	$ 249,600		m^3	-	-	-	
Suspended slab	m^3	59	$ 1,500	$ 87,750		m^3	-	-	-	
Columns	m^3	34.6	$ 1,600	$ 55,296		m^3	-	-	-	
Embedded accessories	-	-	-	-		-	-	-	-	
Superstructure	-	-	-	$ -	**$ 326,520**	-	-	-	$ -	**$ -**
Exterior wall, brick & block system	m^2	480	$ 350	$ 168,000		m^2	-	-	-	
Structural post and frame	TN	3.1	$ 4,200	$ 13,020		TN	-	-	-	
Internal masonry wall system	m^2	42	$ 150	$ 6,300		m^2	-	-	-	
Roof system	m^2	576	$ 200	$ 115,200		m^2	-	-	-	
Doors - Hollow Metal	each	4	$ 2,100	$ 8,400		each	-	-	-	
Doors - Overhead	each	1	$ 12,000	$ 12,000		each	-	-	-	
Windows	each	4	$ 900	$ 3,600		each	-	-	-	
Equipment	-	-	-	$ -	**$ 300,000**	-	-	-	$ -	**$ 120,000**
Pumps	each	5	$ 60,000	$ 300,000		each	$ 2	$ 60,000	$ 120,000	
Mechanical	-	-	-	$ -	**$ 309,320**	-	-	-	$ -	**$ 60,000**
HVAC	Lump sum			$ 115,200		Lump sum		-	-	
Plumbing	Lump sum			$ 69,120		Lump sum		-	-	
Process piping & valves	Lump sum			$ 125,000		Lump sum		-	$ 60,000	
Instrumentation	-	-	-	$ -	**$ 200,000**	-	-	-	$ -	**$ -**
Electrical	-	-	-	$ -	**$ 800,000**	-	-	-	$ -	**$ 50,000**
Pumping Station Building Cost					**$ 2,478,087**					**$ 230,000**
CARSON PS AND STORAGE SITE (Underground Storage Tank, 3,700 m3, built once for ultimate - 37m x 20m x 6m)										
Sheeting	m^2	740	2300	$ 1,702,000	**$ 1,702,000**	m^2	-	-	-	**$ -**
Earthwork	-	-	-	$ -	**$ 227,556**	-	-	-	$ -	**$ -**
Excavation	m^3	4788	$ 30	$ 143,640		m^3	-	-	-	
Backfill	m^3	2124	$ 35	$ 74,340		m^3	-	-	-	
Granular Fill	m^3	159.6	$ 60	$ 9,576		m^3	-	-	-	
Concrete	-	-	-	$ -	**$ 1,618,014**	-	-	-	$ -	**$ -**
Slab on grade	m^3	380	$ 750	$ 285,000		m^3	-	-	-	
Footing for columns	m^3	32	$ 750	$ 24,300		m^3	-	-	-	
Wall	m^3	384	$ 1,300	$ 499,200		m^3	-	-	-	
Suspended slab	m^3	389	$ 1,500	$ 582,750		m^3	-	-	-	
Beam cap for columns	-	14.4	$ 1,500	$ 21,600		-	-	-	-	
Columns	m^3	128.2	$ 1,600	$ 205,164		m^3	-	-	-	
Embedded accessories	-	-	-	-		-	-	-	-	
Masonry: Block wall, 8" (Seismic)	m^3	27	$ 140	$ 3,840	**$ 3,840**	m^3	-	-	-	**$ -**
Metal: Access Hatches	each	4	$ 3,000	$ 12,000	**$ 12,000**	each	-	-	-	**$ -**
Thermo & Moisture Protection - Storage Tank Liner	m^2	1789	$ 45	$ 80,496	**$ 80,496**	m^2	-	-	-	**$ -**
Mechanical - Process Piping & Valves	Lump sum				**$ 30,000**	Lump sum			-	**$ -**
Instrumentation	Lump sum				**$ -**	Lump sum			-	**$ -**
Electrical	Lump sum				**$ -**	Lump sum			-	**$ -**
Underground Storage Tank Cost					**$ 3,673,906**					**$ -**
Sitework (10% of storage)					$ 367,391					$ -
General Requirements (10% of process, storage and sitework; 7% Phase 2)					$ 651,938.36					$ 16,100.00
Sub-total					$ 7,171,322					$ 246,100
Contingencies (25% of sub-total)					$ 1,792,830					$ 61,525
Mid-Point of Construction (S=P(1+i)n)					$ 133,469					$ 4,580
Total Probable Construction Cost					**$9,097,621**					**$312,205**

Transmission Main Length (m)	
Diameter (mm)	**2- Doran WTP**
Raw Water Supply	
200	5,882
300	5,091
Distribution System	
200	4,259
300	31,836
400	2,989
500	104

Transmission Main Capital Costs (m)		
Diameter (m)	**RATE $/m**	**2- Doran WTP**
Raw Water Supply		
200	$ 600	$ 3,529,200
300	$ 700	$ 3,563,700
Total		**$ 7,092,900**
Distribution System		
200	$ 600	$ 2,555,364
300	$ 700	$ 22,285,424
400	$ 900	$ 2,689,938
500	$ 1,045	$ 109,046
	Total	**$ 27,639,772**
TOTAL		**$34,732,672**

Calculating NPV																													
																			Phase 1 is reached										Buildout is reached	
Item					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Capital Costs	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**TOTAL**
Water Treatment Plant and Pumping Stations			$19,193,560																$3,876,095											
Transmission Mains			$34,732,672																											
Capital Costs	**$0**	**$0**	**$53,926,231**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,876,095**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**		**$ 57,802,326**
Capital Costs (Year n)	**$0**	**$0**	**$53,926,231**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,894,742**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**		**$ 57,820,973**
Net Present Value (2016)	**$0**	**$0**	**$53,926,231**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,876,095**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**		**$ 57,802,326**
Operating Costs																														
Distribution System Pumping					$3,018	$6,037	$9,055	$12,074	$15,092	$18,111	$21,129	$24,148	$27,166	$30,185	$33,203	$36,222	$39,240	$42,259	$45,277	$48,165	$51,053	$53,940	$56,828	$59,716	$62,603	$65,491	$68,378	$71,266	$74,154	
Raw Water Pumping					$4,855	$9,711	$14,566	$19,421	$24,276	$29,132	$33,987	$38,842	$43,698	$48,553	$53,408	$58,263	$63,119	$67,974	$72,829	$79,332	$85,835	$92,337	$98,840	$105,342	$111,845	$118,348	$124,850	$131,353	$137,855	
Operation Costs (2016)					**$7,874**	**$15,748**	**$23,621**	**$31,495**	**$39,369**	**$47,243**	**$55,116**	**$62,990**	**$70,864**	**$78,738**	**$86,612**	**$94,485**	**$102,359**	**$110,233**	**$118,107**	**$127,497**	**$136,887**	**$146,277**	**$155,668**	**$165,058**	**$174,448**	**$183,838**	**$193,229**	**$202,619**	**$212,009**	**$2,642,384**
Operation Costs (Year n)					**$7,879**	**$15,762**	**$23,650**	**$31,542**	**$39,440**	**$47,342**	**$55,249**	**$63,161**	**$71,077**	**$78,998**	**$86,924**	**$94,854**	**$102,790**	**$110,730**	**$118,675**	**$128,149**	**$137,628**	**$147,113**	**$156,604**	**$166,101**	**$175,603**	**$185,111**	**$194,625**	**$204,144**	**$213,669**	**$2,656,819**
Net Present Value (2016)					**$7,871**	**$15,738**	**$23,602**	**$31,464**	**$39,322**	**$47,177**	**$55,028**	**$62,877**	**$70,722**	**$78,565**	**$86,404**	**$94,240**	**$102,073**	**$109,903**	**$117,729**	**$127,064**	**$136,395**	**$145,723**	**$155,046**	**$164,366**	**$173,683**	**$182,995**	**$192,304**	**$201,609**	**$210,910**	**$2,632,811**
Net Present Value																														
Capital Costs (2016)	**$ 57,802,326**																													
Operation Costs (2016)	**$ 2,632,811**																													
Net Present Value (2016)	**$ 60,435,137**																													
# of Units				0	0	328	657	985	1313	1642	1970	2298	2627	2955	3283	3612	3940	4268	4596	4925	5253	5581	5910	6238	6566	6895	7223	7551	7880	8208

Midhurst Class EA Phases 3 & 4
Midhurst WTP - Cost Estimation Summary
Alternative 3: WTP in both Doran Road and Carson Road Neighbourhoods

Design Basis for WTP and PS	Phase 1	Build Out
Well Production Flow Rates		
Average Demand + 5% Backwash - Carson (L/s)	36.7	40.3
Average Demand + 5% Backwash - Doran (L/s)	32.6	73.4
Total Average Demand + 5% Backwash (L/s)	69.3	113.7
Total Maximum Demand + 5% Backwash (L/s)	138.5	220.1
Doran Road WTP Pumping		
Peak Hour Demand - Doran Area (L/s)	93.0	199.3
Max Day Demand - Doran Area (L/s)	62.0	132.8
Fire Flow Demand - Doran Area (L/s)	133	133
Carson Road WTP Pumping		
Peak Hour Demand - Carson Area (L/s)	104.9	115.1
Max Day Demand - Carson Area (L/s)	69.9	76.8
Fire Flow Demand - Carson Area (L/s)	133	133

Economic Factors	Phase 1	Build Out
Interest (%)	5%	5%
Inflation (%)	3%	3%
Contingency (%SUM Capital Costs)	25%	
Year to Begin	2018	
Duration of Construction is 12 mo (Mid point 0.5 yr)	0.5	0.5
Cost per kW ($/kW)	0.1	0.1

Well Summary	Carson - Sand & Gravel Site TW19 / TW22	Carson - West Snow Valley TW29 / TW34	Doran - Alliance Site TW-E / PW1	Doran - Old Second Road South TW21
Ground Elevation at Well Site (m)	232.0	237.0	286.0	289.5
Ground Water Elevation with Drawdown (m)	187.0	193.0	198.0	195.0
Available Flow Capacity (Permit to Take Water Capacity) (L/s)	73	20	100	40
Vertical Distance from Drawdown to Well Elevation (m)	45		88	95

Distribution Pumping Summary	Phase 1	Build Out	
Hydraulic Grade Line for Carson Area (m)	321.0	321.0	
Hydraulic Grade Line for Doran Area (m)	335.0	335.0	
Assumed Pump Efficiency (wire to water)	80%	80%	
WTP - Pumps to Carson: Pump Static Head (m)	86	86	*Assumed 3m below ground (LWL)*
WTP - Pumps to Carson: Pump Friction Head (m)	8	8	
Annual Power Consumption Carson Pumps (kWh)	353,623	388,185	
WTP - Pumps to Doran: Pump Static Head (m)	55	55	*Assumed 3m below ground (LWL)*
WTP - Pumps to Doran: Pump Friction Head (m)	8	8	
Annual Power Consumption Doran Pumps (kWh)	209,837	473,161	
	-	-	
	-	-	
	-	-	
Combined Power Consumption (kWh)	563,460	861,345	

	Phase 1				Buildout			
Raw Water Pumping (Well to WTP)	Carson - Sand & Gravel Site TW19 / TW22	Carson - West Snow Valley TW29 / TW34	Doran - Alliance Site TW-E / PW1	Doran - Old Second Road South TW21	Carson - Sand & Gravel Site TW19 / TW22	Carson - West Snow Valley TW29 / TW34	Doran - Alliance Site TW-E / PW1	Doran - Old Second Road South TW21
Well to **Carson** WTP Distance (m)	245	4,841			245	4,841		
Ground Elevation of WTP (m)	238	238			238	238		
Assumed % Supply by Well	100%	0%			100%	0%		
Average Day Demand Flow Rate (L/s)	36.7	0.0			40.3	0.0		
Well Pump Static Head (m)	50.9	44.9			50.9	44.9		
Well Pump Friction Head (m)	3.6	2.0			3.9	2.0		
Well Total Dynamic Head Required (m)	54.4	46.9			54.7	46.9		
Power Consumption (kW)	24	0			27	0		
Annual Power Consumption (kWh)	214,619	0			236,875	0		
Well to **Doran** WTP Distance (m)			2,000	3,682			2,000	3,682
Ground Elevation of WTP (m)			283	283			283	283
Assumed % Supply by Well			100%	0%			60%	40%
Average Day Demand Flow Rate (L/s)			32.6	0			44.0	29.4
Well Pump Static Head (m)			85.0	88.0			85.0	88.0
Well Pump Friction Head (m)			12.3	2.0			20.0	17.6
Well Total Dynamic Head Required (m)			97.3	90.0			105.0	105.6
Power Consumption (kW)			39	0			57	38
Annual Power Consumption (kWh)			340,154	0			496,590	333,135

Assumed 140 roughness constant, plus 2m headloss through the filter

Assumed 140 roughness constant, plus 2m headloss through the filter

C-factor 140
Pipe Diameter 200 mm
300 mm

CAPITAL COST

Construction, Equipment, etc.	Phase 1 Units	# of Units	Unit Cost	Cost	Total Cost	Build Out Addition Units	# of Units	Unit Cost	Cost	Total Cost
DORAN WTP SITE (WTP Process Building: 17m x 15m x 5 m (build for ultimate, add a filter); Chlorine Contact Tank; Backwash Tank)										
Earthwork	-	-	-	-	$ 98,136	-	-	-	-	$ -
Excavation	m^3	1728	$ 30	$ 51,840		m^3	0	$ 30	$ -	
Backfill	m^3	1224	$ 35	$ 42,840		m^3	0	$ 35	$ -	
Granular Fill	m^3	57.6	$ 60	$ 3,456		m^3	0	$ 60	$ -	
Concrete	-	-	-	-	$ 580,608	-	-	-	-	$ -
Slab on grade	m^3	144	$ 750	$ 108,000		m^3	0	$ 750	$ -	
Wall	m^3	216	$ 1,300	$ 280,800		m^3	0	$ 1,300	$ -	
Suspended slab	m^3	86	$ 1,500	$ 129,600		m^3	0	$ 1,500	$ -	
Columns	m^3	39	$ 1,600	$ 62,208		m^3	0	$ 1,600	$ -	
Embedded accessories	-	-	-	-		-	-	-	-	
Superstructure	-	-	-	-	$ 238,920	-	-	-	-	$ -
Exterior wall, brick & block system	m^2	360	$ 350	$ 126,000		m^2	0	$ 350	$ -	
Structural post and frame	TN	3.1	$ 4,200	$ 13,020		TN	0.0	$ 4,200	$ -	
Internal masonry wall system	m^2	42	$ 150	$ 6,300		m^2	0	$ 150	$ -	
Roof system	m^2	288	$ 200	$ 57,600		m^2	0	$ 200	$ -	
Doors - Hollow Metal	each	8	$ 2,100	$ 16,800		each	0	$ 2,100	$ -	
Doors - Overhead	each	1	$ 12,000	$ 12,000		each	0	$ 12,000	$ -	
Windows	each	8	$ 900	$ 7,200		each	0	$ 900	$ -	
Equipment	-	-	-	-	$ 1,294,000	-	-	-	-	$ 450,000
Filters	each	2	$ 350,000	$ 700,000		each	1	$ 350,000	$ 350,000	
Pumps	each	5	$ 30,000	$ 150,000		each	0	$ 30,000	$ -	
Chemical feed systems - Chlorine Gas	Lump sum			$ 100,000		Lump sum			$ 50,000	
Chemical feed systems - Sodium bisulphate for dechlorination			$ 33,000	$ 49,500						
Chemical feed systems - Other Chemicals	Lump sum			$ 150,000		Lump sum			$ 50,000	
Chlorine gas Scrubber	each	1	$ 83,000	$ 124,500		each	0		$ -	
Blowers	each	1	$ 20,000	$ 20,000		each	0		$ -	
Mechanical	-	-	-	-	$ 206,600	-	-	-	-	$ -
HVAC	Lump sum			$ 51,000		Lump sum			$ -	
Plumbing	Lump sum			$ 30,600		Lump sum			$ -	
Process piping & valves	Lump sum			$ 125,000		Lump sum			$ -	
Instrumentation	-	-	-	-	$ 300,000	-	-	-	-	$ 150,000
Electrical	-	-	-	-	$ 1,200,000	-	-	-	-	$ -
Process Building Cost					$ 3,918,264					$ 600,000
DORAN WTP SITE (Underground Storage Tank, 3,500 m3 phase 1 (36m x 19m x 6m) and 1,800 m3 addition in build out (36m x 10 m x 6m)										
Sheeting	m2	210	$ 2,300	$ 483,000	$ 483,000	m2	138	2300	$ 317,400	$ 317,400
Earthwork					$ 232,680	-	-	-	-	$ 113,873
Excavation	m3	5016	$ 30	$ 150,480		m3	2160	$ 26	$ 56,160	
Backfill	m3	2088	$ 35	$ 73,080		m3	1656	$ 32	$ 52,992	
Granular Fill	m3	152	$ 60	$ 9,120		m3	81.4	$ 58	$ 4,721	
Concrete					$ 1,577,539	-	-	-		$ 1,184,566
Slab on grade	m3	380	$ 750	$ 285,000		m3	180	$ 730	$ 131,400	
Footing for columns	m3	32	$ 750	$ 24,300		m3	32	$ 730	$ 23,652	
Wall	m3	384	$ 1,300	$ 499,200		m3	384	$ 1,235	$ 474,240	
Suspended slab	m3	380	$ 1,500	$ 570,000		m3	250	$ 1,450	$ 362,500	
Beam cap for columns	m3	14	$ 1,500	$ 21,600		m3	14	$ 1,450	$ 20,880	
Columns	m3	111	$ 1,600	$ 177,439		m3	111	$ 1,550	$ 171,894	
Embedded accessories	-	-	-	-		-	-	-	-	
Masonry: Block wall, 8" (Seismic)	m3	27	$ 136	$ 3,731	$ 3,731	m3	27	$ 136	$ 3,731	$ 3,731
Metal: Access Hatches	each	4	$ 3,000	$ 12,000	$ 12,000	each	2	$ 3,000	$ 6,000	$ 6,000
Thermo & Moisture Protection - Storage Tank Liner	m2	2040	$ 45	$ 91,786	$ 91,786	m2	1624	$ 45	$ 73,066	$ 73,066
Mechanical - Process Piping & Valves	Lump sum				$ 50,000	Lump sum			-	$ 15,000
Instrumentation	Lump sum				$ -	Lump sum			-	$ 10,000
Electrical	Lump sum				$ -	Lump sum			-	$ -
Underground Storage Tank Cost					$ 2,450,735					$ 1,723,635
Sitework (10% of storage)					$ 245,074					$ 172,364
General Requirements (10% of process, storage and sitework; 7% Phase 2					$ 661,407.26					$ 174,719.92
Sub-total					$ 7,275,480					$ 2,670,719
Contingencies (25% of sub-total)					$ 1,818,870					$ 667,680
Mid-Point of Construction (S=P(1+i)n)					$ 135,407					$ 49,706 assumed 12 mo
Total Probable Construction Cost					**$9,229,757**					**$3,388,104**

Transmission Main Length (m)	
Diameter (mm)	3->Two WTPs
Raw Water Supply	
200	10,723
300	0
Distribution System	
200	4,259
300	27,475
400	2,861
500	127

Transmission Main Capital Costs (m)		
Diameter (m)	RATE $/m	3->Two WTPs
Raw Water Supply		
200	$ 600	$ 6,433,800
300	$ 700	$ -
Total		**$ 6,433,800**
Distribution System		
200	$ 600	$ 2,555,364
300	$ 700	$ 19,232,843
400	$ 900	$ 2,575,224
500	$ 1,045	$ 133,196
	Total	**$ 24,496,627**
TOTAL		**$30,930,427**

CAPITAL COST

Construction, Equipment, etc.	Phase 1 (Nitrate Treatment) Units	# of Units	Unit Cost	Cost	Total Cost	Build Out Addition Units	# of Units	Unit Cost	Cost	Total Cost
CARSON WTP SITE (WTP Process Building: 12m x 13m x 5m for Phase 1 and addition of 12m x 13m for build out; Chlorine Contact Tank; Backwash Tank)										
Earthwork	-	-	-	$	$ 61,452	-	-	-	$ -	$ -
Excavation	m^3	936	$ 30	$ 28,080		m^3		$ 26	$ -	
Backfill	m^3	900	$ 35	$ 31,500		m^3		$ 32	$ -	
Granular Fill	m^3	31.2	$ 60	$ 1,872		m^3		$ 58	$ -	
Concrete	-	-	-	$	$ 372,972	-	-	-	$ -	$ -
Slab on grade	m^3	78	$ 750	$ 58,500		m^3		$ 730	$ -	
Wall	m^3	156	$ 1,300	$ 202,800		m^3		$ 1,235	$ -	
Suspended slab	m^3	47	$ 1,500	$ 70,200		m^3		$ 1,450	$ -	
Columns	m^3	25.9	$ 1,600	$ 41,472		m^3		$ 1,550	$ -	
Embedded accessories	-	-	-	-	-	-	-	-	-	-
Superstructure	-	-	-	$ -	$ 175,870	-	-	-	-	$ -
Exterior wall, brick & block system	m^2	260	$ 350	$ 91,000		m^2		$ 350	$ -	
Structural post and frame	TN	3.1	$ 4,200	$ 13,020		TN		$ 4,000	$ -	
Internal masonry wall system	m^2	31	$ 150	$ 4,650		m^2		$ 136	$ -	
Roof system	m^2	156	$ 200	$ 31,200		m^2		$ 200	$ -	
Doors - Hollow Metal	each	8	$ 2,100	$ 16,800		each		$ 2,100	$ -	
Doors - Overhead	each	1	$ 12,000	$ 12,000		each		$ 12,000	$ -	
Windows	each	8	$ 900	$ 7,200		each		$ 900	$ -	
Equipment	-	-	-	$ -	$ 1,354,500	-	-	-	-	$ 200,000
Filters	each	2	$ 350,000	$ 700,000		each			$ -	
Pumps	each	10	$ 25,000	$ 250,000		each			$ -	
Chemical feed systems - Chlorine Gas	Lump sum			$ 100,000		Lump sum			$100,000	
Chemical feed systems - Sodium bisulphate for dechlorination			$ 33,000	$ 49,500					50	
Chemical feed systems - Other Chemicals	Lump sum			$ 100,000		Lump sum			$100,000	
Chlorine gas Scrubber	each	1	$ 90,000	$ 135,000		each			50	
Blowers	each	1	$ 20,000	$ 20,000		each			50	
Mechanical	-	-	-	$ -	$ 174,920	-	-	-	-	$ -
HVAC	Lump sum			$ 31,200		Lump sum				
Plumbing	Lump sum			$ 18,720		Lump sum				
Process piping & valves	Lump sum			$ 125,000		Lump sum				
Instrumentation	-	-	-	$ -	$ 300,000	-	-	-	-	$ -
Electrical	-	-	-	$ -	$ 1,200,000	-	-	-	-	$ -
Process Building Cost					$ 3,639,714					$ 1,000,000
CARSON WTP SITE (Underground Storage Tank, 3870 m3 (37m x 21m x 6m)										
Sheeting	m^2	777	2300	$ 1,787,100	$ 1,787,100	m^2	-	-	$ -	$ -
Earthwork	-	-	-	$	$ 236,112	-	-	-	$ -	$ -
Excavation	m^3	5016	30	$ 150,480		m^3	-	-	-	
Backfill	m^3	2160	35	$ 75,600		m^3	-	-	-	
Granular Fill	m^3	167.2	60	$ 10,032		m^3	-	-	-	
Concrete	-	-	-	$	$ 1,632,264	-	-	-	$ -	$ -
Slab on grade	m^3	399	750	$ 299,250		m^3	-	-	-	
Footing for columns	m^3	32	750	$ 24,300		m^3	-	-	-	
Wall	m^3	384	1,300	$ 499,200		m^3	-	-	-	
Suspended slab	m^3	389	1,500	$ 582,750		m^3	-	-	-	
Beam cap for columns	-	14.4	1,500	$ 21,600		-	-	-	-	
Columns	m^3	128.2	1,600	$ 205,164		m^3	-	-	-	
Embedded accessories	-	-	-	-	-	-	-	-	-	-
Masonry: Block wall, 8" (Seismic)	m^3	27	140	$ 3,840	$ 3,840	m^3	-	-	-	-
Metal: Access Hatches	each	4	3,000	$ 12,000	$ 12,000	each	-	-	-	-
Thermo & Moisture Protection - Storage Tank Liner	m^2	1789	45	$ 80,496	$ 80,496	m^2	-	-	-	-
Mechanical - Process Piping & Valves	Lump sum				$ 30,000	Lump sum				$ -
Instrumentation	Lump sum				$ -	Lump sum				$ -
Electrical	Lump sum				$ -	Lump sum				$ -
Underground Storage Tank Cost					$ 3,781,812					$ -
Sitework (10% of storage)					$ 378,181					$ -
General Requirements (10% of process, storage and sitework; 7% Phase 2					$ 779,970.72					$ 70,000.00
Sub-total					$ 8,579,678					$ 1,070,000
Contingencies (25% of sub-total)					$ 2,144,919					$ 267,500
Mid-Point of Construction (S=P(1+i)n)					$ 159,680					$ 19,914
Total Probable Construction Cost					**$10,884,277**					**$1,357,414**

Phase 1 is reached — Buildout is reached

Calculating NPV Item	2016	2017	2018	2019	1 2020	2 2021	3 2022	4 2023	5 2024	6 2025	7 2026	8 2027	9 2028	10 2029	11 2030	12 2031	13 2032	14 2033	15 2034	16 2035	17 2036	18 2037	19 2038	20 2039	21 2040	22 2041	23 2042	24 2043	25 2044	TOTAL
Capital Costs																														
Water Treatment Plant and Pumping Stations			$20,114,034																$4,745,518											
Snow Valley Wells (well drilling, pumps and transmission main)			$0																$200,000											
Transmission Mains			$28,025,827																$2,904,600											
Capital Costs	$0	$0	**$48,139,861**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$7,850,118**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$55,989,979**
Capital Costs (Year n)	$0	$0	**$48,139,861**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$7,887,884**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$56,027,745**
Net Present Value (2016)	$0	$0	**$48,139,861**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$7,850,118**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$55,989,979**
Operating Costs																														
Distribution System Pumping					$3,756	$7,513	$11,269	$15,026	$18,782	$22,538	$26,295	$30,051	$33,808	$37,564	$41,320	$45,077	$48,833	$52,590	$56,346	$59,325	$62,304	$65,283	$68,261	$71,240	$74,219	$77,198	$80,177	$83,156	$86,135	
Raw Water Pumping					$3,698	$7,397	$11,095	$14,794	$18,492	$22,191	$25,889	$29,588	$33,286	$36,985	$40,683	$44,382	$48,080	$51,779	$55,477	$60,596	$65,714	$70,832	$75,950	$81,069	$86,187	$91,305	$96,423	$101,542	$106,660	
Operation Costs (2016)					**$7,455**	**$14,910**	**$22,365**	**$29,820**	**$37,274**	**$44,729**	**$52,184**	**$59,639**	**$67,094**	**$74,549**	**$82,004**	**$89,459**	**$96,914**	**$104,368**	**$111,823**	**$119,920**	**$128,018**	**$136,115**	**$144,212**	**$152,309**	**$160,406**	**$168,503**	**$176,600**	**$184,697**	**$192,795**	**$2,458,161**
Operation Costs (Year n)					**$7,459**	**$14,923**	**$22,392**	**$29,864**	**$37,342**	**$44,823**	**$52,310**	**$59,800**	**$67,296**	**$74,795**	**$82,299**	**$89,808**	**$97,321**	**$104,839**	**$112,361**	**$120,533**	**$128,711**	**$136,893**	**$145,080**	**$153,271**	**$161,468**	**$169,670**	**$177,876**	**$186,088**	**$194,304**	**$2,471,526**
Net Present Value (2016)					**$7,452**	**$14,901**	**$22,347**	**$29,790**	**$37,230**	**$44,667**	**$52,101**	**$59,532**	**$66,960**	**$74,385**	**$81,807**	**$89,226**	**$96,643**	**$104,056**	**$111,466**	**$119,514**	**$127,558**	**$135,599**	**$143,636**	**$151,671**	**$159,702**	**$167,730**	**$175,755**	**$183,777**	**$191,795**	**$2,449,298**
Net Present Value																														
Capital Costs (2016)	**$55,989,979**																													
Operation Costs (2016)	**$2,449,298**																													
Net Present Value (2016)	**$58,439,277**																													
# of Units					0	0	328	657	985	1313	1642	1970	2298	2627	2955	3283	3612	3940	4268	4596	4925	5253	5581	5910	6238	6566	6895	7223	7551	7880	8208

APPENDIX B

FIRE FLOW CALCULATION TABLE

B&V PROJECT NO. 180261

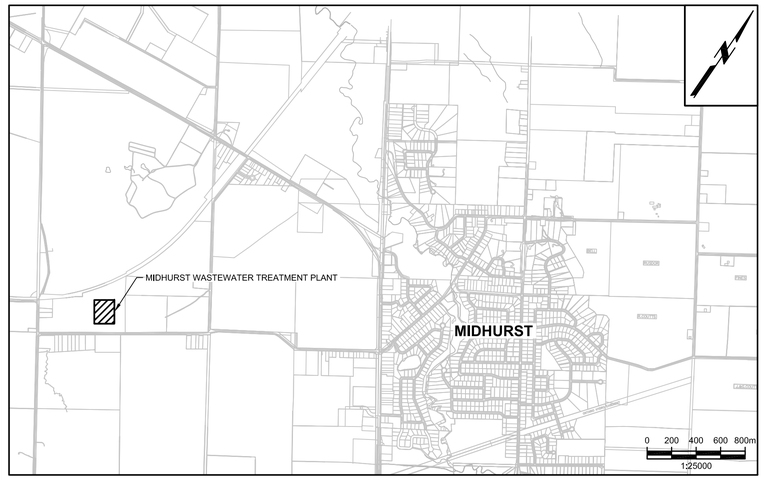
Summary of Results of Different Required Fire Flow Calculation Methodologies

REQUIRED FIRE FLOW CALCULATION METHOD		BUILDING TYPE					
		SINGLE DETACHED DWELLING Dwelling is 186 m^2 (2,000 ft^2); 11.5 m (38 ft) high. Distance between buildings is 3.4m - 9.2 m	**SEMI DETACHED DWELLING** Each dwelling is 140 m^2 (1500 ft^2); 11.5 m (38 ft) high. Distance between buildings is 3.4 m - 9.2m	**DUPLEX DWELLINGS** Dwelling is 186 m^2 (2000 ft^2); 13 m (43 ft) high. Distance between buildings is 3.4 m-9.2 m	**TOWNHOUSE DWELLING** Each dwelling is 140 m^2 (1500 ft^2); 11.5 m (38 ft) high. Total of 8 contiguous units in each complex	**APARTMENT BUILDING DWELLING** Dwelling is a 3 story building; 2 units per floor. Each unit is 42 m^2	**RETAIL STORE OR COMMERCIAL USE** Each commercial unit is 400 m^2; 18 m (59 ft) high
FROM MANUAL OF WATER SUPPLY PRACTICES (M-31) BY AMERICAN WATER WORKS ASSOCIATION	**Insurance Services Office (ISO)** ISO method considers building construction, occupancy, adjacent exposed buildings, and fire communication paths between buildings.	**63 L/s** Table 1-6 AWWA M-31	**63 L/s** Table 1-6 AWWA M-31	**63 L/s** Table 1-6 AWWA M-31	**101 L/s** ISO formula applied to Construction Class 3 (Noncombustible) or Class 4 (Construction); and Occupancy Factor C-2 (Limited combustible class)	**60 L/S** ISO formula applied to Construction Class 3 (Noncombustible) or Class 4 (Construction); and Occupancy Factor C-3 (Combustible class)	**169 L/s** ISO formula applied to Construction Class 3 (Noncombustible) or Class 4 (Construction); and Occupancy Factor C-3 (Combustible class)
	Iowa State University (ISU) ISU method is a commonly used method based on the amount of water needed to deplete the oxygen in a confined area, when the water is vaporized into steam by the heat of the fire. The method does not consider the occupancy hazard, only the volume of the building to be filled with steam.	**48 L/s** ISU Formula applied	**72 L/s** ISU Formula applied	**54 L/s** ISU Formula applied	**287 L/s** ISU Formula applied	**101 L/s** ISU Formula applied	**161 L/s** ISU Formula applied
	National Fire Academy (NFA) NFA method calculates the fire flow at the scene of a fire. The formula depends on the size of the floor and can be applied to four or fewer floors.	**42 L/s** NFA Formula applied	**63 L/s** NFA Formula applied	**42 L/s** NFA Formula applied	**252 L/s** NFA Formula applied	**114 L/s** NFA Formula applied	**91 L/s** NFA Formula applied
	Illinois Institute of Technology Research Institute (IITI) The results of a large survey were used with regression analysis to develop fire flow formulas based on building area. For large non -residential buildings, this becomes invalid.	**86 L/s** ITTI Formula applied	**146 L/s** ITTI Formula applied	**86 L/s** ITTI Formula applied	**1,196 L/s** ITTI Formula applied	**127 L/s** ITTI Formula applied	**99 L/s** ITTI Formula applied
FIRE UNDERWRITERS SURVEY (FUS)	The purpose of the FUS is to survey the fire protection conditions of Canadian communities and municipalities, providing data and advisory services to fire insurance underwriters and public officials concerned. The FUS provides a method for calculating fire flow rate based on type of construction and area of building.	**67 L/s** Table on Page 20 FUS	**67 L/s** Table on Page 20 FUS	**67 L/s** Table on Page 20 FUS	**133 L/s** Table on Page 20 FUS (Contiguous units)	**87 L/s** FUS formula applied to Construction Coefficient for Wood Frame Construction	**110 L/s** FUS formula applied to Construction Coefficient for Wood Frame Construction

APPENDIX C

SAND AND GRAVEL OVERALL SITE PLAN

B&V PROJECT NO. 180261



KEY-PLAN
SCALE 1 : 25000

LIQUID DIGESTED BIOSOLIDS STORAGE 1 PHASE 1
LIQUID DIGESTED BIOSOLIDS STORAGE 2 PHASE 1
LIQUID DIGESTED BIOSOLIDS STORAGE 3 PHASE 2
LIQUID DIGESTED BIOSOLIDS STORAGE 4 PHASE 2
PUMPS
PUMPS
FF 238.30
FF 238.30
FF 238.30
FF 238.30
ENVIRONMENTAL PROTECTION AREA II
BUFFER ZONE TO ENVIRONMENTAL PROTECTION AREA II
DIGESTER PHASE 1
DIGESTER PHASE 2
ROOM PHASE 2
FF 238.70
THICKENING BUILDING PHASE 1
SECONDARY CLARIFIER 1 PHASE 1
SECONDARY CLARIFIER 2 PHASE 1
SECONDARY CLARIFIER 3 PHASE 2
RAS PUMPING STATION BUILDING PHASE 1
RAS PUMPING STATION BUILDING PHASE 1
STAND BY POWER GENERATOR
STORM SEWER
ACCESS GATE FOR WELL FIELD
WELL FIELD GRAVEL AREA
BLOWERS AND CHEMICAL PUMPS BUILDING PHASE 1
STEP FEED BNR BIO-REACTOR PHASE 1
STEP FEED BNR BIO-REACTOR PHASE 2
PROPERTY LINE
FG 238.00
FG 238.00
CHEMICAL STORAGE TANKS
BLOWERS BUILDING PHASE 2
TW22
OW19-3
OW19-2
OW19-1
ACCESS GATE
UNDERGROUND RESERVOIR
STAFF PARKING
FF 237,85
FF 238,30
FF 238,50
FF 238,80
FF 238,50
CARSON WATER TREATMENT PLANT
ADMINISTRATION BUILDING
STORM SEWER OUTLET TO STORM DETENTION POND
ACCESS GATE
CONCRETE CURB
WATER TREATMENT PLANT SITE
TERTIARY TREATMENT BUILDING PHASE 1
HEADWORKS AND PUMPING STATION BUILDING PHASE 1 & 2
TERTIARY TREATMENT BUILDING PHASE 2
PROPERTY LINE
SNOW VALLEY ROAD

SITE PLAN
SCALE 1 : 500

KEY

FF FINISHED FLOOR
FG FINISHED GROUND

LEGEND

- ENVIRONMENTAL PROTECTION AREA II
- BUFFER ZONE TO ENVIRONMENTAL PROTECTION AREA II
- WATER TREATMENT PLANT SITE BOUNDARY
- WELL FIELD GRAVEL AREA
- PROPERTY LINE
- FENCE
- EXISTING CONTOUR
- PROPOSED CONTOUR MAJOR
- PROPOSED CONTOUR MINOR
- STORM SEWER
- STORM MH
- STORM CB
- PROPOSED MUNICIPAL WELL SITE
- BUILDING
- TANK
- ROAD

0 5 10 15m
1:500

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Building a world of difference.

DESIGN	AP
DRAWN	AVK
QA/QC	

TOWNSHIP OF SPRINGWATER
MIDHURST WASTEWATER TREATMENT PLANT
SITE PLAN

DWG. NO. G-102
CONT. NO.
SERIES NO.

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ENVIRONMENTAL PROTECTION AREA II

BUFFER ZONE TO ENVIRONMENTAL PROTECTION AREA II

PROPERTY LINE

ACCESS GATE FOR WELL FIELD

WELL FIELD GRAVEL AREA

TW22

OW19-3

OW19-4

OW19-2

OW19-2

ACCESS GATE

ACCESS ROAD

WATER TREATMENT PLANT SITE

UNDERGROUND RESERVOIR

WASTEWATER TREATMENT PLANT SITE

CARSON WATER TREATMENT PLANT

ACCESS ROAD

100m

PROPERTY LINE

STORM OUTLET PIPE TO DETENTION POND

ACCESS GATE

STORM WATER MANAGEMENT POND AREA

WILSON DRIVE

SNOW VALLEY ROAD

100m

PROPERTY LINE

LEGEND

- ENVIRONMENTAL PROTECTION AREA II
- BUFFER ZONE TO ENVIRONMENTAL PROTECTION AREA II
- WATER TREATMENT PLANT SITE BOUNDARY
- WELL FIELD GRAVEL AREA
- PROPERTY LINE
- FENCE
- 238.00 EXISTING CONTOUR
- 235.00 PROPOSED CONTOUR MAJOR
- 238.00 PROPOSED CONTOUR MINOR
- STORM SEWER
- PROPOSED MUNICIPAL WELL SITE
- BUILDING
- TANK
- ROAD

0 10 20 30m

1:1000

OVERALL SITE PLAN

SCALE 1 : 1000

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DESIGN	AP
DRAWN	AVK
QA/QC	

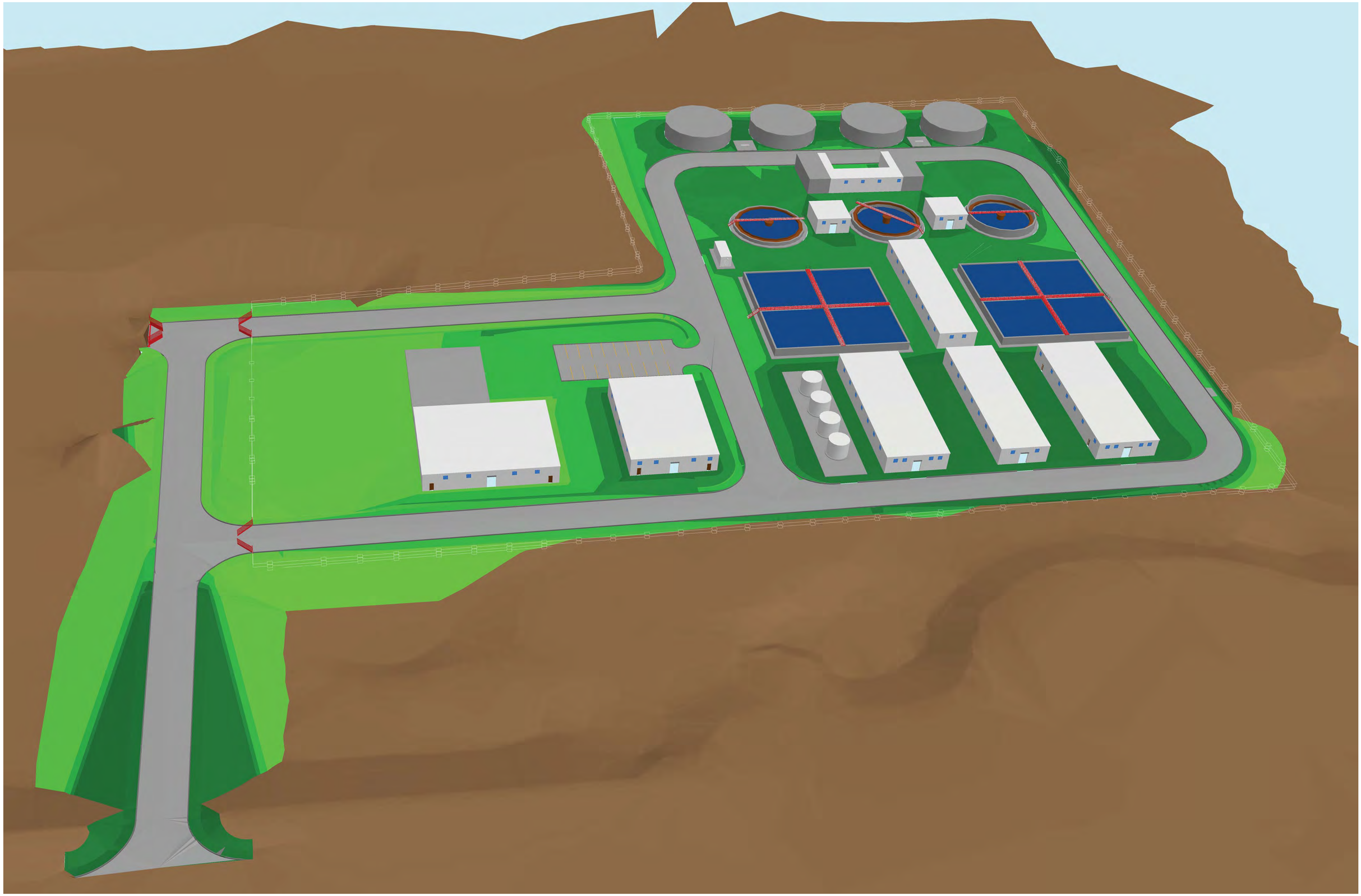
TOWNSHIP OF SPRINGWATER
MIDHURST WASTEWATER TREATMENT PLANT
OVERALL SITE PLAN

DWG. NO. G-101

CONT. NO.

SERIES NO.

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DESIGN	TOWNSHIP OF SPRINGWATER MIDHURST WASTEWATER TREATMENT PLANT	DWG. NO.
DRAWN AVK	CONCEPTUAL SITE 3D MODEL	CONT. NO.
QA/QC		SERIES NO.

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DESIGN	
DRAWN	AVK
QA/QC	

TOWNSHIP OF SPRINGWATER
MIDHURST WASTEWATER TREATMENT PLANT

CONCEPTUAL
SITE 3D MODEL

DWG. NO.

CONT. NO.

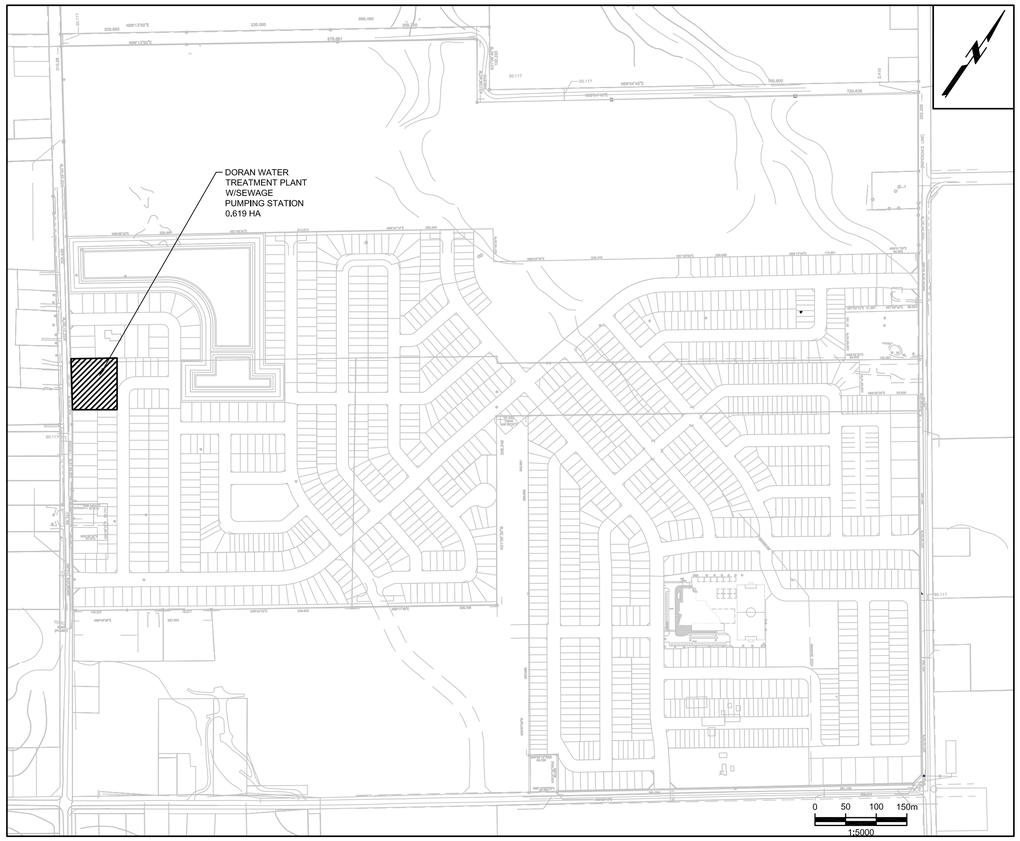
SERIES NO.

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APPENDIX D

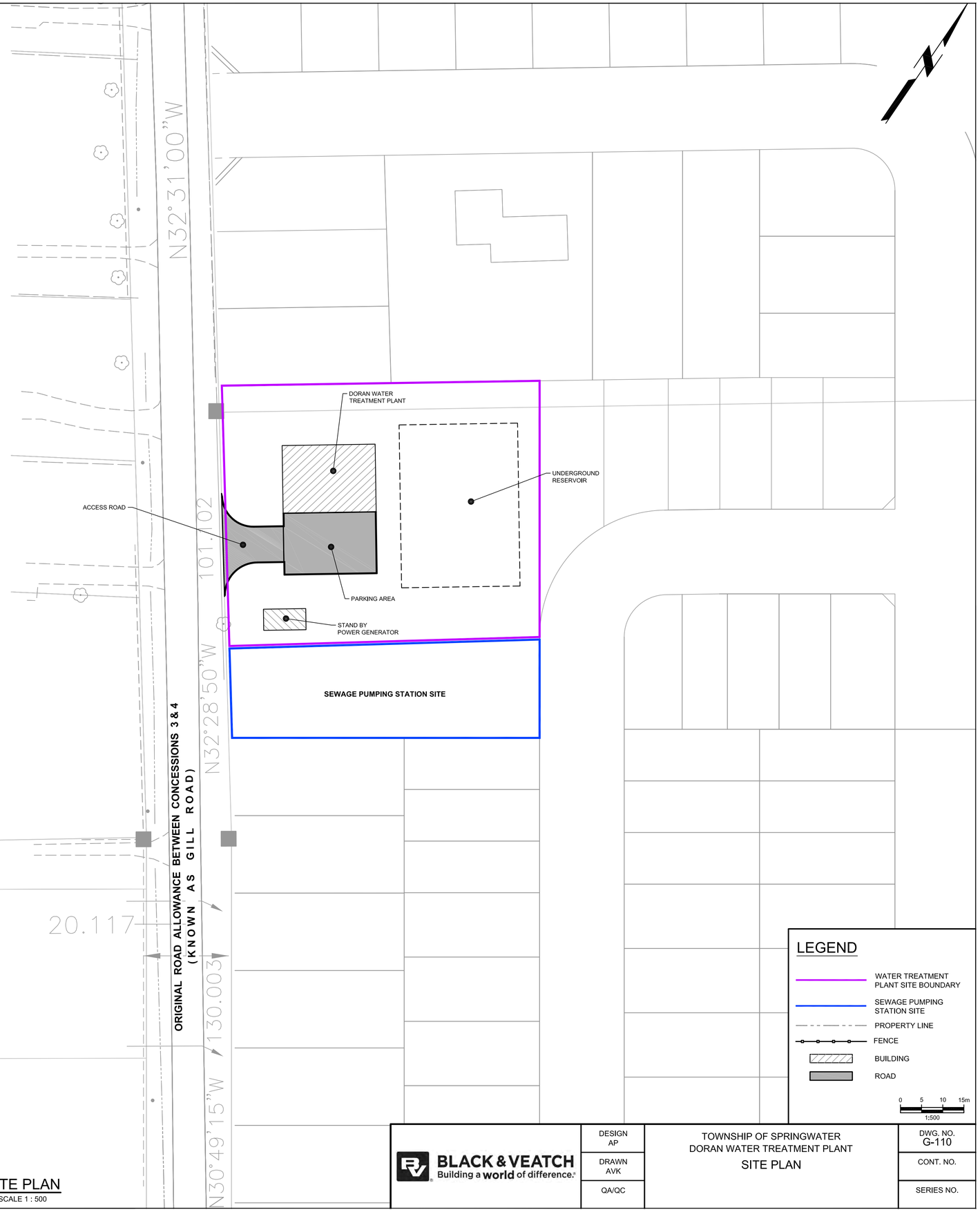
DORAN AREA WATER TREATMENT PLANT SITE PLAN

B&V PROJECT NO. 180261



KEY-PLAN

SCALE 1 : 5000



SITE PLAN

SCALE 1 : 500

BLACK & VEATCH
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DESIGN	AP
DRAWN	AVK
QA/QC	

TOWNSHIP OF SPRINGWATER
DORAN WATER TREATMENT PLANT
SITE PLAN

DWG. NO.	G-110
CONT. NO.	
SERIES NO.	

APPENDIX 'L'

**Willow Creek Assimilative Capacity Study –
Hutchinson Environmental Sciences Ltd., May 2018
&
Hine's Emerald Dragonfly Habitat in the Minesing Wetlands and the Midhurst Development - Hutchinson Environmental Sciences Ltd., February 2017
&
Technical Memorandum, Estimating Phosphorus Loads to the Minesing Wetland, August 2016
&
Technical Memorandum, Monthly Total Phosphorus Concentrations in Willow Creek Predicted at Phase 1 and Full Build Out of the Midhurst Secondary Plan Area, October 2016
&
Memorandum, Response to XCG Review of Midhurst Phosphorus Budget, March 2017**

Hutchinson

Environmental Sciences Ltd.

Willow Creek Assimilative Capacity Study

Final Report

May 2018

Prepared for: The Township of Springwater c/o Ainley and Associates
Job #: J130030

May 28, 2018

1-5 Chancery Lane, Bracebridge ON, P1L 2E3 │ 705-645-0021
Suite 202 – 501 Krug Street, Kitchener, ON N2B 1L3 │ 519-576-1711
4482 97 St. NW. Edmonton AB, T6E 5R9 │587-773-4850

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4482 97 St. NW. Edmonton AB, T6E 5R9 | 587-773-4850
www.environmentalsciences.ca

May 28, 2018 HESL Job #: J130030

Mr. Joe Mullan
The Township of Springwater c/o Ainley and Associates
550 Welham Road
Barrie, Ontario
L4N 8Z7

Dear Mr. Mullan;

Re: Final Assimilative Capacity Study for Willow Creek

We are pleased to submit the final assimilative capacity study of Willow Creek for receiving treated sewage effluent from the proposed Midhurst Secondary Plan Area, in connection with the Class Environmental Assessment for servicing of the Midhurst Secondary Plan area.

This report builds on draft report issued in May 2016 by incorporating monthly TP, TSS and nitrate mass-balance modeling in response MOECC comments received on the May 2016 report.

We thank you for the opportunity to work on this project. If you have any questions, please do not hesitate to contact me.

Sincerely,
per: Hutchinson Environmental Sciences Ltd.



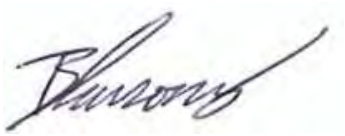
Neil Hutchinson., Ph.D.
Neil.Hutchinson@environmentalsciences.ca

Signatures

Report Prepared by:

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Senior Aquatic Scientist

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Senior Environmental Engineer



Brent Parsons, M.Sc.
Senior Aquatic Ecologist



Deborah Sinclair, M.A.Sc.
Senior Aquatic Scientist

Report Reviewed by:



Neil J. Hutchinson, Ph.D.
Principal Scientist

Executive Summary

Assimilation models for discharge of effluent from the proposed Midhurst Waste Water Treatment Plant (WWTP) to Willow Creek were run for effluent flows (SCS, Appendix H) for:

- Phase 1 of the Midhurst Development (5000 equivalent units, 6450 m^3/day, 74.65 L/s); and
- Full Build Out (9546 equivalent units, 12,314 m^3/day, 142.53 L/s)

in accordance with the population projections provided in section 3 of the Phase 1 & 2 Class EA Report, and at a 7Q20 low flow of 0.43 m^3/s for Willow Creek. This 7Q20 was based on 10 years of data (including 10 low flow periods) from the Willow Creek WSC Station 02ED032 at Highway 26. The 7Q20 flow was then modified (i.e., reduced) to account for potential baseflow losses due to the proposed groundwater takings for the Midhurst Secondary Plan (HESL, 2018a).

CORMIX was used to model the nearfield mixing of ammonia after discharge, the QUAL2K model was used to model far field dissolved oxygen and assimilation (nitrification) of ammonia, and a mass balance model was used for total phosphorus (TP), total suspended solids (TSS) and nitrate (as N) concentrations.

CORMIX predicted total distances to complete mixing of 302 m to 361 m, depending on the season (i.e., summer low flow or winter) and the flow at the WWTP (i.e., Phase 1 versus Full Build Out).

The existing water quality record shows that the present-day 75th percentile concentration of total phosphorus in Willow Creek is 0.031 mg/L. Willow Creek is therefore considered a “Policy 2” receiver for TP as it exceeds Ontario Ministry of the Environment and Climate Change’s (MOECC) Provincial Water Quality Objective (PWQO) of 0.03 mg/L. (Our analysis shows, however, a statistically significant relationship between total phosphorus and total suspended solids (TSS) such that Willow Creek is likely only a Policy 2 receiver during periods of high TSS in the creek, such as spring freshet and storm events, and is a Policy 1 receiver the remainder of the time). For the purpose of the assimilative capacity study, Willow Creek was treated as a Policy 2 receiver. Policy 2 states that *“Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.”* Deviations from Policy 2 may be considered, however, under the regulation of a “Director’s Deviation” from the MOECC.

Although Willow Creek is a Policy 2 receiver for total phosphorus, it is resilient to the addition of highly treated WWTP effluent. Adoption of a total phosphorus effluent limit of 0.05 mg/L for Phase 1 would result in phosphorus concentrations between 0.032 mg/L and 0.034 mg/L in Willow Creek and would generate an additional 118 kg/yr of phosphorus loading. An effluent limit of 0.03 mg/L for Full Build Out would reduce total phosphorus concentrations to just below the current value of 0.031 mg/L and add a total of 135 kg/yr of phosphorus loading to the creek. These loadings must be considered against the reductions from stormwater runoff from the development lands, as modelled and described in the *Midhurst Secondary Plan Area Phosphorus Budget* (HESL, 2018b). Through implementation of best management practices (BMPs) and low impact development (LIDs), a total of 68 kg/yr reduction in stormwater phosphorus loadings from Pre-Development conditions was predicted with 23 mm of infiltration. These reductions will offset the loadings from the WWTP, reducing the net increase to 66 kg/yr to Willow Creek at Full Build Out. Monthly mass balance modelling showed little change to monthly concentration to total phosphorus,

and in all cases, except May minimum flows for Phase 1, the input from the WWTP discharge did increase downstream TP concentrations above the PWQO of 0.03 mg/L. Given this minor increase in phosphorus loadings, and improvement in phosphorus concentrations, a phosphorus offsetting program is not recommended.

The mass balance modeling of TSS found that a TSS effluent limit of 15 mg/L for Phase 1 and 10 mg/L for Full Build Out will improve TSS concentrations in the Creek in some months and increase only marginally in other months. These effluent limits will be discussed with MOECC at the ECA stage and lowered if required.

The mass balance modeling of nitrate found that a TIN effluent limit of 15.4 mg/L for Phase 1 and Full Build Out will maintain nitrate concentrations at or below the CWQG of 3.0 mg-N/L.

The summer low flow Phase 1 and Full Build Out scenarios resulted in dissolved oxygen concentrations above the PWQO at all locations in Willow Creek downstream of the point of complete mixing, with predicted minimum concentrations of 8.1 mg/L at 4.4 km downstream (Phase 1) and 7.8 mg/L at 2.4 km downstream (Full Build Out).

Total ammonia concentrations below 5.3 mg/L would assure that effluent was non-acutely lethal at the point of discharge, in accordance with MOE requirements, at effluent pH of 8 or lower and temperature of 20^{o}C and lower. The proposed effluent ammonia concentrations of 1 and 1.5 mg/L (Black & Veatch 2018) would result in un-ionized ammonia concentrations of 0.038 mg/L and 0.057 mg/L, respectively, in the effluent prior to discharge, well below the 0.20 mg/L threshold of acute lethality.

The near field modelling showed that, for both Phase 1 and Full Build Out at summer low flows at effluent ammonia concentrations of 1.5 mg/L and 1 mg/L, respectively, the PWQO for un-ionized ammonia were met prior to the point of complete mixing. For Phase 1 conditions, the total ammonia concentration in the effluent could be as high as 2.2 mg/L and still meet the PWQO by the point of complete mixing. At Full Build Out, the effluent ammonia concentration could be as high as 1.2 mg/L and still meet the PWQO by the point of complete mixing. In winter, the proposed effluent ammonia concentrations of 3 mg/L and 2 mg/L were sufficient to meet the PWQO at the point of complete mixing for both Phase 1 and Full Build Out, respectively.

The far field modelling showed that un-ionized ammonia concentrations remained below the PWQO at all locations downstream of the point of complete mixing in the creek under all scenarios. The un-ionized ammonia concentrations declined with distance from the outfall and reached concentrations between 6.9 and 7.5 µg/L at the downstream end of the study area (i.e., 5.4 km downstream) for all scenarios. These concentrations are well within the PWQO and therefore acceptable.

The recommended *E. coli* objective and limit of 100 CFU/100 mL is supportable as it meets the PWQO of 100 CFU/100 mL for body contact recreation.

We also recommend that the Environmental Compliance Approval for the proposed WWTP include loading limits for total phosphorus in addition to effluent concentration limits. This would encourage innovative treatment processes by recognizing that the occasional effluent excursion above a compliance limit has a low environmental consequence so long as the annual loading limit is achieved.

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1. Introduction

The Township of Springwater is presently carrying out Phases 3 and 4 of a Class Environmental Assessment (EA) to determine the servicing/infrastructure (water, wastewater, transportation) requirements for the Midhurst Secondary Plan. One of the objectives of the Class EA is to ensure that impacts to the natural environment are minimized and that appropriate mitigation measures are employed. The Class EA work is being undertaken by Ainley & Associates on behalf of the Township.

One of the key elements of the required infrastructure is a new Waste Water Treatment Plant (WWTP), proposed to be located along Snow Valley Road near Wilson Drive. In 2009, the study team for the Phases 1 and 2 Midhurst Class EA recommended Willow Creek at Hwy. 26 as the preferred receiver. The treated effluent from the WWTP is proposed to be conveyed via a new sewer west along Snow Valley Road, north on Wilson Drive and west along Highway 26 where it will be discharged into Willow Creek in the area of Highway 26 and Golf Course Road. AECOM (2009) undertook preliminary assimilation modelling of the response of total phosphorus and ammonia in Willow Creek to the proposed discharge following the completion of the Phase 1 and 2 EA.

This report finalizes the mixing and far-field assimilation modelling using updated flow and water quality statistics and effluent characteristics based on the following:

- The Water Survey of Canada has maintained the flow station number 02ED032 on Willow Creek at Highway 26 (immediately upstream of the proposed WWTP effluent discharge location) since April 2006. There is 10 years of data available for this station, including 10 low flow periods. From this data set, the 7Q20 was calculated and then modified (i.e., reduced) to account for potential baseflow losses due to the proposed groundwater takings for municipal servicing of the Midhurst Secondary Plan. A 7Q20 flow of 430 L/s was recommended to be adopted as a conservative value for assimilation modelling (Hutchinson Environmental Sciences Limited [HESL], 2018, [Appendix A]).

- The first phase (Phase 1) of development has now been approved through the Midhurst Secondary Plan. It will consist of approximately 5000 equivalent units, with an effluent discharge volume of 74.65 L/s. At Full Build Out of 9546 equivalent units, the total discharge volume, including flows from existing development in Midhurst, will be 142.53 L/s. These figures were provided to HESL by SCS Consulting Group in March of 2014 (Appendix B).

- Effluent quality for carbonaceous biochemical oxygen demand (CBOD), ammonia-N, nitrate+nitrite, total phosphorus, and *E. coli* as per the technical memorandum *Design Basis for Midhurst Wastewater Treatment Plant, Class EA Phase 3 & 4 for the Midhurst Secondary Plan* (Black & Veatch, 2018). Of note, a total phosphorus limit of 0.05 mg/L was used for Phase 1 assimilation modelling, and 0.03 mg/L was used for Full Build Out modelling. Although an effluent limit of 0.03 mg/L for total phosphorus is attainable by today's technology, limits of 0.05 – 0.07 mg/L have been more typically assumed for advanced phosphorus removal in Ontario over the past three years. Effluent quality for all other parameters not listed in the Black & Veatch report were obtained by computing the 75th percentile concentrations of measured effluent data from the Alcona Water

Pollution Control Plan (WPCP) in Innisfil, Ontario, which is of similar size and design to that proposed for Midhurst.

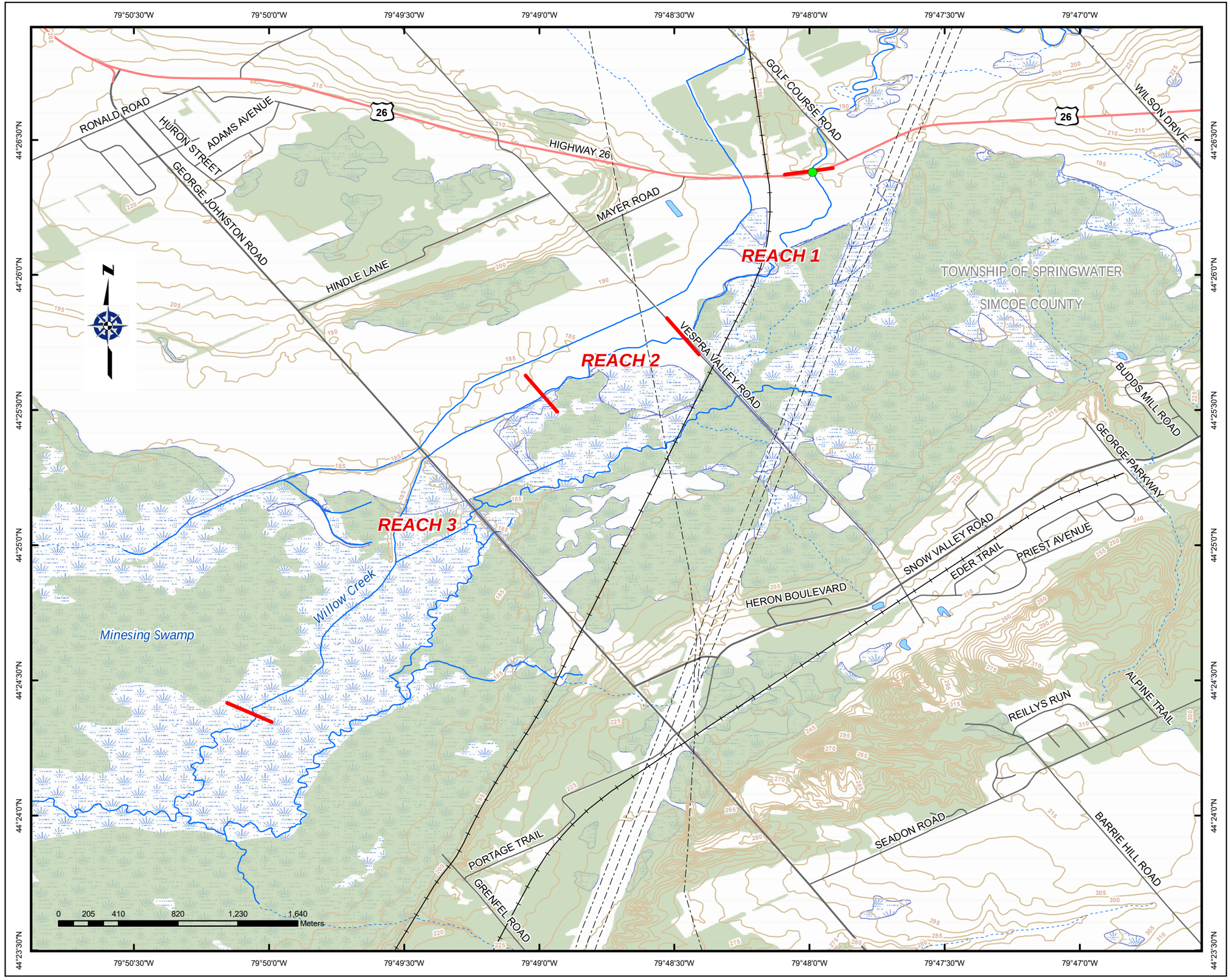
Fieldwork and initial modelling for this project were completed in the autumn of 2009 by AECOM as a part of Phases 1 and 2 of the Class EA. Upon commencement of Phases 3 and 4 of the Class EA process in 2013, the Midhurst Landowners Group retained HESL to complete the assimilation modelling. The effluent and assimilation modelling were therefore completed to inform effluent limits for Phase 1 and Full Build Out of the development with the updated information confirmed since the 2009 Phase 1 & 2 Class EA undertaking.

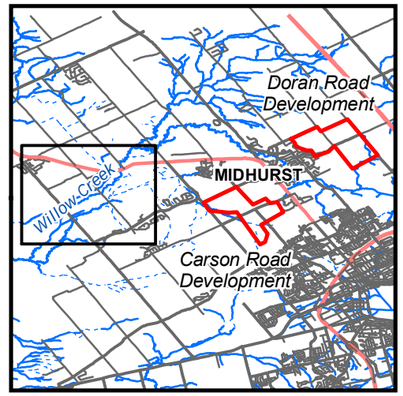
The assimilative capacity study consisted of four components, as follows:

- A time-of travel dye tracer study for Willow Creek which was completed in 2009. The study results were used to calibrate the hydrodynamic component of the modelling exercise using measured data;
- The behaviour of the effluent plume, the point of complete mixing in the near field, ammonia and total phosphorus concentrations in Willow Creek at the proposed WWTP outfall location were modelled using a mixing zone model (CORMIX);
- Total phosphorus, TSS and nitrate concentrations at the point of complete mixing were calculated using a mass balance model; and
- Dissolved oxygen and the assimilation of ammonia in the far-field region beyond the point of complete hydrologic mixing was modelled using a far-field water quality model (QUAL2K).

2. Study Site

Willow Creek is in Simcoe County, Township of Springwater. A map of the study area is provided in Figure 1. The far-field model (QUAL2K) of the effluent discharge required a spatial segmentation of Willow Creek into a series of “reaches” of similar hydrogeometric characteristics. The study area was therefore subdivided into three reaches downstream of the point of discharge on the basis of creek bed type, bank type, bank erosion, channel depth, cross sectional area, bank slopes, average velocity and average flow, etc. (Palmer Environmental Consulting Group, April 2014 [Appendix C]), plus one upstream reach (Reach 0) that was required for the far-field modelling exercise. Reach 0 stretches from Golf Course Road to Highway 26 at the site of the proposed WWTP discharge outfall; Reach 1 stretches 1.7 km from Highway 26 to Vespra Valley Rd; Reach 2 covers 1 km downstream of Vespra Valley Rd; and Reach 3 stretches a further 2.7 km downstream to where Willow Creek enters the Minesing wetland area. Thus, the study area covers a total of 5.4 km downstream of the proposed discharge location at Highway 26. The reaches differ in their degree of meandering, substrate, tree cover of banks, river width and side slopes, as well as presence of obstructions in the river. These are important parameters for the hydraulic portion of the modelling exercise, as they determine how fast the water moves from upstream to downstream and the degree of mixing it undergoes.





- Proposed Discharge Location
- Geomorphic Reach Break
- Railway
- Transmission Line
- Contour (5m)
- Stream - Intermittent
- Stream - Permanent
- Waterbody
- Wetland
- Wooded Area

Note: Adapted from AECOM 2009

Data Source: Ministry of Natural Resources

Coordinate System: GCS North American 1983

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\ArcMap_Documents\Figure 1 - 11x17L.mxd

Figure 1:
Geomorphic Reaches

Midhurst Landowners Group

Project HESL J130030

May 2016

Hutchinson
Environmental Sciences Ltd.

2.1 Water Quality Policy Status of Willow Creek

The Ontario Ministry of the Environment (MOE, 1994) provides two policies for management of surface water quality.

> Policy 1 states that *"In areas which have water quality better than the objectives, water quality shall be maintained at or above the objectives. Although some lowering of water quality is permissible in these areas, degradation below the Provincial Water Quality Objectives will not be allowed, ensuring continuing protection of aquatic communities and recreational uses."*
>
> Policy 2 states that *"Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives."*

Deviations from Policy 2 may be considered, however, under the regulation of a "Director's Deviation" from the MOE. *"...where it is clearly demonstrated that all reasonable and practical measures to attain Provincial Water Quality Objectives have been undertaken but where:*

> *1) the Provincial Water Quality Objectives are not attainable because of natural background water quality; or*
>
> *2) the Provincial Water Quality Objectives are not attainable because of irreversible human-induced conditions; or*
>
> *3) to attain or maintain the Provincial Water Quality Objectives would result in substantial and widespread adverse economic and social impact; or*
>
> *4) suitable pollution prevention techniques are not available.*

Water quality data from the MOECC's Provincial Water Quality Monitoring Network (PWQMN) station on Willow Creek at George Johnson Road was summarized for the period 2002-2014 to determine the Policy status for water quality as input to the modelling exercise. (Data are provided in Appendix D). Data for 2015 were not yet available at the time of preparation of this report.

- These data establish a 75th percentile nitrate concentration of 0.85 mg-N/L (median = 0.68 mg-N/L). The MOE does not provide a Provincial Water Quality Objective (PWQO) for nitrate and so we have interpreted nitrate concentrations against the Canadian Water Quality Guideline (CWQG) of 3.0 mg/L of nitrate-N for long-term exposure (CCME, 2012. Willow Creek is therefore considered a "Policy 1" receiver for nitrate as concentrations are below the CWQG of 3.0 mg/L of nitrate-N.
- The requirement for non-lethal effluent is the key concern for ammonia in effluent but the Policy status of the receiver is also important. The PWQMN data establish a 75th percentile total ammonia concentration of 0.025 mg-N/L (median = 0.017 mg-N/L) and a maximum un-ionized ammonia concentration of 0.002 mg/L (at the 75th percentile pH of 8.40 and the 75th percentile summer [Jun-Aug] temperature of 18.5°C) versus a PWQO for un-ionized ammonia of 0.02 mg/L. Willow Creek is therefore considered a "Policy 1" receiver for ammonia.

- These data establish a 75th percentile Total Phosphorus (TP) concentration of 0.031 mg (median = 0.019 mg/L). Willow Creek is therefore considered a "Policy 2" receiver for TP as it exceeds MOE's Provincial Water Quality Objective (PWQO) of 0.03 mg/L. Policy 2 therefore requires that Willow Creek TP concentrations "…*shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.* Any approval would likely require phosphorus offsetting (i.e., measures taken elsewhere in the watershed to reduce phosphorus loadings from other sources so that a net reduction in loadings was achieved and water quality in the creek was maintained or improved).
- These data establish a 25th percentile dissolved oxygen concentration of 10.16 mg/L (median = 11.18 mg/L). This is well above the PWQO of 6 mg/L (at temperatures above 10°C for cold water biota). Willow Creek is therefore considered a "Policy 1" receiver for dissolved oxygen.

Although Willow Creek is classified as a Policy 2 receiver for total phosphorus, the nature of the high TP values deserves some additional analysis. Figure 2 shows a highly significant ($p<0.00001$) relationship between total phosphorus and total suspended solids (TSS) in Willow Creek at the George Johnson Road PWQMN station. This indicates that erosion of particulate matter (soils) in the watershed from natural sources and land use practices is a significant factor in the high TP values and a major factor in the Policy 2 status of the creek. Solving the regression equation for the PWQO of 0.03 mg/L, for example, produces a TSS concentration of 20 mg/L such that, in general, PWQO exceedances are associated with TSS values over 20 mg/L. This relationship shows that that a) Willow Creek is a Policy 1 receiver for total phosphorus during clear flow periods when TSS concentrations are low and b) control of erosion in other parts of the watershed to reduce the TSS and hence the TP loading could be a useful management tool to offset increased loading from the proposed WWTP.

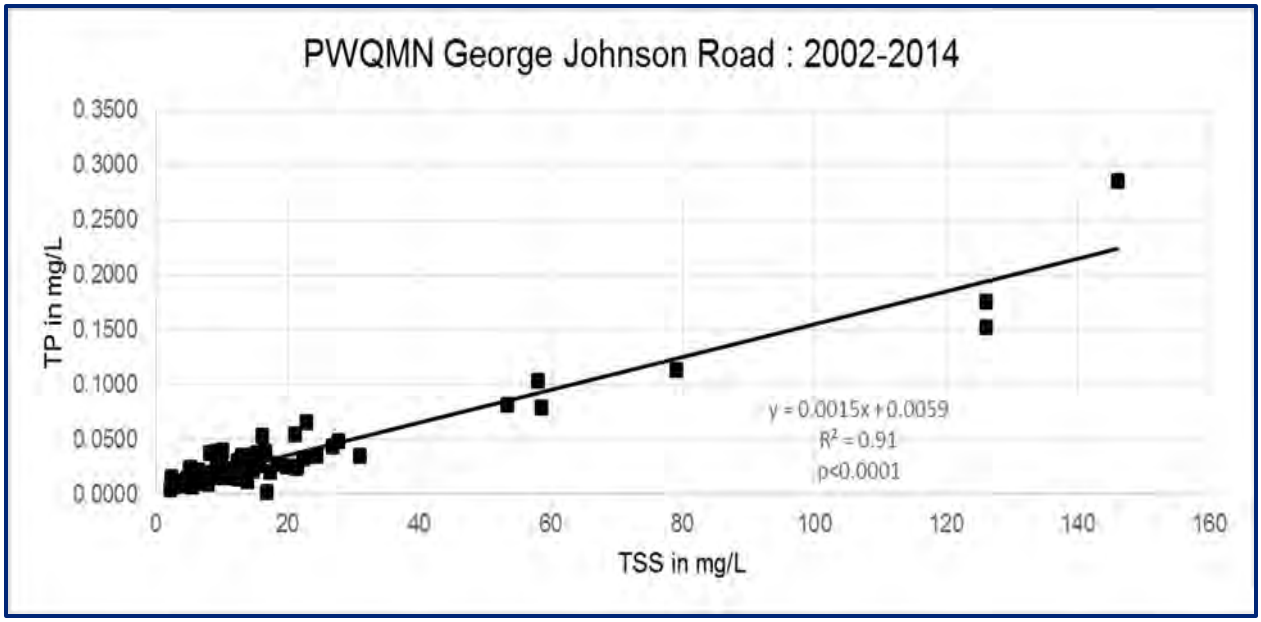


Figure 2. Total Phosphorus versus Total Suspended Solids in Willow Creek

The water quality status of Willow Creek is confirmed in a review of Nottawasaga Valley Conservation Authority (NVCA) materials provided by Beacon Environmental. (Beacon Environmental, Correspondence to Midhurst Landowners Group September 19, 2013). They conclude that *"near their confluence ... Matheson and Willow Creeks are considered "below potential", with stream health continuing to decline as Willow Creek enters an agricultural plain upstream of Minesing Swamp. NVCA has identified several factors that contribute to the existing water quality impacts to this reach of Willow Creek, namely the general absence of riparian cover and unrestricted livestock access. Stream health is considered "below potential" from the confluence of Willow and Matheson Creeks to the point where the main branch of Willow Creek enters the Minesing Wetlands".* Phosphorus reduction measures that include erosion controls are therefore a feasible means to balance against phosphorus loadings from the proposed discharge to a Policy 2 stream and improve overall stream health.

3. Tracer Study

3.1 Methodology

Tracer testing was conducted on November 5, 2009 under a moderate flow scenario of 1.7 m^3/s, as measured at the Water Survey of Canada (WSC) gauging station 02ED032 (Willow Creek near Minesing), located at Golf Course Road. Data gathered during the tracer tests were used to calculate time of travel and longitudinal dispersion for use in the far-field model (QUAL2K) of Willow Creek and to provide a one-time calibration of the model using the flow conditions on that date.

Rhodamine WT dye, a fluorescent xanthene dye that is pink in colour, was used as the tracer for the study. Rhodamine WT dye was chosen because it is a stable, non-toxic, and chemically non-reactive dye that is

easily measured in the field. The substance is non-carcinogenic and is safe if it comes into contact with skin. Rhodamine WT dye tracers are also very robust over a variety of different flow regimes.

Three slug injection tracer tests were carried out – one test for each reach. A known amount of tracer was added to Willow Creek at the start of each of the three reaches (Figure 1). Fluorometers (YSI 600 OMS instruments equipped with Rhodamine WT optical sensors) were placed in Willow Creek at three locations downstream of the tracer injection site, as follows:

- In Reach 1, fluorometers were placed 50 m, 200 m, and 500 m from the start of the reach;
- In Reach 2, fluorometers were placed 50 m, 230 m, and 520 m from the start of the reach; and
- In Reach 3, fluorometers were placed 50 m, 240 m, and 475 m from the start of the reach.

The fluorometers were equipped with an optical sensor to determine the concentration of Rhodamine WT in the water, in units of µg/L (ppb), and were set up to collect one measurement every 10 seconds for the duration of the test. The fluorometers were capable of measuring concentrations of Rhodamine WT with a resolution of 0.1 ppb. The Rhodamine WT optical sensors were calibrated in the field on a 2-point scale that included 0 ppb and 100 ppb Rhodamine WT. The 100 ppb solution was mixed in the field from a 20% Rhodamine WT dye solution, which was obtained from a local supplier.

To begin each of the slug injection tracer tests, a certain volume of Rhodamine WT 20% dye solution was mixed into a bucket containing 10 L of water collected from Willow Creek. The volume of tracer required was estimated by applying the following empirical equation by Kilpatrick (1989):

$$V_s = 3.79 \times 10^{-5} \frac{QL}{v} C_p \qquad \text{Equation (1)}$$

where Vs is the volume of Rhodamine WT 20% dye, in mL;

Q is the flow rate of Big Creek, in ft^3/s;

L is the length of the measurement reach, in ft;

v is the mean-stream velocity, in ft/s; and

Cp is the peak concentration at the sampling site, in µg/L.

Equation 1 was used to determine the amount of Rhodamine WT 20% dye needed, such that the peak tracer concentration detected at the furthest fluorometer, (about 500 m downstream), would be detectable by the fluorometer. Calculations are presented in Appendix E.

The bucket containing the 10L of the Rhodamine WT 20% dye and Willow Creek water mixture was then quickly emptied to simulate an instantaneous injection across the width of Willow Creek at the start of each of the three “reaches”. The time of the injection was recorded. Figure 3 shows this instantaneous injection, and Figure 4 shows Willow Creek approximately 1 minute after the instantaneous injection.



Figure 3. Rhodamine WT slug test dye injection at Reach 3 on Willow Creek



Figure 4. Rhodamine WT Dye Plume in Reach 3 Approximately 1 Minute after Slug (Instantaneous) Injection

The measured Rhodamine WT concentrations versus time were graphed for each of the fluorometer stations, with the time axis, (the x-axis), beginning at the recorded time of the slug injection, as illustrated in the following theoretical example (Figure 5).

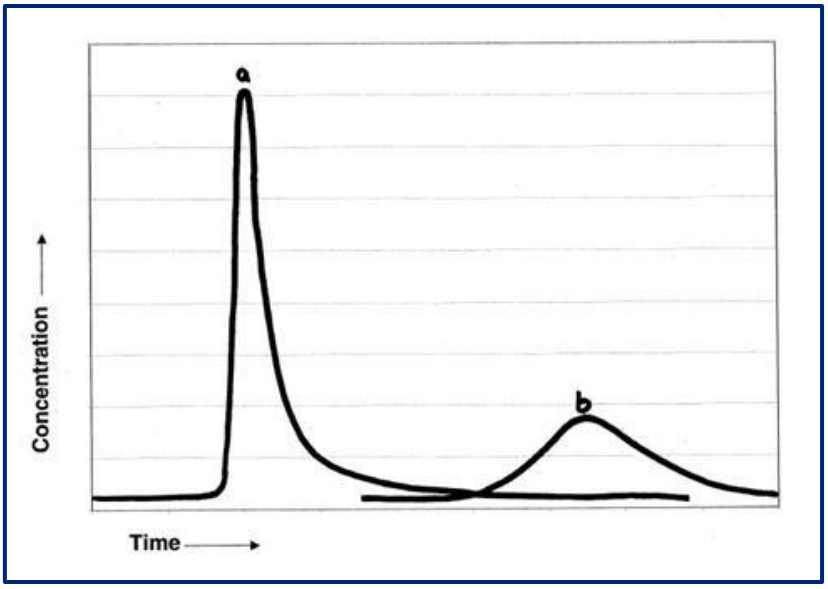


Figure 5. Example Graph of Rhodamine WT Concentration Versus Time for a Slug Injection Test

Figure 5 shows that the fluorometer closest to the injection point, (line a in the figure), would exhibit a tracer peak that was higher and seen sooner than the peak at the other fluorometer station located further downstream, (line b in the figure). The time of travel and longitudinal dispersion was computed by comparing the peak Rhodamine WT concentrations and the time between the slug injection and the peak.

The travel time ($\bar{t}$) between the dye injection point and a given fluorometer station was calculated by the following equation:

$$\bar{t} = \frac{\sum_{i=0}^{n-1}(c_i t_i + c_{i+1} t_{i+1})(t_{i+1} - t_i)}{\sum_{i=0}^{n-1}(c_i + c_{i+1})(t_{i+1} - t_i)}$$

Equation (2)

where ci is the Rhodamine WT concentration at a given time, in µg/L;

t_i is the corresponding time, in minutes elapsed since the time of injection; and

n is the number of data points collected by the fluorometer.

The temporal variance (S_t^2) was calculated from the data collected at each fluorometer by the following equation:

$$s_t^2 = \frac{\sum_{i=0}^{n-1}(c_i t_i^2 + c_{i+1} t_{i+1}^2)(t_{i+1} - t_i)}{\sum_{i=0}^{n-1}(c_i + c_{i+1})(t_{i+1} - t_i)}$$ Equation (3)

The mean velocity (U) between two fluorometer stations was calculated by the following equation:

$$U = \frac{x_2 - x_1}{\overline{t_2} - \overline{t_1}}$$ Equation (4)

where x is the distance between the dye injection point and the fluorometer, in m.

The longitudinal dispersion coefficient (E) between two stations was calculated by:

$$E = \frac{U^2(s_{t2}^2 - s_{t1}^2)}{2(\overline{t_2} - \overline{t_1})}$$ Equation (5)

The calculated time of travel, mean velocity, and dispersion coefficient values were input into the QUAL2K model for Willow Creek.

3.2 Results

The volumes of Rhodamine WT 20% dye added to the 10 L bucket of Willow Creek water for each of the three slug injection tests were determined based on Equation 1, using a Willow Creek flow rate of 1.43 m^3/s, which was the flow rate measured at Golf Course Road on October 29, 2009 by AECOM field personnel. All data collected during the tracer tests are presented in Appendix F. For the Reach 1 slug injection test, a volume of 34 mL of Rhodamine WT 20% dye was added to the 10 L bucket of water, while 33 mL and 44 mL of the dye were added for the Reach 2 and Reach 3 slug injection tests, respectively.

Figures 3 and 4 show the slug of dye being injected into the river and follow the slug of dye as it flows downstream. The traditional “parabolic-shaped” velocity profile was evident by observing the Rhodamine WT dye profile shortly after it was injected, since stream velocities are higher through the centre of the river, and slower along the banks. Figure 6 presents the Rhodamine WT concentration over time, as recorded at each of the fluorometer stations during the Reach 1 slug injection tracer test. Data were not collected from the location 200 m downstream due to a malfunction of the fluorometer. The absence of this station’s data did not have an impact on the time of travel, velocity and longitudinal dispersion coefficient calculations, as the data from the other two stations was sufficient for generating these values.

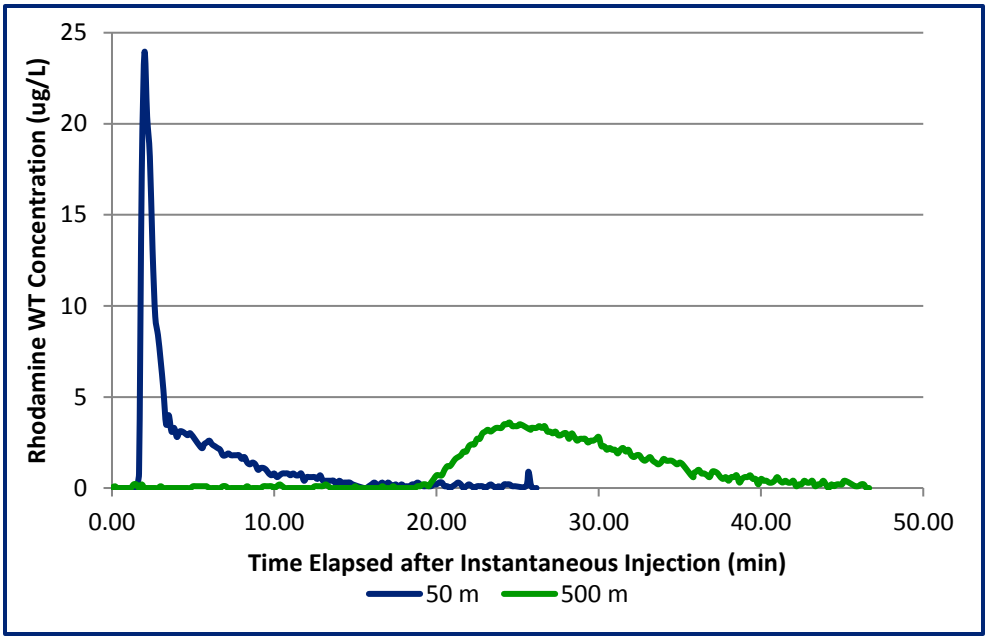


Figure 6. Reach 1 – Slug Injection Test Results

Figure 7 presents the rhodamine concentration over time, as recorded at each of the fluorometer stations during the Reach 2 slug injection tracer test.

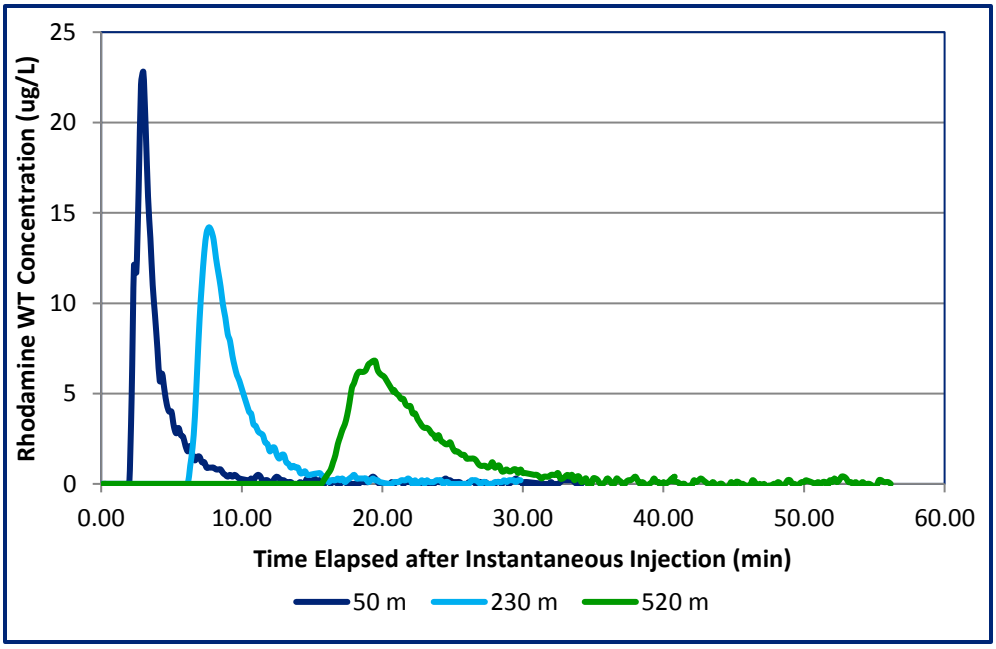


Figure 7. Reach 2 Slug Injection Test Results

Figure 8 presents the rhodamine concentration over time, as recorded at each of the fluorometer stations during the Reach 3 slug injection tracer test.

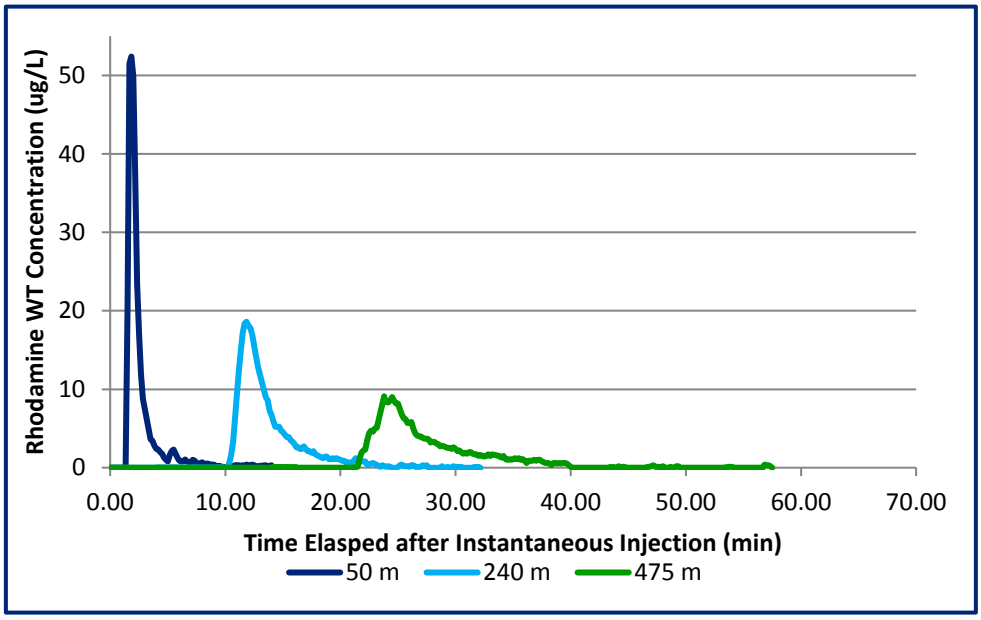


Figure 8. Reach 3 Slug Injection Test Results

The data obtained from the slug injection tests showed that dye dispersion in Willow Creek behaved in the expected manner (as per Figure 5) and could therefore be used to determine the time of travel between the start of the reach and each fluorometer station. Data are presented as total travel time (in minutes) and average velocity (in m/s) between the start of the reach and each fluorometer station in Table 1.

Table 1. Willow Creek Time of Travel and Velocity Based on Slug Injection Test Data

Reach	Reach Start to ~50 m		Reach Start to ~200 m		Reach Start to ~500 m	
	min	m/s	min	m/s	min	m/s
Reach 1	5.02	0.138	n/a	n/a	28.27	0.295
Reach 2	5.15	0.162	9.59	0.400	22.31	0.388
Reach 3	2.67	0.312	13.77	0.290	27.54	0.287

The average Willow Creek velocity for the November 5, 2009 slug injection test was calculated to be about 17 m/min (or 24.5 km/day). The data also show that the creek moved more quickly in Reach 1 and Reach 2 than it did further downstream. The longitudinal dispersion coefficient for November 2009 was 110.6 m^2/min.

3.3 Extrapolation of Time-of-Travel Results to Low Flows

The time of travel study described in Section 3.1 and 3.2 was carried out under moderate flow conditions. The results of the tracer study are therefore not directly applicable to the low-flow (i.e. 7Q20) scenarios that were modeled using the near-field and far-field assimilation models as described in Sections 4 and 5. The

three reaches were calibrated and the time of travel inferred for other flow scenarios using the time-of-travel results, flow data from the day of the tracer study (November 5, 2009), geometric parameters of the stream bed and published empirical relationships. This approach is based on the knowledge that time of travel or velocity is related to flow, channel width and flow resistance and involves some empirical constants available in the literature that were developed from hydraulic data collected from a large number of U.S. rivers (Jobson, 2001).

Jobson (2001) also found that division of the cross-sectional area of a creek into areas of active flow and inactive storage improves predictions where inactive storage was defined as an area where water would accumulate and be retained at low flow. This approach takes into account the fact that the bottom of natural streams is not smooth and uniform, but often consists of a sequence of pools and riffles.

3.3.1 Calibration

Calibrating the reaches included two steps. The first step was to calculate the reach-specific hydraulic constant W1 using Equation (6).

$$W1 = W/Q^{W2} \qquad \text{Equation (6)}$$

Where

Q is the river discharge (1.7 m^3/s on November 5th, 2009, the day of the tracer study);

W1 is the reach-specific hydraulic constant;

W2 is a dimensionless exponent that generally ranges between 0.1 and 0.4, with a typical value of 0.26 (Jobson, 2001) which was used for this calculation;

and W is the channel width.

The second step was to calculate the inactive area A0 using Equation (7).

$$A0 = A - (n^{0.6} \times S^{-0.3} \times W^{0.4}) \times Q^{0.6} \qquad \text{Equation (7)}$$

Where

N is the Manning resistance coefficient, which was initially set to 0.04 for all reaches. When the result for the inactive area is a negative number, the resistance coefficient Manning's n is adjusted such that the inactive area becomes zero;

S is the channel slope measured from the upstream end of a reach to the downstream end of the reach, as provided by the geomorphological study; and

A is the total flow area in m^2, which was calculated by dividing flow (Q in m^3/s) by velocity (U in m/s). The velocity in turn was computed by dividing the reach length (x, in m) by the time of travel (t, in s) as estimated from the tracer study.

Using a Manning's n number 0.04 for all reaches in Equation 7 resulted in a negative number for inactive area for Reaches 2 and 3; therefore, the Manning's n was adjusted to 0.025 and 0.02, for these reaches, respectively, which resulted in inactive areas close to zero. The Manning's n for Reach 1 was adjusted to 0.07, where the modeled velocities best matched the extrapolated tracer-study velocities. These calibrated resistance coefficients were used for far-field water quality modelling as discussed in Section 6. The small proportion of inactive areas estimated for Willow Creek was probably the result of the fact that the tracer study was carried out at relatively high flow. The good agreement of modeled and extrapolated estimates of tracer time of travel, as shown in Section 6, indicates that the equations were valid to extrapolate time-of-travel for low flow.

3.3.2 Estimation of Reach Velocity

Once A0 and W1 were calculated for each reach, the calibration of these reaches was complete. Velocity for the different reaches at low-flow scenarios was then inferred using the calibrated values of A0 and W1 and the same equations as above but solving for different terms.

First, the wetted width of the channel under low-flow scenarios was estimated using Equation (6) solved for W, as shown in Equation (8).

$$W = W1 \times Q^{W2} \qquad \text{Equation (8)}$$

Second, the total flow area A was calculated using the width W, the calculated inactive area A0 and the river discharge for the 7Q20 low-flow scenario (e.g., 0.43 m^3/s), according to Equation (7), but solved for A (Equation (9)).

$$A = A0 + (n^{0.6} \times S^{-0.3} \times W^{0.4}) \times Q^{0.6} \qquad \text{Equation (9)}$$

Velocity and time of travel were then calculated for each of the scenarios from the flow area A (m^2) and the river discharge (m^3/s) from the 7Q10 low-flow scenario. The results of the time-of travel estimates for low-flow are summarized in Table 2. Detailed results for all calculation steps are provided in Appendix G.

Table 2. Velocity from Dye Tracer Study Extrapolated to 7Q20 Low Flow Scenario

Reach	Velocity (m/s)		
	Tracer study	Extrapolated	
	Q = 1.7 m^3/s	Q = 0.43 m^3/s	
		Phase 1	Full Build Out
1	0.30	0.19	0.20
2	0.39	0.25	0.27
3	0.29	0.17	0.18

Notes: Flows given are Willow Creek flows. The extrapolated velocities take into account the added flow from Phase 1 and Full Build Out WWTP effluent discharges.

4. Mixing Zone Modelling (CORMIX)

The mixing zone modelling focussed on ammonia as the potentially toxic component of the effluent that is assimilated by a) dilution in the near field area through initial mixing with the creek and b) nitrification, the biological conversion of ammonia to nitrate. There are two requirements for assessment of ammonia:

- The regulatory requirement that undiluted effluent be non-acutely lethal at the point of discharge. This is calculated without the need for an assimilation model, is based solely on the toxicity of ammonia in the effluent and results in an ammonia concentration limit that is the minimum standard of protection (Section 4.1); and
- The need to determine the size and characteristics of the mixing zone for ammonia in Willow Creek since this is the volume of water in which ammonia concentrations will exceed the PWQO of 0.02 mg/L of un-ionized ammonia (MOE, 1994). The mixing zone is allowed under MOECC surface water quality policy (MOE, 1994). The size of the mixing zone is determined by modelling the physical mixing of effluent with the creek and then setting an ammonia limit for the effluent which will maintain the un-ionized ammonia concentration below the PWQO (Section 4.2) outside of the zone of initial mixing. For a smaller receiver such as Willow Creek, this limit will be lower than that required to maintain non-lethal effluent.

The lower of the two values was then recommended for adoption as the effluent limit.

4.1 Effluent characteristics - Non-lethal Effluent Requirement

The MOECC requires that all effluent discharging to surface waters be non-acutely lethal at the end of the pipe. MOECC considers an effluent concentration of 0.20 mg/L or less of un-ionized ammonia (NH_3) as a conservative estimate of the lethal threshold[1] An effluent pH of 8 and temperature of 20°C, were used to estimate un-ionized ammonia concentrations based on measured effluent data for a typical WWTP of similar size to that proposed for Midhurst (i.e., the Alcona Water Pollution Control Plant in Innisfil [Wes Cyr, Plant Operator, personal communication]). The maximum effluent total ammonia concentration (corresponding to 0.20 mg/L of un-ionized ammonia) was calculated to be 5.3 mg/L. Thus, a total ammonia effluent limit of 5.3 mg/L or less would meet the requirement for non-lethality.

4.2 Mixing Zone Modelling Methodology

The second requirement for an effluent discharge is that the receiver water quality must be maintained within PWQO except for the volume of water within the mixing zone. From *Deriving Receiving Water Based, Point-Source Effluent Requirements for Ontario Waters* (MOE, 1994b), the mixing zone is defined in one of two ways:

[1] *Letter from Paul Martin, Supervisor Air, Pesticides and Environmental Planning to Joe Mullan, Ainley and Associates dated April 30, 2018.*

- The volume of water contiguous to the discharge in which the effluent undergoes physical mixing with the receiver such that dilution by mixing is the dominant process reducing effluent concentrations in the water; or
- The volume of water contiguous to the discharge in which concentrations of effluent parameters exceed their respective PWQOs.

Since total phosphorus concentrations exceed the PWQO in Willow Creek, the mixing zone was defined by the first criterion, and a point of complete mixing (PCM) determined using the mixing zone model.

The near-field mixing of the proposed Midhurst WWTP discharge with Willow Creek was hydrodynamically modeled using CORMIX Version 9.0. CORMIX is a software system developed by Cornell University for the analysis, prediction, and design of aqueous toxic or conventional pollutant discharges into diverse water bodies (Doneker et al., 2007). CORMIX specializes in analyzing the effluent plume in the mixing zone region (i.e., the region between the outfall and the point of complete mixing of the plume with Willow Creek). Downstream of the point of complete mixing, the QUAL2K model was used to predict water quality in Willow Creek, as discussed in Section 6.

The basis of the CORMIX model is a flow classification system. The model classifies the discharge configuration into generic flow classifications based on dimensionless length scales (Gomm, 1999). Once the flow has been classified, the model assembles and executes a sequence of sub-models to simulate the hydrodynamic behaviour of the discharge, and calculates the plume trajectory, dilution and maximum centerline concentration. CORMIX uses these different sub-models to predict mixing in both the near-field region and far-field region from the discharge point. The terminology “near-field” and “far-field” in the internal CORMIX usage have no relation to the point of complete mixing – the near-field region refers to the region where the initial jet characteristics, including momentum flux and buoyancy flux, and outfall geometry govern the plume mixing. The “far-field” region is representative of where conditions existing in the ambient environment (such as density current buoyant spreading and passive diffusion within Willow Creek) govern the trajectory and dilution of the plume. The distance to the boundary between the near-field to far-field regions depends on the model input parameters as determined by creek characteristics and the scenario modelled (i.e. effluent flow, discharge configuration).

The Midhurst WWTP discharge to Willow Creek was modeled using CORMIX1, a subsystem which is used for positively and negatively buoyant single port discharges. The single port configuration represents effluent discharged from a single point, such as a pipe, and not through a diffuser.

The CORMIX mixing zone model was run for 4 scenarios (Table 3):

- Two seasons, summer and winter, to capture the range in temperature and density-dependent mixing in the creek and temperature effects on the proportion of un-ionized ammonia; and
- Each of the Phase 1 and Full Build Out effluent flows.

Table 3. Mixing Modelling Scenarios

Scenario	Season	Development Phase	Willow Creek Flow (m^3/s)	Conditions
1	Summer Low Flow	Phase 1	0.43	• Summer temperatures • 7Q20 Low flow • 75th percentile water quality in Willow Creek
2		Full Build Out		
3	Winter	Phase 1	0.90	• Winter temperatures • Typical low winter flow • 75th percentile water quality in Willow Creek.
4		Full Build Out		

Table 4. CORMIX Model Inputs (Ammonia)

Input Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	Phase 1 Summer (Ammonia/TP)	Full Build Out Summer (Ammonia)	Phase 1 Winter (Ammonia/TP)	Full Build Out Winter (Ammonia)
Effluent Worksheet:				
Conservative/non-conservative pollutant	Non-conservative		Conservative	
Decay rate (1/d) if non-conservative	5		n/a	
Discharge Concentration (mg/L)	1.5 / 0.05	1	3 / 0.05	2
Discharge excess concentration (mg/L)	1.475 / 0.019	0.975	2.975 / 0.019	1.975
Effluent flow rate (m^3/s)	0.075	0.143	0.075	0.143
Effluent temperature (°C)	20		13	
Ambient Worksheet:				
Average channel depth (m)	0.48	0.51	0.78	
Depth at discharge (m)	0.4	0.43	0.55	
Wind speed 2 m above water surface (m/s)	2			
Ambient Willow Creek) flow rate (m^3/s)	0.43		0.9	
Ambient Concentration (NH_4 mg/L)	0.025			
Bounded width (m)	6.7		8.1	
Bounded appearance	Slight meander			
Manning's n	0.07			
Ambient temperature (deg. C)	18.5		4	
Ambient pH	8.4			
Discharge Worksheet (CORMIX1):				
Discharge bank (looking downstream)	Left			
Distance to nearest bank (m)	0			
Horizontal angle sigma (degrees)	270			

Input Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	Phase 1 Summer (Ammonia/TP)	Full Build Out Summer (Ammonia)	Phase 1 Winter (Ammonia/TP)	Full Build Out Winter (Ammonia)
Vertical angle theta (degrees)	0			
Discharge pipe exit type	Jet-like			
Discharge pipe diameter (m)	0.4			
Discharge pipe height above water surface (m) **	0.2			
Mixing Zone Worksheet:				
PWQO (Total NH_4 in mg/L)	0.36		0.96	
Temperature used for WQS calculation*	19		6	
pH used for WQS calculation*	8.2			
Excess concentration for the WQ standard (mg/L)	0.335		0.935	

Notes: n/a = not applicable.

WQS – Water Quality Standard

**from QUAL2K*

*** assumed above surface discharge to prevent channel disturbance. Need to confirm during detailed design.*

4.2.1 Effluent Worksheet

An effluent parameter may be modeled as either conservative (concentrations are reduced by physical mixing and dilution only) or non-conservative (concentrations are reduced by biological assimilation processes). For the summer scenarios, ammonia was modeled as a non-conservative parameter with a rate of decay of 5/d, which was based on a literature review of similar streams that indicate rates between 0.2 and 9/d. Given the low biological activity due to cold temperatures in winter, ammonia was modelled as a conservative parameter (zero decay) for the winter scenarios. Phosphorus was modelled as a conservative parameter for both winter and summer scenarios since significant settling, adsorption, precipitation, or uptake would not be expected in the length of time required to achieve full mixing.

The discharge excess concentration refers to the excess concentration of the effluent above background (i.e., Willow Creek) concentrations. For ammonia, the background (Willow Creek) concentration was 0.025 mg/L based on the 75th percentile value[2] of all 2002 to 2014 PWQMN Station Data (at George Johnson Road). WWTP effluent total ammonia concentrations of 1.5 mg/L (Phase 1) and 1 mg/L (Full Build Out) for summer and 3 mg/L (Phase 1) and 2 mg/L (Full Build Out) for winter were modeled, as per the proposed effluent limits specified in the technical memorandum *Design Basis for Midhurst Wastewater Treatment Plant, Class EA Phase 3 & 4 for the Midhurst Secondary Plan* (Black & Veatch, 2018). As such, the discharge excess ammonia concentration ranged from 0.975 mg/L (when a 1 mg/L ammonia discharge was modelled) to 2.975 mg/L (when a 3 mg/L ammonia discharge was modelled).

For total phosphorus, the background concentration was 0.031 mg/L, which was the 75th percentile total phosphorus concentration recorded between 2002 and 2014 at the Willow Creek PWQMN Station located

[2] *MOE (1994) recommends the use of the 75th percentile statistic to describe ambient conditions in receiving waters.*

at George Johnson Road. The proposed total phosphorus in the WWTP effluent during Phase 1 is 0.05 mg/L. Therefore, the discharge excess concentration was 0.019 mg/L (i.e., 0.050 mg/L – 0.031 mg/L). The effluent TP concentration for the Full Build Out was 0.03 mg/L, therefore there would be no discharge excess and that scenario was not modelled using CORMIX. This scenario was further explored in the mass balance modelling (Section 5).

The estimated discharge flow rate for the Phase 1 development (0.075 m^3/s) was used for Scenarios 1 and 3. The discharge flow rate for Full Build-Out of 0.143 m^3/s was used for Scenarios 2 and 4, which includes the Full Build out development figures (SCS Consulting Group, 2013, Appendix H).

For the summer scenarios (Scenarios 1 and 2), a WWTP discharge temperature of 20˚C was used in the model, while for the winter scenario, a discharge temperature of 13 ˚C was used. This temperature was based on the 75th percentile summer and winter temperatures, respectively, of a similar sized WWTP located in southern Ontario, the Innisfil WPCP (Wes Cyr, Plant Operator, personal communication).

4.2.2 Ambient Worksheet

For the Willow Creek geometry, CORMIX requires that the cross-section of the creek be “schematized” as a rectangular channel. For the summer low flow scenarios (Scenarios 1 and 2), the average depth dimension was obtained by dividing the flow area by the wetted width, which was determined from the result of the velocity extrapolations described in Section 3.3. A factor of 0.8 was applied to the wetted width, as the wetted width represents the width of the river at the water surface, which is the largest width, while width decreases with depth and the rectangular channel dimensions as modeled by CORMIX require an average width over all depths. A flow of 0.43 m^3/s was used as the summer low flow (i.e., 7Q20 flow). As detailed in the HESL report *7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment Final Report* (2018a, Appendix A), the 7Q20 was calculated from WSC Station 02ED032 flow data and modified (i.e., reduced) to account for potential baseflow losses due to the proposed groundwater takings for the Midhurst Secondary Plan.

For the winter scenarios (Scenario 3 and 4), the average depth of 0.78 m measured by AECOM field personnel on September 10, 2009 in Willow Creek at the Golf Course Road, Vespra Valley, and George Johnson Road stations was used, since the flows recorded at that date (0.92 m^3/s) were nearly the same as the winter low flows used in the winter scenarios (0.9 m^3/s), which is a typical winter low flow rate based on the WSC Station data.

For the modelling exercises, the WWTP outfall was located on the east bank (left bank, looking downstream) of Willow Creek, immediately upstream of the Highway 26 bridge. The CORMIX model also required the input of a water depth and channel width at the WWTP outfall point. For the summer scenarios, the water widths were set equal to the wetted width estimated using the velocity extrapolations. For the winter scenario, the wetted width measured at the Golf Course Road station (located 200 m upstream of the Highway 26 bridge) on September 10, 2009 was used. The water depth at discharge was set to the minimum possible within the requirements of CORMIX (within +/- 30% of average depth), given that the outfall is assumed to be located at the bank.

A wind speed of 2 m/s was used for all scenarios. In the absence of field data, this is the velocity recommended by CORMIX for conservative design conditions.

Manning's n was estimated through the time-of travel study, as discussed in Section 3.3. Given that the mixing zone is expected to be limited to Reach 1 (see Section 4.3), the Reach 1 Manning's n estimate of 0.07 was used for mixing modelling.

For Scenarios 1 and 2, a Willow Creek water temperature of 18.5˚C was used. This was calculated as the 75th percentile temperature recorded in the summer months (June to August) between 2002 and 2014 at the PWQMN Station. For Scenarios 3 and 4, a temperature of 4˚C was assigned to Willow Creek, which represents the most conservative winter scenario since water is most dense at this temperature and therefore has the highest resistance to mixing.

4.2.3 Discharge Worksheet

Under the "discharge" worksheet, the discharge bank location is the location of the nearest bank to the outfall when facing downstream in the direction of the river flow. For the proposed Midhurst WWTP outfall, this is the left bank. The outfall was modeled as being located at the bank, (rather than for example, protruding into the river), as a surface pipe discharge is the most likely configuration in a small creek like Willow Creek. As such, the distance to the nearest bank was input as 0 m.

The horizontal angle is the angle between the outfall pipe centreline and the direction of river flow, if the pipe is measured in a counter-clockwise direction from the point where the discharge pipe is pointing in the direction of the river flow. As such, the horizontal angle was set to 270 degrees or perpendicular to the bank. The vertical angle of the discharge pipe, which is the angle between the outfall pipe centreline and the horizontal plane, was set to 0 degrees.

The discharge configuration can be described as jet-like, deflected jet-like, or spray-like. A jet-like configuration was assumed for the proposed WWTP outfall. The pipe diameter was input as 0.4 m, which is an average size of discharge pipe for plants of similar capacity to the proposed Midhurst WWTP. The pipe was assumed to be at the water surface, so the height above the water surface, as measured from the centre of the pipe was 0.2 m.

4.2.4 Mixing Zone Worksheet

Mixing zone modelling requires calculation of the "excess concentration" of the water quality standard over the upstream (background) concentration, or the amount of additional concentration that could be added to the background concentration to maintain the total concentration below the PWQO.

For phosphorus, the background concentrations exceed the PWQO of 0.03 mg/L, and therefore there is no "excess concentration".

There is no PWQO for total ammonia but the PWQO for un-ionized ammonia is 0.02 mg/L. As such, the maximum excess concentration for ammonia in order to remain below the PWQO for un-ionized ammonia, was determined using the pH and temperature of Willow Creek for each respective scenario. The pH and temperature values of the effluent plume were predicted by QUAL2K for full mixing of the discharge and used to calculate the total ammonia concentration that would be required to meet the PWQO for un-ionized ammonia, and used as input to the CORMIX model. These values are not the same values as the measured pH and temperature in the creek but represent the values after the creek mixes with the effluent, with an average mixed temperature of 6˚C for winter, 19˚C for summer, and a pH of 8.2 for both seasons.

For summer Scenarios 1 and 2, the background (Willow Creek) total ammonia concentration was 0.025 mg/L (based on the 75th percentile value at the George Johnson Road PWQMN Station 03005703002 Data for 2002-2014). The maximum acceptable total ammonia concentration was calculated as 0.36 mg/L (=PWQO of 0.02 mg/L un-ionized ammonia at 19˚C and pH 8.2). The background ammonia concentration was subtracted from the maximum acceptable ammonia concentration to determine that the excess concentration of ammonia over the water quality standard was 0.335 mg/L (i.e., 0.36 mg/L – 0.025 mg/L = 0.335 mg/L).

For winter Scenarios 3 and 4, the maximum acceptable total ammonia concentration was calculated as 0.96 mg/L (=PWQO of 0.02 mg/L un-ionized ammonia at the winter Willow Creek temperature of 6˚C and pH of 8.2). The allowable excess concentration of ammonia was therefore 0.935 mg/L (i.e., 0.96 mg/L – 0.025 mg/L = 0.935 mg/L).

No winter temperature data were available for Willow Creek, as the PWQMN Station data only cover the open-water period. Although water temperatures may approach 0˚C under ice cover, the lowest fresh water temperature that CORMIX will accept is 4˚C. Water has its lowest density at a temperature of 4˚C resulting in the largest density difference between effluent and river water and therefore using a 4˚C river temperature represents the most conservative approach for mixing modelling.

4.3 Results

The individual results for each scenario are discussed in the following sections. We present tabular and graphic results for the four scenarios.

4.3.1 Scenario 1 (Summer Low Flow, Phase 1, TAN Effluent Limit = 1.5 mg/L, TP Effluent Limit = 0.05 mg/L)

The flow classification IPV4 issued by CORMIX corresponds to a slightly submerged positively buoyant effluent, which issues vertically or near-vertically from the discharge port. It consists of three main flow zones.

The first zone is a weakly deflected jet in crossflow: the flow is dominated by the effluent momentum and is weakly deflected by the ambient creek current. This represents the outflow from an elevated pipe into the creek waters, where it forms a recirculation zone, reaches the creek bottom locally and spreads a limited distance upstream and laterally across the creek.

The second zone, starting immediately downstream from the discharge, is characterized by full vertical mixing of the effluent. The weakly bent jet reaches the bottom at a near-vertical angle and given the shallow depth and the weak buoyancy of the discharge, the flow becomes unstable, resulting in a re-circulating region immediately downstream that extends over the full depth.

After some distance, the third zone starts where mixing is dominated by turbulence in the creek flow. In this zone, the plume is slowly growing in width while decreasing in concentration.

The CORMIX model predicted that the plume will be fully mixed with creek water at 319 m downstream of the discharge at a 7Q20 low flow of 0.43 m^3/s (Table 5). This is also called the point of complete mixing. The PWQO was met at a distance 156 m downstream of the outfall, prior to the point of compete mixing.

At this distance, the plume width was 72% of the wetted width of the creek. A 3-dimensional schematic of the plume is provided in Figure 9.

Table 5. Summary of Mixing Modelling Results for Ammonia: Phase 1, Summer, Effluent Limit = 1.5 mg/L

Modelled/Calculated Parameter	Result
Point of Complete Mixing (m downstream of outfall)	319
Distance to Meet PWQO (m downstream of outfall)	156
Plume Width (% of channel) where PWQO is Met	72

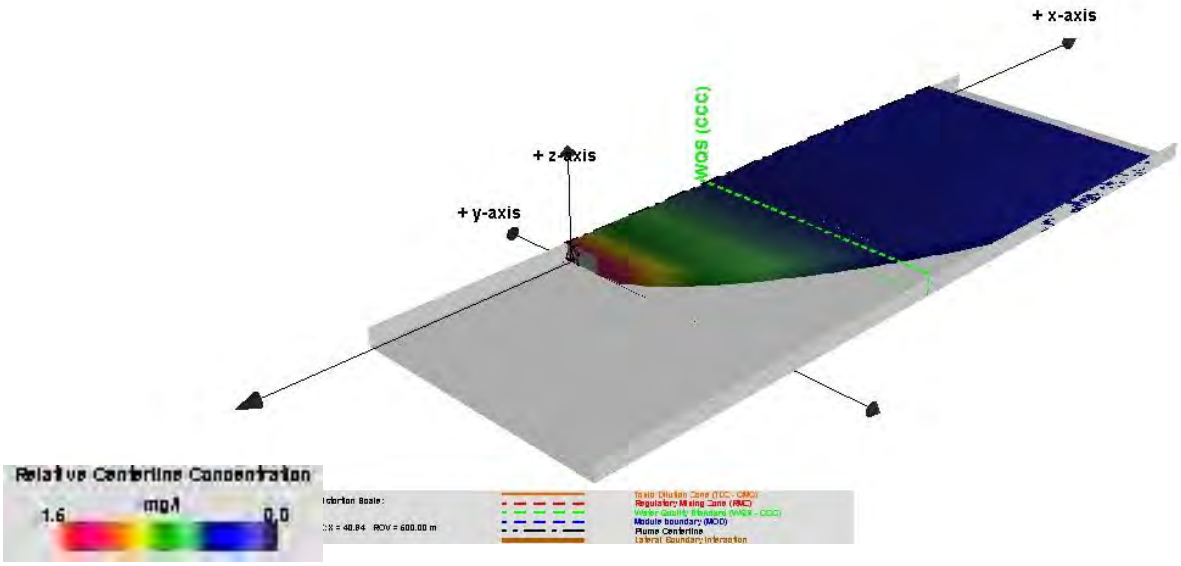


Figure 9. 3-D View of Phase 1 Discharge Plume for Summer (0.43 m^3/s) Willow Creek Flow and 1.5 mg/L Effluent Total Ammonia

The PQWO for un-ionized ammonia was met 156 m downstream from the outfall at 0.43 m^3/s Willow Creek flow (Figure 10) at an effluent concentration of 1.5 mg/L. To meet the PWQO at the point of complete mixing, the effluent total ammonia concentration could be as high as 2.2 mg/L.

The 75th percentile Willow Creek total phosphorus concentration (0.031 mg/L) currently exceeds the Ontario PWQO for TP of 0.03 mg/L. The CORMIX modelling found that the total phosphorus concentration at the point of complete mixing (i.e., 319 m downstream) was 0.034 mg/L.

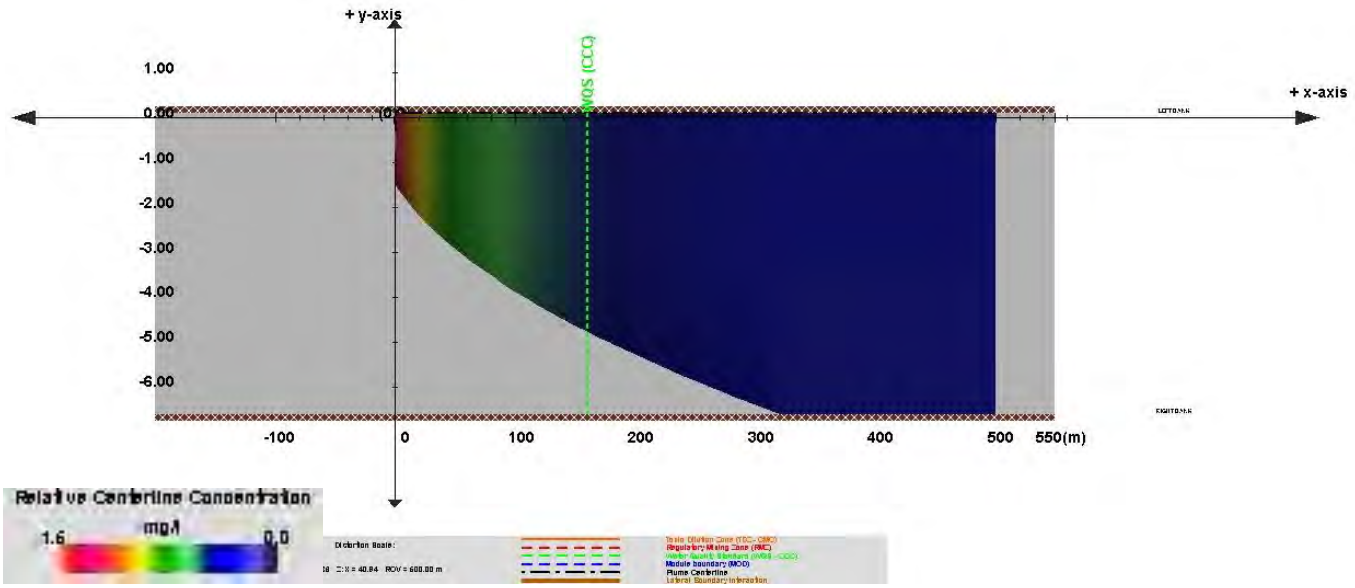


Figure 10. Top View of Phase 1 Discharge Plume for Summer (0.43 m^3/s) Willow Creek Flow and 1.5 mg/L Effluent Ammonia

4.3.2 Scenario 2 (Summer Low Flow, Full Build Out, Ammonia Effluent Limit = 1 mg/L)

The flow characteristics of Willow Creek downstream of the proposed discharge for the Full Build Out effluent volume of 0.143 m^3/s and Willow Creek 7Q20 low flow of 0.43 m^3/s was similar in nature to that observed for the Phase 1 scenario. Both scenarios showed quick vertical mixing close to the outfall and then slow spread of the plume across the creek to the right bank. In the Full Build Out scenario, the point of complete mixing was located 302 m downstream.

The PWQO for un-ionized ammonia was met at 225 m downstream (Figure 11) where the plume occupied 90% of the channel width (Table 6).

Table 6. Summary of Mixing Modelling Results for Ammonia: Full Build-Out, Summer, Effluent Limit = 1 mg/L.

Modelled/Calculated Parameter	Result
Point of Complete Mixing (m downstream of outfall)	302
Distance to Meet PWQO (m downstream of outfall)	225
Plume Width (% of channel) where PWQO is Met	90

To meet the PWQO at the point of complete mixing, the effluent total ammonia concentration could be as high as 1.2 mg/L.

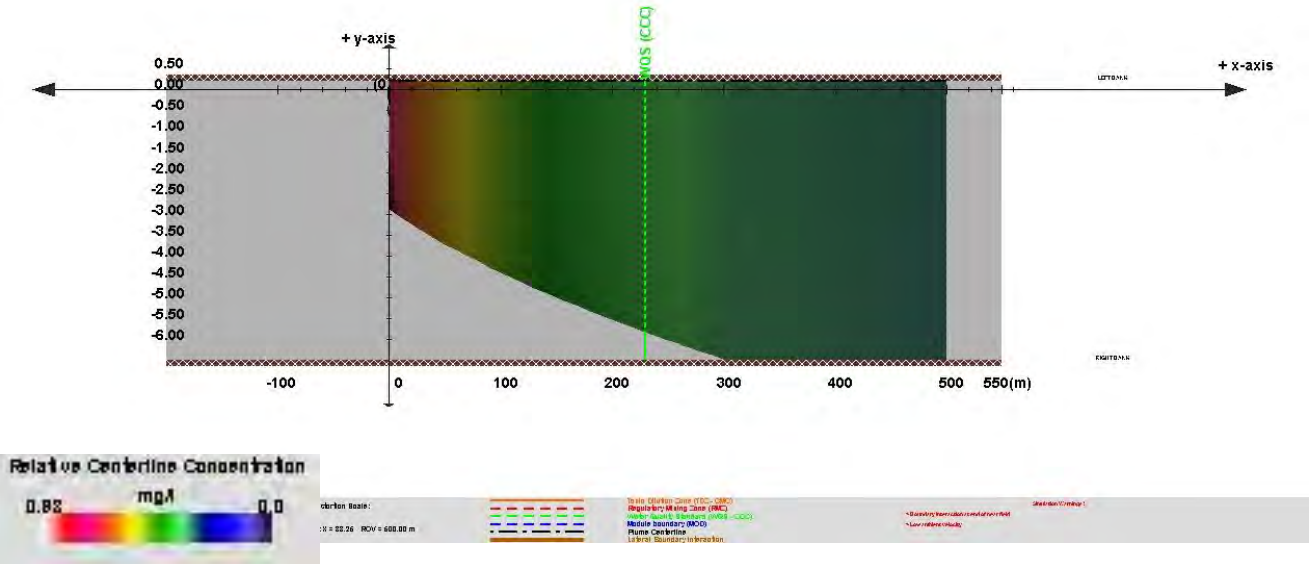


Figure 11. Top View of Full Build-Out Discharge Plume for Summer (0.43 m^3/s) Willow Creek Flow and 1 mg/L Effluent Ammonia

4.3.3 Scenarios 3 and 4 (Winter, Phase 1 and Full Build Out, TAN Effluent Limits = 3 and 2 mg/L, TP Effluent Limit = 0.05 mg/L).

The overall flow classification of the plume in winter was the same as that for the summer scenarios (IPV4), with a weakly deflected jet, rapid vertical mixing at the discharge and a plume that slowly spread laterally with distance downstream. The plume, however, would be much less dense than the creek water, due to the warmer effluent compared to the creek, and leading to slower passive mixing in the creek. The point of complete mixing was therefore predicted for a location further downstream than in the summer scenarios (i.e., at 361 and 352 m downstream of the point of discharge, respectively, for the Phase 1 and Full Build Out scenarios, Table 7).

Table 7. Summary of Mixing Modelling Results for Winter Ammonia Scenarios

Modelled/Calculated Parameter	Phase 1	Full Build Out
Point of Complete Mixing (m downstream of outfall)	361	352
Distance to Meet PWQO (m downstream of outfall)	34	26
Plume Width (% of channel) where PWQO is Met	35	42

In winter, un-ionized ammonia concentrations are considerably lower than in summer due to the low temperatures, even if total ammonia concentrations are higher since the speciation of ammonia to its un-ionized form is governed by increasing pH and temperature. Despite the higher total ammonia effluent concentrations, the PWQO for un-ionized ammonia was met at 34 m downstream (Figure 12) for Phase 1 with an effluent limit of 3 mg/L, and at 26 m (Figure 13) for Full Build Out at a 2 mg/L total ammonia effluent

limit. At these downstream distances, the plume width was 35 and 42% of the channel width, respectively, for the Phase 1 and Full Build Out scenarios.

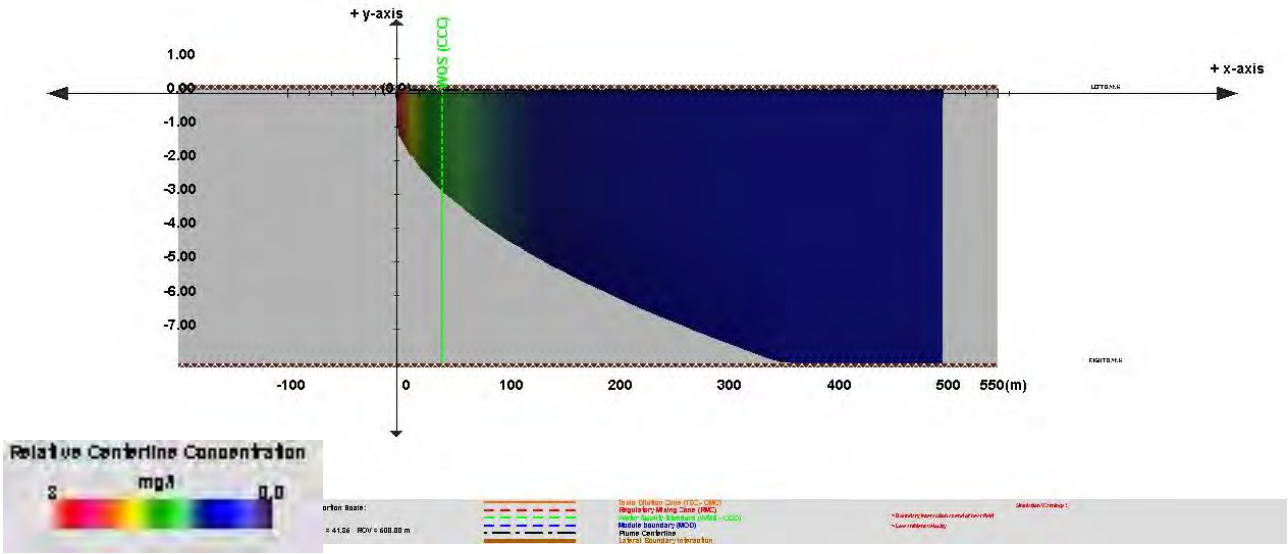


Figure 12. Top View of Phase 1 Winter Discharge Plume and 3 mg/L Effluent Total Ammonia

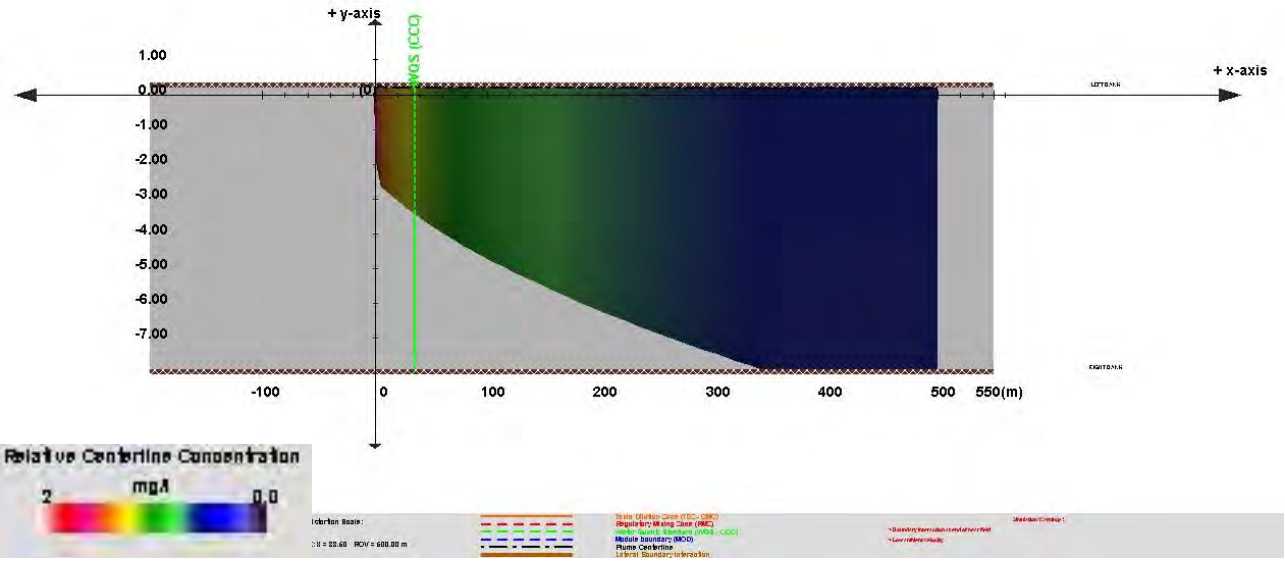


Figure 13. Top View of Full Build Out Winter Discharge Plume and 2 mg/L Effluent Total Ammonia

The CORMIX modelling found that the total phosphorus concentration at the point of complete mixing (i.e., 361 m downstream) was 0.032 mg/L for Phase 1. The effluent TP concentration for the Full Build Out was

0.03 mg/L, therefore there would be no discharge excess and that scenario was not modelled using CORMIX. This scenario was further explored in the mass balance modelling (Section 5).

4.4 Summary of Near Field Mixing Modelling

The tabulated results from the CORMIX modelling detailing the distance to the point of complete mixing, to the point in which the PWQO for un-ionized ammonia is met, and corresponding un-ionized ammonia concentrations are presented in Table 8 for all Scenarios.

The impact of the effluent on the creek increased at lower creek flows and higher effluent concentrations and volumes, as expected; however, the PWQO for unionized ammonia was met prior the point of complete mixing for all scenarios.

The CORMIX modelling found that:

- For Phase 1 summer low flow conditions, effluent total ammonia concentrations must be 2.2 mg/L or lower to meet the un-ionized ammonia PWQO by the point of complete mixing,
- For the Full Build Out summer low flow conditions, the effluent total ammonia must be 1.2 mg/L or lower.

Total phosphorus concentrations at the point of complete mixing for the Phase 1 summer and winter scenarios were 0.034 mg/L and 0.032 mg/L, respectively.

The ammonia and total phosphorus concentrations at the point of complete mixing predicted by CORMIX differ from those estimated by the QUAL2K model (Section 6.2), because the terms “complete mixing” are defined differently by each model:

- QUAL2K predicts fully mixed conditions with homogenous concentrations across the river cross-section; while
- CORMIX predicts water quality at the centerline of the plume, and the point of complete mixing is where all effluent water has been mixed to some degree with creek water, but a dilution gradient still exists. The CORMIX centerline is the line that cuts the horizontal (y) and vertical (z) axes in two and represents the highest concentrations in the plume. Concentrations decline towards the edges of the plume, where more mixing with the surrounding water occurs. For the Willow Creek predictions, the centerline follows the left bank, with pollutant concentrations declining across the creek towards the right bank.

This implies that all above predictions are the maximum concentrations encountered at the left bank, with pollutant concentrations in the creek declining towards the right bank. It can therefore be concluded that there is room for aquatic life to move around the area that exceeds PWQO, if the PWQO is met at the point of complete mixing. Table 8 also shows that at no point does the plume occupy the entire width of Willow Creek and so there are always areas where water quality meets the PWQO for un-ionized ammonia.

Table 8. Summary of CORMIX Modelling Results

Modelled/Calculated Parameter	**Scenario 1** (Phase 1, Summer, Effluent Ammonia=1.5 mg/L, Willow Creek Q=0.43 m^3/s)	**Scenario 2** (Full Build Out, Summer, Effluent Ammonia=1 mg/L, Willow Creek Q=0.43 m^3/s)	**Scenario 3** (Phase 1, Winter, Effluent Ammonia=3 mg/L, Willow Creek Q=0.9 m^3/s)	**Scenario 4** (Full Build Out, Winter, Effluent Ammonia=2 mg/L, Willow Creek Q=0.9 m^3/s)
Distance (m) to Point of Complete Mixing (PCM)	319	302	361	352
Distance (m) at which PWQO for Un-ionized Ammonia is met	156	225	34	26
Total Ammonia at PCM	0.251	0.313	0.317	0.390
Plume width where PWQO is met (m)	4.8	6.0	2.8	3.4
% of wetted width	72	90	35	42
Un-ionized Ammonia concentration (mg/L) at PCM	0.014	0.017	0.007	0.008
Required effluent Total Ammonia concentration (mg/L) to meet un-ionized ammonia PWQO at PCM	2.2	1.2	8.5	4.6
Proposed Total Ammonia Limit	1.5	1	3	2
Total phosphorus concentration (mg/L) at PCM	0.034	n/a	0.032	n/a

Note: Bold-face values denote concentrations that exceed the PWQO for unionized ammonia.
n/a – CORMIX cannot model effluent concentrations that are lower than background concentrations.

5. Mass Balance Modelling

Mass balance modelling was undertaken to determine the effect of WWTP effluent on Willow Creek water quality after complete mixing. Parameters modeled include total phosphorus, total suspended solids, and nitrate.

A mass balance model simply calculates the average total daily load of a parameter to the creek from the effluent discharge and the creek itself (in mg/day), and divides it by the total combined daily flow of effluent + creek (in L/day) to estimate the fully mixed total parameter concentrations in mg/L. This model does not assume any mixing zone – it is based on the fully mixed creek concentrations and treats all parameters as a conservative parameter that do not undergo any assimilation reactions after discharge.

5.1 Total Phosphorus

A mass balance model was used to predict total phosphorus concentrations at the point of complete mixing between the WWTP effluent and the creek and assuming homogenous concentrations across the river cross-section. Although there are several processes leading to loss of phosphorus over the course of a year, these are balanced out by resuspension such that on average, phosphorus is not retained in a river system. The creek was therefore assumed to not act as a net sink for total phosphorus. Modelling these processes is difficult using an un-calibrated water quality model and lacking an existing discharge where assimilation processes could be observed in the field. A mass balance model of phosphorus loadings to Willow Creek was therefore used as a conservative estimate of the likely total phosphorus concentrations under seasonal and monthly scenarios, for a variety of effluent limits, for Phase 1 of the development (74.7 m^3/s effluent discharge) and for Full Build Out (142.5 m^3/s effluent discharge).

5.1.1 Seasonal Analysis

The creek was modelled for the four scenarios detailed in Section 4:

- Phase 1, Summer 7Q20 low flow, effluent total phosphorus = 0.05 mg/L
- Full Build Out, Summer 7Q20 low flow, effluent total phosphorus = 0.03 mg/L
- Phase 1, winter low flow, effluent total phosphorus = 0.05 mg/L
- Full Build Out, winter low flow, effluent total phosphorus = 0.03 mg/L

Note that any effluent limit less than 0.031 mg/L (i.e., the current 75th percentile concentration of total phosphorus in Willow Creek) would maintain or improve current conditions in Willow Creek, such as the case for the Full Build Out scenarios. The results of the mass balance modelling are presented in Table 9.

Table 9. Downstream, Fully Mixed Total Phosphorus Concentrations in Willow Creek (by Mass Balance Modelling)

Parameter	**Scenario 1** (Phase 1, Summer, Effluent TP=0.05 mg/L, Willow Creek Q=0.43 m^3/s)	**Scenario 2** (Full Build Out, Summer, Effluent TP=0.03 mg/L, Willow Creek Q=0.43 m^3/s)	**Scenario 3** (Phase 1, Winter, Effluent TP=0.05 mg/L, Willow Creek Q=0.9 m^3/s)	**Scenario 4** (Full Build Out, Winter, Effluent TP=0.03 mg/L, Willow Creek Q=0.9 m^3/s)
Total Phosphorus Concentration (mg/L) at point of complete mixing between effluent and Willow Creek	0.034	0.031	0.032	0.031

The mass balance calculations show that at a total phosphorus discharge effluent of 0.05 mg/L for Phase 1, concentrations will not exceed 0.034 mg/L in Willow Creek in the summer and 0.032 mg/L in the winter.

The existing phosphorus enrichment of Willow Creek is related to high concentrations of suspended solids. Implementation of improved watershed management practices to reduce erosion and associated solids and phosphorus would offset the increased phosphorus load from the Midhurst effluent and maintain concentrations in the creek at or below their present day 75th percentile levels of 0.031 mg/L, preventing further degradation. Although Willow Creek is a Policy 2 receiver for total phosphorus, it is resilient to the addition of highly treated WWTP effluent. An effluent limit of 0.05 mg/L is therefore a feasible and achievable limit for Phase 1.

The Full Build Out of the Midhurst Secondary Plan area will occur over an extended time period. Although effluent limits of 0.05 – 0.07 mg/L have been more typically assumed for advanced phosphorus removal in Ontario over the past few years, a limit of 0.03 mg/L for total phosphorus is attainable by today's technology and is likely to become an acceptable standard between Phase 1 and Full Build Out. The mass balance calculations show that, at a total phosphorus discharge effluent of 0.03 mg/L for Full Build Out, concentrations will not exceed 0.031 mg/L in Willow Creek in the summer and winter, thus improving Willow Creek to total phosphorus concentrations below the current 75th percentile concentration of 0.031 mg/L.

Adoption of an effluent limit of 0.05 mg/L for Phase 1 would generate 118 kg/yr of phosphorus loading to the creek. This would be the minimum requirement for loading reductions from other sources in the watershed if the increase from the WWTP was to be offset.

An effluent limit of 0.03 mg/L for Full Build out would result in an additional 17 kg/yr, for a total of 135 kg/yr of phosphorus loading to the creek. This would be the minimum requirement for loading reductions from other sources in the watershed if the increase from the WWTP was to be offset, although the merit of doing so would need to be balanced against the fact that TP concentrations in the creek would be improved by the discharge.

Discussions with the MOECC are required to finalize effluent limits. We also recommend that the Environmental Compliance Approval (ECA) for the proposed WWTP include loading limits in combination to effluent concentration limits. This would encourage innovative treatment processes by recognizing that the occasional effluent excursion above a compliance limit has a low environmental consequence so long as the annual loading limit is achieved.

5.1.2 Monthly Analysis

Water quality often varies with flow and periods of low flows do not necessarily coincide with periods of the poorest water quality. This is the case in Willow Creek where a highly significant relationship ($p<0.00001$) between TP and total suspended solids (TSS) was found at the George Johnson Road Water Quality Monitoring Network (PWQMN) station (Section 2.1). The relationship showed that Willow Creek is a Policy 1 receiver for total phosphorus (i.e., TP concentrations are below the Provincial Water Quality Objective [PWQO] of 0.03 mg/L) during clear flow periods. For Willow Creek, this equated to periods when TSS concentrations are below 20 mg/L.

The purpose of this analysis is to provide an understanding of TP concentrations in Willow Creek during all times of the year, and the associated effect the proposed Midhurst WWTP will have on TP concentrations in the creek.

To examine TP in Willow Creek throughout the year, the existing water quality data set from the PWQMN station at George Johnson Road (2002 through 2014 data) was supplemented with water quality data collected by HESL in 2013, 2014 and 2016. The monthly average TP concentration was then calculated (Table 10).

Table 10. Monthly Average Total Phosphorus Concentrations in Willow Creek

Month	Average Total Phosphorus (mg/L)	Number of Samples
January	0.021	See note
February	0.008	1
March	**0.148**	2
April	**0.059**	6
May	0.029	12
June	**0.031**	15
July	**0.038**	12
August	0.018	19
September	0.026	11
October	0.022	18
November	0.027	10
December	**0.033**	2

- Note: There were no water quality data collected during the month of January. The average TP concentration for January was therefore calculated as the average between the months of December and February.
- **Bold** concentrations represent TP concentrations above the PWQO of 0.03 mg/L.

As would be expected, TP concentrations in Willow Creek are not consistent year-round. Agricultural activities in the lower Willow Creek watershed are the primary source of nutrient loading to the creek. Concentrations are above the PWQO for five of twelve months of the year, with the highest concentrations measured in March and April (at 0.148 mg/L and 0.059 mg/L, respectively), coinciding with spring freshet. Correspondingly, TP concentrations were below the PWQO in seven of twelve months of the year. Notably, this includes August and September, in which some of the lowest flows of the year are typically measured.

Daily minimum and median Willow Creek flows were calculated using the 10-year period of flow measurements available from the Water Survey of Canada (WSC) Station 02ED032 located on Willow Creek at Highway 26. The daily minimum flow was the single lowest flow measured for each date of the year, and the median flow was calculated as the median of all flows measured for each date of the year.

Figure 14 shows the resulting minimum and median Willow Creek flows. Flows are highest in spring and lowest in the summer and early fall months.



Figure 14. Willow Creek Minimum and Median Daily Flows

The resulting TP concentrations in Willow Creek, downstream of the proposed WWTP discharge were calculated by a mass balance using the existing monthly TP concentrations in Willow Creek (as presented in Table 10), daily flow (at both the minimum and median rates, as presented in Figure 14) and the WWTP effluent flows and concentrations for Phase 1 and Full Build Out (Phase 1 – 74.7 L/s and 0.05 mg/L TP; Full Build Out – 142.5 L/s and 0.03 mg/L TP). The daily change in TP concentration as a result of the addition of the proposed Midhurst WWTP discharge to Willow Creek was compared to the existing TP concentration in Figures 2 and 3 for Phase 1 and Full Build Out, respectively.

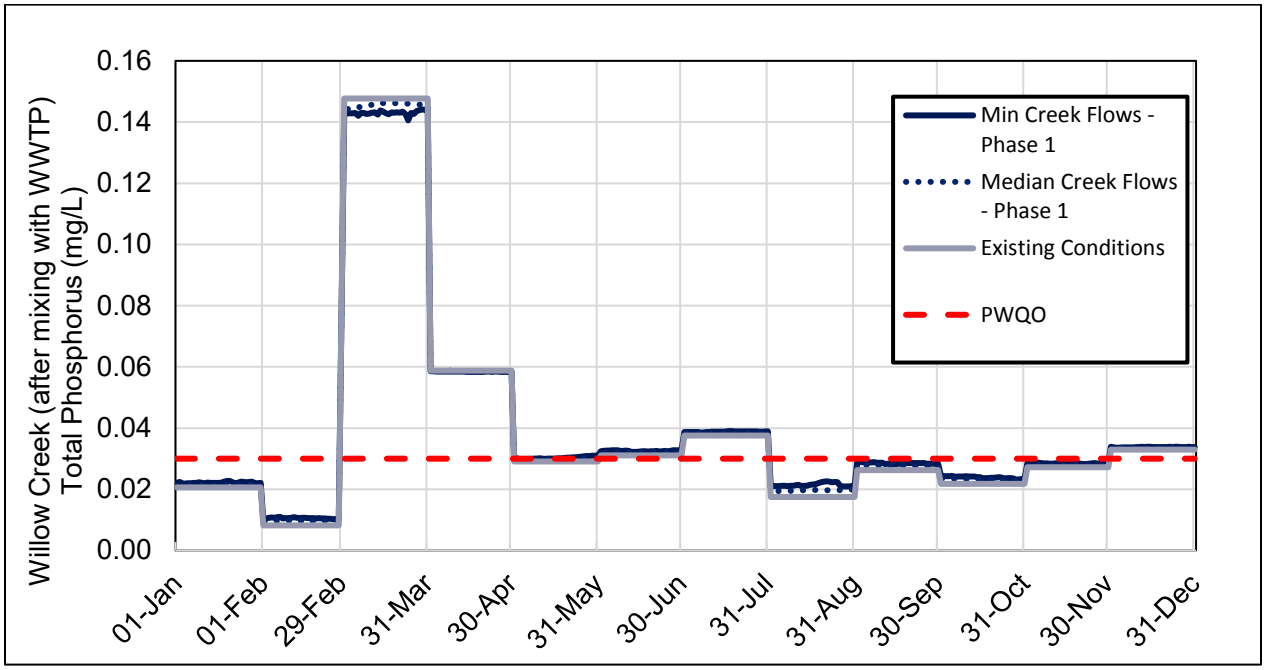


Figure 15. Resulting Willow Creek Total Phosphorus Concentrations After Mixing with Midhurst WWTP (Phase 1)

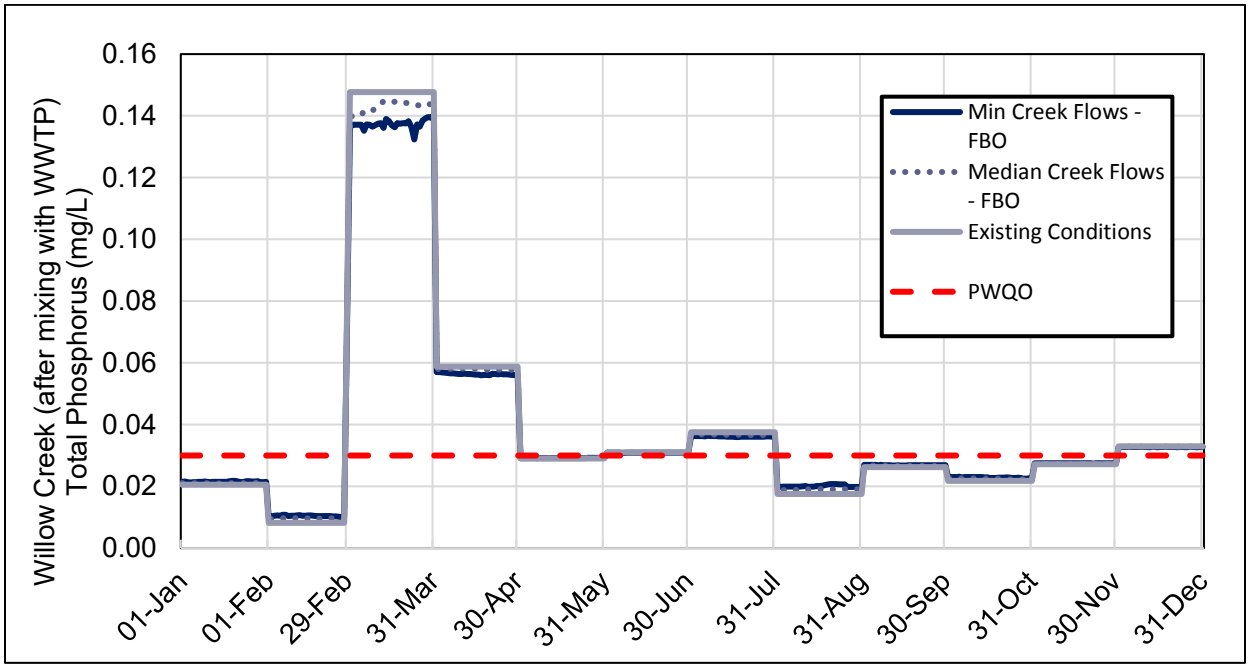


Figure 16. Resulting Willow Creek Total Phosphorus Concentrations After Mixing with Midhurst WWTP (Full Build Out)

When existing TP concentrations are examined throughout the year and in comparison to predicted fully mixed (downstream) concentrations at Phase 1 and Full Build Out of the WWTP (Figures 15 and 16,

respectively), the impact of the additional loading from the WWTP is minimal in months with existing TP concentrations near the PWQO. In the month of March, the WWTP discharge notably improves downstream water quality in Willow Creek since the TP concentrations in the effluent are lower than the average TP concentrations measured in March in Willow Creek. The existing March Willow Creek TP concentration of 0.148 mg/L is reduced to a monthly average concentration of 0.143 mg/L and 0.146 mg/L at minimum and median creek flows, respectively, at Phase 1 effluent concentrations and flows. At Full Build Out, the Willow Creek TP concentration is reduced to 0.137 mg/L and 0.143 mg/L at minimum and median flows, respectively.

In the months of January, February, May, August, September, October, and November, existing Willow Creek average TP concentrations were below the PWQO. In all cases, except May minimum flows for Phase 1, the input from the WWTP discharge (at both Phase 1 and Full Build Out levels) did not result in the downstream TP concentration increasing to beyond the PWQO of 0.03 mg/L.

The MOECC agreed[3] that this detailed TP analysis supports that WWTP discharge will have a marginal effect on downstream phosphorus concentrations, and that phosphorus offsets in the watershed are not needed to balance the impact of the WWTP discharge.

5.2 Total Suspended Solids

A monthly mass balance model was used to predict total suspended solids concentrations at the point of complete mixing between the WWTP effluent and the creek and assuming homogenous concentrations across the creek cross-section. The purpose of this analysis is to provide an understanding of the effect of effluent TSS loadings on TSS concentrations in Willow Creek during all times of the year (e.g. high and low flow conditions).

TSS concentrations in Willow Creek downstream of the proposed WWTP discharge were calculated using the same approach presented in section 5.1.2, using the existing monthly TSS concentrations in Willow Creek (Table 11) and the recommended effluent limits of 15 mg/L for Phase 1 and 10 mg/L for Full Build Out (Black and Veatch 2018). These effluent limits will be discussed with MOECC at the ECA stage and lowered if required.

The water quality data set from the PWQMN station at George Johnson Road (2002 through 2014 data) was used to summarized existing TSS concentrations in Willow Creek. This was supplemented with water quality data collected by HESL in 2013 and 2014[4]. TSS concentrations in Willow Creek vary monthly. During high flows in March and April, TSS concentrations are the highest, due to overland runoff, mobilization of bed sediments, and bank erosion. The TSS concentration of 146 mg/L for March is based on 1 measurement, and likely does not reflect actual TSS concentrations during this period. For the rest of the year TSS concentrations are equal to or below 20 mg/L (threshold for PWQO TP exceedances; see section 2.1) and are lowest in August (9 mg/L) and September (10 mg/L), when creek flows are also low.

[3] *Letter from Paul Martin, Supervisor Air, Pesticides and Environmental Planning to Joe Mullan, Ainley and Associates dated April 30, 2018.*

[4] *Recent HESL data (2014-2017) is consistent with 2013 and 2014 data.*

Table 11. Monthly Average Total Suspended Solids (mg/L) Concentrations in Willow Creek

Month	Average Total Suspended	Number of Samples
January	10	See note
February	4	1
March	146	1
April	40	6
May	17	11
June	15	14
July	20	12
August	9	19
September	10	11
October	12	16
November	11	13
December	16	2

- Note: There were no water quality data collected during the month of January. The average TSS concentration for January was therefore calculated as the average between the months of December and February.

The CWQG for TSS is a maximum increase of 25 mg/L under high flow conditions, and 5 mg/L under clear flow (i.e. low flow) conditions (CCME 2002). High flow conditions are considered to be from January to May, and October to December (based on the median flows presented on Figure 14), and low or clear flow conditions from June to September. In all cases, the input from the WWTP discharge (at both Phase 1 and Full Build Out levels) did not increase the downstream TSS concentrations above CWQG thresholds. The WWTP discharge reduced, and hence improved, TSS concentrations in Willow Creek in March, April, May, July, and December during Phase 1 (Figure 17) in Phase 1, and from March to July, and from October to December during Full Built Out (Figure 18). Concentrations are predicted to increase only marginally (less than 1 mg/L) in all other months. The increase in TSS will not be observable from current conditions.

This TSS analysis supports the TSS effluent limits of 15 mg/L for Phase 1 and 10 mg/L for Full Build Out. These effluent limits will be discussed with MOECC at the ECA stage and lowered if required.

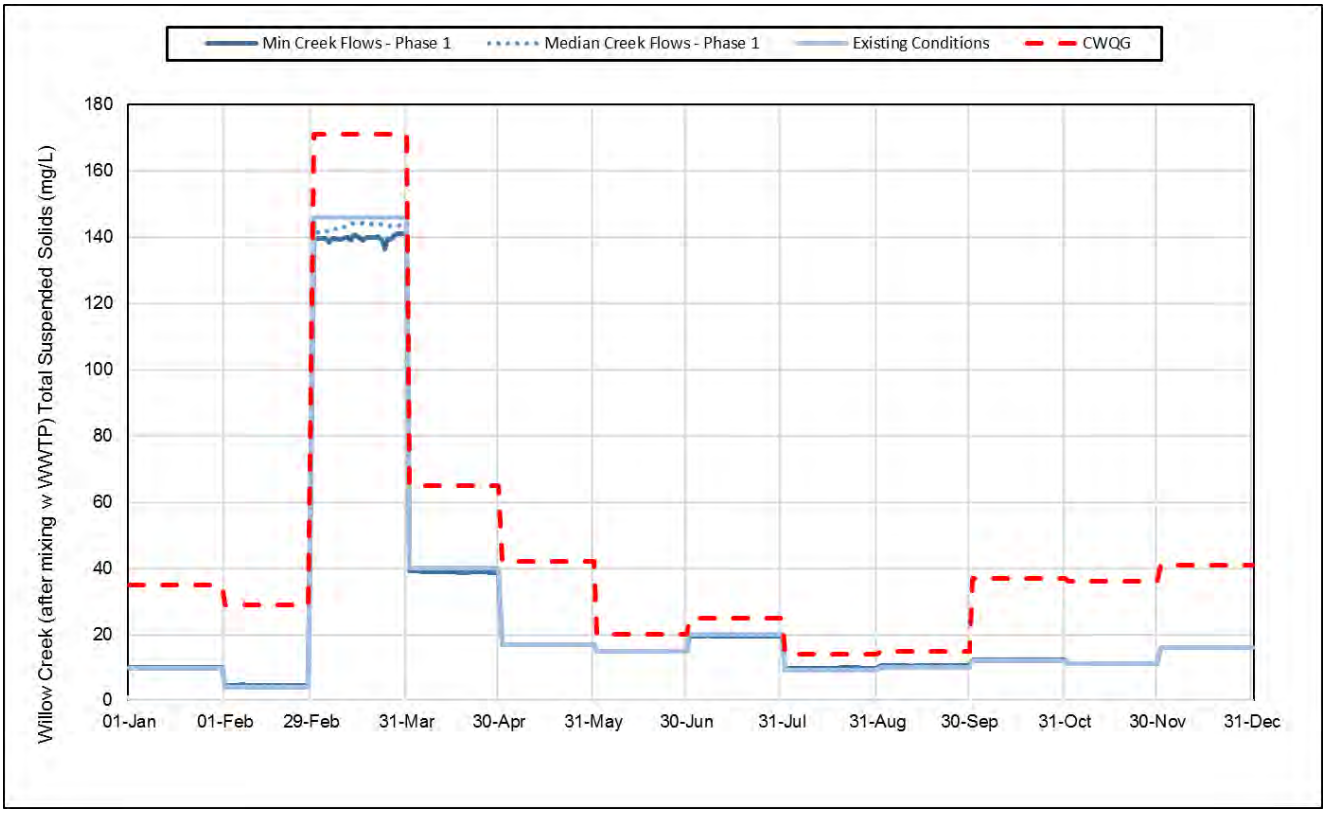


Figure 17 Willow Creek Total Suspended Solids Concentrations After Mixing with Midhurst WWTP (Phase 1)

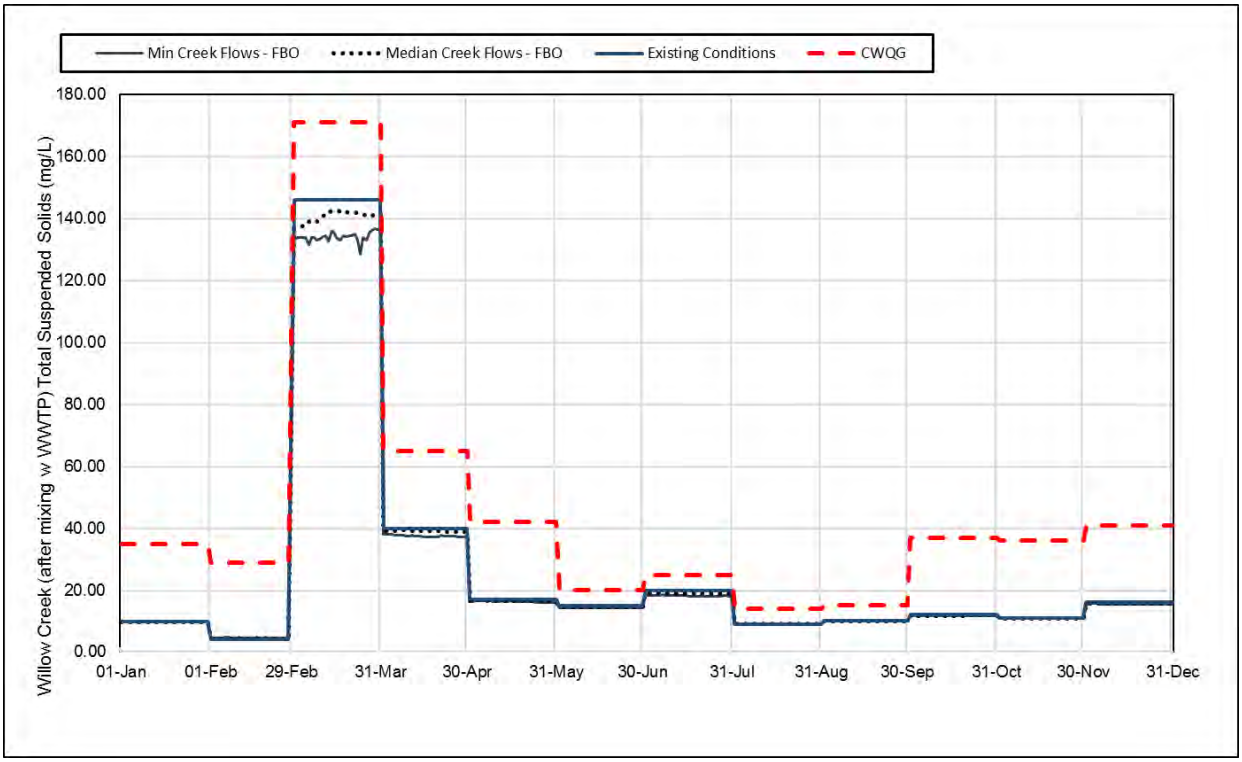


Figure 18 Willow Creek Total Suspended Solids Concentrations After Mixing with Midhurst WWTP (Full Build Out)

5.3 Nitrate

A mass balance model was used to predict nitrate (as N) concentrations at the point of complete mixing between the WWTP effluent and the creek and assuming homogenous concentrations across the creek cross-section. The purpose of this analysis is to provide an understanding of the effect of total inorganic nitrogen (TIN) loadings on nitrate concentrations in Willow Creek during all times of the year (e.g. high and low flow conditions). The proposed TIN effluent limit for Phase 1 is 15.4 mg/L (Black and Veatch 2018). There is no proposed TIN limit for Full Build Out, rather nitrate concentrations will be monitored in the effluent and receiver during Phase 1, and a limit will be proposed for Full Build Out at the ECA stage, if necessary (Black and Veatch 2018). TIN is a sum of the inorganic nitrogen (total ammonia, nitrate and nitrite) in the effluent. For the purposes of this analysis, it was conservatively assumed that the nitrate concentration in the effluent will equal the TIN concentration of 15.4 mg/L.

Nitrate concentrations in Willow Creek downstream of the proposed WWTP discharge were calculated for Phase 1 using the same approach presented in section 5.1.2, the existing average monthly nitrate concentrations in Willow Creek (Table 12) and the recommended TIN effluent limit of 15.4 mg/L for Phase 1.

The water quality data set from the PWQMN station at George Johnson Road (2002 through 2014 data) was used to summarized existing nitrate concentrations in Willow Creek. This was supplemented with water quality data collected by HESL in 2013 and 2014[5]. The monthly average nitrate concentrations are provided in Table 12). Monthly average nitrate concentrations in Willow Creek vary monthly, and are highest in January, February and March. Concentrations are well below the CWQG of 3.0 mg/L for long-term exposure during all months.

Table 12. Monthly Average Nitrate (mg-N/L) Concentrations in Willow Creek

Month	Average Nitrate (mg/L)	Number of Samples
January	0.877	See note
February	0.990	1
March	0.891	2
April	0.673	6
May	0.591	12
June	0.651	15
July	0.740	12
August	0.760	19

[5] *Recent HESL data (2014-2017) is consistent with 2013 and 2014 data.*

September	0.743	11
October	0.612	18
November	0.647	10
December	0.763	2

- Note: There were no water quality data collected during the month of January. The average nitrate concentration for January was calculated as the average between the months of December and February.
- Bold concentrations are above the CWQG of 3.0 mg/L for long-term exposure

Nitrate concentrations are predicted to increase downstream of the WWTP discharge for both minimum and median flow conditions, however concentrations will remain at or below the CWQG of 3.0 mg/L for long-term exposure. For median flow conditions nitrate concentrations will remain below 2.0 mg/L (Figure 19). For minimum flow conditions, nitrate concentrations will remain at or below 2.5 mg-N/L, except for August. In August, nitrate concentrations are predicted to increase to 3.0 mg/L for three (3) days (Figure 19). The CWQG of 3.0 mg-N/L is for long-term exposure to nitrate, in that concentrations of nitrate are above 3.0 mg/L for more than seven (7) days. For exposure to nitrate for less than 7 days, the short-term CWQG of 124 mg-N/L applies. The three days nitrate is predicted to increase to 3.0 mg-N/L, is short-term (i.e. less than 7 days), and well below the short-term guideline of 124 mg/L. The modelled flows in August used to predict the increase to 3.0 mg-N/L nitrate are also less than 7Q20 flow of 430 L/s (405 to 412 L/s), and therefore represent a very low likelihood (1 in 20 year) occurrence.

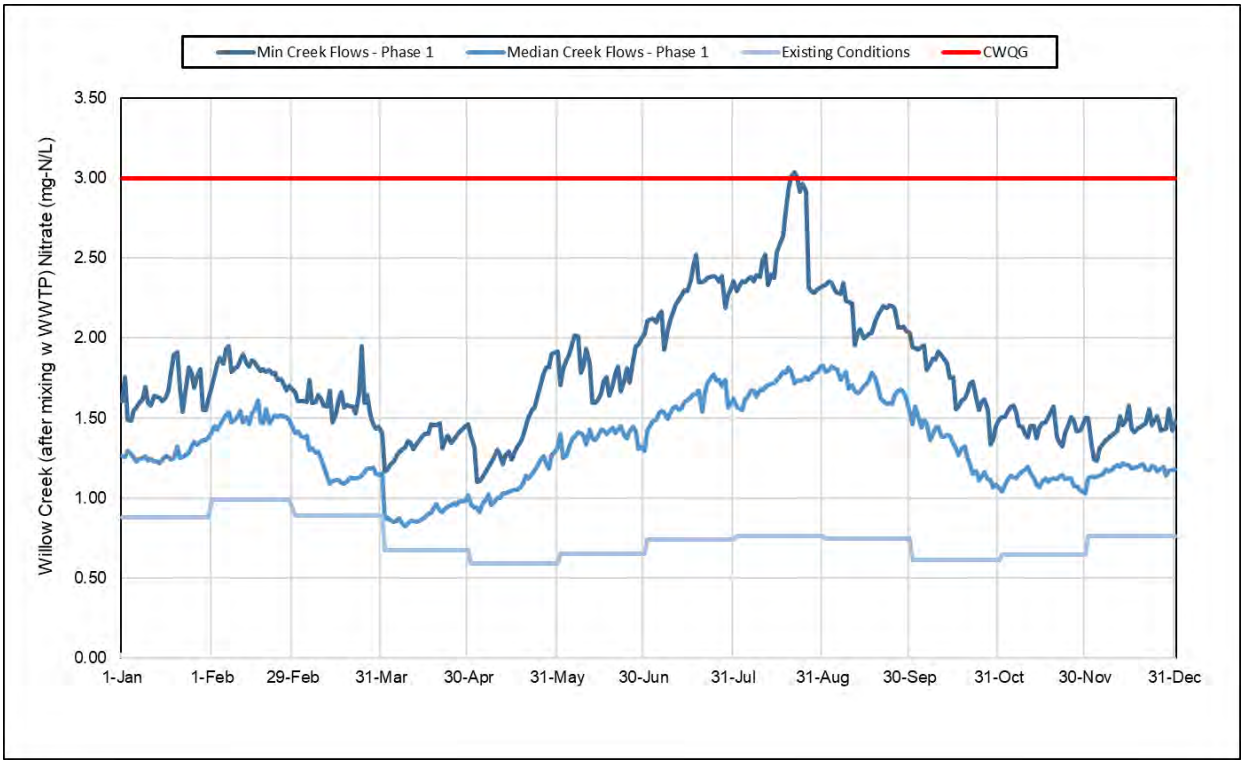


Figure 19 Willow Creek Nitrate Concentrations After Mixing with Midhurst WWTP (Phase 1)

This nitrate analysis supports the TIN effluent limit of 15.4 mg-N/L for Phase 1. Monitoring of the effluent and receiver during Phase 1 will be used to assess the limit for Full Build Out.

6. Far-Field Water Quality Modelling (QUAL2K)

The mixing zone model provided information on effluent plume behaviour and pollutant concentrations in the hydraulic near-field mixing zone. The mixing zone model focuses on the physical component of modelling, where assimilation processes are dominated by mixing and dilution of the effluent with the receiving waters. In order to model assimilation of pollutants by the complex physical, chemical and biological processes in a river system beyond the point of complete mixing, a far-field water quality model was applied. This model takes into account a large variety of water quality and physical parameters and processes and thus is both more complex and more precise regarding the fate of pollutants in the river.

We limited the more complex far-field modelling to the summer scenarios since it is the most critical season due to increased water temperatures which result in increased speciation of ammonia to its un-ionized form.

6.1 Methodology for Ammonia and Dissolved Oxygen Far-Field Modelling

The water quality model QUAL2K was used for predicting dissolved oxygen concentrations and the assimilation of ammonia in Willow Creek beyond the point of complete mixing. QUAL2K is a one-dimensional (1-D) river and stream water quality model that is typically used to assess the environmental impact of pollution discharges along the length of rivers. A wide range of water quality parameters and chemical and biological pollutants within the river can be modeled, including temperature, pH, dissolved oxygen (DO), carbonaceous biochemical oxygen demand (CBOD), nitrogen species, phosphorus species, and suspended solids.

Since QUAL2K is a 1-D model, the model assumes that all point source inputs (such as the outfall from the proposed WWTP) are instantaneously mixed laterally and vertically at each particular point in the river. The actual point of complete mixing beyond the WWTP discharge outfall was determined through near-field modelling (CORMIX, Section 4) to be between 302 m and 319 m downstream for the summer scenarios. Downstream of the point of complete mixing, QUAL2K model predictions were used since QUAL2K is a more complex model that simulates assimilation by taking into account a number of additional parameters and processes. Although some assimilation will occur in the mixing zone, the CORMIX model does not account for this. The QUAL2K predictions can therefore be considered conservative as they begin with the CORMIX concentrations, which are based on mixing only.

Further, CORMIX cannot be used to model dissolved oxygen, whereas the Streeter-Phelps dissolved oxygen equation is built in to the QUAL2K model and therefore makes the QUAL2K model suitable for predicting downstream dissolved oxygen concentrations.

The study area covers a total of 5.4 km downstream of the proposed discharge and was subdivided into three downstream reaches plus one upstream reach (Section 2). The summer 7Q20 low flow scenario was modeled each at the two different total ammonia effluent concentrations of 1 mg/L and 1.5 mg/L and with the proposed effluent flows for Phase 1 and Full Build Out, respectively.

6.1.1 Model Input

The main input parameters for the QUAL2K model are summarized in Table 13.

Table 13. Input Parameters for QUAL2K Far-field Assimilation Modelling

Parameter	Value	Rationale
Receiving Waters (Willow Creek) Characteristics		
pH	8.4	75th percentile measured at the PWQMN station from 2002-2014
Water temperature	18.5°C	75th percentile of summer (Jun-Aug) data measured at the PWQMN station from 2002-2014
Nutrient concentrations	NH_4-N: 0.025 mg/L NO_3-N: 0.85 mg/L TP: 0.031 mg/L (0.004 inorg. (SRP), 0.027 org. P) N org. 0.49 (TKN 0.51 – NH_4-N)	75th percentile measured at the PWQMN station from 2002-2014
Dissolved Oxygen	10.16 mg/L	25th percentile, consistent with a conservative approach
Flow	0.43 m^3/s	7Q20 flow accounting for potential baseflow losses due to proposed groundwater takings for the Midhurst Secondary Plan
Manning's n	0.07 (Reach 1) 0.025 (Reach 2) 0.02 (Reach 3)	Manning's n values were calibrated using data collected in the time of travel study and the approach described in Jobson (2001) (see section 3.3).
Bottom Algae Coverage	10%	50-80% attached algae on hard surfaces, such as woody debris; none on sandy bottom
Effluent Characteristics		
Flow Rate	0.075/0.143 m^3/s	Flow rates for Phase 1 and Full Build Out of proposed Midhurst development.
Ammonia-N	1.5 mg/L / 1 mg/L	Proposed effluent quality (Phase 1 / Full Build Out) for Midhurst WWTP, as per Black & Veatch (2018)
Temperature	20°C	75th percentile in Alcona WPCP effluent
pH	8	75th percentile in Alcona WPCP effluent, depends on pH of water source and WWTP process
NO_3	15.5 mg/L / 16 mg/L	Proposed effluent quality (Phase 1 / Full Build Out) for Midhurst WWTP, as per Black & Veatch (2018)
Total Phosphorus	0.05/0.03 mg/L (0.01 org P: 0.04 inorg P / 0.006 org P: 0.024 inorg P)	Proposed effluent quality (Phase 1 / Full Build Out) for Midhurst WWTP, as per Black & Veatch (2018)
CBOD	15 mg/L	Proposed effluent quality for Midhurst WWTP, as per Black & Veatch (2018)

Parameter	Value	Rationale
Dissolved Oxygen	5.4 mg/L	25th percentile in Alcona WPCP effluent
Model Parameters		
Nitrification rate	6 per d	Conservative estimate out of a range of 0-10 that is available in QUAL2K. Literature review of similar streams indicates range of 0.2 to 9/d (EPA 1985), with higher values in small streams and lower values in rivers. Nitrification is at its maximum at pH = 8.5 and temperatures between 25 and 35°C and is high in shallow streams, thus medium to high rates would be expected.
Hydrolysis Rate	0.1 per d	Upper range of values presented by EPA (1985)
Reaeration Model	Select from O-Connor-Dobbins, Owens-Gibbs, or Churchill based on water height	This is the default model selection in QUAL2K.

6.1.1.1 Receiving Water Characteristics

A conservative approach was taken to model conditions under which the proportions of un-ionized ammonia within the total ammonia would be high. Such conditions would involve high temperatures and high pH in both effluent and receiving waters and high concentrations of nutrients of concern in the receiving waters. The 75th percentile of measured data for all of the above-noted parameters was used. This low-probability scenario is recommended by MOE (1994b). The resistance coefficient Manning's n was calibrated using the tracer-study results (see Section 3.3) and the approach by Jobson (2001). Bottom algae coverage was estimated from observations made during field visits in the summer of 2009 and 2013.

6.1.1.2 Effluent Parameters

The effluent was modeled at two different total ammonia concentrations that may be considered as effluent limits: 1.5 mg/L (Phase 1); and 1 mg/L (Full Build Out). The effluent was modelled with a single CBOD value of 15 mg/L for both Phase 1 and Full Build Out scenarios. The effluent volumes for Phase 1 and Full Build Out were 0.075 m^3/s and 0.143 m^3/s, respectively. Effluent limits of 0.05 and 0.03 mg/L for total phosphorus were used. Temperature, pH and dissolved oxygen data for a typical WWTP of similar size to that proposed for Midhurst were obtained from the Alcona (Innisfil) Water Pollution Control Plant (Wes Cyr, Plant Operator, personal communication). Seventy-fifth percentile statistics were used for all parameters except dissolved oxygen, in which the 25^{th} percentile statistic was used (MOE, 1994b).

6.1.1.3 Model Rates

Processes that influence the generation (hydrolysis of organic nitrogen) and breakdown (nitrification) of ammonia in a river were assigned values from ranges obtained from a comprehensive review of rates in U.S. rivers (US EPA, 1985). The reaeration model was left at the QUAL2K default setting, which uses water height to determine which of the reaeration models (i.e., between O-Connor-Dobbins, Owens-Gibbs, and Churchill models) to use. Given that this is not an existing but a proposed discharge, no detailed water

quality data were available that would permit calibrating the model rates and validating the model on a set of independent and site-specific data. As a starting point, we therefore used the rates resulting from calibration using detailed water quality and flow data based on a previous study at the Delhi WPCP discharge to Big Creek in Southern Ontario (AECOM 2009), which, at the time of calibration, was similar in flow to Willow Creek (at 0.74 m^3/s). We also conducted a sensitivity analysis with varying nitrification and hydrolysis rates, in order to assess the potential error in the resulting ammonia concentrations associated with variable rates.

6.2 Dissolved Oxygen and Ammonia Far-Field Modelling Results

The velocities predicted by the QUAL2K model and extrapolated from the dye tracer study were in good agreement for both scenarios, Phase 1 and Full Build Out (Figures 20 and 21). The two types of predictions are not entirely independent, given the Manning's n values estimated from the tracer study were used in QUAL2K. The agreement does confirm, however, that the two independent algorithms for stream hydraulcs, supported by field data, resulted in similar velocity predictions and therefore demonstrate that the extrapolations from the dye-tracer study were applicable to the QUAL2K modelling environment. Velocities were therefore extrapolated from the dye-tracer study at the flow of 1.7 m^3/s (Section 3.1) to the 7Q20 low flow and a line modelled to provide a continuous velocity estimate for the creek downstream of the discharge point.

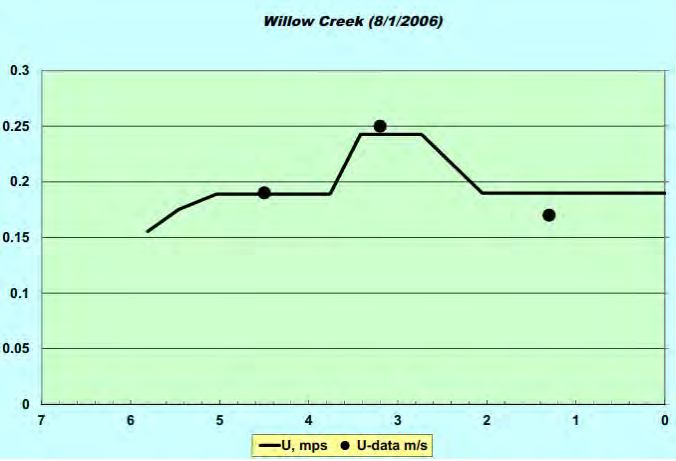


Figure 20. Modelled (solid line) and Extrapolated (dot) Field Velocities at Willow Creek Low Flow of 0.43 m^3/s, Phase 1

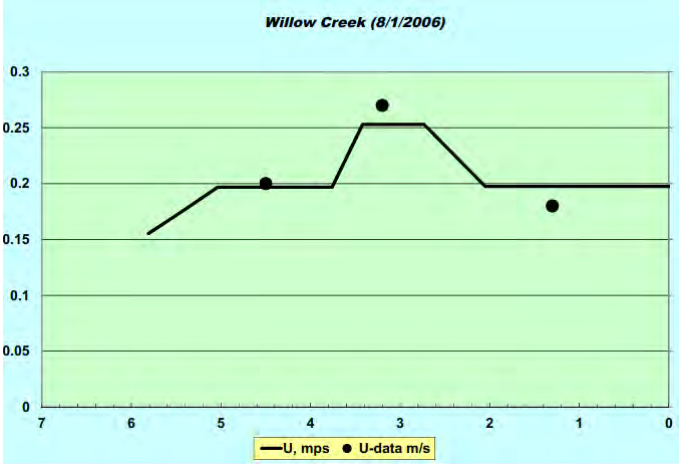


Figure 21. Modelled (solid line) and Extrapolated (dot) Field Velocities at Willow Creek Low Flow of 0.43 m^3/s, Full Build Out

For the Phase 1 summer low flow scenario, dissolved oxygen concentrations were predicted to decrease to minimum concentration of 8.1 mg/L at a distance approximately 4.4 km downstream of the proposed WWTP discharge location and then begin recovering (Figure 22). As such, dissolved oxygen concentrations are predicted to remain well above the PWQO.

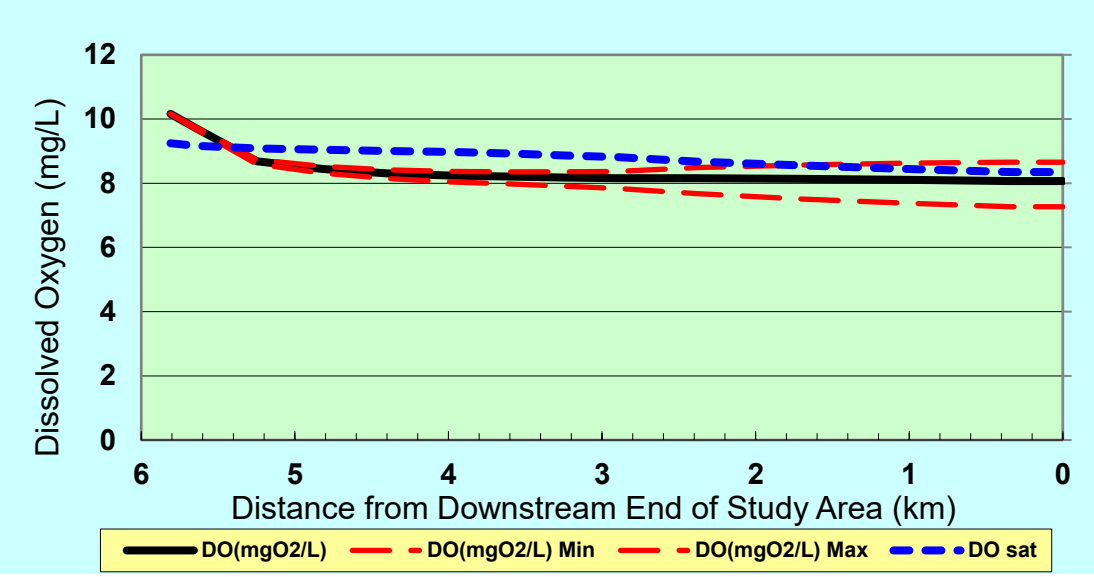


Figure 22. Dissolved Oxygen in Willow Creek Predicted by QUAL2K for 0.43 m^3/s streamflow and 15 mg/L Effluent cBOD, Phase 1

For the Phase 1 summer low flow scenario, the maximum un-ionized ammonia concentration at the point of complete mixing was predicted at 16.0 µg/L for 1.5 mg/L effluent ammonia (Figure 23), which is below the PWQO of 20 µg/L. (From Section 4, the PWQO for un-ionized ammonia was predicted by CORMIX to

be met prior to the point of complete mixing). Un-ionized ammonia concentrations declined to 7.5 µg/L at the downstream edge of the study area.

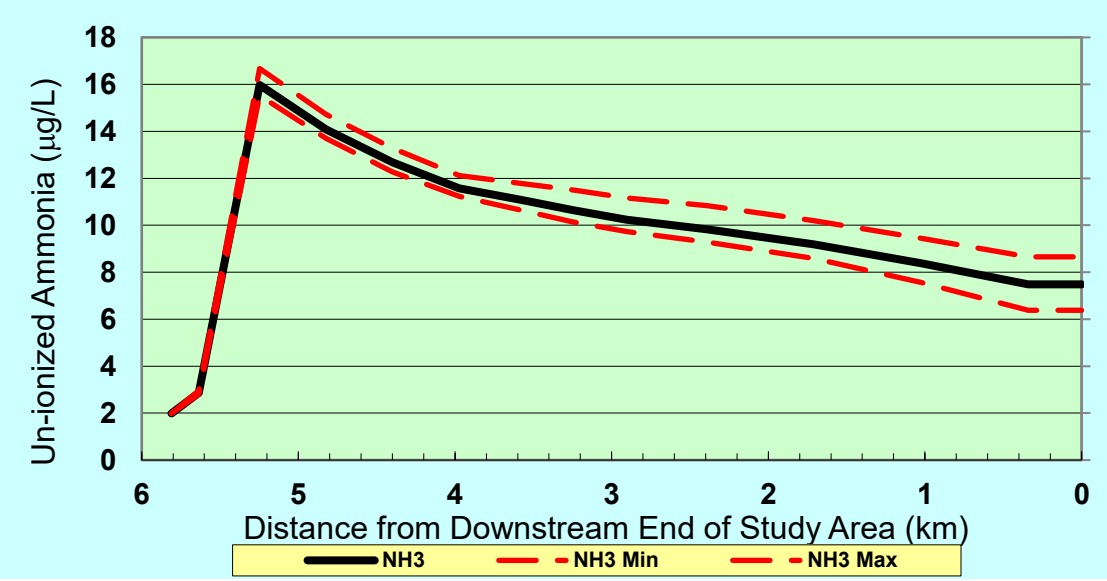


Figure 23. Un-ionized Ammonia in Willow Creek Predicted by QUAL2K for 0.43 m^3/s streamflow and 1.5 mg/L Effluent Ammonia, Phase 1

For the Full Build Out summer low flow scenario, dissolved oxygen concentrations were predicted to decrease to minimum concentration of 7.8 mg/L at a distance approximately 2.4 km downstream of the proposed WWTP discharge location and then begin recovering (Figure 24). As such, dissolved oxygen concentrations are predicted to remain well above the PWQO.

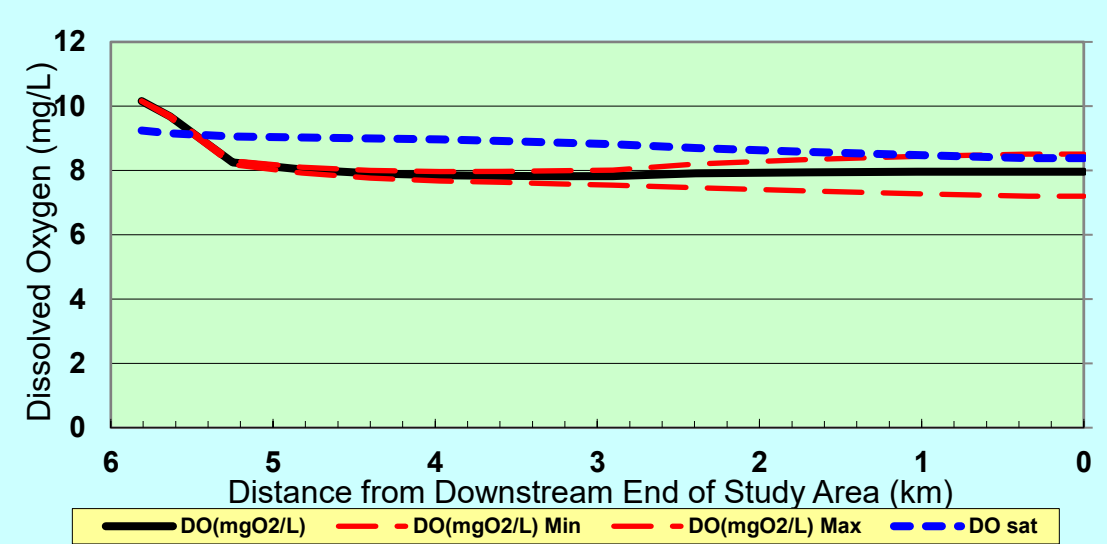


Figure 24. Dissolved Oxygen in Willow Creek Predicted by QUAL2K for 0.43 m^3/s streamflow and 15 mg/L Effluent cBOD, Full Build Out

Ammonia concentrations in the far-field modelling of the Full Build Out scenario showed similar spatial patterns to those seen in the Phase 1 scenario (Figures 23 and 25). Ammonia was assimilated over the course of Willow Creek through the study area but remained higher than background at ca. 5 km downstream of the discharge for all modeled scenarios. The un-ionized ammonia concentrations predicted by QUAL2K were lower than those predicted by CORMIX, because QUAL2K assumes complete mixing of the water column, while CORMIX predicts a gradient of concentrations with the predicted centerline concentrations representing a maximum value (see discussion in Section 4.3). The maximum modeled concentration of un-ionized ammonia during full build-out was 15.5 µg/L, declining to 6.9 µg/L by the downstream end of the study area.

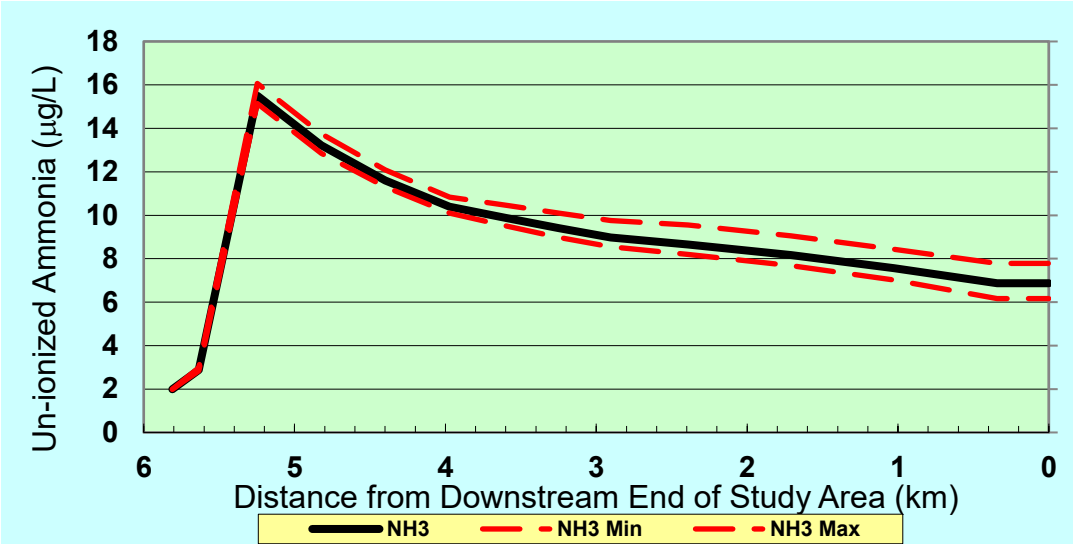


Figure 25. Un-ionized Ammonia in Willow Creek Predicted by QUAL2K for 0.43 m^3/s streamflow and 1 mg/L Effluent Ammonia, Full Build Out

6.2.1 Sensitivity Analysis

Some of the model parameters such as nitrification and hydrolysis rates had no creek-specific data available and had to be estimated from the literature. The model sensitivity was therefore assessed to address the uncertainty associated with these estimates and the resultant model results. The nitrification and hydrolysis rates are the most important factors that determine total ammonia formation and breakdown as modeled by QUAL2K but temperature was also varied, given its importance in the formation of the toxic, un-ionized fraction of ammonia. Nitrification rates were varied between 4 and 8, hydrolysis rates between 0.05 and 0.2 and temperature from 1 degree below the 75th percentile value to 1 and 2 degrees above it (Table 14).

Table 14. Results of QUAL2K Sensitivity Analysis for 0.43 m^3/s creek flow and 1 mg/L Total Ammonia in Effluent (Full Build Out, Summer)

430 L/s|1.0 mg/L	Hydrolysis = 0.1			Nitrification = 6			Hydrolysis = 0.1, Nitrification = 6		
NH3 (ug/L)	Nitrification rates			Hydrolysis rates			Temperature		
x(km)	4/d	6/d	8/d	0.05/d	0.15/d	0.2/d	- 1 deg C	+ 1 deg C	+ 2 deg C
5.8	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
5.6	2.46	2.37	2.28	2.33	2.40	2.43	2.37	2.37	2.37
5.2	15.06	14.18	13.39	14.13	14.23	14.27	14.00	14.36	14.50
4.8	13.31	11.92	10.75	11.86	11.98	12.04	11.80	12.03	12.11
4.4	12.13	10.40	9.01	10.32	10.47	10.54	10.32	10.46	10.51
4.0	11.32	9.31	7.79	9.23	9.40	9.48	9.28	9.36	9.38
3.6	11.02	8.85	7.23	8.76	8.93	9.02	8.82	8.88	8.89
3.2	10.78	8.45	6.76	8.36	8.54	8.63	8.43	8.47	8.47
2.9	10.58	8.10	6.34	8.00	8.20	8.30	8.09	8.11	8.10
2.4	10.89	7.93	5.95	7.81	8.04	8.16	7.93	7.91	7.89
1.7	10.96	7.57	5.45	7.44	7.71	7.84	7.60	7.55	7.51
1.0	10.79	7.08	4.89	6.93	7.23	7.37	7.13	7.04	6.99
0.3	10.42	6.49	4.30	6.33	6.65	6.81	6.54	6.44	6.38
0.0	10.42	6.49	4.30	6.33	6.65	6.81	6.54	6.44	6.38

Note: The sensitivity analysis was completed using a Full Build Out effluent flow of 0.142 m^3/s and an effluent quality of 1 mg/L.

Lower nitrification rates, higher hydrolysis rates and higher temperatures resulted in higher un-ionized ammonia concentrations. The predicted un-ionized ammonia concentrations in Willow Creek downstream of the proposed discharge were most sensitive to differing nitrification rates, moderately sensitive to hydrolysis rates and insensitive to the small range of effluent temperatures assumed. The highest un-ionized ammonia concentration of 15 µg/L resulted from using a low rate for nitrification (2/d) but was well below the PWQO of 20 µg/L.

6.3 Summary of Far-Field Modelling

The summer low flow Phase 1 and Full Build Out scenarios resulted in dissolved oxygen concentrations above the PWQO at all locations in Willow Creek downstream of the point of complete mixing (Table 15).

Table 15. Overview of QUAL2K Modelling Results for Dissolved Oxygen

Development Phase (Effluent Flow)	CBOD Concentration (mg/L)	Minimum Willow Creek Dissolved Oxygen Concentration and Location
Phase 1 (0.075 m^3/s)	15	8.1 mg/L at 4.4 km
Full Build Out (0.143 m^3/s)		7.8 mg/L at 2.4 km

The summer low flow Phase 1 and Full Build Out scenarios resulted in un-ionized ammonia concentrations below the PWQO at all locations in Willow Creek (Table 16), downstream of the point of complete mixing.

Further, the PWQO for un-ionized ammonia was predicted by CORMIX to be met prior to the point of complete mixing.

The un-ionized ammonia concentrations declined with distance from the outfall and reached concentrations between 6.9 and 7.5 µg/L at the downstream end of the study area, 5.4 km from the point of discharge (Table 16). These concentrations are well below the PWQO.

Table 16. Overview of QUAL2K Modelling Results for Un-ionized Ammonia

Development Phase (Effluent Flow)	Effluent Total Ammonia Concentration (mg/L)	Willow Creek NH_3 Concentration:	
		Maximum after discharge (assuming complete mixing, µg/L)	At 5.2 km downstream of outfall (µg/L)
Phase 1 (0.075 m^3/s)	1.5	16.0	7.5
Full Build Out (0.143 m^3/s)	1	15.5	6.9

7. Summary

Assimilation models for discharge of effluent from the proposed Midhurst WWTP to Willow Creek were run for Phase 1 and Full Build Out effluent flows at a 7Q20 low flow of 0.43 m^3/s for Willow Creek. This 7Q20 was based on 10 years of data (including 10 low flow periods) from the Willow Creek WSC Station 02ED032 at Highway 26. The 7Q20 flow was then modified (i.e., reduced) to account for potential baseflow losses due to the proposed groundwater takings for the Midhurst Secondary Plan (HESL, 2018a).

CORMIX was used to model the nearfield mixing of ammonia after discharge, the QUAL2K model was used to model far field dissolved oxygen and assimilation (nitrification) of ammonia, and a mass balance model was used for total phosphorus, total suspended solids, and nitrate concentrations. Dye tracer testing was conducted in 2009 to calculate time of travel and longitudinal dispersion for use in the far-field model (QUAL2K) of Willow Creek and to provide a one-time calibration of the model using the flow conditions on that date.

CORMIX predicted total distances to complete mixing of 302 m to 361 m, depending on the season (i.e., summer low flow or winter) and the flow at the WWTP (i.e., Phase 1 versus Full Build Out).

The existing water quality record shows that the present-day 75th percentile concentration of total phosphorus in Willow Creek is 0.031 mg/L. Willow Creek is therefore considered a “Policy 2” receiver for TP as it exceeds Ontario Ministry of the Environment and Climate Change’s (MOECC) Provincial Water Quality Objective (PWQO) of 0.03 mg/L. (Our analysis shows, however, a statistically significant relationship between total phosphorus and total suspended solids (TSS) such that Willow Creek is likely only a Policy 2 receiver during periods of high TSS in the creek, such as spring freshet and storm events, and is a Policy 1 receiver the remainder of the time). For the purpose of the assimilative capacity study,

Willow Creek was treated as a Policy 2 receiver. Policy 2 states that *"Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives."* Deviations from Policy 2 may be considered, however, under the regulation of a "Director's Deviation" from the MOECC.

Although Willow Creek is a Policy 2 receiver for total phosphorus, it is resilient to the addition of highly treated WWTP effluent. Adoption of a total phosphorus effluent limit of 0.05 mg/L for Phase 1 would result in phosphorus concentrations between 0.032 mg/L and 0.034 mg/L in Willow Creek and would generate an additional 118 kg/yr of phosphorus loading. An effluent limit of 0.03 mg/L for Full Build Out would reduce total phosphorus concentrations to just below the current value of 0.031 mg/L and add a total of 135 kg/yr of phosphorus loading to the creek. These loadings must be considered against the reductions from stormwater runoff from the development lands, as modelled and described in the *Midhurst Secondary Plan Area Phosphorus Budget – Final Report* (HESL, 2018b). Through implementation of best management practices (BMPs) and low impact development (LIDs), a total of 68 kg/yr reduction in stormwater phosphorus loadings from Pre-Development conditions was predicted with 23 mm of infiltration. These reductions will offset the loadings from the WWTP, reducing the net increase to 66 kg/yr to Willow Creek at Full Build Out. Monthly mass balance modelling showed little change to monthly concentration to total phosphorus, and in all cases, except May minimum flows for Phase 1, the input from the WWTP discharge did increase downstream TP concentrations above the PWQO of 0.03 mg/L. Given this minor increase in phosphorus loadings, and improvement in phosphorus concentrations, a phosphorus offsetting program is not recommended. This is discussed further in HESL (2018b).

The mass balance modeling of TSS found that a TSS effluent limit of 15 mg/L for Phase 1 and 10 mg/L for Full Build Out will improve TSS concentrations in the Creek in some months and increase only marginally in other months. These effluent limits will be discussed with MOECC at the ECA stage and lowered if required.

The mass balance modeling of nitrate found that a TIN effluent limit of 15.4 mg/L for Phase 1 and Full Build Out will maintain nitrate concentrations at or below the CWQG of 3.0 mg-N/L.

The summer low flow Phase 1 and Full Build Out scenarios resulted in dissolved oxygen concentrations above the PWQO at all locations in Willow Creek downstream of the point of complete mixing, with predicted minimum concentrations of 8.1 mg/L at 4.4 km downstream (Phase 1) and 7.8 mg/L at 2.4 km downstream (Full Build Out).

Total ammonia concentrations below 5.3 mg/L would assure that effluent was non-acutely lethal, in accordance with MOE requirements, at effluent pH of 8 or lower and temperature of 20^{o}C and lower. The proposed WWTP effluent ammonia concentrations of 1 and 1.5 mg/L (for Phase 1 and Full Build Out, respectively) would result in effluent un-ionized ammonia concentrations of 0.038 mg/L and 0.057 mg/L, respectively, well below the 0.20 mg/L threshold of acute lethality.

The near field modelling showed that, for both Phase 1 and Full Build Out at summer low flows at effluent ammonia concentrations of 1.5 mg/L and 1 mg/L, respectively, the PWQO for un-ionized ammonia were met prior to the point of complete mixing. For Phase 1 conditions, the total ammonia concentration in the effluent could be as high as 2.2 mg/L and still meet the PWQO by the point of complete mixing. At Full Build Out, the effluent ammonia concentration could be as high as 1.2 mg/L and still meet the PWQO by the point

of complete mixing. In winter, the proposed WWTP effluent ammonia concentrations of 3 mg/L and 2 mg/L were sufficient to meet the PWQO at the point of complete mixing for both Phase 1 and Full Build Out, respectively.

The far field modelling showed that un-ionized ammonia concentrations remained below the PWQO at all locations downstream of the point of complete mixing in the creek under all scenarios. The un-ionized ammonia concentrations declined with distance from the outfall and reached concentrations between 6.9 and 7.5 µg/L at the downstream end of the study area (i.e., 5.4 km downstream) for all scenarios. These concentrations are well within the PWQO and therefore acceptable.

The recommended *E. coli* objective and limit of 100 CFU/100 mL is supportable as it meets the PWQO of 100 CFU/100 mL for body contact recreation.

We recommend that the Environmental Compliance Approval for the proposed WWTP include loading limits for total phosphorus in addition to effluent concentration limits. This would encourage innovative treatment processes by recognizing that the occasional effluent excursion above a compliance limit has a low environmental consequence so long as the annual loading limit is achieved.

8. References

AECOM 2009.
Big Creek Receiving Water Assessment. Technical report prepared for Norfolk County. February 24, 2009. 111 pp.

Beacon Environmental. 2003.
Correspondence to Midhurst Landowners Group September 19, 2013.

Black and Veatch. 2018.
Design Basis for Midhurst Wastewater Treatment Plant, Class EA Phase 3 & 4 for the Midhurst Secondary Plan

Canadian Council of Ministers of the Environment. 2012.
Canadian Water Quality Guidelines for Protection of Aquatic Life. Nitrate Ion. Canadian Council of Ministers of the Environment. 2012.

Canadian Council of Ministers of the Environment. 2002.
Canadian Water Quality Guidelines for Protection of Aquatic Life: Total particulate matter. In Canadian environmental quality guidelines, 1999. Canadian Council of Ministers of the Environment. Winnipeg

Doneker, R.L. and Jirka, G.H. 2007:
CORMIX User Manual.

Gomm, L.S. 1999.
Near Field Mixing of a Vertical Buoyant Jet in a Shallow Crossflow: Implications on Adsorption and Flocculation. Doctoral Thesis, Department of Civil Engineering, University of British Columbia, Vancouver, B.C.

Hutchinson Environmental Sciences Ltd. (HESL). 2018a.
7Q20 Flow Assessment of Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment Report. Report prepared for Midhurst Landowners Group by Hutchinson Environmental Sciences Ltd. May 2018.

Hutchinson Environmental Sciences Ltd. (HESL). 2018b.
Midhurst Secondary Plan Area Phosphorus Budget. Final Report prepared for The Township of Springwater c/o Ainley Group by Hutchinson Environmental Sciences Ltd. May 2018.

Jobson, Harvey E. 2001.
Predicting River Travel Time from Hydraulic Characteristics. Journal of Hydraulic Engineering, Volume 127, Issue 11, pp. 911-918. November 2001.

Louch, J., V. Tatum, P. Wiegand, E. Ebert, K. Connor and P. Anderson 2012. A review of methods for deriving human health-based water quality criteria with consideration of protectiveness. National Council for Air and Stream Improvement.

Ontario Ministry of Environment and Energy 1994.
Policies, Guidelines, Provincial Water Quality Objectives. July 1994. ISBN 0-7778-8473-9 rev.

Ontario Ministry of Environment and Energy 1994b.
Deriving Receiving Water Based Point Source Effluent Requirements for Ontario Waters. Procedure B-1-5 PIBS #3302. July 1994.

Palmer Environmental Consulting Group (PECG). 2014.
Fluvial Geomorphological Assessment of Willow Creek Downstream of Proposed WWTP Discharge, Midhurst ON. Prepared for Midhurst Landowners Group. April 17, 2014.

U.S. Environmental Protection Agency 1985.
Rates, Constants, and Kinetics Formulations in Surface Water Quality Modelling (Second Edition). EPA Number: 600385040. 475 pp.

U.S. Environmental Protection Agency. 2009.
Draft 2009 update aquatic life ambient water quality criteria for ammonia - Freshwater EPA 822-D-09-001. December 2009.

Appendix A. 7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment Final Report (HESL, 2018a)

Hutchinson

Environmental Sciences Ltd.

7Q20 Flow Assessment Update for Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment

Final Report

Prepared for: Township of Springwater c/o
Job #: J130030

May 28, 2018

1-5 Chancery Lane, Bracebridge ON, P1L 2E3 | 705-645-0021

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Environmental Sciences Ltd.

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May 28, 2018 HESL Job #: J130030

J.A. Mullan, P.Eng.
Ainley & Associates Limited
280 Pretty River Parkway
Collingwood, ON L9Y 4J5

Dear Mr. Mullan:

Re: 7Q20 Flow Assessment of Willow Creek at Highway 26 (Near Minesing) and Ecological Low Flow Assessment

This report provides an updated assessment of the 7Q20 flow in Willow Creek at Highway 26, near Minesing. The 7Q20 flow will form the basis for all future receiving water assessments, including mixing zone and far-field modeling and establishment of wastewater treatment plant (WWTP) effluent limits that have been completed as part of Phases 3 and 4 of a Class Environmental Assessment (EA) for the Midhurst Secondary Plan area. The report also provides an Ecological Low Flow Assessment based on the modelled baseflow losses associated with groundwater extraction. The assessment includes presentation of the modelled baseflow losses prepared by Golder (2018), a review of baseflow loss guidelines, and predicted changes in both wetted perimeter and water temperature.

There were 10 years of data available at the time of the assessment, including 10 low flow periods, for the Water Survey of Canada (WSC) Station 02ED032 located on Willow Creek at Highway 26. The WSC 02ED032 dataset was used to calculate a 7Q20 value for Willow Creek. The 7Q20 flow was then modified to account for potential baseflow losses due to the proposed groundwater takings for the Midhurst Secondary Plan, as predicted and described in the *Hydrogeological Study: Midhurst Water Supply Exploration Program, Township of Springwater, Ontario* (Golder Associates 2018). A 7Q20 value between 430 L/s and 464 L/s was determined based on applying statistical distributions to the available data and accounting for the potential baseflow losses. Therefore, we recommend that a 7Q20 flow of 430 L/s be adopted as a conservative value for assimilation modelling in connection with the Class EA process.

Our Ecological Low Flow Assessment concludes that the predicted flow reductions in Willow Creek and its tributaries associated with the proposed water taking to supply the Midhurst Secondary Plan Area will have no significant adverse effects on habitat and water temperature in Matheson, Black and Willow Creeks. Future monitoring completed as part of the Monitoring and Adaptive Management Plan for the development will allow early identification of any unlikely changes and the implementation of mitigation, if required. If you have any questions, please feel free to give me a call.

Sincerely,
per: Hutchinson Environmental Sciences Ltd.



Neil J. Hutchinson, Ph.D.
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Signatures

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Neil J. Hutchinson, Ph.D.
Principal Scientist

Executive Summary

The Township of Springwater is presently carrying out Phases 3 and 4 of a Class Environmental Assessment (EA) to determine the future servicing/infrastructure (water, wastewater, transportation) requirements to accommodate growth associated with the Midhurst Secondary Plan area. A receiving water assessment on Willow Creek was carried out for the wastewater treatment plant as part of the EA process using a representative low flow value for Willow Creek at the proposed discharge location to ensure that the receiving water assessment is protective of Willow Creek over its full range of flows. The Ministry of the Environment and Climate Change (MOECC) typically requires the use of a 7-day average annual low flow with an expected probability equal to a 20-year return period (7Q20) calculated from a minimum of 10 years of data.

The Water Survey of Canada (WSC) has maintained a streamflow gauging station (02ED032) on Willow Creek at Highway 26 (located immediately upstream of the proposed discharge location) since 2006 and reached ten full years of data at the end of March 2016. We used the data from ten low-flow periods at this station to calculate a current 7Q20 for Willow Creek. Applying statistical distributions to the Willow Creek dataset using HYFRAN-PLUS found 7Q20 low flows ranging from 509 L/s to 542 L/s. For comparison, the actual minimum 7-day average flow measured between 2006 and 2016 was 499 L/s, recorded in 2013.

Midhurst is entirely dependent on groundwater for its water supply and about 80 to 90% of the existing Midhurst community's water taking is derived from the Willow Creek watershed. Groundwater pumping rates will gradually increase by full build out of the Midhurst Secondary Plan area and it is important to assess whether the increased water takings may affect flows in Willow Creek over the long term. Therefore, the current 7Q20 for Willow Creek was modified to account for potential baseflow losses due to future increases in groundwater supply well pumping, as predicted and described in the report *Hydrogeological Study: Midhurst Water Supply Exploration Program, Township of Springwater, Ontario* (Golder Associates 2018). The 7Q20 low flow estimate was reduced to 430 L/s to 464 L/s after accounting for predicted baseflow losses to Willow Creek due to future (full build out) water takings. We therefore recommend that a 7Q20 estimate of 430 L/s be adopted as a conservative estimate for assimilation modelling in relation to the Class EA process.

Golder Associates modelled baseflow losses associated with projected groundwater pumping as part of the Class EA and we have assessed the ecological impact of modelled baseflow losses on various watercourses in Midhurst that are located within the modelled area of impact. Modelling completed by Golder established that monthly volumetric baseflow losses as a result of proposed Midhurst Secondary Plan Area pumping at full build out are estimated to range from 985 m^3/day in Willow Creek at Midhurst in August to 2595 m^3/day in April, while percent losses range from 2.5% in Matheson Creek in February to 9.6% in Willow Creek at Midhurst in August (Golder 2016). Modelled baseflow losses are less than the maximum loss guidelines presented in peer-reviewed and regulator-based literature, indicating no threats to aquatic life related to the water takings.

Reductions in wetted stream width (a surrogate of aquatic habitat) were calculated to range from 0.0131 m in August to 0.0149 m in October using data collected from 2015-2017. It was not possible to calculate a breakpoint in accordance with Wetted Perimeter Method protocols but it is clear that predicted changes to the wetted perimeter are a) minute, b) well within natural variation, and c) not anticipated to negatively affect ecosystem functions or features within Willow Creek.

Average summer temperatures in Black Creek and Matheson Creek are estimated to increase by 0.28 and 0.15^{o}C to 14.1 and 14.2^{o}C respectively with maximum temperatures of 17.3 and 16.6^{o}C at the peak level of water taking. The average summer temperature in Willow Creek are predicted to increase from 19.4 to 20^{o}C and maximum temperature from 23.7 to 24.4^{o}C.

In summary, substantial baseline monitoring has been completed to characterize fish communities and habitat, including water temperatures, and detailed flow surveys are being collected to further refine the Wetted Perimeter Method as part of the Monitoring and Adaptive Management Plan. This monitoring will continue into the future construction and post-construction periods to assess any unlikely impacts and determine if adaptive management associated with stormwater, and wastewater management or groundwater extraction is required for mitigation.

In summary, the predicted potential effects on habitat and water temperature in Matheson, Black and Willow Creeks associated with groundwater takings will not significantly affect aquatic the habitat. Future monitoring will allow early identification of any unlikely changes and the implementation of mitigation, if required.

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Appendices

Appendix A. HYFRAN-PLUS Tabular and Graphical Output (Current Conditions 7Q20)
Appendix B. HYFRAN-PLUS Tabular and Graphical Output (Future Conditions 7Q20)

1. Introduction

The Township of Springwater has completed Phases 3 and 4 of a Class Environmental Assessment (EA) to determine the servicing/infrastructure (water, wastewater, transportation) requirements to accommodate growth associated with the Midhurst Secondary Plan area. One of the objectives of the Class EA is to ensure that impacts to the natural environment are minimized and that appropriate mitigation measures are employed. The Class EA work is being undertaken by Ainley & Associates Limited on behalf of the Township.

One of the key elements of the required infrastructure is a new wastewater treatment plant (WWTP) which is proposed to be located along Snow Valley Road near Wilson Drive. In 2009, the study team for the Phases 1 and 2 Midhurst Class EA for Servicing recommended Willow Creek at Highway 26 as the preferred receiver. The treated effluent from the WWTP is proposed to be conveyed via a new sewer west along Snow Valley Road, north on Wilson Drive, and west along Highway 26 where it will be discharged into Willow Creek.

A representative low flow value must be confirmed for Willow Creek at the proposed discharge location to assure that the receiving water assessment results in protective effluent limits. The Ministry of the Environment and Climate Change (MOECC) typically requires the use of a 7-day average annual low flow with an expected probability equal to a 20-year return period (7Q20). Typically, a 7Q20 flow is calculated through the statistical analysis of daily flow data collected from a long term gauging station containing at least ten years' worth of data. The Water Survey of Canada (WSC) has maintained a streamflow gauging station (02ED032) on Willow Creek, located immediately upstream of the proposed discharge location, since 2006. As of 2016, when the ACS was completed, there was 10 years' worth of data available for this station, including 10 low flow periods (typically experienced in summer/early fall).

Assessments of the Willow Creek (at Minesing) 7Q20 flow were previously carried out by AECOM (2009) and Hutchinson Environmental Sciences Limited (HESL 2010) with less than ten years' worth of data. Because of the limited dataset at the time of these reports, the flow assessments used a regional flow analysis and multiple regression relationships between the Willow Creek subwatershed and other similar subwatersheds. As of 2016, however, there was ten years of flow data available at the Willow Creek at Minesing station (02ED032) and so these statistical estimation methodologies were no longer required.

Midhurst is entirely dependent on groundwater for its water supply and about 80 to 90% of the existing Midhurst community's water taking is derived from the Willow Creek watershed. At full build out of the Midhurst Secondary Plan area, groundwater takings will gradually increase by an average of 13,130 m^3/d (152 L/s). It is prudent that the 7Q20 flow be representative of future Willow Creek flows at full build out, since the main objective of calculating the 7Q20 flow is to inform the assimilative capacity assessment for the future wastewater treatment plant. As such, the current 7Q20 was modified to account for potential baseflow losses due to future increases in groundwater supply well pumping, as predicted and described in the Golder Associates' *Report on Carson and Doran Neighbourhoods Proposed Water Supply Groundwater Modelling* which appears as Appendix M in the Golder Associates Report *Hydrogeological Study: Midhurst Water Supply Exploration Program, Township of Springwater, Ontario*, (Golder Associates 2018).

The following report details the calculation of the current and future predicted 7Q20 for Willow Creek as follows:

a. Section 2 presents the methodology and results of the current 7Q20 flow assessment;

b. Section 3 presents the methodology and results of the predicted future 7Q20 flow assessment; and

c. Section 4 presents conclusions and recommendations.

2. Current 7Q20 Flow Assessment - Willow Creek (Highway 26) WSC Station 02ED032

As of mid 2016 there was 10 years of data, including 10 low flow periods, available for the WSC Station 02ED032 located on Willow Creek at Highway 26 (1 April 2006 through 27 April 2016).

Figure 1 presents the average daily flows recorded at this WSC Station between 2006 and 2016. The largest daily flows measured since the WSC station was installed in 2006 were 21,100 L/s measured on both April 8, 2008 and April 12, 2014 (Figure 1). The minimum single daily flow was 484 L/s, recorded on August 21, 2013, and the minimum 7-day average flow was 499 L/s calculated on August 25, 2013 (Table 1).

Table 1. Minimum Daily and 7-Day Average Flows for Willow Creek at Hwy. 26.

	Minimum Average Daily Flow (L/sec) and Corresponding Date		Minimum 7-Day Average Flow (L/sec) and Corresponding Dates	
2006 through 2016	484	August 21, 2013	499	August 25, 2013

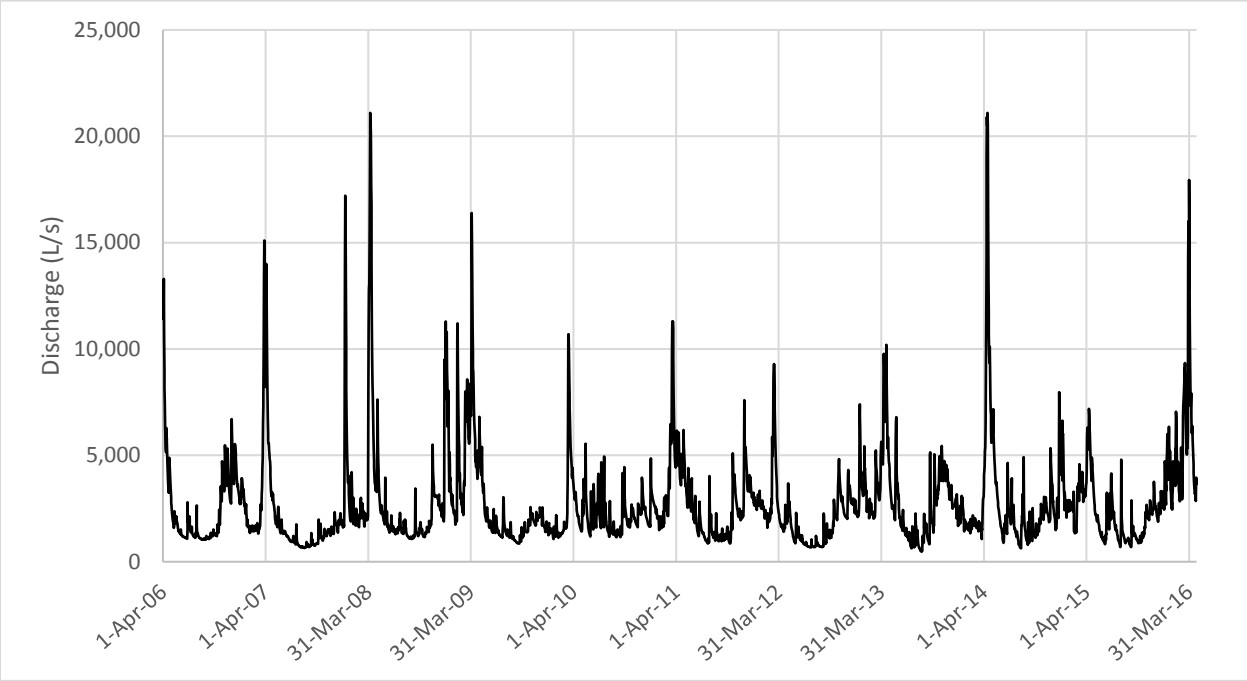


Figure 1. Average Daily Flows for Willow Creek at Hwy. 26 Between 2006 and 2016

Figure 2 highlights the lowest flows measured each year since 2006 at the Willow Creek WSC Station at Highway 26 (near Minesing). The lowest annual measured flows ranged from 484 L/s (August 2013) to 1,060 L/s (March 2008 and January 2010).

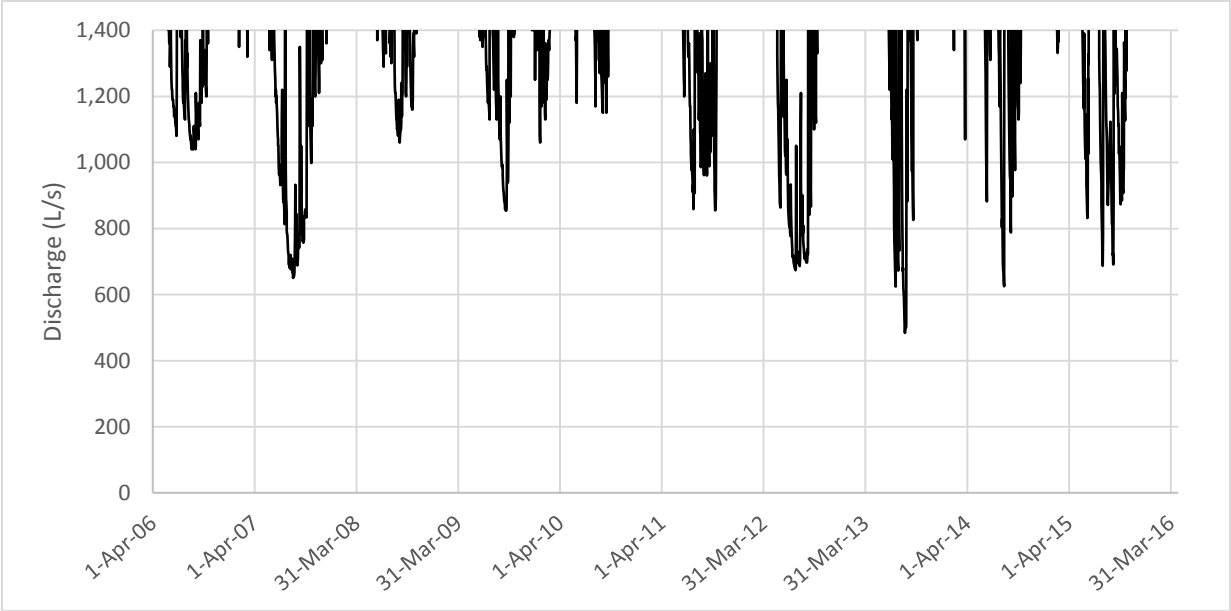


Figure 2. Average Daily Flows for Willow Creek at Hwy. 26 Between 2006 and 2016, Highlight of Lowest Flows

Table 2 presents the flow statistics for the WSC Station at Willow Creek (at Highway 26) including the minimum daily flow, the maximum daily flow and the 5th, 10th, 25th, median, and 75th percentile flows. Figure 3 graphically presents the minimum, maximum, 25th percentile, median, and 75th percentile flows on an annual scale for the 2006 through 2016 time period.

Table 2. Average Daily and 7-Day Average Flow Statistics, 2006 through 2016 (L/sec).

	Minimum Flow	5th Percentile Flow	10th Percentile Flow	25th Percentile Flow	Median Flow	75th Percentile Flow	Maximum Flow
Daily Value	484	847	1,040	1,370	2,040	3,100	21,100
7-Day Average	499	904	1,078	1,394	2,079	3,104	18,929

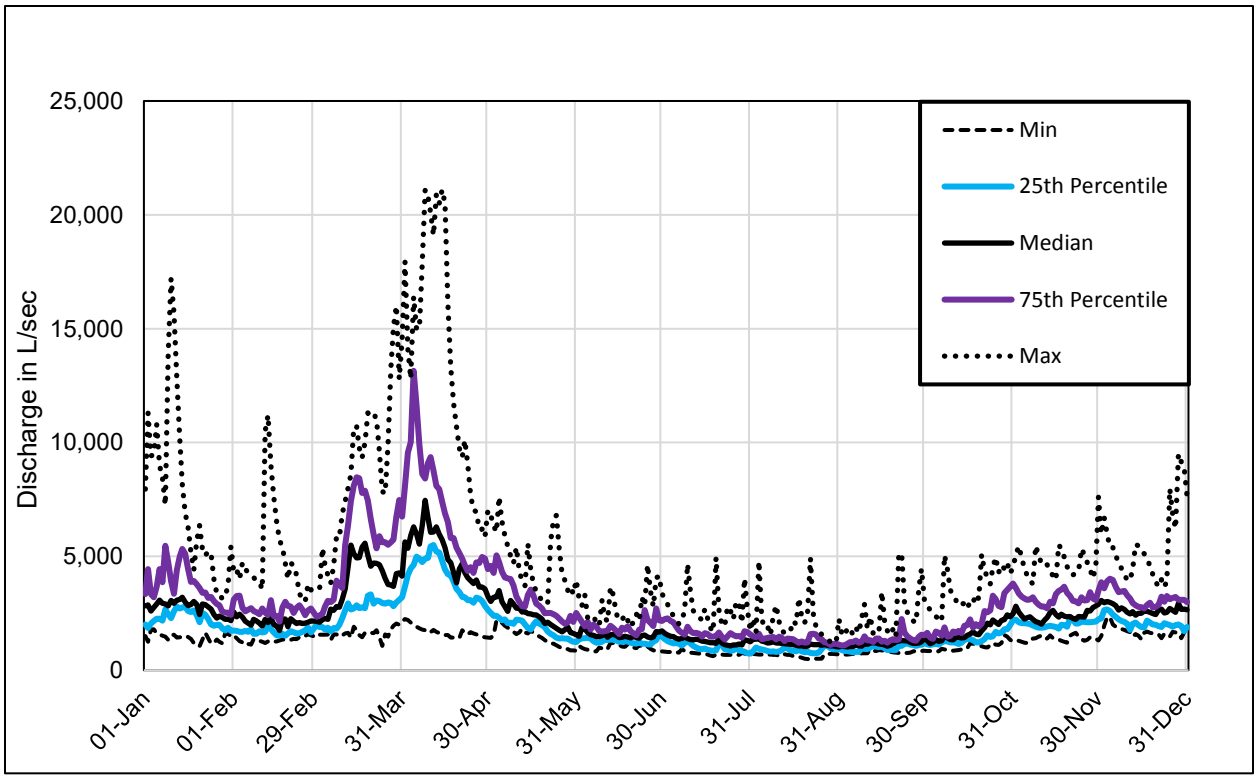


Figure 3. Annual Flow Statistics for Willow Creek at Hwy. 26, 2006 through 2016

The current 7Q20 low flow was calculated as 904 L/s, based on the 5th percentile (i.e., 1 in 20 year probability) of all 7-day averaged flows from the data collected at the WSC Station 02ED032 between 2006 and 2016 (Table 2).

The 7Q20 low flow was also calculated using a statistical distribution software package (HYFRAN-PLUS) along with the annual 7-day minimum flows calculated from the 2006 through 2016 dataset. (Note that the 2016 data is not complete and was therefore not included in the statistics review). HYFRAN-PLUS is a hydrological data software package that allows for the fitting of sixteen different statistical distributions to a dataset of extreme values (i.e., either flood or drought events) (Bobée, 2008). The software also contains a decision support system (DSS) to provide guidance in selecting the most appropriate distribution or class of distributions to use in fitting a dataset. The goodness of fit to a particular statistical distribution is then calculated in HYFRAN-PLUS using the Chi-Square test.

The HYFRAN-PLUS DSS determined the regular varying distribution functions (i.e., Inverse Gamma, Log Pearson Type 3, Fréchet [Extreme Value 2], and Halphen Type Inverse B distributions) to be the most appropriate with which to fit the Willow Creek (at Highway 26) dataset for 2006 to 2015 annual minimum 7-day flows; however, the Chi-Square test to judge the goodness of fit to each distribution function could not be carried out because the sample size was too small. As such, the 7Q20 low flow was calculated for all regular variation distribution functions for the sake of comparison. The estimated 7Q20 flow values for these distributions are presented in Table 3.

Table 3. Estimated 7Q20 Flows for Willow Creek at Highway 26 based on the Application of Regular Varying Distribution Functions using HYFRAN-PLUS.

Distribution Type	Estimated 7Q20 (L/s)
Inverse Gamma	542
Log Pearson Type 3	527
Fréchet (Extreme Value 2)	509
Halphen Type Inverse B	520

The 7Q20 flow estimates ranged from 509 L/s to 542 L/s for the 2006 through 2016 Willow Creek WSC Station 02ED032 dataset. HYFRAN-PLUS tabular results and graphical analyses of the data versus the statistical distribution are presented in Appendix A. Although goodness of fit could not be statistically determined given the small sample size, all of the regular varying distribution functions (i.e., Inverse Gamma, Log Pearson Type 3, Fréchet [Extreme Value 2], and Halphen Type Inverse B) visually appeared to fit the data well.

Environment Canada has typically recommended fitting the Gumbel distribution to flow data, while the United States has recommended using the Log Pearson Type 3 distribution. Recent literature (Millington, 2011) has shown that the Generalized Extreme Value (GEV) distribution and the Halphen Type A and B distributions perform better than the Gumbel distribution for smaller sample sizes. Regardless, with respect to Willow Creek, the narrow range of 7Q20 values estimated by the various distributions (i.e., 509 L/s to 542 L/s) support a true current 7Q20 flow in this range.

3. Predicted Future 7Q20 Flow Assessment

Midhurst is entirely dependent on groundwater for its water supply and about 80 to 90% of the existing Midhurst community's water taking is derived from the Willow Creek watershed. The community is currently serviced by eight wells in two wellfields (Midhurst and Paddy Dunn's Circle), with an average water taking of 1,300 m^3/d (15 L/s). In addition, the City of Barrie has an average (2010) water taking of 40,208 m^3/d (465 L/s) from the area. From Section 2, under the current water taking volumes, the statistical estimate of the 7Q20 for Willow Creek is 509 L/s to 542 L/s.

At full build out of the Midhurst Secondary Plan area, groundwater takings (i.e., water supply) will gradually increase to an average of 13,130 m^3/d (152 L/s). It is prudent that the 7Q20 flow be representative of Willow Creek flows predicted into the future at full build out, since the main objective of calculating the 7Q20 flow is to inform the assimilative capacity assessment for the future wastewater treatment plant. As such, the current 7Q20 was modified to account for potential baseflow losses due to future increases in groundwater supply well pumping, as predicted and described in Golder Associates (2018). This report is summarized in Section 3.1.

3.1 Summary of Predicted Additional Baseflow Losses from *Hydrogeological Study*: *Midhurst Water Supply Exploration Program, Township of Springwater, Ontario* (Golder Associates 2018)

The 2018 Golder Associates report describes the groundwater modelling undertaken to estimate the hydrogeological effects of the groundwater supply well pumping to service the Midhurst Secondary Plan area.

The groundwater modelling was conducted using the 3-dimensional Kempenfelt Bay FEFLOW model, with refinements in the Midhurst and surrounding Willow Creek watershed areas, for two scenarios: 1) existing conditions; and 2) future conditions (i.e., the addition of the nine Carson and Doran neighbourhood pumping wells at full build out rates). The existing conditions model was calibrated with monthly baseflow estimates for Willow Creek. The existing conditions model then formed the baseline for creating the future conditions model. The future conditions model delineated the capture zones for the existing and proposed pumping wells, and predicted aquifer drawdown and baseflow changes as a result of the additional water demand.

The FEFLOW model found a seven month or longer delay between pumping increase/decrease and associated baseflow response. Baseflow losses as a percent of current baseflows (i.e., existing conditions) are amplified during summer months when recharge is lower. By contrast, maximum water demand generally occurs in summer, so that maximum pumping losses of baseflow would be expressed on winter flows, given the seven month delay.

The future conditions model (Table 4, as provided by Golder Associates [D. Hannan, personal communication, February 12, 2016]) predicted an average baseflow loss ranging from 3.3% of existing baseflow (for the month of April) to 7.2% (for the month of October). The model predicted a minimum average baseflow loss ranging from 79 L/s (for the month of August) to a maximum baseflow loss of 120 L/s (for the month of March). Note that the predicted minimum and maximum additional baseflow losses

as a percentage of current baseflow do not coincide with the same month as the minimum and maximum baseflow losses as a flow because the baseflows themselves vary from month to month.

Table 4. Predicted Additional Baseflow Losses for Willow Creek near Minesing (WSC 02ED032)

Month	Average Baseflow Loss (m^3/d)	Average Baseflow Loss (L/s)	Average % Baseflow Loss
JAN	7,624	88	5.5
FEB	7,325	85	4.7
MAR	10,375	120	3.9
APR	9,444	109	3.3
MAY	8,961	104	4.8
JUN	8,569	99	6.2
JUL	7,222	84	6.5
AUG	6,863	79	6.8
SEP	7,153	83	6.9
OCT	7,241	84	7.2
NOV	7,802	90	6.3
DEC	7,887	91	5.7

3.2 Approach to Incorporating the Predicted Additional Baseflow Losses

The 7Q20 flow value is a statistical derivation and is not tied to any one particular date. The low flow period in Willow Creek each year is typically experienced in summer/early fall, as shown in Table 5. The monthly average baseflow loss (Table 4) was therefore subtracted from the daily flows from the corresponding month from the WSC Station 02ED032 dataset. All daily flows measured in any one month had the same baseflow loss subtracted. Following this, the “baseflow-adjusted” 7-day average flows for the entire 10-year dataset were re-calculated using HYFRAN-PLUS. The 7Q20 statistics, as were originally carried out for the 2006-2015 Willow Creek WSC 02ED032 dataset, were then repeated.

Table 5. Seven-Day Average Minimum Flows for Willow Creek (from WSC 02ED032)

Year	Minimum 7-Day Low Flow (L/s)	Dates of 7-Day Low Flow
2006	1,049	Aug 19-25
2007	657	Aug 16-22
2008	1,086	Sept 1-7
2009	859	Sept 15-21
2010	1,203	Aug 27-Sept 2
2011	915	Oct 6-12
2012	681	July 19-25
2013	499	Aug 19-25
2014	704	Aug 2-8
2015	777	Sept 1-7

3.3 Modified 7Q20 Results

Table 6 presents the yearly minimum 7-day average flows, as measured at the WSC Station, along with the computed minimum 7-day average flows incorporating the future additional baseflow losses, as outlined in Section 3.2.

Table 6. Yearly Minimum 7-Day Average Flows for Willow Creek (WSC 02ED032), Existing and Incorporating Predicted Baseflow Losses

Year	Minimum 7-Day Average Flow (L/s)	Minimum 7-Day Average Flow Incorporating Future Additional Baseflow Losses (m^3/s)
2006	1,049	969
2007	657	578
2008	1,086	1,003
2009	859	776
2010	1,203	1,122
2011	915	831
2012	681	598
2013	499	420
2014	704	625
2015	777	694

The minimum 7-day average flow incorporating future potential baseflow losses (predicted from all groundwater takings at full build out) was 420 L/s for the 2013 flow data. By comparison, the year 2013 had the lowest minimum 7-day average measured flow under existing conditions of 499 L/s (Section 2). The future conditions 7-day average low flows were decreased by between 79 L/s and 84 L/s from existing conditions after consideration of additional water takings. This number was not consistent for each year because the annual minimum 7-day average low flow was measured during different months or over a span of two months (as shown in Table 5) and the amount of baseflow subtracted from the daily WSC flows varied on a monthly basis.

The annual minimum 7-day average flows for the 2006 through 2015 dataset (both existing and future predicted 7-day average flows, Table 6) were input into the HYFRAN-PLUS software package to estimate the 7Q20 statistic. Table 7 presents the estimated 7Q20 flow under the regular varying distribution functions (i.e., Inverse Gamma, Log Pearson Type 3, Fréchet [Extreme Value 2], and Halphen Type Inverse B) for existing and future conditions. HYFRAN-PLUS tabular results and graphical analyses of the data versus the statistical distribution are presented in Appendix B.

Table 7. Estimated 7Q20 Flows for Willow Creek (WSC 02ED032) based on the Application of Regular Varying Distribution Functions using HYFRAN-PLUS, Existing Conditions and Future Conditions Incorporating Predicted Additional Baseflow Losses

Distribution Type	Current Estimated 7Q20 (L/s)	Modified 7Q20 (L/s) Incorporating Predicted Future Additional Baseflow Losses
Inverse Gamma	542	464
Log Pearson Type 3	527	449
Fréchet (Extreme Value 2)	509	430
Halphen Type Inverse B	520	442

The resulting 7Q20 flow estimates for the future conditions dataset ranged from 430 L/s to 464 L/s. A 7Q20 flow of 430 L/s is therefore recommended as a conservative value to be used for assimilation modelling in support of the prosed wastewater treatment plant.

4. Conclusions and Recommendations

Ten years of flow data, which included 10 low flow periods from the WSC Station 02ED032 located on Willow Creek at Highway 26 was combined with potential additional baseflow losses to Willow Creek due to future groundwater pumping requirements (Golder Associates 2018) to calculate a future 7Q20 to inform the Assimilative Capacity Study for the proposed Midhurst WWTP. The following conclusions were drawn:

- Between 2006 and 2016, the lowest measured flows each year in Willow Creek at Highway 26 ranged from 484 L/s (2013) to 1,060 L/s (2008 and 2010). The minimum 7-day average calculated flow was 499 L/s for the 7 days ending on August 25, 2013.

- The 7Q20 flow calculated from the 5th percentile (i.e., 1 in 20 year probability) of all 7-day averaged flows from the data collected at the WSC Station 02ED032 between 2006 and 2016 was 904 L/s.

- HYFRAN-PLUS was used to apply a variety of statistical distributions to the 2006 through 2015 Willow Creek WSC 02ED032 dataset. The resulting 7Q20 flow estimates ranged from 509 L/s to 542 L/s[1].

- The predicted additional monthly average potential baseflow loss due to future groundwater pumping was subtracted from each daily flow from the WSC Station 02ED032 dataset. All daily flows measured in any one month had the same baseflow loss subtracted.

- HYFRAN-PLUS was used to apply a variety of statistical distributions to the modified 2006 through 2015 Willow Creek WSC 02ED032 dataset. The resulting "future condition" 7Q20 flow estimates ranged from 430 L/s to 464 L/s.

We therefore recommend that the 7Q20 flow of 430 L/s be adopted as a conservative estimate for assimilation modelling in relation to the Class EA process.

5. Ecological Low Flow Assessment

The municipal servicing of water to the Midhurst Secondary Plan Area (SPA) will draw water from regional aquifers A3 and A4. There is some connection between these aquifers and the shallow aquifers A2 and A1 that provide groundwater to local area creeks which support cold water fisheries. As a result, the potential that the water taking may reduce flows or water levels and alter fish habitat must be assessed. Details of the interaction between the proposed water supply and the groundwater system are provided in *Hydrogeological Study, Midhurst Water Supply Exploration Program, Township of Springwater, Ontario* (Golder Associates 2018).

We assessed the potential impacts to aquatic biota associated with groundwater taking in the study area through the following approaches:

1) A review of Golder's groundwater modelling results.
2) A review of literature to determine ecological guidelines associated with water level drawdown through a desktop approach.
3) Predicted changes in wetted perimeter of tributaries as a surrogate for habitat.
4) A thermal mass balance calculation to predict changes in water temperature in relation to habitat requirements of sensitive, resident coldwater fish species.
5) A review of baseline monitoring efforts and adaptive management.

[1] *Note that the 7Q20 derived using the 5th percentile is calculated using the entire daily flow dataset from 2006 to 2016 (i.e., 3,593 data points), whereas the 7Q20 values calculated in the HYFRAN-PLUS software use only the minimum 7-day average flow from each year, which represent the extreme left tail of the distribution. The 5th percentile value of the ten minimum 7-day average flows is 570 L/s, which is similar in range to the 7Q20 values predicted using HYFRAN-PLUS.*

5.1 Groundwater Modelling

Golder Associates modelled baseflow losses in Matheson Creek, Black Creek and Willow Creek based on average climatic conditions and maximum permitted pumping rates for the summer period. Pumping rates were pro-rated as a function of these maximum rates for the remainder of the year based on existing Midhurst usage. Modelled baseflow losses are presented as both m^3/day and % in Table 8 (Hannan. D. (Golder Associates), Re: Baseflow Loss – Midhurst, Message to B. Parsons, December 4, 2017. E-Mail).

Table 8. Modelled Baseflow Losses

Month	Matheson Creek		Black Creek		Willow Creek at Midhurst	
	Loss (m^3/day)	% Loss	Loss (m^3/day)	% Loss	Loss (m^3/day)	% Loss
JAN	2325	3.8	1383	6.4	1671	5.2
FEB	2306	3.5	1336	6	1694	4.2
MAR	2470	2.5	1869	7.1	2131	2.6
APR	2465	2.3	1822	6.3	2595	2.5
MAY	2166	2.8	1878	7.2	2288	4.5
JUN	2096	3.4	1515	6.6	1929	7.4
JUL	2107	4	1529	7.2	1161	8.4
AUG	2245	4.5	1684	8.3	985	9.6
SEP	2390	4.7	1744	8.7	1110	8.5
OCT	2403	4.9	1669	8.4	1118	9
NOV	2542	4.5	1546	7.4	1612	6.4
DEC	2402	4	1447	6.8	1786	5.6
AVG	*2326*	*3.7*	*1619*	*7.2*	*1673*	*6.2*

Monthly estimates of volumetric baseflow losses ranged from 985 m^3/day in Willow Creek in August to 2595 m^3/day in April, while percent losses ranged from 2.5% in Matheson Creek in February to 9.6% in Willow Creek in August. Average monthly volumetric baseflow loss was highest in Matheson Creek (2326 m^3/day), while average percent loss was highest in Black Creek (7.2%).

5.2 Ecological Low Flow Guidelines

A variety of ecological flow guidelines have been developed to provide scientists and decision-makers with management tools for assessing potential flow alterations and any resulting impacts on aquatic features and functions. Such guidelines are intended as screening tools, in that maintaining flows within them is considered to have no significant effect, whereas flows that exceed guidelines warrant further detailed analysis to determine if the exceedances represent a significant loss to ecological habitat. Guidelines have been developed for various parts of Canada based on general hydrological and

ecological traits of watercourses prevalent in those areas. Most guidelines are focused on predicted changes in surface water flows because of direct surface water taking, while fewer focus on predicted changes to streamflow resulting from losses of groundwater inflow to watercourses.

Groundwater is a sensitive habitat feature in the study area as coldwater thermal regimes and elevated dissolved oxygen concentrations support a variety of cold water fish species, and groundwater upwellings provide both overwintering habitat for a variety of fish and critical spawning habitat for Brook Trout (*Savelinus fontinalis*) and Brown Trout (*Salmo trutta*).

Fisheries and Oceans Canada (Fisheries and Oceans Canada (DFO) 2013) state that flow alterations <10% of the instantaneous flow *"…have a low probability of detectable impacts to ecosystems that support commercial, recreational or Aboriginal fisheries based on "expert consensus""* and recommend that site-specific studies should be completed where flows are subjected to >10% flow alteration. The modelled baseflow losses presented in Table 8 are predicted on the basis of maximum permitted pumping rates during summer and are less than the 10% instantaneous flow guideline recommended by DFO to determine the need for more rigorous level of assessment as flow alterations <10% have a "low probability of detectable impacts to ecosystems" (DFO 2013).

The Ontario Ministry of Natural Resources (MNR) and Ontario Ministry of Environment ((MOE) (MNR and MOE 2011) compared consumptive water demand to water supply and developed thresholds which reflect Ontario's climate, including summer peak water demand. Surface water and groundwater stress levels were developed in accordance with monthly surface water level demands and both annual and monthly groundwater demands (Tables 9 and 10). They advise that additional assessment of threats to aquatic life is required if water demands exceed the thresholds.

Monthly surface water (Table 9) and ground water (Table 10) demands of <20% and <25% respectively represent a low stress level and so the maximum demands of 2.5 – 9.6% predicted for the Midhurst SPA represent a low probability of stress to aquatic life.

Table 9. Surface Water Quantity Stress Threshold (MNR/MOE 2011).

Surface Water Quantity Stress Level Assignment	Maximum Monthly Percent Water Demand
Significant	>50%
Moderate	20%-50%
Low	<20%

Table 10. Groundwater Quantity Stress Threshold (MNR/MOE 2011).

Groundwater Quantity Stress Level Assignment	Monthly Maximum Percent Water Demand
Significant	>50%
Moderate	>25%
Low	0-25%

MNR/MOE (2011) also developed more conservative stress thresholds for coldwater streams. An unacceptable impact is defined by a reduction in groundwater discharge of more than 20% of average monthly baseflow. Localized areas are assigned moderate risk if groundwater discharge is reduced between 10% - 20% of existing monthly baseflow. These thresholds are directly applicable to Midhurst as they represent the response of surface water to removal of groundwater, and not to direct surface water takings.

Gleeson and Richter (2017) determined that high-levels of ecological protection are provided if groundwater pumping decreases monthly baseflow by <10% through time.

The modelled baseflow losses of 2.5 – 9.6% presented in Table 8 which are based on the maximum permitted pumping rates for the summer period, therefore represent a “Low” probability of stress for Black Creek, Matheson Creek and Willow Creek and do not require additional assessment of water budget requirements.

Linnansaari et al. (2013) compared approaches to deriving ecological flow thresholds and listed a number of advantages to Percentage of Flow (POF) methods such as those discussed above. Advantages include:

- POF methods suggest allowable deviation from natural flow regime, rather than assigning specific volume of flow to be maintained, which is more protective of flow variability.
- POF methods reduce scientific uncertainty because they consider only the magnitude of flow altered and not the timing, duration or frequency.
- POF methods are easy to implement and understand.

The modelled baseflow losses presented in Table 8 do not account for inputs that may mitigate loss of groundwater, such as infiltration of stormwater to local shallow groundwater systems. Nonetheless, the modelled percent flow losses shown in Table 8 remain less than the most stringent guidelines of 10% presented in peer-reviewed and regulator-based literature and so will not adversely affect existing aquatic habitat and ecological functions. Although the predicted losses do not exceed the guidelines, we have provided more detailed analyses in the following sections.

5.3 Changes in Wetted Perimeter

The Wetted Perimeter Method is a hydraulic rating method commonly used in Canada and the USA to assess ecological flow thresholds through an assessment of habitat quantity (Kilgour et al. 2005). A relationship between wetted perimeter (potential habitat area) and discharge is developed at a site and a breakpoint is identified along the curve, below which the aquatic habitat conditions for benthic invertebrates rapidly decline as the water level drops.

Willow Creek was selected for our analysis because the highest monthly % baseflow reductions were predicted in the study reach as compared to Black or Matheson Creeks. Existing data that were used to measure flows in Willow Creek approximately 100 m downstream of Finlay Mill Road in 2015, 2016 and 2017 (HESL 2018a) were used to develop a wetted perimeter-discharge curve (Table 11; Figure 4). These data are adequate for calculation of flows but not precise enough for a clear determination of the breakpoint below which aquatic habitat conditions for benthic invertebrates rapidly decline. Nonetheless, the information provides an indication of the relationship between discharge and wetted width in Willow

Creek and the equation of the trendline can be used to estimate changes in wetted width associated with future groundwater takings.

Table 11. Wetted Perimeter and Discharge Measurements Collected from Willow Creek Between 2015 and 2017.

Date	Discharge (m^3/sec)	Wetted Perimeter (m)
18-Jun-15	0.949	9
30-Jul-15	0.204	8.5
20-Aug-15	0.895	8
31-Aug-15	0.269	7.6
14-Sep-15	0.435	7.7
30-Sep-15	0.297	7.2
18-May-16	1.323	8.4
16-Jun-16	0.1387	7.6
5-Jul-16	0.0823	7.2
11-Aug-16	0.0452	7.6
14-Aug-16	0.1093	7.6
3-Oct-16	0.1088	7.5
21-Oct-16	0.1936	7.6
24-Jul-17	1.0458	8.6
25-Aug-17	0.098	7.2
11-Sep-17	0.0779	7
25-Sep-17	0.0823	7.4
30-Oct-17	0.3185	8.6
22-Nov-17	1.2786	9.2

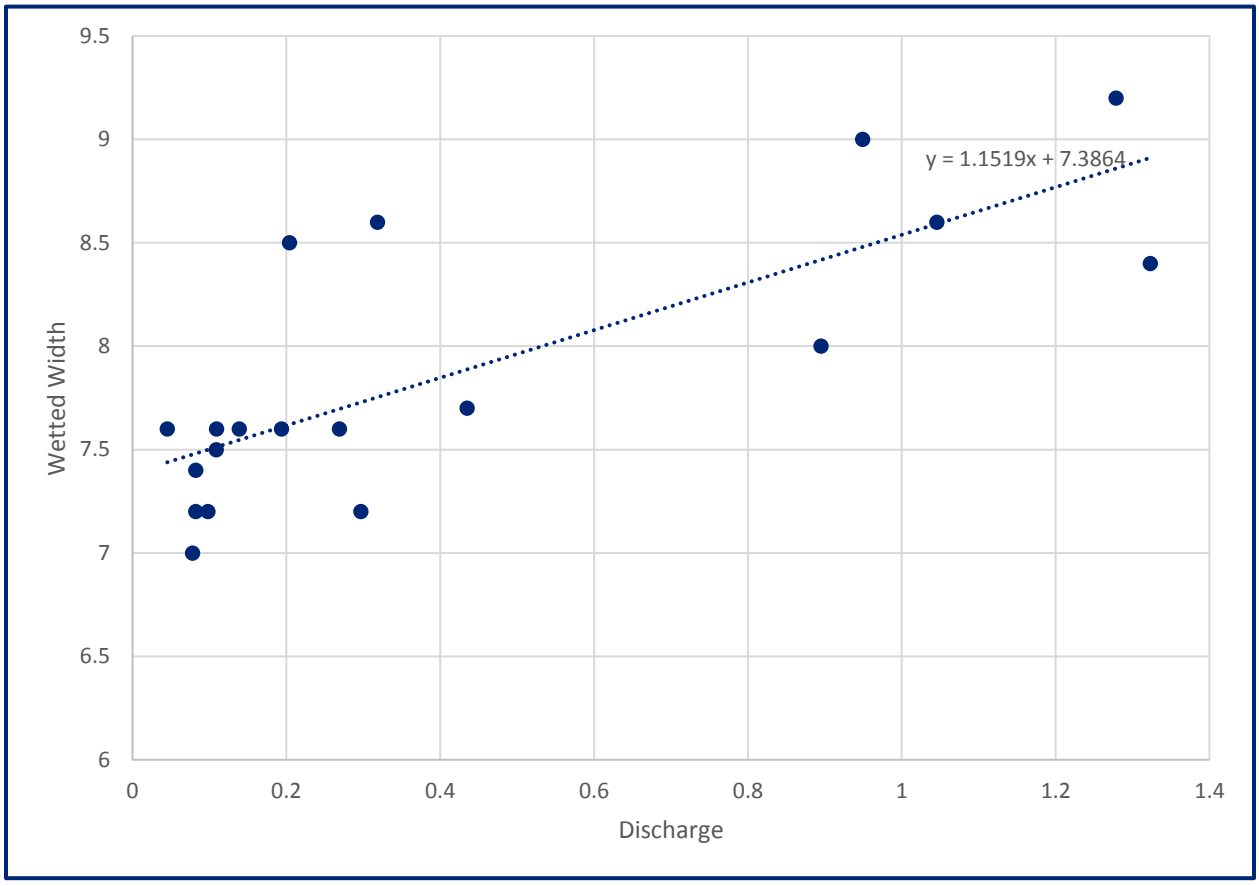


Figure 4. Wetted Width-Discharge Relationship in Willow Creek Downstream of Finlay Mill Road.

Changes in wetted width were assessed in Willow Creek for August, September and October 2017 because continuous data were available for that period and those months were predicted to have the greatest percentage baseflow loss associated with future groundwater takings (Table 8). Changes in wetted width were also predicted on the three days of the lowest measured discharge: July 5, 2016, August 11, 2016 and September 11, 2017.

Predicted changes in wetted width and supporting data are provided in Tables 12 and 13. Data includes:

- Discharge values measured in the field with a flow meter (Table 12 and 13)
- Wetted width calculated from the wetted width-discharge trendline equation (Table 12 and 13)
- Wetted width measured in the field (Table 11)
- Average discharge values less volumetric baseflow losses presented in Table 8
- Future predicted wetted width resulting from baseflow loss (Tables 12 and 13)
- Resulting changes in wetted width (Tables 12 and 13)

Changes in wetted width were calculated to range from 0.013 m to 0.015 m (Table 12). Predicted changes during low flows were similar as changes in wetted perimeter were based on the same trendline equation and volumetric baseflow loss (Table 13). It is clear that predicted changes to the wetted perimeter are minute (13-15mm of a stream width of 7.5m or <0.5%) and well within natural variation

Table 12. Predicted Changes in Continuously Measured Wetted Width Associated with Groundwater Takings.

Month	Average Discharge (m^3/sec)	Modelled Wetted Width (m)	Discharge less Groundwater Takings (m^3/sec)	Future Predicted Wetted Width (m)	Change in Wetted Width (m)	Change in Wetted Width (%)
AUG	0.11	7.52	0.10	7.50	0.013	0.17%
SEPT	0.13	7.53	0.12	7.52	0.015	0.2%
OCT	0.31	7.75	0.30	7.73	0.015	0.19%

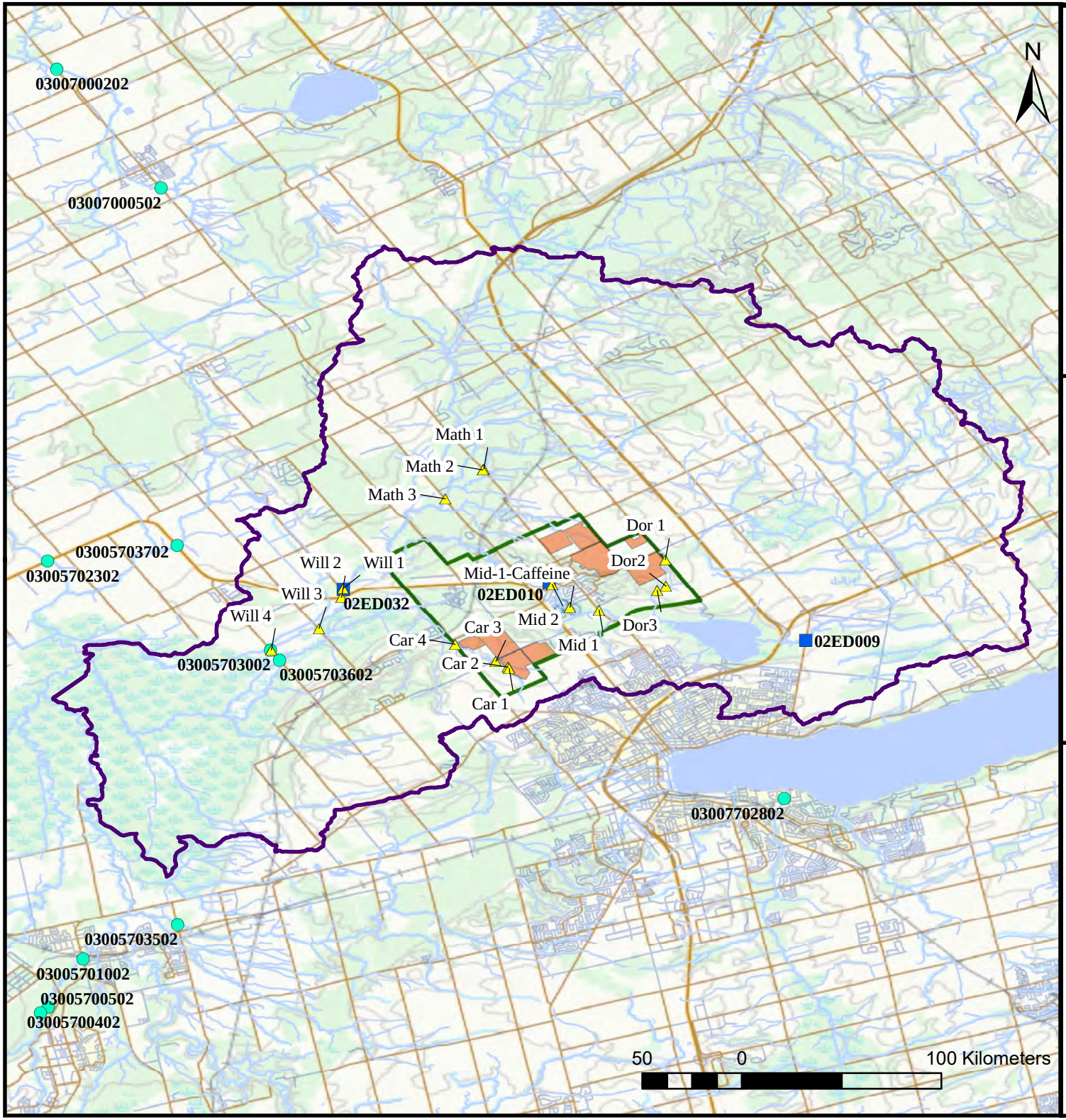
Table 13. Predicted Changes in Wetted Width Associated with lowest Measured Discharge Due to Groundwater Takings

Date	Measured Discharge (m^3/sec)	Measured Wetted Width (m)	Discharge less Groundwater Takings (m^3/sec)	Future Predicted Wetted Width (m)	Change in Wetted Width (m)	Change in Wetted Width (%)
JUL 5, 2016	0.08	7.2	0.07	7.18	0.015	0.22%
AUG 11, 2016	0.05	7.6	0.03	7.59	0.013	0.17%
SEPT 11, 2017	0.08	7.0	0.30	6.99	0.015	0.21%

5.4 Willow Creek Mass Balance Thermal Calculation

A mass balance thermal calculation was used to predict the response of Willow Creek and its tributaries to any loss of base flow and cool groundwater inputs during the summer period of maximum stream temperatures and low flows. Three sites were modelled using the records of flow and temperature obtained by HESL between 2015 and 2017 for the baseline studies (Figure 5; HESL 2018a, HESL 2018b, HESL 2018c):

- Black Creek at Wilson Road (Site SWC), a cold water watercourse that drains the Carson Neighbourhood, supports a reproducing brook trout population, and has records of flow and temperature from the summer of 2015 (May 13 – August 31).
- Matheson Creek at County Road 27 (Site Math3) is a cold water creek that will receive stormwater flow from the Midhurst Heights development which forms a portion of the Doran Neighbourhood and has records of flow and temperature from the summer of 2016 (May 18 – August 31).
- Willow Creek at Finlay Mill Road (Site Mid2) in Midhurst is the cool-warm water main stem of Willow Creek that will receive a portion of the stormwater flow from the Doran Neighbourhood and has records of flow and temperature from the late summer of 2017 (July 25 – August 31).



Legend

- Baseline Monitoring Sites
- Water Survey of Canada Stations
- PWQMN Stations
- Draft Plan Boundaries
- Lakes
- Rivers
- Midhurst Settlement Area Boundary
- Willow CreekWatershed

Figure 5:
Willow Creek
Watershed

Project: Midhurst Baseline
Monitoring Program

Project #: J140054

Project Lead: Brent Parsons
Prepared by: Kris Hadley
Data Source: HESL,Ontario Land
Coordinate System: WGS 1984

Hutchinson
Environmental Sciences Ltd.

Estimates of the potential reductions in groundwater flow during the summer months were provided by Golder Associates (Table 8. pers. comm. Devin Hannan, November 2017). These are considered to be the maximum potential volumetric reductions as a result of using the maximum permitted pumping rates for summer. The modelled flow losses were estimated for the much greater catchment areas of Willow Creek, Black Creek and Matheson Creek than those at the monitoring point and thus overestimate the potential losses for the MSPA in the upper portions of the watershed. These flow losses were converted to percentage reductions in baseflow and applied to the low flow measurements made by HESL to estimate the losses to the creeks and any resultant changes in temperature.

Daily stream flow records for each site were obtained as described in the baseline reports prepared by HESL for the Midhurst SPA (HESL 2018 a,b,c). The streamflow hydrograph is made up of surface and ground water components with the proportion of groundwater increasing as surface runoff decreases after a rain event and as summer proceeds. Minimum flows in the Midhurst SPA occur in mid to late summer but the actual contributions of surface and ground water to total flow during these periods is not known. We therefore made a conservative assumption that all creek flow over the period of the simulation was groundwater such that all flow was considered “baseflow”.

Groundwater temperatures were estimated from records of “stream bed temperature” data provided for local groundwater streams within the NVCA watershed by Golder Associates (John Easton. pers. comm. December 2017). These data showed an approximately linear increase in temperature from 8^{o}C - 12^{o}C between May and September. These increases and rates of increase were assumed for the groundwater portion of the thermal model and applied to the daily estimates.

The calculation used the measured daily flow records for each creek and reduced these by the percentage reductions provided in Table 8 for each creek and each month of simulation. This calculation estimated the response to the potential loss of groundwater to each creek at full Midhurst SPA build out. The heat content of the total creek flow (temperature x flow) was adjusted by the heat content (cooling) contributed by the groundwater (groundwater loss x groundwater temperature) to calculate the heat content of the resultant new (lower) flow in the streams. The revised heat content (temperature x flow) was then divided by the reduced flow to estimate the resultant temperature increases (Table 14).

Table 14. Predicted temperature response of Midhurst area tributaries to reduced groundwater inputs in summer.

	Black Creek	Matheson Creek	Willow Creek
Simulation Period	**May 13-Aug 31 2015**	**May 18 - Aug 31 2016**	**July 25 - Aug 30 2017**
Baseline			
Mean Temperature	13.8	14.0	19.4
Maximum Temperature	16.7	16.4	23.7
75th Percentile Temperature	14.6	15.2	21.2
Model Scenario Pumping at Full Build Out			
Mean Temperature	14.1	14.2	20.0
Maximum Temperature	17.3	16.6	24.4
75th Percentile Temperature	14.9	15.4	21.9
Change			
Mean Temperature	0.28	0.15	0.61
Maximum Temperature	0.66	0.25	0.72
75th Percentile Temperature	0.34	0.19	0.68

Average summer temperatures in Black Creek and Matheson Creek are estimated to increase by 0.28 and 0.15^{o}C to 14.1 and 14.2^{o}C respectively, with maximum temperatures of 17.3 and 16.6^{o}C. The average summer temperature in Willow Creek will increase from 19.4 to 20^{o}C and maximum temperature from 23.7 to 24.4^{o}C. Current and predicted future flows and temperatures are plotted for each creek in Figures 5 - 7.

Figure 6. Current and predicted future flows and temperatures for Black Creek at Wilson Drive.

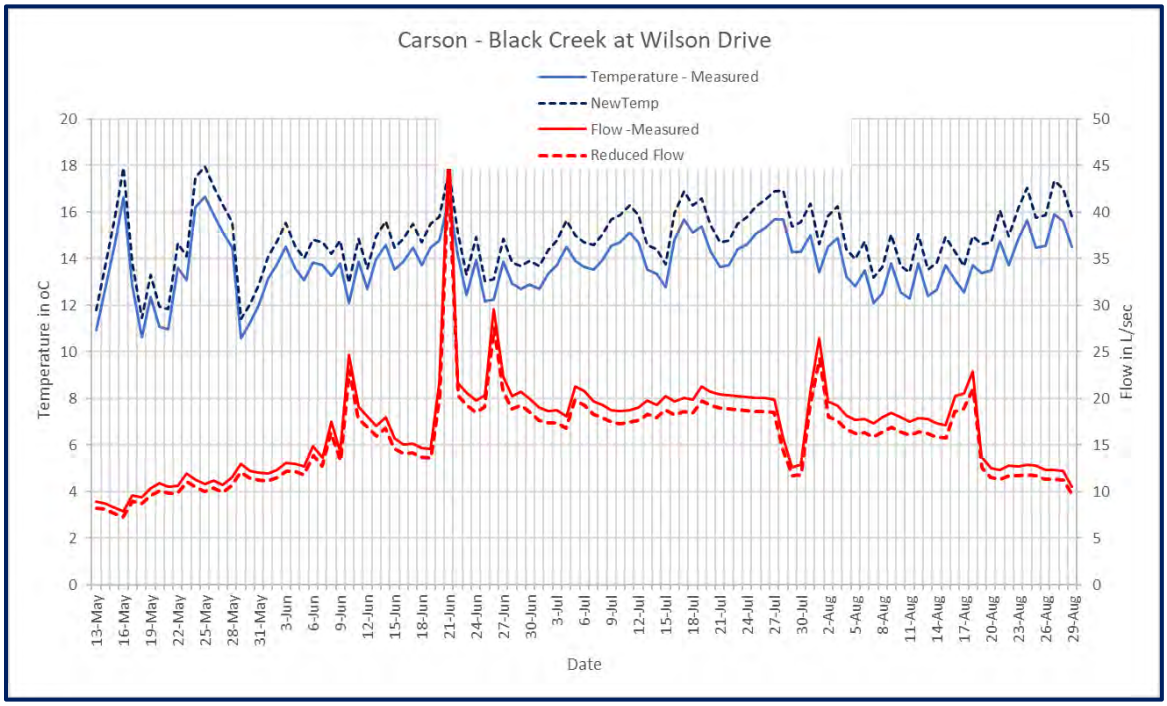


Figure 7. Current and predicted future flows and temperatures for Matheson Creek at CR 27.

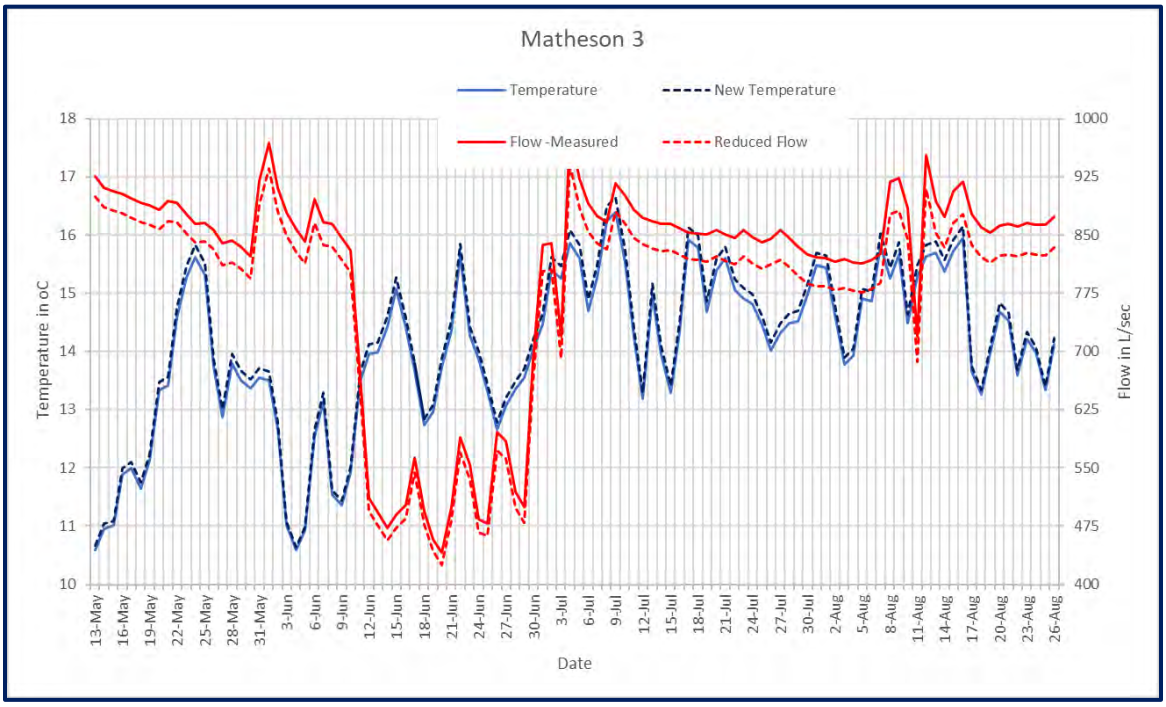
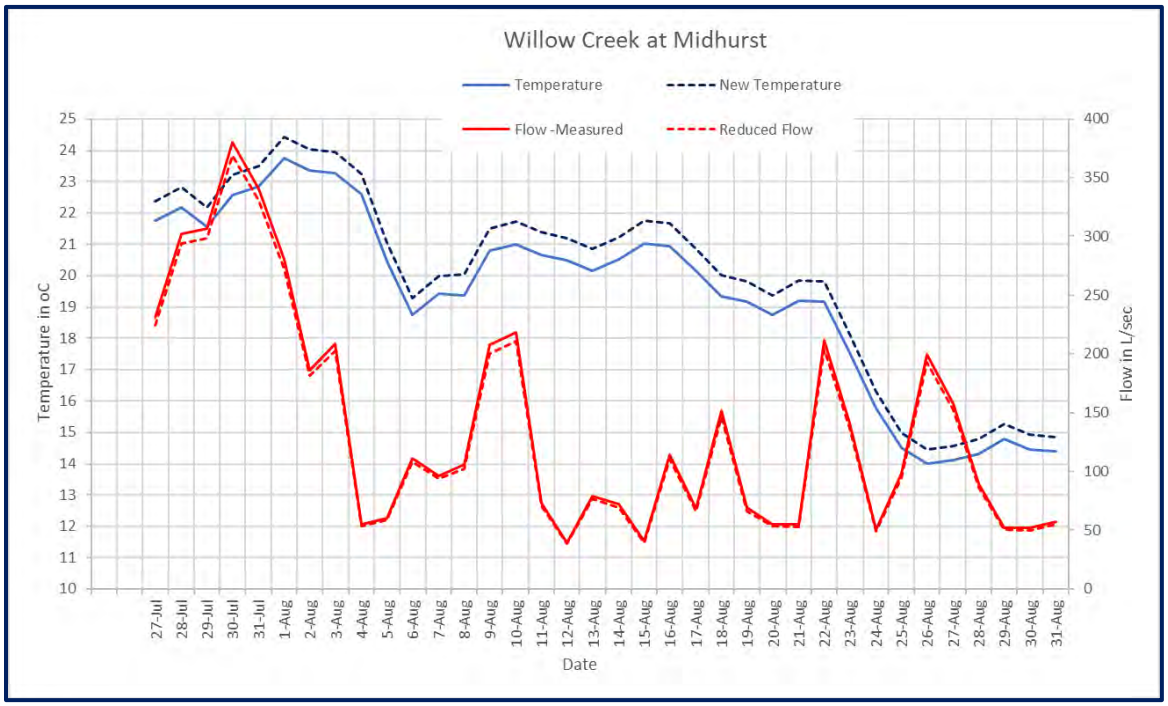


Figure 8. Current and predicted future flows and temperatures for Willow Creek in Midhurst.



The Provincial Water Quality Objective for water temperature is, *"The natural thermal regime of any body of water shall not be altered so as to impair the quality of the natural environment. In particular, the diversity, distribution and abundance of plant and animal life shall not be significantly changed."* (MOE 1994). The determination of "significantly" is difficult to define but NVCA has requested that aquatic communities should not be impacted by the proposed Midhurst developments. Predicted changes in water temperature are best assessed against habitat requirements of a keystone species and in this case, appropriate target species are Brook Trout in Matheson and Black Creeks, and Brown Trout in Willow Creek since those species are known to occupy the study reaches under investigation (HESL 2018a,b,c).

Brook trout are sensitive to changes in water temperature because they do not tolerate water temperatures greater than 19 – 20 °C for long (Gibson 1966). Brook trout are known to seek thermal refuge within streams at small scales (Ebersole et al. 2001) but a general upper tolerance of 19 – 20 °C is evident throughout the literature. The predicted temperature changes in Black and Matheson Creek will still maintain creek temperatures well below the upper tolerance limits of Brook Trout.

Reported temperature limits for Brown Trout include a range from 12 - 19°C to support good growth and survival (US Department of the Interior 1986) and 27.2°C as an upper limiting, near lethal water temperature (Needham 1969). The predicted changes to water temperature associated with groundwater taking are <0.75°C and will maintain creek temperatures well below the upper limiting temperature requirements of Brown Trout.

Daily temperatures in Black Creek and Matheson Creek are <19°C at present and all predicted temperatures will remain below 19°C (Figures 6 and 7). Daily temperatures in Willow Creek exceeded the 19°C upper limit of the range defined to support good growth and survival on 25 of the 35 days modelled under current conditions (Figure 7) and resident fish have adapted to these localized conditions and have the ability to seek cool water refuge. The thermal model predicted that temperatures will exceed 19°C on 27 of the 35 days under the maximum water taking, an increase of 2 days.

5.5 Baseline Monitoring and Adaptive Management Review

An Adaptive Monitoring and Management Plan to implement any necessary mitigation measures will be in place as part of the Midhurst Secondary Plan Master Drainage Plan. Baseline monitoring was initiated by Gartner Lee Limited in 2008 to characterize existing conditions in various watercourses that could be impacted by the development. Building on the data collected in 2008, HESL expanded the monitoring program and have collected baseline data since 2014. Baseline sampling is ongoing. Sampling includes collection and interpretation of water quality, flows, benthic invertebrates and fisheries at 16 sampling stations to identify any changes to surface water from the proposed methods of stormwater management, wastewater management or groundwater drawdown, and provide guidance for the design and any necessary mitigation of the future developments. Information from baseline monitoring informs the ongoing development and implementation of the Adaptive Monitoring and Management Plan. Sampling locations are included on Figure 5 and include:

- 3 sampling locations in Matheson Creek (Math 1-3)
- 3 sampling locations in an unnamed creek that drains to Little Lake (SW1-3)
- 2 sampling locations in Willow Creek within the Village of Midhurst (Mid-1 and Mid-2)
- 4 additional sampling locations in Willow Creek from Golf Course Road to George Johnston Road (Will 1-4), and
- 4 sampling locations in a tributary to Black Creek (SWTrib, SWA-C)

The dataset describes natural inter-annual variation within the watercourses and provides a robust description of baseline water quality and ecological condition for future assessment. Future monitoring will continue to characterize water quality, flows, benthic invertebrates and fisheries, but will also be focused on collecting data to inform the site-specific assessment of ecological low flows via the Wetted Perimeter Method.

Efforts will include detailed flow measurements at various riffle habitats where groundwater pumping is modelled to influence surface water levels so that the Wetted Perimeter Method can be further refined. Modelled baseflow losses and resulting surface water drawdown results will be compared to the breakpoints to predict ecological impact and provide a baseline with which future conditions can be compared to determine the presence or absence of impacts and provide for any necessary mitigation.

5.6 Conclusions

Modelling completed by Golder (2016) established that monthly volumetric baseflow losses as a result of proposed MSPA pumping at full build out are estimated to range from 985 m^3/day in Willow Creek at Midhurst in August to 2595 m^3/day in April, while percent losses range from 2.5% in Matheson Creek in

February to 9.6% in Willow Creek at Midhurst in August. Average monthly volumetric baseflow loss was highest in Matheson Creek (2326 m^3/day), while percent loss was highest in Black Creek (7.2%).

1. Ecological Low Flow Guidelines

Modelled baseflow losses are less than the maximum loss guidelines presented in peer-reviewed and regulator-based literature, indicating no threats to aquatic life related to the water takings.

2. Changes in Wetted Perimeter

Changes in wetted width were calculated to range from 0.0131 m in August to 0.0149 m in October using data collected from 2015-2017. As noted previously, it is not possible to calculate a breakpoint in accordance with Wetted Perimeter Method protocols but it is clear that predicted changes to the wetted perimeter are a) minute, b) well within natural variation, and c) not anticipated to negatively affect ecosystem functions or features within Willow Creek.

3. Thermal Mass Balance Model

Average summer temperatures in Black Creek and Matheson Creek are estimated to increase by 0.28 and 0.15^{o}C to 14.1 and 14.2^{o}C respectively with maximum temperatures of 17.3 and 16.6^{o}C. The average summer temperature in Willow Creek at Mid-2 will increase from 19.4 to 20^{o}C and maximum temperature from 23.7 to 24.4^{o}C.

4. Monitoring and Adaptive Management

Substantial baseline monitoring has been completed to characterize baseline fish communities and habitat, including water temperatures and water quality and flow measurements have been made. The baseline monitoring will be refined in 2018 to collect the detailed stream cross-sectional data required for the Wetted Perimeter Method as part of the Monitoring and Adaptive Management Plan (HESL 2018a,b,c). This monitoring will continue into the future construction and post-construction periods to assess any potential impacts and determine if adaptive management associated with stormwater, wastewater management or groundwater extraction is required to mitigate any potential impacts.

In summary, the predicted potential effects on habitat and water temperature in Matheson, Black and Willow Creeks associated with groundwater takings will not adversely affect the habitat and future monitoring will allow early identification of any potential changes and the implementation of mitigation, if required.

6. References

AECOM. Letter to Ms. Shauna Dudding, Midhurst Landowners Group, *Willow Creek at Midhurst, 7Q20 Flow Assessment*, dated December 24, 2009.

Bobée, B. *HYFRAN-PLUS for Windows, User Manual*. 2008.

Ebersole, J.L., Liss, W.J., and C.A. Frissell. 2001. Relationship Between Stream Temperature, Thermal Refuge and Rainbow Trout Abundance in Arid Land Streams in the Northwestern United States. Ecology of Freshwater Fish 10:1-10.

Fisheries and Oceans Canada. 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/017.

Gibson, R.J. 1966. Some Factors Influencing the Distribution of Brook Trout and Young Atlantic Salmon. Journal of the Fisheries Research Board of Canada 23: 1977-1980.

Gleeson, T. and B. Richter. 2017. How much groundwater can we pump and protect environmental flows through time? Presumptive standards for conjunctive management of aquifers and rivers. River Research and Applications.

Golder Associates. 2018. *Report on Carson and Doran Neighbourhoods Proposed Water Supply Groundwater Modelling*, appearing as Appendix M in the Golder Associates report *Midhurst Water Supply Program, Township of Springwater, Ontario*, 2018.

Golder Associates. 2018. Hydrogeological Study, Midhurst Water Supply Exploration Program, Township of Springwater, Ontario

Hutchinson Environmental Sciences Limited. *Response to March 2010 MOE Comments on December 24, 2009 AECOM Report "Willow Creek at Midhurst – 7Q20 Flow Assessment"*, July 2010.

Hutchinson Environmental Sciences Ltd. 2018a. Baseline Aquatic Studies for Midhurst Development – Village of Midhurst 2015-2016. Prepared for Midhurst Landowners Group

Hutchinson Environmental Sciences Limited. 2018b. Baseline Aquatic Studies for Midhurst Development – Carson Road Development. Prepared for Midhurst Landowners Group

Hutchinson Environmental Sciences Limited. 2018c. Baseline Aquatic Studies for Midhurst Secondary Plan – Midhurst Heights Development. Prepared for Midhurst Landowners Group.

Kilgour, B.K., Neary,, J., Ming, D. and D. Beach. 2005. Preliminary Investigations of the Use and Status of Instream -Flow-Needs Methods in Ontario with Specific Reference to Application with Hydroelectric Developments. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2723.

Linnansaari, T., W.A. Monk, D.J. Baird and R.A. Curry. 2013. Review of approaches and methods to assess Environmental Flows across Canada and internationally. DFO. Can. Sci. Advis. Sec. Res. Doc. 2012/039. Vii + 75 pp.

Millington, N., S. Das, and S.P. Simonovic. *The Comparison of GEV, Log Pearson Type 3, and Gumbel Distributions in the Upper Thames River Watershed Under Global Climate Models*. University of Western Ontario, Department of Civil and Environmental Engineering. September 2011.

Ministry of Environment. 1994. Provincial Water Quality Objectives.

Ministry of Natural Resources and Ministry of Environment. 2011. Water Budget and Water Quantity Risk Assessment Guide, Drinking Water Source Protection Program.

Needham, P.R. 1969. Trout Streams (Revised Edition). Winchester Press, New York. 241 pp.

US Department of the Interior. 1986. Habitat Suitability Index Models and Instream Flow Suitability Curves: Brown Trout. Fish and Wildlife Service.Water Survey of Canada. *Real-time Data and Historical Data for WSC Station 02ED032 (Willow Creek at Highway 26, near Minesing),* downloaded February 10, 2016.

Appendix A. HYFRAN-PLUS Tabular and Graphical Output (Current Conditions 7Q20)

HYFRANPLUS
(c) INRS-ETE, 2002

Willow Creek 7Q20

Inverse Gamma (Maximum Likelihood)

Results of the fitting

Number of observations : 10

Parameters

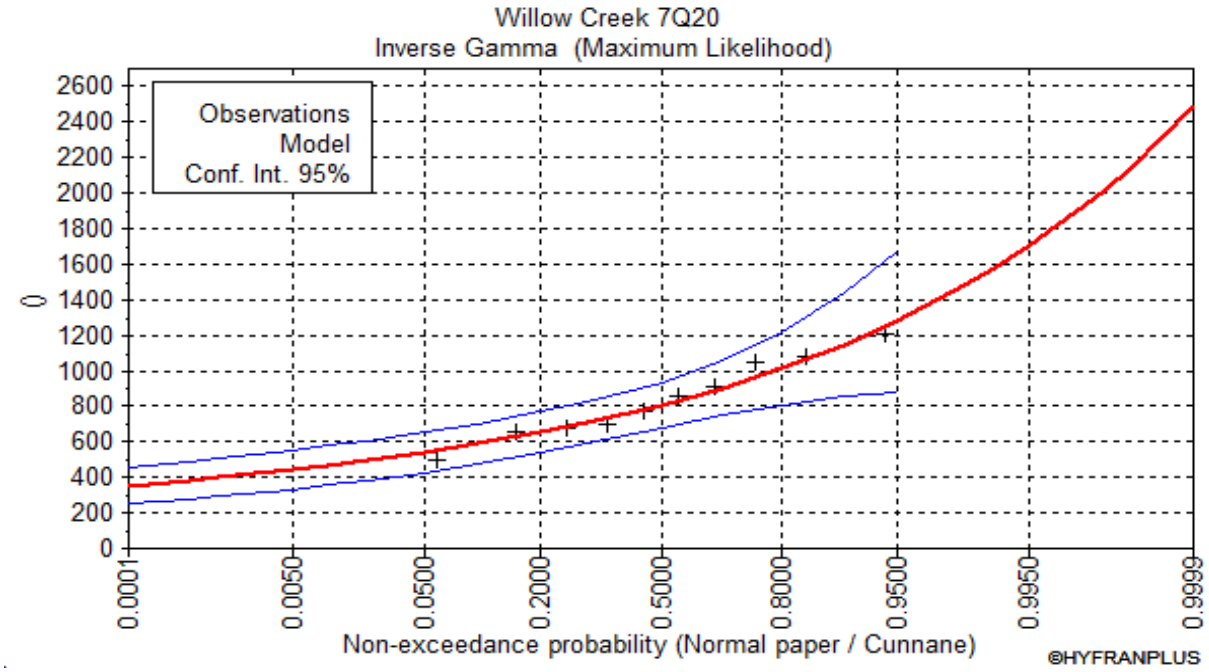
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Quantiles

q = F(X) : non-exceedance probability
T = 1/q

T	q	XT	Standard deviation	Confidence interval (95%)
10000.0	0.0001	351	51.7	250 - 453
2000.0	0.0005	382	53.5	277 - 487
1000.0	0.0010	398	54.3	291 - 504
200.0	0.0050	442	56.1	333 - 552
100.0	0.0100	467	56.7	355 - 578
50.0	0.0200	495	57.3	383 - 607
20.0	0.0500	542	57.9	429 - 656
10.0	0.1000	589	58.2	475 - 703
5.0	0.2000	654	58.6	539 - 769
3.3	0.3000	707	59.7	590 - 824
2.0	0.5000	807	65.7	678 - 936
1.5000	0.6667	905	79.1	750 - 1060
1.2500	0.8000	1010	104	809 - 1220
1.1111	0.9000	1150	148	857 - 1440
1.0526	0.9500	1280	204	879 - 1680
1.0204	0.9800	1450	292	N/D
1.0101	0.9900	1580	371	N/D
1.0050	0.9950	1710	460	N/D
1.0010	0.9990	2020	711	N/D
1.0005	0.9995	2150	841	N/D
1.0001	0.9999	2490	1200	N/D

Willow Creek 7Q20



HYFRANPLUS
(c) INRS-ETE, 2002

Willow Creek 7Q20

Log-Pearson type 3 (Méthode SAM)

Results of the fitting

Number of observations : 10

Parameters

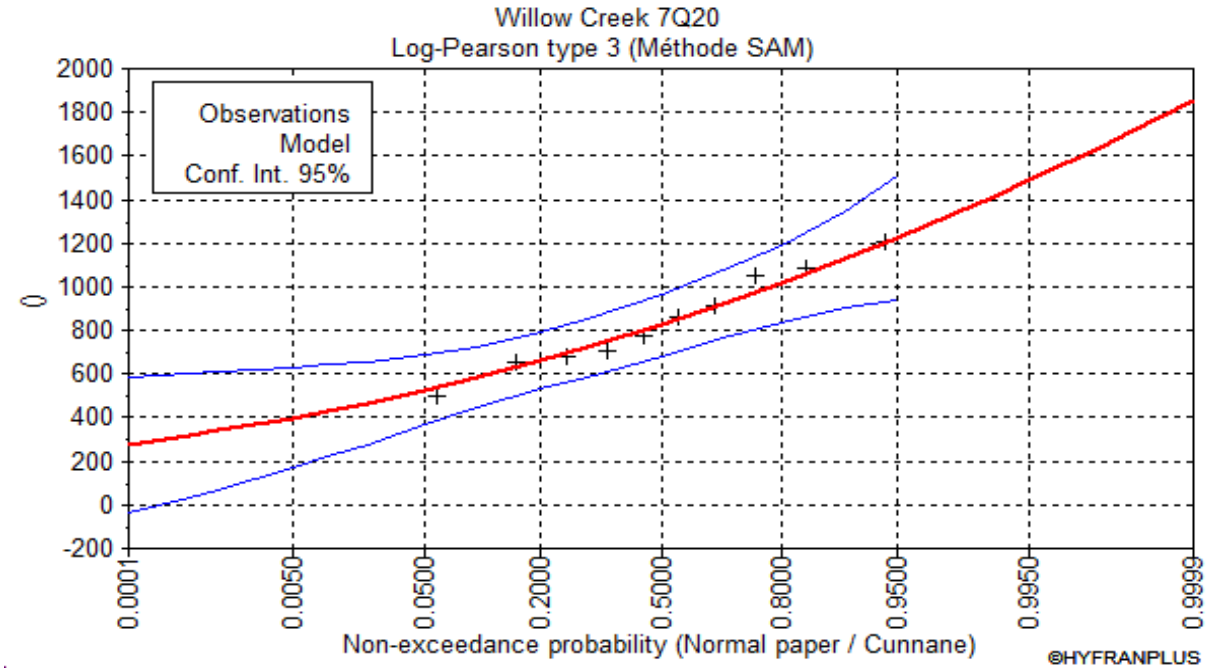
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Quantiles

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2000.0	0.0005	318	145	33.3 - 603
1000.0	0.0010	340	138	68.5 - 611
200.0	0.0050	399	118	168 - 631
100.0	0.0100	431	108	219 - 643
50.0	0.0200	468	97.0	278 - 658
20.0	0.0500	527	82.1	366 - 688
10.0	0.1000	585	72.1	443 - 726
5.0	0.2000	661	66.3	531 - 791
3.3	0.3000	719	66.5	589 - 850
2.0	0.5000	825	72.1	683 - 966
1.5000	0.6667	920	79.1	765 - 1070
1.2500	0.8000	1010	90.0	838 - 1190
1.1111	0.9000	1120	112	906 - 1340
1.0526	0.9500	1220	144	939 - 1500
1.0204	0.9800	1340	206	N/D
1.0101	0.9900	1410	265	N/D
1.0050	0.9950	1490	332	N/D
1.0010	0.9990	1650	518	N/D
1.0005	0.9995	1710	608	N/D
1.0001	0.9999	1850	833	N/D

Willow Creek 7Q20



HYFRANPLUS
(c) INRS-ETE, 2002

Willow Creek 7Q20

GEV (Maximum Likelihood)

Results of the fitting

Number of observations : 10

Parameters

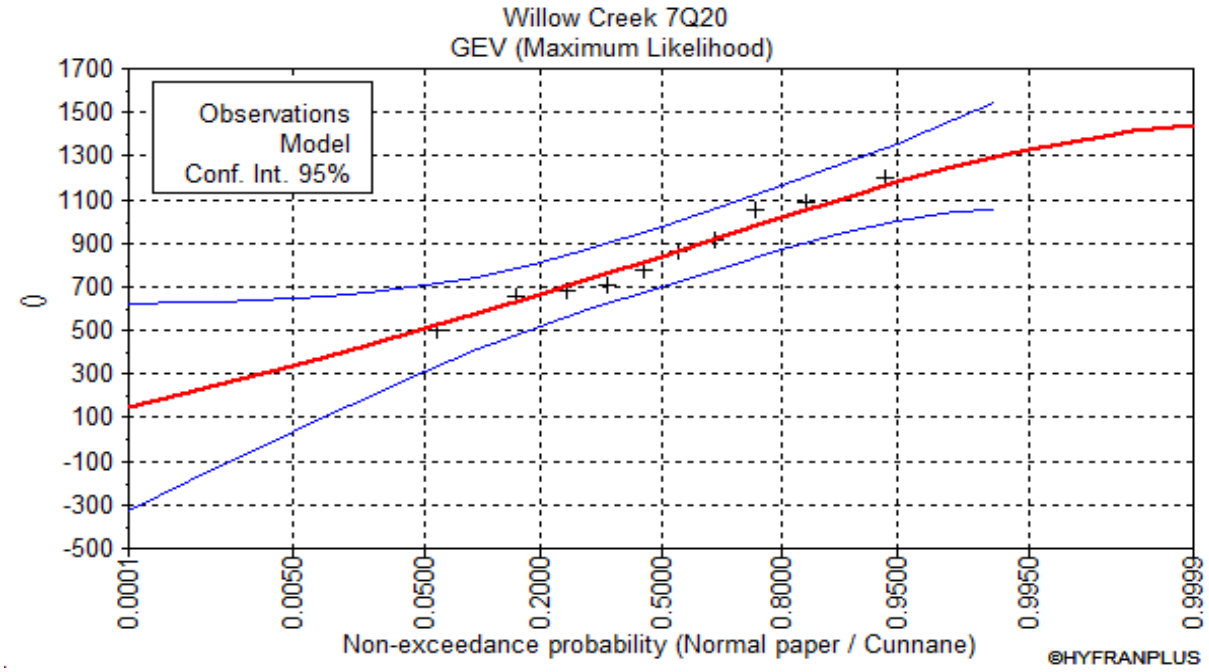
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Quantiles

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T = 1/q

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10000.0	0.0001	147	243	-330 - 623
2000.0	0.0005	217	209	-193 - 626
1000.0	0.0010	250	193	-129 - 629
200.0	0.0050	339	156	33.5 - 644
100.0	0.0100	383	139	111 - 656
50.0	0.0200	432	122	193 - 672
20.0	0.0500	509	100	312 - 705
10.0	0.1000	578	85.0	412 - 745
5.0	0.2000	665	73.6	521 - 810
3.3	0.3000	730	70.2	592 - 867
2.0	0.5000	839	70.6	701 - 978
1.5000	0.6667	931	73.4	787 - 1070
1.2500	0.8000	1020	76.4	868 - 1170
1.1111	0.9000	1110	81.4	949 - 1270
1.0526	0.9500	1180	90.0	1000 - 1360
1.0204	0.9800	1250	108	1040 - 1460
1.0101	0.9900	1300	125	1050 - 1540
1.0050	0.9950	1330	144	N/D
1.0010	0.9990	1390	188	N/D
1.0005	0.9995	1410	206	N/D
1.0001	0.9999	1440	242	N/D

Willow Creek 7Q20



HYFRANPLUS
(c) INRS-ETE, 2002

Willow Creek 7Q20

Halphen of type B (Maximum Likelihood)

Results of the fitting

Number of observations : 10

Parameters

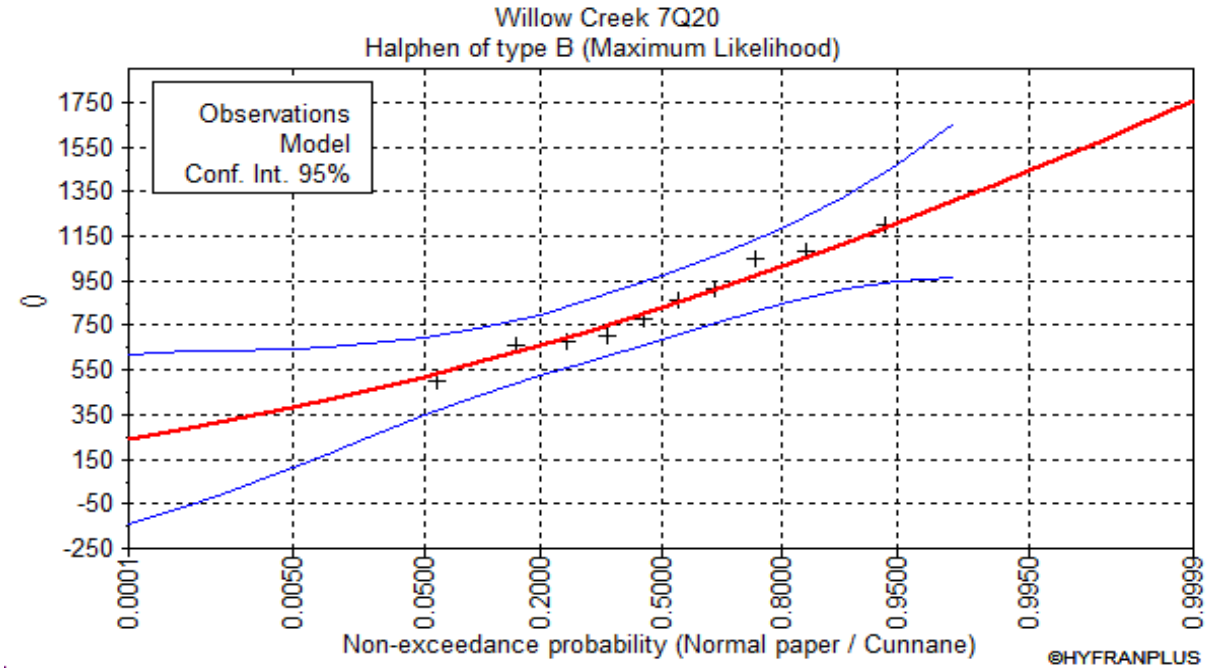
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Quantiles

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T = 1/q

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1000.0	0.0010	311	165	-12.2 - 635
200.0	0.0050	378	137	111 - 646
100.0	0.0100	414	122	174 - 654
50.0	0.0200	455	108	244 - 666
20.0	0.0500	520	88.6	346 - 694
10.0	0.1000	582	76.7	432 - 733
5.0	0.2000	663	69.8	526 - 799
3.3	0.3000	724	69.1	588 - 859
2.0	0.5000	831	71.9	690 - 972
1.5000	0.6667	924	76.4	774 - 1070
1.2500	0.8000	1020	84.9	850 - 1180
1.1111	0.9000	1120	104	915 - 1320
1.0526	0.9500	1210	132	950 - 1470
1.0204	0.9800	1310	177	964 - 1660
1.0101	0.9900	1380	215	N/D
1.0050	0.9950	1450	256	N/D
1.0010	0.9990	1580	357	N/D
1.0005	0.9995	1640	443	N/D
1.0001	0.9999	1750	746	N/D

Willow Creek 7Q20



Appendix B. HYFRAN-PLUS Tabular and Graphical Output (Future Conditions 7Q20)

HYFRANPLUS
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Midhurst 7Q20 Adjusted_Feb 2016 Update

Inverse Gamma (Maximum Likelihood)

Results of the fitting

Number of observations : 10

Parameters

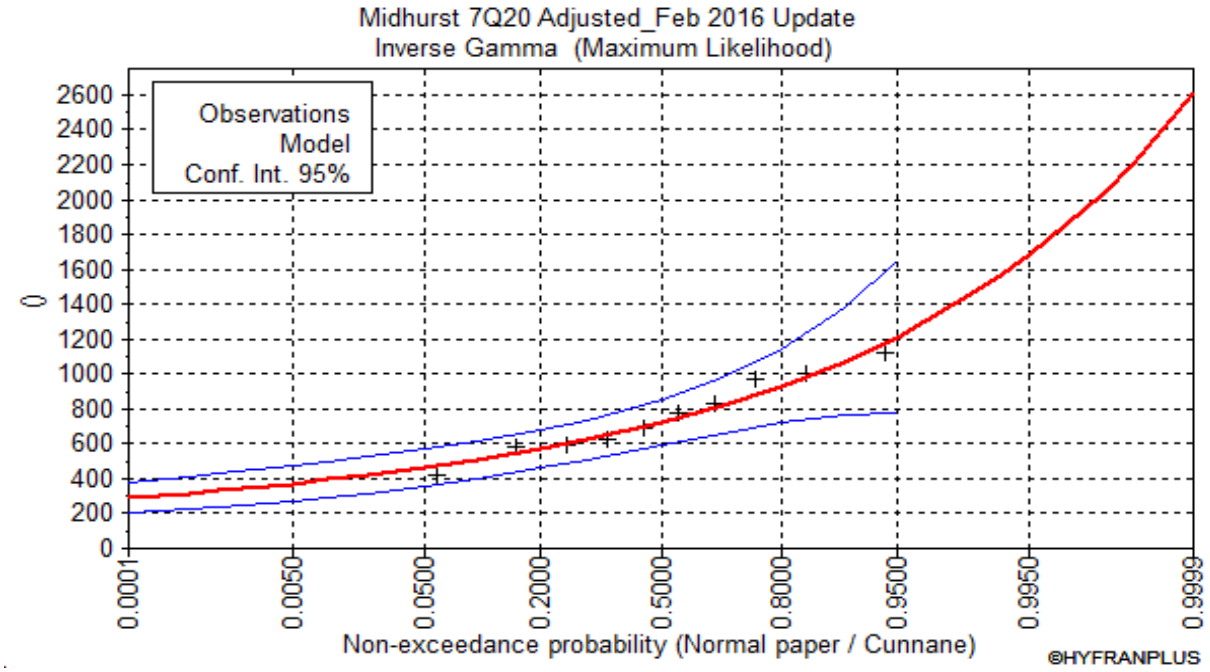
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Quantiles

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T = 1/q

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1000.0	0.0010	331	48.9	235 - 427
200.0	0.0050	372	51.2	271 - 472
100.0	0.0100	394	52.2	292 - 496
50.0	0.0200	420	53.2	316 - 525
20.0	0.0500	464	54.5	358 - 571
10.0	0.1000	509	55.5	400 - 618
5.0	0.2000	571	56.8	460 - 683
3.3	0.3000	623	58.5	508 - 737
2.0	0.5000	722	65.5	594 - 850
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1.2500	0.8000	931	107	720 - 1140
1.1111	0.9000	1070	158	763 - 1380
1.0526	0.9500	1210	223	775 - 1650
1.0204	0.9800	1400	330	N/D
1.0101	0.9900	1540	428	N/D
1.0050	0.9950	1680	542	N/D
1.0010	0.9990	2040	877	N/D
1.0005	0.9995	2200	1060	N/D
1.0001	0.9999	2610	1580	N/D

Midhurst 7Q20 Adjusted_Feb 2016 Update



HYFRANPLUS
(c) INRS-ETE, 2002

Midhurst 7Q20 Adjusted_Feb 2016 Update

Log-Pearson type 3 (Méthode SAM)

Results of the fitting

Number of observations : 10

Parameters

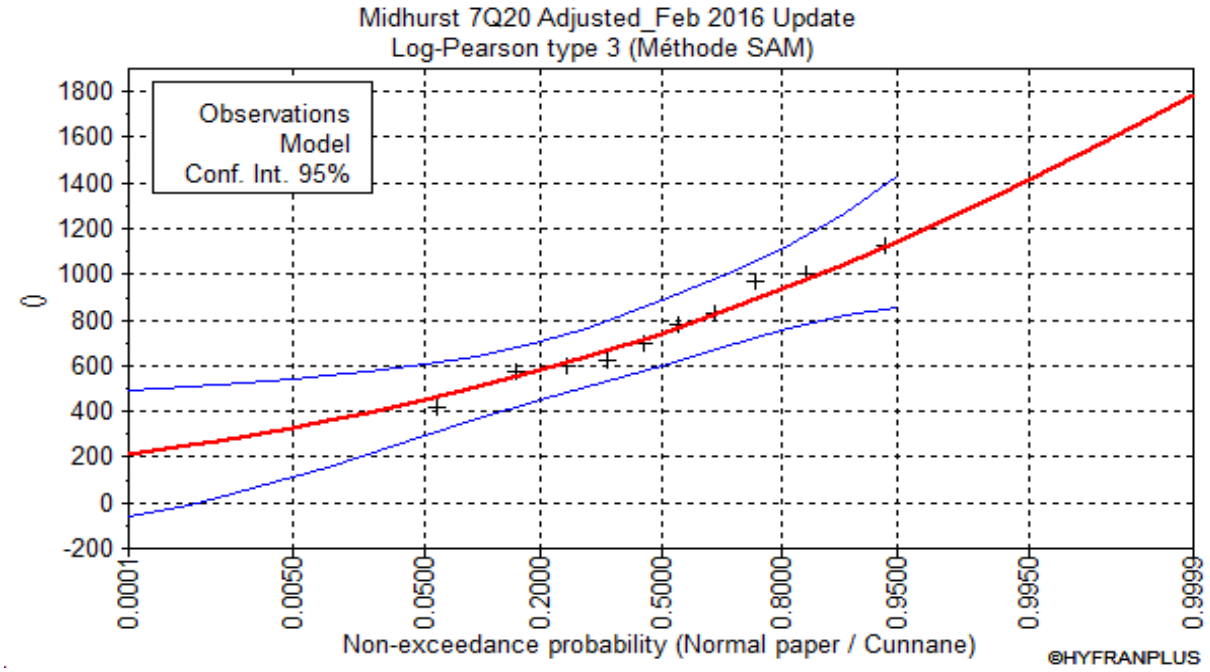
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2000.0	0.0005	252	132	-6.84 - 511
1000.0	0.0010	272	127	23.0 - 520
200.0	0.0050	327	111	110 - 545
100.0	0.0100	357	102	156 - 558
50.0	0.0200	392	92.8	210 - 574
20.0	0.0500	449	79.5	293 - 605
10.0	0.1000	505	70.4	367 - 643
5.0	0.2000	579	65.2	451 - 707
3.3	0.3000	637	65.9	508 - 766
2.0	0.5000	742	72.3	600 - 883
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1.2500	0.8000	933	91.0	754 - 1110
1.1111	0.9000	1040	113	823 - 1270
1.0526	0.9500	1140	147	854 - 1430
1.0204	0.9800	1260	212	N/D
1.0101	0.9900	1340	274	N/D
1.0050	0.9950	1410	346	N/D
1.0010	0.9990	1580	541	N/D
1.0005	0.9995	1640	635	N/D
1.0001	0.9999	1780	872	N/D

Midhurst 7Q20 Adjusted_Feb 2016 Update



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Midhurst 7Q20 Adjusted_Feb 2016 Update

GEV (Maximum Likelihood)

Results of the fitting

Number of observations : 10

Parameters

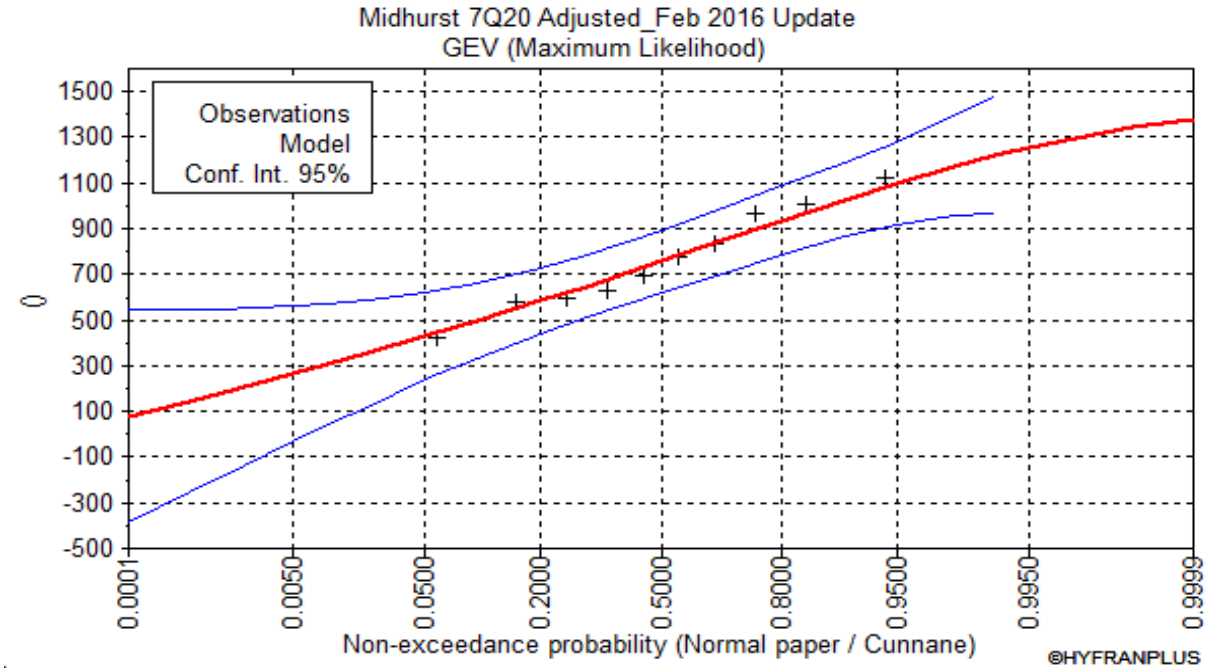
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200.0	0.0050	265	152	-34.1 - 563
100.0	0.0100	308	136	41.0 - 574
50.0	0.0200	356	120	122 - 590
20.0	0.0500	430	98.1	238 - 623
10.0	0.1000	499	83.5	335 - 662
5.0	0.2000	584	72.6	442 - 727
3.3	0.3000	648	69.5	512 - 784
2.0	0.5000	757	70.4	619 - 895
1.5000	0.6667	848	73.5	704 - 992
1.2500	0.8000	935	76.9	784 - 1090
1.1111	0.9000	1030	82.7	865 - 1190
1.0526	0.9500	1100	92.5	918 - 1280
1.0204	0.9800	1170	112	954 - 1390
1.0101	0.9900	1220	131	963 - 1480
1.0050	0.9950	1260	152	N/D
1.0010	0.9990	1320	200	N/D
1.0005	0.9995	1340	220	N/D
1.0001	0.9999	1380	260	N/D

Midhurst 7Q20 Adjusted_Feb 2016 Update



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Midhurst 7Q20 Adjusted_Feb 2016 Update

Halphen of type B (Maximum Likelihood)

Results of the fitting

Number of observations : 10

Parameters

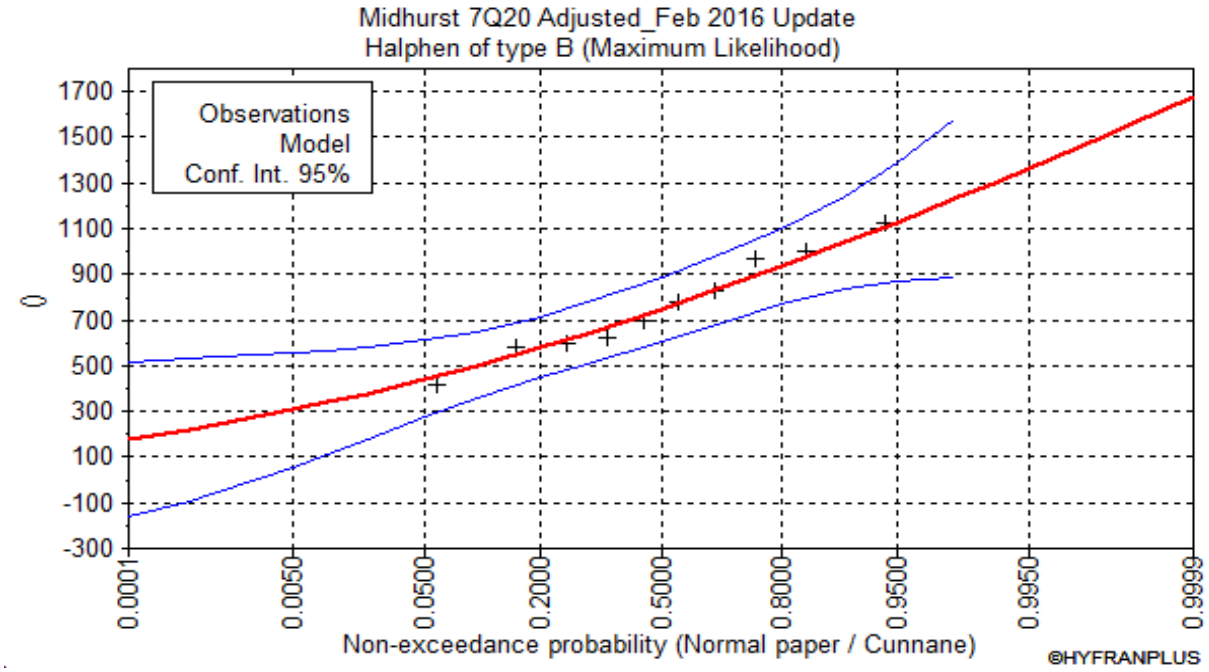
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1000.0	0.0010	244	152	-54.7 - 542
200.0	0.0050	306	129	53.4 - 559
100.0	0.0100	339	117	111 - 568
50.0	0.0200	378	103	176 - 581
20.0	0.0500	442	86.0	273 - 610
10.0	0.1000	502	75.1	355 - 649
5.0	0.2000	581	69.0	446 - 716
3.3	0.3000	642	68.6	507 - 776
2.0	0.5000	748	71.9	608 - 889
1.5000	0.6667	841	76.6	691 - 992
1.2500	0.8000	934	85.3	767 - 1100
1.1111	0.9000	1040	105	833 - 1240
1.0526	0.9500	1130	133	867 - 1390
1.0204	0.9800	1230	178	882 - 1580
1.0101	0.9900	1300	216	N/D
1.0050	0.9950	1370	257	N/D
1.0010	0.9990	1510	357	N/D
1.0005	0.9995	1560	428	N/D
1.0001	0.9999	1680	656	N/D

Midhurst 7Q20 Adjusted_Feb 2016 Update



Appendix B. SCS Wastewater Flows (2013)

AVERAGE SANITARY FLOW RATE
for WWTP Design
MIDHURST PHASE 1 AND FULL BUILD OUT

Average Sanitary Flow Rate - Phase 1 (5000 units)					
Average Domestic Flow (as per EA)=			1.02	m^3/unit/day	A
Extreneous Flow Rate (as per EA) =			0.27	m^3/unit/day	B
Total Flow Rate (as per EA) =			1.29	m^3/unit/day	C=A+B
	Total Units within Phase 1 =		5000	units	D
	Average Flow for Phase 1 =		6,450	m^3/day	E=D*C
Convert to Litres per Second =			74.65	L/s	F=E/(60x60x24)*1000

Average Sanitary Flow Rate - Full Build Out plus Existing Area					
Average Domestic Flow (as per EA)=			1.02	m^3/unit/day	A
Extreneous Flow Rate (as per EA) =			0.27	m^3/unit/day	B
Total Flow Rate (as per EA) =			1.29	m^3/unit/day	C=A+B
Total Units within Full Build Out =			9,546	units	D
Average Flow for Full Build Out =			12,314	m^3/day	E=D*C
Convert to Litres per Second =			142.53	L/s	F=E/(60x60x24)*1000

Notes:

1) Average Daily Demand of 1.02m^3/unit/day based on 340 L/c/d x 3 persons/unit as per Midhurst Phase 1 and 2 Class EA prepared by Ainley Group (July 2009).

2) Extraneous Flow Rate of 0.27m^3/unit/day based on 90 L/c/d as per Midhurst EA.

AVERAGE WATER DEMAND
MIDHURST PHASE 1 AND FULL BUILD OUT

Average Water Demand - Phase 1 (5000 units)					
Average Daily Demand (as per EA)=			1.14	m^3/unit/day	A
	Total Units within Phase 1 =		5000	units	B
	Average Daily Demand =		5,700	m^3/day	C=A*B
Convert to Litres per Second =			65.97	L/s	D=C/(60x60x24)*1000

Average Water Demand - Full Build Out plus Existing Area					
Average Domestic Flow (as per EA)=			1.14	m^3/unit/day	A
Total Units within Full Build Out =			8,208	units	B
Average Flow for Full Build Out =			9,357	m^3/day	C=A*B
Convert to Litres per Second =			108.30	L/s	D=C/(60x60x24)*1000

Notes:

1) Average Daily Demand of 1.14m^3/unit/day based on 380 L/c/d x 3 persons/unit as per Midhurst Phase 1 and 2 Class EA prepared by Ainley Group (July 2009).

Appendix C. Fluvial Geomorphological Assessment of Willow Creek Downstream of Proposed WWTP Discharge Near Highway 26, Midhurst, Ontario (PECG, 2014)

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

*357 Bay Street, Suite 800, Toronto, ON M5H 2T7 **t** 647-795-8153*

April 17, 2014

Midhurst Landowners Group
c/o Neil Hutchinson, Ph.D.
President, Principal Aquatic Scientist
Hutchinson Environmental Sciences Ltd.
3-1 Taylor Road
Bracebridge, ON P1L 1S6

Dear Dr. Hutchinson,

Re: Fluvial Geomorphological Assessment of Willow Creek Downstream of Proposed WWTP Discharge near Highway 26, Midhurst, ON

Palmer Environmental Consulting Group Inc. (PECG) is pleased to submit to Hutchinson Environmental Sciences Ltd. (HESL), on behalf of Midhurst Landowners Group, the results of a two-phase fluvial geomorphology study of Willow Creek, in the Midhurst Settlement Area, in connection with the assessment of potential downstream impacts from wastewater treatment plant (WWTP) effluent on channel morphology.

This report represents a synthesis of work completed under the direction of Robin McKillop, M.Sc., P.Geo. in 2009 (while with AECOM) and in 2013 (now with PECG). Based on field investigations and desktop analyses, the addition of proposed effluent discharge to Willow Creek in the vicinity of Highway 26 and Golf Course Road is not anticipated to increase downstream erosion above existing, natural rates.

Should you or your client have any questions pertaining to this assessment, please feel free to contact Robin McKillop at 647-795-8153 or robin@pecg.ca.

Yours truly,

Palmer Environmental Consulting Group Inc.



Robin McKillop, M.Sc., P.Geo.
Senior Fluvial Geomorphologist

Introduction

Midhurst Landowners Group will construct a WWTP that discharges treated effluent to Willow Creek, in the vicinity of Highway 26 and Golf Course Road, in the Midhurst Settlement Area (hereinafter referred to as "Midhurst"), in the Township of Springwater. At full development, the total discharge, including flows from existing development in Midhurst, will be about 0.17[1] m^3/s. In order to assess potential erosional impacts of the discharge on Willow Creek, downstream of Highway 26, a two-phase fluvial geomorphological assessment was completed under the direction of Robin McKillop, M.Sc., P.Geo. Mr. McKillop led the first phase of work in 2009, while working with AECOM, and completed the second phase of work in 2013, now with PECG. This report represents the culmination of both work programs.

The geomorphological assessment was completed to meet four main objectives:

1. Characterize existing channel morphology of Willow Creek from the proposed discharge point in the vicinity of Highway 26 and Golf Course Road to the Minesing Wetlands Conservation Area;
2. Assess existing channel stability and areas potentially susceptible to erosion;
3. Assess the existing geomorphic capacity of Willow Creek to convey flows; and
4. Assess the potential for changes in geomorphic processes, including changes in erosion rates and channel form, following the proposed increase in discharge from municipal effluent.

The 2013 follow-up assessment was completed to verify that the channel morphology and erosion conditions documented by the 2009 assessment are still valid, given the potential for morphological changes to have occurred since the first phase of the assessment was completed in 2009. This memorandum summarizes the methods used in this study; characterizes the physical setting, as a basis for understanding channel form and function; describes three reaches with reference to channel dimensions and watercourse functions, flow conveyance and channel stability; documents existing erosion; and evaluates the sensitivity of the watercourse to the proposed effluent discharge.

Methods

Several sources of information provided the basis for completing the initial desktop component of the geomorphological assessment:

- Regional topographic and drainage mapping;
- Surficial geology mapping completed by the Ontario Geological Survey and Geological Survey of Canada; and
- Historical aerial photography (1978) and recent orthophotography (2009).

[1] This value is rounded conservatively from the anticipated 0.164 m^3/s total.

The topographic, drainage and surficial geology mapping were reviewed to identify surface features that define the drainage characteristics within the Willow Creek watershed. Special attention was given to the characteristics of, and changes in, valley confinement, headwater tributaries, breaks in slope and stream substrate. Orthophotography of the watershed and surrounding areas provided an overview of surface features influencing drainage, and facilitated preliminary geomorphic characterization of the watercourse. Differences in meander pattern, channel gradient, floodplain characteristics and vegetation were used to delineate stream reaches. Surrounding land use, possible sites of erosion and existing anthropogenic constraints that may provide insight on stream flow characteristics were noted. Historical aerial photography was examined to identify any changes in land use or stream configuration between 1978 and 2009.

Preliminary field reconnaissance was completed on February 13, 2009 at road crossings along Willow Creek, from Midhurst to the Minesing Wetlands Conservation Area at George Johnson Road. The purpose of this initial visit, conducted during baseflow (low-flow) conditions, was to make qualitative observations of geomorphic form and function, topographic variability and valley confinement, substrate characteristics, vegetative cover, and land use and anthropogenic influence. Snow and ice cover precluded detailed geomorphic analysis at the time, but the observations assisted with the delineation of channel reaches and identification of sites for further investigation.

A geomorphic survey was completed on August 18, 19 and 26, 2009 along Willow Creek from the proposed discharge point in the vicinity of Highway 26 and Golf Course Road to approximately 2 km west of George Johnson Road, in the Minesing Wetland area. Within each of the stream reaches, observations of channel morphology, including valley confinement, floodplain dimensions, channel pattern, bankfull shape, bed material composition, and riparian vegetation were recorded in a field notebook, with key features additionally documented in photographs (Appendix A). Special attention was given to areas influenced by anthropogenic activities and to any existing flow obstructions, erosion features and areas potentially susceptible to erosion.

As a basis for assessing the present geomorphic capacity of the subject watercourse to convey flows and the potential for changes in geomorphic processes from the proposed addition of effluent discharge, channel cross-sections and energy gradients (~water surface slopes) were measured in representative locations along each reach. An assessment of the flow at which the channel bed and banks are susceptible to erosion was completed, based on Hjulstrom's relation and ASCE (1967), which account for both fine and coarse substrates.

Follow-up field investigations were completed on November 15, 2013, with a focus on sites originally assessed in 2009, in order to confirm that previous descriptions and measurements are still representative. Channel cross-sections were measured and photographed (Appendix B) at the approximate locations originally established in 2009, as identified by field maps and photographs, and a comparison was made of the channel and erosion descriptions from 2009 with current conditions.

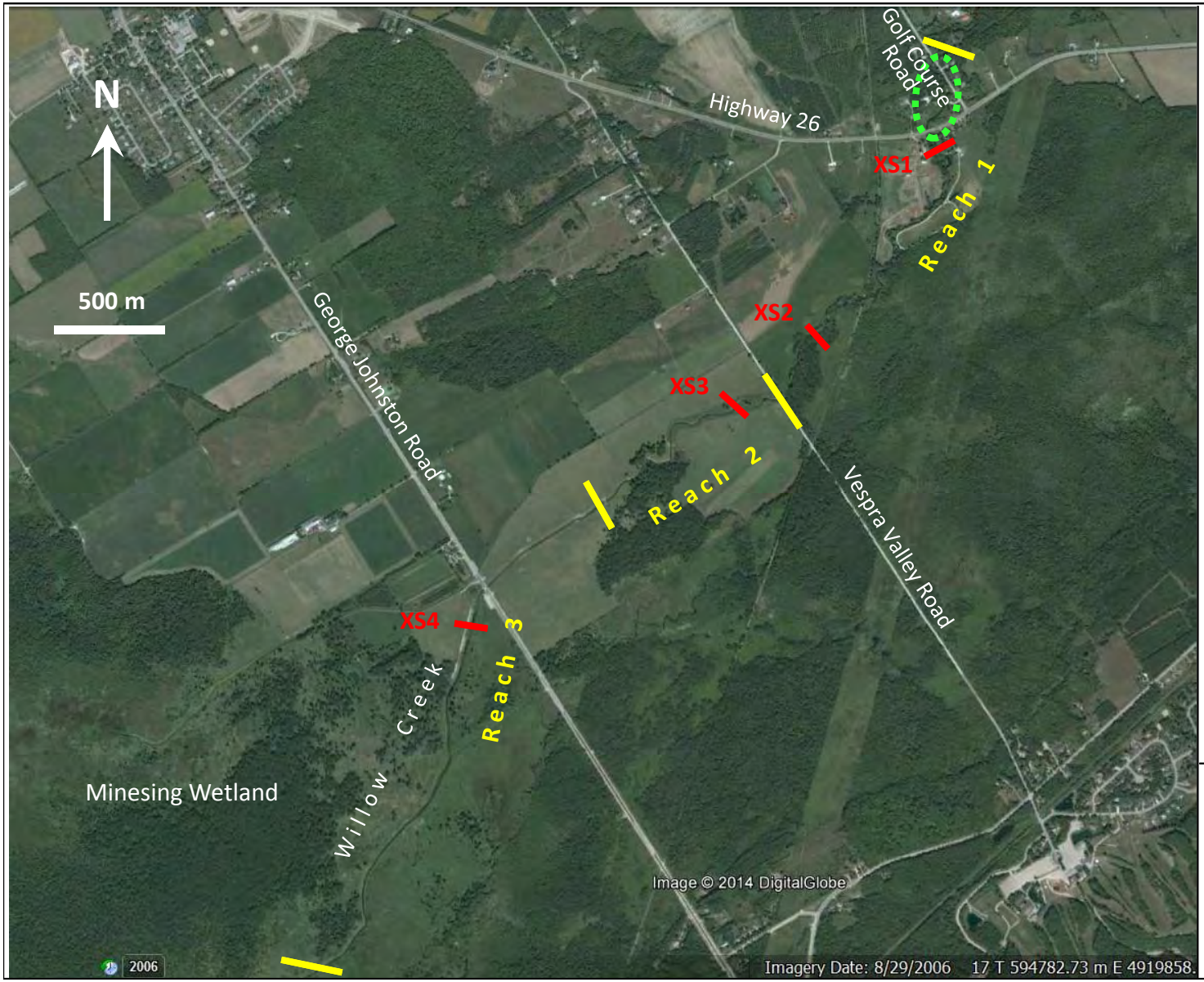
Physiography and Land Use

Most of Willow Creek is within the Lake Simcoe Lowlands physiographic region, which encompasses nearly 3,000 km^2 of lowland areas bordering Georgian Bay and Lake Simcoe (Chapman and Putnam, 1984). The region was inundated by Glacial Lake Algonquin and, in part, Glacial Lake Nipissing. It is covered in sand, silt and clay that settled on the bottom of these glacial lakes. Willow Creek flows across clay/silt glaciolacustrine deposits within all three study reaches and ultimately drains into the vast Minesing Wetland, a wetland complex of poorly drained, peaty soils (Figure 1). Parts of the margin of the wetland, west of George Johnston Road, appear to have been reclaimed for agricultural use in historical times through land draining and berm construction.

The Willow Creek subwatershed is partially within the limits of the Township of Springwater, west of Lake Simcoe. The subwatershed is about 229 km^2. Willow creek drains the south portion of the subwatershed over the sand-rich Simcoe Uplands, through Little Lake, and north through Midhurst. Through Midhurst and downstream, Willow Creek is confined in a deep, wooded valley incised into littoral and foreshore deposits. East of Nursery Road, the valley widens and Willow Creek flows over low-relief foreshore deposits. The present land use of this area is predominantly agricultural. Matheson Creek, a tributary that drains the north portion of the subwatershed, joins Willow Creek west of Wilson Drive. Willow Creek continues to flow westward over glaciolacustrine deposits and ultimately into the Minesing Wetlands Conservation Area. Willow Creek is a tributary to the Nottawasaga River, which it joins within the Minesing Wetlands. The Nottawasaga River ultimately drains northeasterly into Georgian Bay.

Geomorphological Description

Willow Creek has been divided into three distinct reaches for descriptive and analysis purposes (Figure 1). An emphasis has been placed on characterizing geomorphic form (channel planform and cross-section characteristics) and function (erosion, transport and depositional processes) to assist in defining the channel's present stability and geomorphic capacity to convey flows under various conditions. Additional emphasis has been placed on documenting areas potentially susceptible to erosion as well as existing evidence for erosive processes. Qualitative characteristics of each reach are described below, based on both the 2009 and 2013 field investigations, and quantitative details from 2009 are summarized in Table 1. Key photographs from the 2009 and 2013 assessments are contained in Appendix A and Appendix B, respectively.



Legend

- Proposed Discharge Location (approximate)
- Cross-section (XS)
- Reach Break

Note: Base imagery (2006) from Google Earth

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Midhurst Landowners Group

Willow Creek Reaches

Figure 1

Table 1. Estimated Channel Characteristics under Observed (August 2009), Proposed and Full-Capacity Flow Conditions

Reach	Cross-section	Energy Gradient (m/m)	Observed Low-Flow Conditions				Observed + Proposed Effluent Discharge				Full-Capacity Flow Conditions[2]			
			Width (m)	Depth (m)	Average Velocity[1] (m/s)	Discharge (m^3/s)	Width (m)	Depth (m)	Average Velocity[1] (m/s)	Discharge (m^3/s)	Width (m)	Depth (m)	Average Velocity[1] (m/s)	Discharge (m^3/s)
1	1	0.0010	12.73	0.66	0.26	1.09	12.77	0.69	0.27	1.26	14.17	2.16	0.70	17.2
1	2	0.0011	4.89	1.35	0.23	1.07	5.39	1.47	0.24	1.24	9.13	3.02	0.71	11.9
2	3	0.0002	5.92	1.02	0.32	1.25	6.16	1.09	0.34	1.42	12.79	2.48	0.54	10.1
3	4	0.0001	10.84	0.72	0.22	1.26	10.91	0.76	0.23	1.43	11.69	1.25	0.33	3.8

Manning's n values based on back-calculation from flow values, based on measurements from nearby flow stations, and field observations of channel roughness.

[1] Average velocities estimated based on field measurements.

[2] Full-capacity channel defined by physical (geometric) tops of bank.

Reach 1

Reach 1 extends from just upstream of Golf Course Road, at an oxbow adjacent to the current channel, downstream past Highway 26 (Photographs 1, 2) to Vespra Valley Road. Between Golf Course Road and Highway 26, the channel flows within an open to wooded area of residential land. Minor bank erosion was observed along the outer bank of the bend immediately downstream from the culvert beneath Golf Course Road. For approximately 750 m downstream from Highway 26, the channel flows between agricultural lands with a narrow, wooded, riparian buffer in most areas. The downstream 1,000 m of the reach is bounded by agricultural lands, with wooded banks to the north and a wooded wetland to the south (Figure 1).

Through the reach, relief is low and the creek exhibits an unconfined, sinuous to irregularly meandering pattern. The upstream end of the reach, near Highway 26, may have undergone minor straightening in the past. Local irregularity in channel pattern is attributed to large flow obstructions (fallen trees and accumulated anthropogenic debris), which are common throughout the reach. Such obstructions are associated with bank erosion, as evident by exposed tree roots and steep or undercut banks (Photographs 5, 6, 7).

Channel dimensions and the distribution of bed material are also influenced by the abundance of in-stream debris. Anthropogenic debris is commonly pinned against the upstream side of fallen trees. Sandy sediment has accumulated where the flow has been obstructed, and diverted flow has led to local bank erosion and channel widening. Cross-section 1 was selected to represent this channel condition (Photograph 3). Where fallen trees or other obstructions are absent, the channel tends to exhibit a narrower, deeper form with a greater proportion of the underlying glaciolacustrine clay/silt exposed on the channel bed. Cross-section 2 was selected to represent this channel condition (Photograph 4). These two channel conditions alternate throughout the length of the reach, creating a sequence of debris, sand accumulation and pools.

Glaciolacustrine clay/silt, which is highly resistant to erosion, is exposed along the channel banks (Photograph 8) and approximately 50% of the channel bed. Fine to medium sand forms a discontinuous veneer over the glaciolacustrine deposit. The majority of this sand has been transported downstream from headwater sources such as the Simcoe Uplands. However, some cut-banks in glaciolacustrine clay/silt expose overlying, patchy sandy veneers, which are erodible and undoubtedly also contribute some sand to the channel. The sandy bed material is continuously transported through the system by observation of grain movement during baseflow conditions and by the lack of algal or macrophyte growth on the frequently disturbed bedforms.

Channel dimensions are well-defined throughout the reach, but irregularly-shaped, varying in cross-section between broad and rectangular, and narrow, deep and triangular. Isolated low floodplain benches exist alongside the main channel. Steep, unvegetated banks testify to the cohesive material with which they are composed. As Willow Creek enters the wetland area in the downstream portion of Reach 1, it is

expected that a substantial fraction of streamflow floods overbank and dissipates in the surrounding swamp land. This process would account for the modelled decrease in stream discharge during full-capacity flow events between Cross-section 1 and Cross-section 2, as interpreted between tops of bank (Table 1).

Reach 2

Reach 2 extends approximately 1,000 m downstream from Vespra Valley Road. Relief is low, land use along both banks is agricultural, and vegetation is limited to grasses with the exception of a few trees and a small wooded patch. Throughout the reach, Willow Creek follows an unconfined, regularly meandering pattern (Figure 1, Photographs 9, 10).

Reach 2 overlies glaciolacustrine clay/silt that is exposed along channel banks and about 50% of the channel bed. Channel dimensions are well-defined and irregular in cross-section. Bed material is composed of fine to medium sand, which forms regularly-spaced bedforms, alternating with deeper pools that commonly contain vegetated mats along the banks (Photograph 12). Sparsely-vegetated sandy side bars exposed during field reconnaissance (low-flow conditions) are likely transported and deposited during moderately high flows. As in Reach 1, banks are steep to undercut with locally exposed tree roots (Photographs 13, 14, 15). Bank failures are more common where sandy deposits overlie clay bank material. Large woody debris is less common in Reach 2 due to the rarity of tree cover. With less in-stream material available to obstruct flows, there is less variation in channel dimensions.

Due to the low relief and distribution of wetland in surrounding areas, it is expected that Reach 2 may once have passed through a wetland area. A slightly greater proportion of high flows likely spills overbank in the vicinity of Cross-section 3 (Reach 2, Photograph 11) than in the vicinity of Cross-section 2 (Reach 1), which explains the downstream reduction in estimated full-capacity flow conditions (Table 1).

Reach 3

Reach 3 extends from 700 m upstream of George Johnson Road, to 2,000 m downstream of George Johnson Road. Upstream of the road crossing, land use is agricultural and bank vegetation is composed predominantly of grasses (Photograph 16). Downstream of the road crossing, Willow Creek enters the Minesing Wetland area, where bank vegetation includes a mixture of grasses, cattails and riparian shrubs, with a greater abundance of trees near the downstream end of the reach (Photographs 17, 18).

The entire length of the reach has been artificially straightened, pre-dating aerial photography that was obtained (1978), although some recent attempts have been made to naturalize the reach through the in-stream placement of woody debris and the deliberate displacement of bed material downstream of George Johnson Road. The channel is unconfined as it flows across level ground, except where it parallels a 350 m-long berm constructed along the north bank downstream of George Johnson Road. The downstream extent of the reach is defined based on the change in channel form from straightened to

natural, irregularly meandering, narrow and locally multi-threaded. Based on aerial photography, Willow Creek becomes smaller as it enters the wetland. The majority of the streamflow contained within the channel during high-flow events in upstream reaches would likely flood overbank and attenuate through the wetland. Indeed, the estimate of full-capacity flow at Cross-section 4 (Reach 3, Photograph 19) was substantially less than that at the upstream cross-sections.

Similar to the areas characterized upstream, Reach 3 of Willow Creek overlies glaciolacustrine clay/silt. Due to the extremely low energy gradient and swamp-like characteristics, clay/silt bed and bank material is exposed in few areas along Reach 3. Upstream of George Johnson Road, erosion is exacerbated by the frequent disturbance of stream banks by cattle (Photograph 16). Downstream of George Johnson Road, there is little evidence of erosion. Stream banks in some areas were undercut (e.g., downstream of the confluence with a tributary channel approximately 750 m downstream from George Johnson Road – Photograph 20), but the dense bank vegetation contributes greatly to stability. Bed material was composed of fine to medium sand, which was mobile even during low flows.

Assessment of Potential Morphological Impacts from Effluent Discharge

As described above, bed and bank erosion occurs naturally along Willow Creek downstream of the proposed discharge site in the vicinity of Highway 26 and Golf Course Road. The pattern and rates of erosion reflect the existing hydrologic regime, substrate characteristics and channel morphology. An increase in stream flow has the potential to accelerate erosion, depending on the magnitude of change in depths and velocities. Over prolonged periods, increased erosion can lead to changes in channel form, which could adversely affect aquatic habitat or damage property. Thus, it is important to assess what effect the proposed WWTP discharge may have on flow conditions and erosional processes in Willow Creek.

Observed and proposed flow conditions within Willow Creek were originally estimated based on field surveys conducted in 2009 (Table 1). The downstream decrease in full-capacity channel conditions (from 17.2 m^3/s at Cross-section 1 to 3.8 m^3/s at Cross-section 4), based on the physical (geometric) tops of bank, relates to the anthropogenic history and morphological trends along Willow Creek. The highest capacities are closest to Highway 26, where Willow Creek exhibits natural morphology within a forested setting with the steepest gradient relative to downstream reaches. Farther downstream, where the creek appears to have been artificially excavated within an area reclaimed from the Minesing Wetland, its dimensions are unnatural and its gradient is nearly flat. Flows are backwatered from the wetland, have little energy available for erosion, and readily spill overbank into the adjacent floodplain.

The addition of 0.17 m^3/s would be most evident during low-flow conditions, when it comprises a greater relative proportion of total stream discharge. During low-flow conditions observed during the 2009 field investigations, this increase in stream discharge would result in an average increase in flow depth of just 7 cm (Table 1). During higher flow conditions, this increase in depth would be much lower. During full-capacity flow conditions, the effect of effluent discharge on flow parameters would be unmeasurable.

The potential impacts from the addition of effluent discharge have been assessed by an examination of substrate composition and by determining threshold conditions for sediment transport under different depth and velocity scenarios. Downstream of Golf Course Road, Willow Creek overlies cohesive glaciolacustrine silty clay, which is highly resistant to erosion. Regular "loose boundary" analysis of erosion thresholds is not applicable to channels with clay and silt beds, which are held together by cohesion. Clay tends to erode irregularly, through pot-hole development, percussive wear and bioturbation. According to Hjulstrom's relation and ASCE (1967), the velocity threshold for clay erosion is approximately 1 m/s. As indicated in Table 1, even the velocity at full-capacity flow conditions (0.33-0.70 m/s) does not exceed this threshold. Therefore, the proposed increase in streamflow from effluent discharge is not anticipated to exceed the erosion threshold of silty clay. Erosion of clayey substrates in these reaches of Willow Creek likely only occurs in association with locally increased velocities around in-stream flow obstructions, and through post-flood bank collapses caused by more rapid drops in stream level than can be achieved through drawdown in the adjacent, saturated banks.

The discontinuous veneer of fine to medium sand was observed to be mobile even during low-flow conditions. During extreme low-flow conditions (e.g., 7Q20 flows), velocities may be sufficiently low that there is little to no movement of sand along the bed. Based on the daily discharges for Willow Creek near Highway 26, this condition is rare. With the supplemental flow contributed by the effluent discharge, the recurrence of periods during which there is *no* movement of sand may be reduced slightly. Regardless, the sand moves continuously during 'normal' baseflow conditions to which aquatic species are adapted, and the transport of the surface veneer of sand does not affect overall channel morphology, so any minor differences would be imperceptible.

"Bankfull", or channel-forming, flows were estimated based on the new field measurements from 2013 at approximately the same locations originally surveyed in 2009. The bankfull stage was based on field indicators such as changes in vegetation, scour patterns or bank steepness, providing a slightly more conservative reference than does the full-capacity channel defined in 2009 by the physical (geometric) tops of bank. A comparison was made between the existing (natural) "bankfull" flows at each cross-section and the proposed conditions with the addition of 0.17 m^3/s of effluent discharge (Table 2).

The addition of 0.17 m^3/s of effluent to the bankfull condition increases water depth by only 0.01 to 0.03 m and average velocity by no more than about 0.01 m/s. Such changes would be virtually unmeasurable in Willow Creek, and the velocities are still below the ~1 m/s threshold for erosion of clayey substrates (Hjulström's relation and ASCE, 1967). The minor increase in velocity would also have no measurable effect on the observed, continuous throughput of fine sands along the three reaches downstream of the proposed discharge site in the vicinity of Highway 26 and Golf Course Road.

Table 2. Estimated Bankfull Characteristics under Existing and Proposed Conditions

Reach	XS[1]	Energy gradient[2] (m/m)	Manning's n[3]	"Bankfull" flow[4]				"Bankfull" flow + proposed effluent discharge			
				Width (m)	Depth (m)	Average velocity (m/s)	Discharge (m^3/s)	Width (m)	Depth (m)	Average velocity (m/s)	Discharge (m^3/s)
1	1	0.0010	0.045	13.50	1.48	0.65	8.0	13.50	1.49	0.65	8.2
1	2	0.0011	0.045	9.10	1.61	0.76	8.2	9.10	1.63	0.77	8.4
2	3	0.0002	0.035	11.80	1.46	0.34	3.5	11.80	1.49	0.35	3.7
3	4	0.0001	0.035	13.50	1.09	0.24	2.5	13.50	1.12	0.24	2.7

[1] Locations selected as close to original (2009) sites as possible, based on site map and photographs

[2] Estimated based on water surface slope measured in 2009

[3] Estimated visually, based on pictorial guide (Hicks and Mason, 1998)

[4] Bankfull stage based on indicators such as change in vegetation, scour patterns and bank steepness, not physical (geometric) tops of bank as considered above in Table 1

Conclusion

Erosion is a natural process that occurs along Willow Creek. Bed and bank erosion are most extensive immediately downstream of Highway 26, within forested areas, and least extensive farther downstream due to the channel's cohesive, clayey substrates, low gradient and densely vegetated banks. The channel is sufficiently wide that the addition of proposed effluent discharge would have such a small effect on depths and velocities that bed and bank erosion rates would be unaffected. In conclusion, the addition of the treated effluent discharge to Willow Creek in the vicinity of Highway 26 and Golf Course Road is not anticipated to increase downstream erosion rates above existing, natural levels.

References

ASCE, 1967. River Hydraulics (USCE Technical and Engineering Design Guide 18), Washington.

Chapman, L.J., Putnam, D.F., 1984. Physiography of Southern Ontario. Ontario Geological Survey, Special Volume 2, 270 pp.

Hicks, D.M., and Mason, P.D., 1998. Roughness characteristics of New Zealand rivers. National Institute of Water and Atmospheric Research Ltd., Water Resources Publications, LLC, 329 p.

Appendix A – Photograph Log (August 2009, from AECOM)



Photograph 1 ↑
Reach 1 - Downstream of Hwy 26 – August 26, 2009



Photograph 2 ↑
Reach 1 - Downstream of Hwy 26 – February 13, 2009



Photograph 3 ↑
Reach 1 - Cross Section 1 downstream facing - August 26, 2009 - Representative of wider cross section containing woody/anthropogenic debris



Photograph 4 ↑
Reach 1 - Narrow, deep section of reach downstream from Cross Section 2 – August 26, 2009



Photograph 5
Reach 1 - Large erosion site on left bank, at south end of horse farm property – woody and anthropogenic debris accumulated in channel, deflecting flow to sandy bank – August 26, 2009



Photograph 6
Reach 1 - Large erosion site on left bank, at south end of horse farm property – collapsing fence over top of eroding sandy bank – August 26, 2009



Photograph 7
Reach 1 - Large sandy deposit on right bank and high cutbank on left bank – August 26, 2009



Photograph 8
Reach 1 - Glaciolacustrine clay bank material – August 26, 2009



Photograph 9 ↑
Reach 2 - Downstream of Vespra Valley Road – August 19 2009



Photograph 10 ↑
Reach 2 - Downstream of Vespra Valley Road – February 13, 2009



Photograph 11 ↑
Reach 2 - Cross section 3 – downstream facing – August 19, 2009



Photograph 12 ↑
Reach 2 - Large vegetation mat – August 19, 2009



Photograph 13 ↑
Reach 2 - Eroding banks near bases of two large trees – August 19, 2009



Photograph 14 ↑
Reach 2 - Woody debris on stream bed, sandy deposit on right bank and slumping of left bank – August 19, 2009



Photograph 15 ↑
Reach 2 - Steep cutbank – August 19, 2009



Photograph 16 ↑
Reach 3 - Exposed sandy sediment on stream bank – result of trampling from cows – August 18, 2009



Photograph 17 ↑
Reach 3 - Downstream of George Johnson Road – August 26, 2009 (lower water level)



Photograph 18 ↑
Reach 3 - Downstream of George Johnson Road – February 13, 2009



Photograph 19 ↑
Reach 3 - Cross section 4 – downstream facing – August 18, 2009



Photograph 20 ↑
Reach 3 - Erosion on right bank downstream of confluence – August 18, 2009

Appendix B – Cross-section Photograph Log (November 2013)

Appendix B – Cross-section Photograph Log (November 2013)



Photo 21 – Cross-section 1 (downstream view)



Photo 22 – Cross-section 2 (downstream view)



Photo 23 – Cross-section 3 (downstream view)



Photo 24 – Cross-section 4 (downstream view)

Appendix D. PWQMN Station 03005703002 Data (2002-2014)

Parameter	Mean	Median	25th Percentile	75th Percentile	Minimum	Maximum	n=
ALKALINITY, TOTAL	182	184	172	197	119	206	75
AMMONIUM, TOTAL UNFIL.REAC	0.019	0.017	0.01	0.025	0.002	0.071	105
CONDUCTIVITY, 25C	488	494	476	514	335	567	75
CONDUCTIVITY, AMBIENT	495	501	480	513	337	613	100
DISSOLVED OXYGEN	11.56	11.18	10.16	12.61	4.88	19.65	93
NITRATES TOTAL, UNFIL.REAC	0.69	0.68	0.55	0.85	0.22	1.03	103
NITROGEN,TOT,KJELDAHL/UNF.REA	0.43	0.39	0.33	0.51	0.18	1.04	103
PH FIELD	8.30	8.18	8.05	8.40	7.39	13.64	97
PHOSPHORUS,UNFILTERED TOTAL	0.031	0.019	0.013	0.031	0.002	0.286	101

PARM DESCRIPTION	STATION	PARM	DATE	TIME	FIELD_NO	MARK_CO	RESULT	ALUQUALI	ANALMETH	UNITS
ALKALINITY, TOTAL	030057030	ALKT	04-Jul-02	943	10700		174		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	15-Aug-02	954	10711		186		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	10-Sep-02	845	10722		194		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	22-Oct-02	1723	10733		196		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	05-May-03	914	13950		175		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	10-Jun-03	942	13961		176		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	08-Jul-03	946	13972		185		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	13-Aug-03	1454	13983		204		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	09-Sep-03	941	13994		203		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	01-Oct-03	1037	14005		206		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	05-Nov-03	944	14016		164		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	31-Mar-04	1040	23950		119		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	25-May-04	1642	23961		141		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	07-Jun-04	1604	1		175		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	08-Jul-04	1035	23983		153		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	24-Aug-04	1543	23994		202		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	27-Oct-04	1052	24005		202		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	15-Nov-04	954	24016		187		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	08-Dec-04	1025	24027		169		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	06-Apr-05	949	33950		132		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	09-May-05	947	33961		175		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	06-Jun-05	1050	33972		199		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	14-Jun-05	910	33983		166		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	16-Nov-05	1013	34027		176		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	13-Jul-06	1651	13951		182		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	14-Aug-06	1440	13969		194		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	19-Sep-06	1019	13987		203		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	12-Oct-06	710	14005		202		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	23-Nov-06	847	14023		181		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	12-Dec-06	835	14041		184		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	03-Apr-07	817	24101		153		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	07-May-07	954	24119		188		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	14-Aug-07	854	24146		204		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	11-Sep-07	958	24172		194		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	09-Oct-07	1001	24198		189		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	20-Nov-07	930	24224		191		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	29-Apr-08	945	13951		169		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	29-May-08	940	13968		188		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	21-Jul-08	958	13995		197		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	21-Aug-08	922	14012		195		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	27-Oct-08	849	14021		196		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	06-Nov-08	843	14047		196		P2046	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	21-Apr-09	939	23951		169		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	23-Jul-09	854	24003		195		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	17-Aug-09	840	24029		198		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	28-Sep-09	918	24047		199		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	15-Oct-09	905	24065		198		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2010-05-19	824	3959		181.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2010-06-01	848	33977		184.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2010-06-23	835	33995		166.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2010-08-10	933	34013		178.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2010-09-29	840	34039		163.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2010-10-06	840	34057		178.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2011-05-18	837	45401		182.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2011-07-25	855	45445		189.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2011-08-31	827	4527		201.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2011-10-20	854	45571		180.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2011-10-26	903	45589		159.0000		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2012-05-29	915	53401		183		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2012-06-25	0	53419		177		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2012-07-11	906	53453		199		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2012-08-15	840	53471		201		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2012-09-13	850	53497		203		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2012-10-30	854	53515		158		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2013-05-27	900	00063409		170		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2013-06-11	933	00063427		175		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2013-08-08	855	00063445		190		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2013-08-15	850	00063471		204		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2013-10-29	920	00063523		179		E3218A	MILLIGRAM PER LITER

ALKALINITY, TOTAL	030057030	ALKT	2014-05-27	900	C211422		159		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2014-06-12	852	C211956		164		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2014-08-13	850	C213720		166		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2014-08-19	843	C213855		130		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2014-10-21	857	C215770		200		E3218A	MILLIGRAM PER LITER
ALKALINITY, TOTAL	030057030	ALKT	2014-11-05	905	C216211		197		E3218A	MILLIGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	04-Jul-02	943	10700	+/-5	77.4	+/-5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	15-Aug-02	954	10711	+/-8	121	+/-8	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	10-Sep-02	845	10722	+/-5	76.5	+/-5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	22-Oct-02	1723	10733	+/-4	52.7	+/-4	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	05-May-03	914	13950	+/-6	89.8	+/-6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	10-Jun-03	942	13961	+/-10	138	+/-10	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	08-Jul-03	946	13972	+/-5	74	+/-5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	13-Aug-03	1454	13983	+/-6	69.6	+/-6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	09-Sep-03	941	13994	+/-6	68.5	+/-6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	01-Oct-03	1037	14005	+/-5	50.5	+/-5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	05-Nov-03	944	14016	+/-9	96.8	+/-9	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	31-Mar-04	1040	23950	+/-65	727	+/-65	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	25-May-04	1642	23961	+/-40	441	+/-40	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	08-Jul-04	1035	23983	+/-48	538	+/-48	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	24-Aug-04	1543	23994	+/-6	65.8	+/-6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	27-Oct-04	1052	24005	+/-6	63.1	+/-6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	15-Nov-04	954	24016	+/-3	32.5	+/-3	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	08-Dec-04	1025	24027	+/-11	120	+/-11	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	06-Apr-05	949	33950	+/-61	677	+/-61	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	09-May-05	947	33961	+/-7	72.4	+/-7	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	06-Jun-05	1050	33972	+/-7	80.2	+/-7	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	14-Jun-05	910	33983	+/-21	228	+/-21	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	13-Jul-06	1651	13951	+/-9	99.5	+/-9	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	12-Oct-06	710	14005	+/-5	55.4	+/-5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	23-Nov-06	847	14023	+/-6	69.6	+/-6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	12-Dec-06	835	14041	+/-11	107.8753	+/-11	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	03-Apr-07	817	24101	+/-27	273	+/-27	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	07-May-07	954	24119	+/-5.0	50.5	+/-5.0	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	14-Aug-07	854	24146	+/-6.5	64.7	+/-6.5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	11-Sep-07	958	24172	+/-16	165	+/-16	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	09-Oct-07	1001	24198	+/-11	107	+/-11	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	20-Nov-07	930	24224	+/-4.0	39.6	+/-4.0	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	29-Apr-08	945	13951	+/-13	126	+/-13	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	29-May-08	940	13968	+/-5.2	51.5	+/-5.2	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	21-Jul-08	958	13995	+/-14	142	+/-14	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	21-Aug-08	922	14012	+/-3.3	33.3	+/-3.3	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	27-Oct-08	849	14021	+/-7.6	58.8	+/-7.6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	06-Nov-08	843	14047	+/-4.7	36.1	+/-4.7	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	21-Apr-09	939	23951	+/-15	118	+/-15	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	23-Jul-09	854	24003	+/-5.6	43.4	+/-5.6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	17-Aug-09	840	24029	+/-7.3	56.3	+/-7.3	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	28-Sep-09	918	24047	+/-8.7	66.9	+/-8.7	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	15-Oct-09	905	24065	+/-4.1	31.6	+/-4.1	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2010-05-19	824	3959	+/-9.6	101.0000	+/-9.6	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2010-06-01	848	33977	+/-6.9	69.4000	+/-6.9	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2010-06-23	835	33995	+/-25	277.0000	+/-25	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2010-08-10	933	34013	+/-16	169.0000	+/-16	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2010-09-29	840	34039	+/-58	648.0000	+/-58	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2010-10-06	840	34057	+/-8.9	92.7000	+/-8.9	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2011-05-18	837	45401		116.0000	+/-11	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2011-06-14	846	45427		80.8000	+/-7.9	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2011-07-25	855	45445		76.0000	+/-7.5	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2011-08-31	827	4527		42.6000	+/-4.9	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2011-10-20	854	45571		111.0000	+/-11	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2011-10-26	903	45589		84.6000	+/-8.2	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2012-05-29	915	53401		71.3	+/-7.1	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2012-06-25	0	53419		59.9	+/-6.2	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2012-07-11	906	53453		68	+/-6.8	E3386A	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2012-08-15	840	53471		85.8	+/-8.7	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2012-09-13	850	53497		73	+/-7.4	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2012-10-30	854	53515	UAL	178	+/-18	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2013-05-27	900	00063409	+/-12	117	+/-12	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2013-06-11	933	00063427	+/-7.7	76.2	+/-7.7	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2013-08-08	855	00063445	+/-9.7	96.4	+/-9.7	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2013-08-15	850	00063471	+/-5.4	52.8	+/-5.4	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2013-10-29	920	00063523	+/-8.0	79.1	+/-8.0	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2014-05-27	900	C211422		91.1	+/-9.2	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2014-06-12	852	C211956		101	+/-10	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2014-08-13	850	C213720		154	+/-16	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2014-08-19	843	C213855		115	+/-12	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2014-10-21	857	C215770		86.6	+/-8.8	E3497	MICROGRAM PER LITER
ALUMINIUM, UNFILTERED TOTAL	030057030	ALUT	2014-11-05	905	C216211		50.8	+/-5.3	E3497	MICROGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	04-Jul-02	943	10700		0.016		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	15-Aug-02	954	10711		0.012		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	10-Sep-02	845	10722	<T	0.009	<T	E3364A	MILLIGRAM PER LITER

AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	22-Oct-02	1723	10733		0.011		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	05-May-03	914	13950		0.019		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	10-Jun-03	942	13961		0.018		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	08-Jul-03	946	13972		0.012		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	13-Aug-03	1454	13983		0.02		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	09-Sep-03	941	13994		0.014		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	01-Oct-03	1037	14005	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	05-Nov-03	944	14016	<T	0.007	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	31-Mar-04	1040	23950		0.036		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	25-May-04	1642	23961		0.021		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	07-Jun-04	1604	1		0.012		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	08-Jul-04	1035	23983	<T	0.008	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	24-Aug-04	1543	23994	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	27-Oct-04	1052	24005	<T	0.008	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	15-Nov-04	954	24016	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	08-Dec-04	1025	24027		0.029		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	06-Apr-05	949	33950		0.034		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	09-May-05	947	33961		0.015		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	06-Jun-05	1050	33972		0.011		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	14-Jun-05	910	33983		0.039		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	16-Nov-05	1013	34027		0.011		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	13-Jul-06	1651	13951	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	14-Aug-06	1440	13969	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	19-Sep-06	1019	13987		0.011		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	12-Oct-06	710	14005	<T	0.007	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	12-Dec-06	835	14041		0.023		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	03-Apr-07	817	24101		0.017		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	07-May-07	954	24119		0.023		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	11-Jul-07	958	24136		0.026		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	14-Aug-07	854	24146	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	29-Aug-07	944	24163	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	11-Sep-07	958	24172	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	26-Sep-07	1001	24189	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	09-Oct-07	1001	24198		0.01		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	12-Nov-07	1045	24215	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	20-Nov-07	930	24224		0.014		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	29-Apr-08	945	13951		0.021		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	29-May-08	940	13968	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	11-Jun-08	944	13986		0.015		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	21-Jul-08	958	13995	<T	0.007	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	21-Aug-08	922	14012	<=W	0.002	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	09-Sep-08	906	14012		0.016		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	22-Oct-08	859	14038	<=W	0.01	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	27-Oct-08	849	14021	<=W	0.01	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	06-Nov-08	843	14047	<=W	0.01	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	24-Nov-08	900	14064	<T	0.032	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	21-Apr-09	939	23951		0.027		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	28-May-09	902	23986		0.014		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	04-Jun-09	840	23994	<T	0.009	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	23-Jul-09	854	24003		0.019		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	11-Aug-09	848	24020		0.016		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	17-Aug-09	840	24029		0.01		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	28-Sep-09	918	24047	<T	0.006	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	15-Oct-09	905	24065	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-04-14	846	33950		0.0270		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-05-19	824	3959		0.0710		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-06-01	848	33977		0.0160		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-06-23	835	33995		0.0350		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-08-10	933	34013		0.0150		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-08-18	903	34030		0.0220		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-09-29	840	34039	<T	0.0090	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-10-06	840	34057		0.0130		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2010-11-17	1257	34073		0.0140		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-05-18	837	45401		0.0410		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-06-02	905	45418		0.0370		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-06-14	846	45427		0.0280		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-07-25	855	45445		0.0450		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-08-03	859	45462		0.0500		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-08-31	827	4527		0.0130		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-09-20	937	45462		0.0020	<=W	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-10-20	854	45571		0.0190		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-10-26	903	45589		0.0190		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2011-11-01	843	45607		0.0300		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-05-29	915	53401		0.018		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-06-07	937	53436		0.022		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-06-25	0	53419		0.022		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-07-11	906	53453		0.024		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-07-26	908	52444		0.048		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-08-15	840	53471		0.02		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-09-13	850	53497		0.034		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-09-19	917	53488		0.021		E3364A	MILLIGRAM PER LITER

AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-10-15	856	53532		0.018		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2012-10-30	854	53515		0.005	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-04-25	830	00063400		0.025		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-05-27	900	00063409		0.021		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-06-11	933	00063427	<T	0.012	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-07-08	928	00063462	<T	0.01	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-08-08	855	00063445	<T	0.023	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-08-15	850	00063471	<T	0.023	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-10-07	845	00063506	<T	0.019	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-10-29	920	00063523	<T	0.016	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2013-11-07	920	00063514		0.037		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-05-20	930	C211220		0.032		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-05-27	900	C211422		0.026		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-06-12	852	C211956		0.048		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-08-13	850	C213720		0.033		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-08-19	843	C213855		0.025		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-09-02	908	C214237	RRV	0.037		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-10-15	1345	C215560		0.017	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-10-21	857	C215770		0.019	<T	E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-11-05	905	C216211		0.029		E3364A	MILLIGRAM PER LITER
AMMONIUM, TOTAL UNFIL.REAC	030057030	NNHTUR	2014-11-13	925	C216400		0.018	<T	E3364A	MILLIGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	04-Jul-02	943	10700	+/-1.7	43.4	+/-1.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	15-Aug-02	954	10711	+/-2.0	49.9	+/-2.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	10-Sep-02	845	10722	+/-2.1	52.1	+/-2.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	22-Oct-02	1723	10733	+/-2.3	56.8	+/-2.3	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	05-May-03	914	13950	+/-1.8	45.9	+/-1.8	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	10-Jun-03	942	13961	+/-2.0	50.3	+/-2.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	08-Jul-03	946	13972	+/-2.1	51.3	+/-2.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	13-Aug-03	1454	13983	+/-3.8	54	+/-3.8	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	09-Sep-03	941	13994	+/-3.7	52.8	+/-3.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	01-Oct-03	1037	14005	+/-3.5	49.4	+/-3.5	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	05-Nov-03	944	14016	+/-3.0	43.4	+/-3.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	31-Mar-04	1040	23950	+/-3.2	45.2	+/-3.2	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	25-May-04	1642	23961	+/-2.9	41.7	+/-2.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	08-Jul-04	1035	23983	+/-3.4	47.9	+/-3.4	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	24-Aug-04	1543	23994	+/-3.7	53.4	+/-3.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	27-Oct-04	1052	24005	+/-3.7	52.7	+/-3.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	15-Nov-04	954	24016	+/-2.9	41.1	+/-2.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	08-Dec-04	1025	24027	+/-2.9	42.1	+/-2.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	06-Apr-05	949	33950	+/-3.5	50.4	+/-3.5	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	09-May-05	947	33961	+/-3.3	47.5	+/-3.3	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	06-Jun-05	1050	33972	+/-4.1	58.1	+/-4.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	14-Jun-05	910	33983	+/-4.0	57.8	+/-4.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	13-Jul-06	1651	13951	+/-3.6	51.2	+/-3.6	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	12-Oct-06	710	14005	+/-4.0	56.6	+/-4.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	23-Nov-06	847	14023	+/-3.0	43.1	+/-3.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	12-Dec-06	835	14041	+/-4.2	46.88052	+/-4.2	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	03-Apr-07	817	24101	+/-3.6	40.2	+/-3.6	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	07-May-07	954	24119	+/-4.3	48	+/-4.3	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	14-Aug-07	854	24146	+/-5.9	65.8	+/-5.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	11-Sep-07	958	24172	+/-5.7	63.6	+/-5.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	09-Oct-07	1001	24198	+/-5.7	63.8	+/-5.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	20-Nov-07	930	24224	+/-4.8	53.1	+/-4.8	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	29-Apr-08	945	13951	+/-4.2	46.4	+/-4.2	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	29-May-08	940	13968	+/-4.3	47.4	+/-4.3	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	21-Jul-08	958	13995	+/-5.1	56.3	+/-5.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	21-Aug-08	922	14012	+/-4.7	52.3	+/-4.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	27-Oct-08	849	14021	+/-4.9	53.9	+/-4.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	06-Nov-08	843	14047	+/-4.7	52.2	+/-4.7	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	21-Apr-09	939	23951	+/-3.9	42.8	+/-3.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	23-Jul-09	854	24003	+/-5.0	55.9	+/-5.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	17-Aug-09	840	24029	+/-5.0	55.5	+/-5.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	28-Sep-09	918	24047	+/-5.5	61.1	+/-5.5	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	15-Oct-09	905	24065	+/-4.3	54.3	+/-4.3	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2010-05-19	824	3959	+/-4.0	50.5000	+/-4.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2010-06-01	848	33977	+/-4.2	52.3000	+/-4.2	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2010-06-23	835	33995	+/-4.2	52.3000	+/-4.2	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2010-08-10	933	34013	+/-4.3	53.4000	+/-4.3	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2010-09-29	840	34039	+/-4.6	58.1000	+/-4.6	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2010-10-06	840	34057	+/-3.5	43.9000	+/-3.5	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2011-05-18	837	45401		49.4000	+/-3.9	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2011-06-14	846	45427		44.9000	+/-3.6	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2011-07-25	855	45445		57.0000	+/-4.5	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2011-08-31	827	4527		57.0000	+/-4.5	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2011-10-20	854	45571		51.7000	+/-4.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2011-10-26	903	45589		38.1000	+/-3.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2012-05-29	915	53401		51.7	+/-4.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2012-06-25	0	53419		51.5	+/-4.1	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2012-07-11	906	53453		62.4	+/-5.0	E3386A	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2012-08-15	840	53471		67.6	+/-6.8	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2012-09-13	850	53497		65.5	+/-6.6	E3497	MICROGRAM PER LITER

BARIUM, UNFILTERED TOTAL	030057030	BAUT	2012-10-30	854	53515	UAL	50.9	+/-5.1	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2013-05-27	900	00063409	+/-4.5	44.8	+/-4.5	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2013-06-11	933	00063427	+/-4.9	49.1	+/-4.9	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2013-08-08	855	00063445	+/-5.9	59.1	+/-5.9	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2013-08-15	850	00063471	+/-6.4	63.6	+/-6.4	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2013-10-29	920	00063523	+/-4.7	46.8	+/-4.7	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2014-05-27	900	C211422		51.1	+/-5.1	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2014-06-12	852	C211956		54.9	+/-5.5	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2014-08-13	850	C213720		61.4	+/-6.1	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2014-08-19	843	C213855		52.1	+/-5.2	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2014-10-21	857	C215770		49.6	+/-5.0	E3497	MICROGRAM PER LITER
BARIUM, UNFILTERED TOTAL	030057030	BAUT	2014-11-05	905	C216211		51	+/-5.1	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	04-Jul-02	943	10700	+/-0.0	0.00623	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	15-Aug-02	954	10711	+/-0.0	0.00923	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	10-Sep-02	845	10722	+/-0.0	0.00102	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	22-Oct-02	1723	10733	+/-0.0	0.00829	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	05-May-03	914	13950	+/-0.0	0.0185	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	10-Jun-03	942	13961	+/-0.0	0.0155	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	08-Jul-03	946	13972	+/-0.0	0.00887	+/-0.03	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	13-Aug-03	1454	13983	+/-0.0	0.00937	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	09-Sep-03	941	13994	+/-0.0	0.0123	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	01-Oct-03	1037	14005	+/-0.0	0.0092	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	05-Nov-03	944	14016	+/-0.0	0.0123	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	31-Mar-04	1040	23950	+/-0.0	0.0497	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	25-May-04	1642	23961	+/-0.0	0.0292	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	08-Jul-04	1035	23983	+/-0.0	0.0309	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	24-Aug-04	1543	23994	+/-0.0	0.00224	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	27-Oct-04	1052	24005	+/-0.0	0.0372	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	15-Nov-04	954	24016	+/-0.0	0.00604	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	08-Dec-04	1025	24027	+/-0.0	-0.00771	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	06-Apr-05	949	33950	+/-0.0	0.0348	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	09-May-05	947	33961	+/-0.0	0.00281	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	06-Jun-05	1050	33972	+/-0.0	0.0151	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	14-Jun-05	910	33983	+/-0.0	0.0333	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	13-Jul-06	1651	13951	+/-0.0	-0.00785	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	12-Oct-06	710	14005	+/-0.0	-0.0214	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	23-Nov-06	847	14023	+/-0.0	-0.0133	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	12-Dec-06	835	14041	+/-0.0	0.0163	+/-0.02	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	03-Apr-07	817	24101	+/-0.0	-0.0162	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	07-May-07	954	24119	+/-0.0	-0.0201	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	14-Aug-07	854	24146	+/-0.0	-0.0252	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	11-Sep-07	958	24172	+/-0.0	-0.0189	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	09-Oct-07	1001	24198	+/-0.0	-0.0273	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	20-Nov-07	930	24224	+/-0.0	-0.0427	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	29-Apr-08	945	13951	+/-0.0	-0.0313	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	29-May-08	940	13968	+/-0.0	-0.0329	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	21-Jul-08	958	13995	+/-0.0	-0.0145	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	21-Aug-08	922	14012	+/-0.0	-0.0327	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	27-Oct-08	849	14021	+/-0.0	-0.0292	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	06-Nov-08	843	14047	+/-0.0	-0.0367	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	21-Apr-09	939	23951	+/-0.0	0.000155	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	23-Jul-09	854	24003	+/-0.0	0.00783	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	17-Aug-09	840	24029	+/-0.0	-0.00886	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	28-Sep-09	918	24047	+/-0.0	0.000382	+/-0.04	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	15-Oct-09	905	24065	+/-0.0	0.003	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2010-05-19	824	3959	+/-0.0	0.0140	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2010-06-01	848	33977	+/-0.0	0.0190	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2010-06-23	835	33995	+/-0.0	0.0260	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2010-08-10	933	34013	+/-0.0	-0.0750	+/-0.031	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2010-09-29	840	34039	+/-0.0	-0.0490	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2010-10-06	840	34057	+/-0.0	-0.0450	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2011-05-18	837	45401		0.0070	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2011-06-14	846	45427		-0.0170	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2011-07-25	855	45445		-0.0060	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2011-08-31	827	4527		0.0130	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2011-10-20	854	45571		0.0090	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2011-10-26	903	45589		0.0060	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2012-05-29	915	53401		-0.004	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2012-06-25	0	53419		0.001	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2012-07-11	906	53453		0.006	+/-0.030	E3386A	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2012-08-15	840	53471		0.0374	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2012-09-13	850	53497		0.109	+/-0.068	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2012-10-30	854	53515	UAL	0.111	+/-0.068	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2013-05-27	900	00063409	+/-0.0	-0.0149	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2013-06-11	933	00063427	+/-0.0	-0.00404	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2013-08-08	855	00063445	+/-0.0	-0.014	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2013-08-15	850	00063471	+/-0.0	-0.0269	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2013-10-29	920	00063523	+/-0.0	-0.0207	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2014-05-27	900	C211422		-0.00699	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2014-06-12	852	C211956		-0.0138	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2014-08-13	850	C213720		-0.00992	+/-0.067	E3497	MICROGRAM PER LITER

BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2014-08-19	843	C213855		-0.00224	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2014-10-21	857	C215770		0.0177	+/-0.067	E3497	MICROGRAM PER LITER
BERYLIUM,UNFILTERED TOTAL	030057030	BEUT	2014-11-05	905	C216211		0.0697	+/-0.067	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2012-08-15	840	53471		1.8	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2012-09-13	850	53497		1.36	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2012-10-30	854	53515	UAL	1.02	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2013-05-27	900	00063409	+/-3.3	0.134	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2013-06-11	933	00063427	+/-3.3	-0.406	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2013-08-08	855	00063445	+/-3.3	0.217	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2013-08-15	850	00063471	+/-3.3	-0.148	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2013-10-29	920	00063523	+/-3.3	0.0542	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2014-05-27	900	C211422		0.0645	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2014-06-12	852	C211956		1.19	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2014-08-13	850	C213720		-1	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2014-08-19	843	C213855		-0.668	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2014-10-21	857	C215770		-1.12	+/-3.3	E3497	MICROGRAM PER LITER
BISMUTH, UNFILTERED TOTAL	030057030	BIUT	2014-11-05	905	C216211		-0.631	+/-3.3	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	04-Jul-02	943	10700	+/-0.6	-0.148	+/-0.6	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	15-Aug-02	954	10711	+/-0.9	-0.0541	+/-0.9	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	10-Sep-02	845	10722	+/-0.6	0.636	+/-0.6	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	22-Oct-02	1723	10733	+/-0.6	0.0638	+/-0.6	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	05-May-03	914	13950	+/-0.6	-0.0485	+/-0.6	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	10-Jun-03	942	13961	+/-0.6	0.189	+/-0.6	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	08-Jul-03	946	13972	+/-0.9	-0.35	+/-0.9	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	13-Aug-03	1454	13983	+/-0.8	-0.0289	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	09-Sep-03	941	13994	+/-0.8	-0.405	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	01-Oct-03	1037	14005	+/-0.8	-0.00172	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	05-Nov-03	944	14016	+/-1.6	-0.217	+/-1.6	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	31-Mar-04	1040	23950	+/-1.2	-1.81	+/-1.2	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	25-May-04	1642	23961	+/-0.8	-0.178	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	08-Jul-04	1035	23983	+/-0.8	-0.539	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	24-Aug-04	1543	23994	+/-0.8	-0.934	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	27-Oct-04	1052	24005	+/-0.8	0.546	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	15-Nov-04	954	24016	+/-0.8	0.524	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	08-Dec-04	1025	24027	+/-0.8	0.261	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	06-Apr-05	949	33950	+/-0.8	0.101	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	09-May-05	947	33961	+/-0.8	0.071	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	06-Jun-05	1050	33972	+/-0.8	0.11	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	14-Jun-05	910	33983	+/-0.8	0.226	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	13-Jul-06	1651	13951	+/-0.8	0.134	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	12-Oct-06	710	14005	+/-0.8	-0.0415	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	23-Nov-06	847	14023	+/-0.8	0.143	+/-0.8	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	12-Dec-06	835	14041	+/-0.8	-0.437	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	03-Apr-07	817	24101	+/-0.8	-0.0925	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	07-May-07	954	24119	+/-0.8	0.961	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	14-Aug-07	854	24146	+/-0.8	1.01	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	11-Sep-07	958	24172	+/-0.8	0.691	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	09-Oct-07	1001	24198	+/-0.8	0.892	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	20-Nov-07	930	24224	+/-0.8	0.865	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	29-Apr-08	945	13951	+/-0.8	0.417	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	29-May-08	940	13968	+/-0.8	0.37	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	21-Jul-08	958	13995	+/-0.8	0.151	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	21-Aug-08	922	14012	+/-0.8	0.536	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	27-Oct-08	849	14021	+/-0.8	0.871	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	06-Nov-08	843	14047	+/-0.8	0.655	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	21-Apr-09	939	23951	+/-0.8	-0.172	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	23-Jul-09	854	24003	+/-0.8	-0.0929	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	17-Aug-09	840	24029	+/-0.8	0.799	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	28-Sep-09	918	24047	+/-0.8	-0.00164	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	15-Oct-09	905	24065	+/-0.8	-0.244	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2010-05-19	824	3959	+/-0.8	-0.7580	+/-0.81	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2010-06-01	848	33977	+/-0.8	1.1100	+/-0.82	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2010-06-23	835	33995	+/-0.8	0.5090	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2010-08-10	933	34013	+/-0.8	0.1240	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2010-09-29	840	34039	+/-0.8	0.0630	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2010-10-06	840	34057	+/-0.8	0.4640	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2011-05-18	837	45401		0.1160	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2011-06-14	846	45427		-0.4450	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2011-07-25	855	45445		-0.5250	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2011-08-31	827	4527		-0.8370	+/-0.81	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2011-10-20	854	45571		-0.4020	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2011-10-26	903	45589		-0.3500	+/-0.80	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2012-05-29	915	53401		0.675	+/-0.81	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2012-06-25	0	53419		0.692	+/-0.81	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2012-07-11	906	53453		1.1	+/-0.82	E3386A	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2012-08-15	840	53471		1.15	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2012-09-13	850	53497		-0.901	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2012-10-30	854	53515	UAL	-1.2	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2013-05-27	900	00063409	+/-0.6	1.21	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2013-06-11	933	00063427	+/-0.6	1.27	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2013-08-08	855	00063445	+/-0.6	1.36	+/-0.62	E3497	MICROGRAM PER LITER

CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2013-08-15	850	00063471	+/-0.6	1.37	+/-0.62	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2013-10-29	920	00063523	+/-0.6	1.36	+/-0.62	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2014-05-27	900	C211422		1.48	+/-0.62	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2014-06-12	852	C211956		1.03	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2014-08-13	850	C213720		1.54	+/-0.62	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2014-08-19	843	C213855		1.28	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2014-10-21	857	C215770		1.18	+/-0.61	E3497	MICROGRAM PER LITER
CADMIUM, UNFILTERED TOTAL	030057030	CDUT	2014-11-05	905	C216211		1.74	+/-0.63	E3497	MICROGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	04-Jul-02	943	10700	CALCR	49.4		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	04-Jul-02	943	10700	+/-2.8	47.4	+/-2.84	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	15-Aug-02	954	10711	CALCR	57.7		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	15-Aug-02	954	10711	+/-3.1	52.9	+/-3.18	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	10-Sep-02	845	10722	CALCR	57.9		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	10-Sep-02	845	10722	+/-3.0	50.9	+/-3.05	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	22-Oct-02	1723	10733	CALCR	64.9		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	22-Oct-02	1723	10733	+/-4.0	67.1	+/-4.03	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	05-May-03	914	13950	CALCR	61.4		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	05-May-03	914	13950	+/-3.3	55	+/-3.30	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	10-Jun-03	942	13961	CALCR	60.3		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	10-Jun-03	942	13961	+/-3.3	55	+/-3.30	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	08-Jul-03	946	13972	+/-3.3	56.2	+/-3.37	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	08-Jul-03	946	13972	CALCR	58		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	13-Aug-03	1454	13983	CALCR	62.7		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	13-Aug-03	1454	13983	+/-6.9	57.5	+/-6.91	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	09-Sep-03	941	13994	CALCR	51.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	09-Sep-03	941	13994	+/-5.1	42.7	+/-5.12	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	01-Oct-03	1037	14005	CALCR	64.2		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	01-Oct-03	1037	14005	+/-6.0	50.6	+/-6.07	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	05-Nov-03	944	14016	CALCR	55.5		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	05-Nov-03	944	14016	+/-6.1	51.5	+/-6.18	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	31-Mar-04	1040	23950	CALCR	43.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	31-Mar-04	1040	23950	+/-5.7	48	+/-5.76	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	25-May-04	1642	23961	CALCR	48.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	25-May-04	1642	23961	+/-5.1	42.7	+/-5.12	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	07-Jun-04	1604	1	CALCR	58		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	08-Jul-04	1035	23983	CALCR	49.9		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	08-Jul-04	1035	23983	+/-5.0	42.3	+/-5.07	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	24-Aug-04	1543	23994	CALCR	62		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	24-Aug-04	1543	23994	+/-6.2	52	+/-6.24	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	27-Oct-04	1052	24005	CALCR	67.2		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	27-Oct-04	1052	24005	+/-7.1	59.7	+/-7.16	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	15-Nov-04	954	24016	CALCR	91.9		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	15-Nov-04	954	24016	+/-5.3	44.6	+/-5.36	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	08-Dec-04	1025	24027	+/-5.3	44.3	+/-5.32	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	08-Dec-04	1025	24027	CALCR	53.8		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	06-Apr-05	949	33950	CALCR	49.5		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	06-Apr-05	949	33950	+/-6.3	53.3	+/-6.39	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	09-May-05	947	33961	+/-6.4	53.9	+/-6.47	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	09-May-05	947	33961	CALCR	59.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	06-Jun-05	1050	33972	CALCR	64.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	06-Jun-05	1050	33972	+/-7.2	60.7	+/-7.29	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	14-Jun-05	910	33983	CALCR	53.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	14-Jun-05	910	33983	+/-6.6	55	+/-6.60	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	16-Nov-05	1013	34027	CALCR	52.3		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	13-Jul-06	1651	13951	CALCR	55.2		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	13-Jul-06	1651	13951	+/-6.8	56.9	+/-6.83	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	14-Aug-06	1440	13969	CALCR	57.2		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	19-Sep-06	1019	13987	CALCR	61.1		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	12-Oct-06	710	14005	CALCR	60.3		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	12-Oct-06	710	14005	+/-7.2	60.5	+/-7.26	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	23-Nov-06	847	14023	CALCR	53.3		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	23-Nov-06	847	14023	+/-7.1	59.2	+/-7.10	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	12-Dec-06	835	14041	CALCR	62		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	12-Dec-06	835	14041	+/-10	62.6053	+/-10	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	03-Apr-07	817	24101	CALCR	49.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	03-Apr-07	817	24101	+/-8.5	52.9	+/-8.5	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	07-May-07	954	24119	CALCR	56.9		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	07-May-07	954	24119	+/-9.3	57.9	+/-9.3	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	14-Aug-07	854	24146	CALCR	59.6		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	14-Aug-07	854	24146	+/-10.	61	+/-10.0	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	11-Sep-07	958	24172	CALCR	58		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	11-Sep-07	958	24172	+/-10.	60.4	+/-10.0	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	09-Oct-07	1001	24198	CALCR	64		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	09-Oct-07	1001	24198	+/-9.2	57.2	+/-9.2	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	20-Nov-07	930	24224	+/-9.1	56.9	+/-9.1	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	20-Nov-07	930	24224	CALCR	55.7		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	29-Apr-08	945	13951	CALCR	52.8		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	29-Apr-08	945	13951	+/-8.8	55	+/-8.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	29-May-08	940	13968	CALCR	62.8		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	29-May-08	940	13968	+/-8.6	54	+/-8.6	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	21-Jul-08	958	13995	CALCR	65.6		E3171A	MILLIGRAM PER LITER

CALCIUM, UNFILTERED TOTAL	030057030	CAUT	21-Jul-08	958	13995	+/-10	62.7	+/-10	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	21-Aug-08	922	14012	CALCR	64.1		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	21-Aug-08	922	14012	+/-10.	60.6	+/-10.0	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	27-Oct-08	849	14021	CALCR	65.7		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	27-Oct-08	849	14021	+/-5.9	59.1	+/-5.9	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	06-Nov-08	843	14047	CALCR	63.2		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	06-Nov-08	843	14047	+/-5.8	58.4	+/-5.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	21-Apr-09	939	23951	+/-5.8	58.2	+/-5.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	21-Apr-09	939	23951	CALCR	58.7		E3171A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	23-Jul-09	854	24003	+/-5.9	59.4	+/-5.9	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	17-Aug-09	840	24029	+/-6.0	59.6	+/-6.0	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	28-Sep-09	918	24047	+/-5.8	58	+/-5.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	15-Oct-09	905	24065	+/-4.0	67.1	+/-4.0	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2010-05-19	824	3959	+/-3.7	63.2000	+/-3.7	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2010-06-01	848	33977	+/-3.3	56.1000	+/-3.3	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2010-06-23	835	33995	+/-3.8	64.0000	+/-3.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2010-08-10	933	34013	+/-3.6	60.2000	+/-3.6	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2010-09-29	840	34039	+/-3.4	57.2000	+/-3.4	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2010-10-06	840	34057	+/-3.4	57.0000	+/-3.4	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2011-05-18	837	45401		67.1000	+/-4.0	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2011-06-14	846	45427		57.2000	+/-3.4	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2011-07-25	855	45445		61.1000	+/-3.6	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2011-08-31	827	4527		63.7000	+/-3.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2011-10-20	854	45571		58.5000	+/-3.5	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2011-10-26	903	45589		54.5000	+/-3.2	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2012-05-29	915	53401		59.2	+/-3.5	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2012-06-25	0	53419		58.7	+/-3.5	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2012-07-11	906	53453		65	+/-3.8	E3386A	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2012-08-15	840	53471		63.2	+/-6.3	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2012-09-13	850	53497		63.6	+/-6.4	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2012-10-30	854	53515	UAL	52.3	+/-5.2	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2013-05-27	900	00063409	+/-5.7	57.1	+/-5.7	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2013-06-11	933	00063427	+/-6.0	59.5	+/-6.0	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2013-08-08	855	00063445	+/-6.0	59.5	+/-6.0	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2013-08-15	850	00063471	+/-6.4	63.9	+/-6.4	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2013-10-29	920	00063523	+/-6.1	60.9	+/-6.1	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2014-05-27	900	C211422		66	+/-6.6	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2014-06-12	852	C211956		69.4	+/-6.9	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2014-08-13	850	C213720		68.7	+/-6.9	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2014-08-19	843	C213855		61.4	+/-6.1	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2014-10-21	857	C215770		64.7	+/-6.5	E3497	MILLIGRAM PER LITER
CALCIUM, UNFILTERED TOTAL	030057030	CAUT	2014-11-05	905	C216211		69.6	+/-7.0	E3497	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	13-Jul-06	1651	13951		40.4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	14-Aug-06	1440	13969		44.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	19-Sep-06	1019	13987		46.1		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	12-Oct-06	710	14005		45.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	23-Nov-06	847	14023		40.4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	12-Dec-06	835	14041		42.3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	03-Apr-07	817	24101		34.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	07-May-07	954	24119		41.9		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	14-Aug-07	854	24146		47.3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	11-Sep-07	958	24172		45.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	09-Oct-07	1001	24198		44.3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	20-Nov-07	930	24224		43.4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	29-Apr-08	945	13951		40.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	29-May-08	940	13968		42.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	21-Jul-08	958	13995		45.1		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	21-Aug-08	922	14012		45.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	06-Nov-08	843	14047		46.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	21-Apr-09	939	23951		38.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	23-Jul-09	854	24003		46.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	17-Aug-09	840	24029		43.3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	28-Sep-09	918	24047		45.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	15-Oct-09	905	24065		47.7		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2010-05-19	824	3959		42.9000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2010-06-01	848	33977		42.1000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2010-06-23	835	33995		39.4000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2010-08-10	933	34013		43.9000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2010-09-29	840	34039		39.8000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2011-05-18	837	45401		43.2000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2011-07-25	855	45445		45.1000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2011-08-31	827	4527		46.0000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2011-10-20	854	45571		41.4000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2011-10-26	903	45589		37.6000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2012-05-29	915	53401		42.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2012-06-25	0	53419		40.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2012-07-11	906	53453		45.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2012-08-15	840	53471		46.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2012-09-13	850	53497	UAL	48.3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2012-10-30	854	53515	UAL	38.9		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2013-05-27	900	00063409		38.7		E3370A	MILLIGRAM PER LITER

CARBON, DISSOLVED INORGANIC	030057030	DIC	2013-06-11	933	00063427		42.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2013-08-08	855	00063445		44		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2013-08-15	850	00063471		46.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2013-10-29	920	00063523		42.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2014-05-27	900	C211422		45.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2014-06-12	852	C211956		45.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2014-08-13	850	C213720		45.4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2014-08-19	843	C213855		43.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2014-10-21	857	C215770		46.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED INORGANIC	030057030	DIC	2014-11-05	905	C216211		44.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	13-Jul-06	1651	13951		6.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	14-Aug-06	1440	13969		3.7		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	19-Sep-06	1019	13987		3.4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	12-Oct-06	710	14005		3.9		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	23-Nov-06	847	14023		6.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	12-Dec-06	835	14041		6.1		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	03-Apr-07	817	24101		4.7		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	07-May-07	954	24119		4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	14-Aug-07	854	24146		2.1		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	11-Sep-07	958	24172		2.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	09-Oct-07	1001	24198		6.7		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	20-Nov-07	930	24224		4.3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	29-Apr-08	945	13951		6.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	29-May-08	940	13968		4.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	21-Jul-08	958	13995		5.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	21-Aug-08	922	14012		3.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	06-Nov-08	843	14047		4.4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	21-Apr-09	939	23951		4.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	23-Jul-09	854	24003		3.1		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	17-Aug-09	840	24029		3.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	28-Sep-09	918	24047		2.9		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	15-Oct-09	905	24065		4.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2010-05-19	824	3959		5.3000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2010-06-01	848	33977		4.0000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2010-06-23	835	33995		6.2000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2010-08-10	933	34013		7.9000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2010-09-29	840	34039		8.6000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2011-05-18	837	45401		5.0000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2011-07-25	855	45445		2.9000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2011-08-31	827	4527		3.4000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2011-10-20	854	45571		5.5000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2011-10-26	903	45589		7.1000		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2012-05-29	915	53401		3.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2012-06-25	0	53419		3.8		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2012-07-11	906	53453		2.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2012-08-15	840	53471		3.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2012-09-13	850	53497	UAL	4.5		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2012-10-30	854	53515	UAL	8.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2013-05-27	900	00063409		5.9		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2013-06-11	933	00063427		4.7		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2013-08-08	855	00063445		5.2		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2013-08-15	850	00063471		3		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2013-10-29	920	00063523		7.6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2014-05-27	900	C211422		4.1		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2014-06-12	852	C211956		2.7		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2014-08-13	850	C213720		4		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2014-08-19	843	C213855		6.9		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2014-10-21	857	C215770		6		E3370A	MILLIGRAM PER LITER
CARBON, DISSOLVED ORGANIC	030057030	DOC	2014-11-05	905	C216211		5.3		E3370A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	04-Jul-02	943	10700		32.5		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	15-Aug-02	954	10711		23.5		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	10-Sep-02	845	10722		30.6		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	22-Oct-02	1723	10733		34.7		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	05-May-03	914	13950		60.4		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	10-Jun-03	942	13961		70.4		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	08-Jul-03	946	13972		36.6		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	13-Aug-03	1454	13983		38.1		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	09-Sep-03	941	13994		29		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	01-Oct-03	1037	14005		29.5		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	05-Nov-03	944	14016		49.4		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	31-Mar-04	1040	23950		32.6		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	25-May-04	1642	23961		43.6		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	07-Jun-04	1604	1		41		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	08-Jul-04	1035	23983		32.7		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	24-Aug-04	1543	23994		29.5		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	27-Oct-04	1052	24005		31.6		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	15-Nov-04	954	24016		39.1		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	08-Dec-04	1025	24027		50.7		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	06-Apr-05	949	33950		44		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	09-May-05	947	33961		61.6		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	06-Jun-05	1050	33972		34.8		E3016A	MILLIGRAM PER LITER

CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	14-Jun-05	910	33983		48.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	16-Nov-05	1013	34027		34.6		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	13-Jul-06	1651	13951		59.1		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	14-Aug-06	1440	13969		39.1		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	19-Sep-06	1019	13987		29.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	12-Oct-06	710	14005		33.2		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	23-Nov-06	847	14023		47		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	12-Dec-06	835	14041		45.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	03-Apr-07	817	24101		30.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	07-May-07	954	24119		49.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	11-Jul-07	958	24136		40.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	14-Aug-07	854	24146		32.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	29-Aug-07	944	24163		34.1		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	11-Sep-07	958	24172		32		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	26-Sep-07	1001	24189		34.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	09-Oct-07	1001	24198		45.1		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	12-Nov-07	1045	24215		49.4		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	20-Nov-07	930	24224		45.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	29-Apr-08	945	13951		64.1		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	29-May-08	940	13968		50.4		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	11-Jun-08	944	13986		49.1		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	21-Jul-08	958	13995		42.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	21-Aug-08	922	14012		44.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	09-Sep-08	906	14012		43.3		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	22-Oct-08	859	14038		43		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	27-Oct-08	849	14021		47.2		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	06-Nov-08	843	14047		48.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	24-Nov-08	900	14064		63		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	21-Apr-09	939	23951		49.2		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	28-May-09	902	23986		40.6		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	04-Jun-09	840	23994		43.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	23-Jul-09	854	24003		37.4		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	11-Aug-09	848	24020		44.2		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	17-Aug-09	840	24029		43.6		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	28-Sep-09	918	24047		38		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	15-Oct-09	905	24065		45.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-04-14	846	33950		51.6000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-05-19	824	3959		52.2000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-06-01	848	33977		43.0000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-06-23	835	33995		38.8000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-08-10	933	34013		41.6000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-08-18	903	34030		42.1000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-09-29	840	34039		38.0000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-10-06	840	34057		44.1000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2010-11-17	1257	34073		36.0000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-05-18	837	45401		47.6000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-06-02	905	45418		47.8000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-06-14	846	45427		41.3000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-07-25	855	45445		37.3000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-08-03	859	45462		40.6000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-08-31	827	4527		39.4000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-09-20	937	45462		33.5000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-10-20	854	45571		39.0000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-10-26	903	45589		41.3000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2011-11-01	843	45607		43.4000		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-05-29	915	53401		43.9		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-06-07	937	53436		48.3		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-06-25	0	53419		44.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-07-11	906	53453		40.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-07-26	908	52444		32.4		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-08-15	840	53471		35.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-09-13	850	53497		45.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-09-19	917	53488		37.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-10-15	856	53532		50.3		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2012-10-30	854	53515		48		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-04-25	830	00063400		56.2		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-05-27	900	00063409		56.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-06-11	933	00063427		43.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-07-08	928	00063462		38.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-08-08	855	00063445		43.5		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-08-15	850	00063471		35.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-10-07	845	00063506		35		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-10-29	920	00063523		45.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2013-11-07	920	00063514		44.3		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-05-20	930	C211220		48.6		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-05-27	900	C211422		45.8		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-06-12	852	C211956		33.4		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-08-13	850	C213720		36.2		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-08-19	843	C213855		41.6		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-09-02	908	C214237		41.7		E3016A	MILLIGRAM PER LITER
CHLORIDE,	UNFIL.REAC	030057030	CLIDUR	2014-10-15	1345	C215560		41.3		E3016A	MILLIGRAM PER LITER

CHLORIDE, UNFIL.REAC	030057030	CLIDUR	2014-10-21	857	C215770		41		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	2014-11-05	905	C216211		44.9		E3016A	MILLIGRAM PER LITER
CHLORIDE, UNFIL.REAC	030057030	CLIDUR	2014-11-13	925	C216400		45.4		E3016A	MILLIGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	04-Jul-02	943	10700	+/-1.0	-0.0541	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	15-Aug-02	954	10711	+/-1.0	0.0813	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	10-Sep-02	845	10722	+/-1.0	0.513	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	22-Oct-02	1723	10733	+/-1.0	-0.159	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	05-May-03	914	13950	+/-1.0	0.0056	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	10-Jun-03	942	13961	+/-1.0	0.174	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	08-Jul-03	946	13972	+/-1.0	0.733	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	13-Aug-03	1454	13983	+/-1.0	-0.477	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	09-Sep-03	941	13994	+/-1.6	0.0054	+/-1.6	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	01-Oct-03	1037	14005	+/-1.0	0.199	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	05-Nov-03	944	14016	+/-1.0	0.98	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	31-Mar-04	1040	23950	+/-1.5	0.563	+/-1.5	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	25-May-04	1642	23961	+/-1.0	0.153	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	08-Jul-04	1035	23983	+/-1.0	0.449	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	24-Aug-04	1543	23994	+/-1.0	-0.938	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	27-Oct-04	1052	24005	+/-1.0	0.00958	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	15-Nov-04	954	24016	+/-1.0	0.154	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	08-Dec-04	1025	24027	+/-1.0	-1.07	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	06-Apr-05	949	33950	+/-1.0	0.794	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	09-May-05	947	33961	+/-1.0	0.166	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	06-Jun-05	1050	33972	+/-1.0	0.111	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	14-Jun-05	910	33983	+/-1.0	0.969	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	13-Jul-06	1651	13951	+/-1.0	0.906	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	12-Oct-06	710	14005	+/-1.0	0.101	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	23-Nov-06	847	14023	+/-1.0	0.302	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	12-Dec-06	835	14041	+/-1.0	0.304605	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	03-Apr-07	817	24101	+/-1.0	0.758	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	07-May-07	954	24119	+/-1.0	0.509	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	14-Aug-07	854	24146	+/-1.0	0.364	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	11-Sep-07	958	24172	+/-1.0	0.802	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	09-Oct-07	1001	24198	+/-1.0	0.171	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	20-Nov-07	930	24224	+/-1.0	0.354	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	29-Apr-08	945	13951	+/-1.0	0.804	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	29-May-08	940	13968	+/-1.0	-0.237	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	21-Jul-08	958	13995	+/-1.0	0.404	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	21-Aug-08	922	14012	+/-1.0	-0.0197	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	27-Oct-08	849	14021	+/-1.0	-0.158	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	06-Nov-08	843	14047	+/-1.0	0.239	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	21-Apr-09	939	23951	+/-1.0	0.911	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	23-Jul-09	854	24003	+/-1.0	0.28	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	17-Aug-09	840	24029	+/-1.0	0.93	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	28-Sep-09	918	24047	+/-1.0	0.889	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	15-Oct-09	905	24065	+/-1.0	-0.571	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2010-05-19	824	3959	+/-1.0	0.0930	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2010-06-01	848	33977	+/-1.0	-0.3450	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2010-06-23	835	33995	+/-1.0	-0.2840	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2010-08-10	933	34013	+/-1.0	0.9150	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2010-09-29	840	34039	+/-1.0	0.1470	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2010-10-06	840	34057	+/-1.0	-0.5280	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2011-05-18	837	45401		0.1330	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2011-06-14	846	45427		-0.1510	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2011-07-25	855	45445		-0.3380	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2011-08-31	827	4527		-0.4890	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2011-10-20	854	45571		-1.1000	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2011-10-26	903	45589		0.1440	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2012-05-29	915	53401		-0.428	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2012-06-25	0	53419		0.012	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2012-07-11	906	53453		-0.642	+/-1.0	E3386A	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2012-08-15	840	53471		0.207	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2012-09-13	850	53497		0.215	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2012-10-30	854	53515	UAL	0.434	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2013-05-27	900	00063409	+/-0.6	0.479	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2013-06-11	933	00063427	+/-0.6	1.56	+/-0.69	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2013-08-08	855	00063445	+/-0.6	0.731	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2013-08-15	850	00063471	+/-0.6	0.52	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2013-10-29	920	00063523	+/-0.6	0.7	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2014-05-27	900	C211422		1.68	+/-0.69	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2014-06-12	852	C211956		1.7	+/-0.69	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2014-08-13	850	C213720		1.09	+/-0.68	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2014-08-19	843	C213855		0.915	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2014-10-21	857	C215770		0.958	+/-0.67	E3497	MICROGRAM PER LITER
CHROMIUM, UNFILTERED TOTAL	030057030	CRUT	2014-11-05	905	C216211		0.359	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	04-Jul-02	943	10700	+/-1.5	0.274	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	15-Aug-02	954	10711	+/-1.5	-0.0812	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	10-Sep-02	845	10722	+/-1.5	0.447	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	22-Oct-02	1723	10733	+/-1.5	0.172	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	05-May-03	914	13950	+/-1.5	0.673	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	10-Jun-03	942	13961	+/-1.5	1.09	+/-1.5	E3386A	MICROGRAM PER LITER

COBALT, UNFILTERED TOTAL	030057030	COUT	08-Jul-03	946	13972	+/-1.5	0.55	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	13-Aug-03	1454	13983	+/-1.5	-0.228	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	09-Sep-03	941	13994	+/-1.5	0.757	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	01-Oct-03	1037	14005	+/-1.5	0.162	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	05-Nov-03	944	14016	+/-1.5	0.364	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	31-Mar-04	1040	23950	+/-3.2	-2.6	+/-3.2	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	25-May-04	1642	23961	+/-1.5	1.38	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	08-Jul-04	1035	23983	+/-1.5	1.43	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	24-Aug-04	1543	23994	+/-1.5	-0.101	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	27-Oct-04	1052	24005	+/-1.5	-0.882	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	15-Nov-04	954	24016	+/-1.5	-0.486	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	08-Dec-04	1025	24027	+/-1.5	0.517	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	06-Apr-05	949	33950	+/-1.5	-0.0628	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	09-May-05	947	33961	+/-1.5	-0.0351	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	06-Jun-05	1050	33972	+/-1.5	0.0606	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	14-Jun-05	910	33983	+/-1.5	0.117	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	13-Jul-06	1651	13951	+/-1.5	-0.648	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	12-Oct-06	710	14005	+/-1.5	-0.855	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	23-Nov-06	847	14023	+/-1.5	-1.04	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	12-Dec-06	835	14041	+/-1.5	0.31622	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	03-Apr-07	817	24101	+/-1.5	-0.643	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	07-May-07	954	24119	+/-1.5	-0.0133	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	14-Aug-07	854	24146	+/-1.5	-0.44	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	11-Sep-07	958	24172	+/-1.5	0.79	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	09-Oct-07	1001	24198	+/-1.5	0.499	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	20-Nov-07	930	24224	+/-1.5	1.18	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	29-Apr-08	945	13951	+/-1.5	0.536	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	29-May-08	940	13968	+/-1.5	0.752	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	21-Jul-08	958	13995	+/-1.5	0.517	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	21-Aug-08	922	14012	+/-1.5	0.43	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	27-Oct-08	849	14021	+/-1.5	0.142	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	06-Nov-08	843	14047	+/-1.5	1.82	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	21-Apr-09	939	23951	+/-1.5	0.237	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	23-Jul-09	854	24003	+/-1.5	1	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	17-Aug-09	840	24029	+/-1.5	0.341	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	28-Sep-09	918	24047	+/-1.5	0.894	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	15-Oct-09	905	24065	+/-1.5	0.403	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2010-05-19	824	3959	+/-1.5	0.2170	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2010-06-01	848	33977	+/-1.5	0.2740	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2010-06-23	835	33995	+/-1.5	0.4060	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2010-08-10	933	34013	+/-1.5	-0.4240	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2010-09-29	840	34039	+/-1.5	-0.0620	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2010-10-06	840	34057	+/-1.5	-0.7080	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2011-05-18	837	45401		0.0630	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2011-06-14	846	45427		0.3350	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2011-07-25	855	45445		0.2310	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2011-08-31	827	4527		-0.0010	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2011-10-20	854	45571		0.6750	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2011-10-26	903	45589		-0.3210	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2012-05-29	915	53401		0.026	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2012-06-25	0	53419		0.007	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2012-07-11	906	53453		-0.319	+/-1.5	E3386A	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2012-08-15	840	53471		0.454	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2012-09-13	850	53497		0.373	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2012-10-30	854	53515	UAL	0.702	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2013-05-27	900	00063409	+/-0.6	0.593	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2013-06-11	933	00063427	+/-0.6	0.437	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2013-08-08	855	00063445	+/-0.6	0.429	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2013-08-15	850	00063471	+/-0.6	0.194	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2013-10-29	920	00063523	+/-0.6	0.231	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2014-05-27	900	C211422		0.313	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2014-06-12	852	C211956		0.185	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2014-08-13	850	C213720		0.263	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2014-08-19	843	C213855		0.25	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2014-10-21	857	C215770		0.147	+/-0.67	E3497	MICROGRAM PER LITER
COBALT, UNFILTERED TOTAL	030057030	COUT	2014-11-05	905	C216211		0.347	+/-0.67	E3497	MICROGRAM PER LITER
CONDUCTIVITY, 25C	030057030	COND25	04-Jul-02	943	10700		404		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	15-Aug-02	954	10711		407		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	10-Sep-02	845	10722		477		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	22-Oct-02	1723	10733		487		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	05-May-03	914	13950		533		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	10-Jun-03	942	13961		567		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	08-Jul-03	946	13972		479		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	13-Aug-03	1454	13983		519		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	09-Sep-03	941	13994		480		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	01-Oct-03	1037	14005		474		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	05-Nov-03	944	14016		468		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	31-Mar-04	1040	23950		335		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	25-May-04	1642	23961		415		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	07-Jun-04	1604	1		455		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	08-Jul-04	1035	23983		401		E3218A	MICRO SIEMENS PER

CONDUCTIVITY, 25C	030057030	COND25	24-Aug-04	1543	23994		483		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	27-Oct-04	1052	24005		475		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	15-Nov-04	954	24016		486		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	08-Dec-04	1025	24027		505		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	06-Apr-05	949	33950		409		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	09-May-05	947	33961		526		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	06-Jun-05	1050	33972		477		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	14-Jun-05	910	33983		483		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	16-Nov-05	1013	34027		452		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	13-Jul-06	1651	13951		518		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	14-Aug-06	1440	13969		484		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	19-Sep-06	1019	13987		460		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	12-Oct-06	710	14005		470		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	23-Nov-06	847	14023		501		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	12-Dec-06	835	14041		507		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	03-Apr-07	817	24101		395		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	07-May-07	954	24119		521		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	14-Aug-07	854	24146		488		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	11-Sep-07	958	24172		460		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	09-Oct-07	1001	24198		507		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	20-Nov-07	930	24224		506		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	29-Apr-08	945	13951		535		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	29-May-08	940	13968		523		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	21-Jul-08	958	13995		509		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	21-Aug-08	922	14012		518		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	27-Oct-08	849	14021		521		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	06-Nov-08	843	14047		538		P2046	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	21-Apr-09	939	23951		491		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	23-Jul-09	854	24003		499		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	17-Aug-09	840	24029		510		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	28-Sep-09	918	24047		503		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	15-Oct-09	905	24065		524		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2010-05-19	824	3959		520.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2010-06-01	848	33977		488.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2010-06-23	835	33995		453.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2010-08-10	933	34013		486.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2010-09-29	840	34039		435.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2010-10-06	840	34057		484.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2011-05-18	837	45401		503.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2011-07-25	855	45445		484.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2011-08-31	827	4527		501.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2011-10-20	854	45571		471.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2011-10-26	903	45589		450.0000		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2012-05-29	915	53401		498		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2012-06-25	0	53419		509		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2012-07-11	906	53453		525		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2012-08-15	840	53471		513		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2012-09-13	850	53497		548		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2012-10-30	854	53515		479		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2013-05-27	900	00063409		509		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2013-06-11	933	00063427		486		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2013-08-08	855	00063445		510		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2013-08-15	850	00063471		515		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2013-10-29	920	00063523		509		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2014-05-27	900	C211422		521		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2014-06-12	852	C211956		489		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2014-08-13	850	C213720		498		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2014-08-19	843	C213855		494		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2014-10-21	857	C215770		516		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, 25C	030057030	COND25	2014-11-05	905	C216211		528		E3218A	MICRO SIEMENS PER
CONDUCTIVITY, AMBIENT	030057030	CONDAM	05-May-03	914	13950		536		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	10-Jun-03	942	13961		555		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	08-Jul-03	946	13972		482		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	13-Aug-03	1454	13983		503		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	09-Sep-03	941	13994		472		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	01-Oct-03	1037	14005		475		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	05-Nov-03	944	14016		487		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	31-Mar-04	1040	23950		344		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	25-May-04	1642	23961		415		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	07-Jun-04	1604	1		470		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	08-Jul-04	1035	23983		386		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	24-Aug-04	1543	23994		613		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	27-Oct-04	1052	24005		490		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	08-Dec-04	1025	24027		512		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	06-Apr-05	949	33950		408		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	06-Jun-05	1050	33972		493		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	14-Jun-05	910	33983		480		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	16-Nov-05	1013	34027		467		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	13-Jul-06	1651	13951		548		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	14-Aug-06	1440	13969		503		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	19-Sep-06	1019	13987		482		FIELD	MICROMHOS/CM

CONDUCTIVITY, AMBIENT	030057030	CONDAM	12-Oct-06	710	14005		490		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	23-Nov-06	847	14023		507		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	12-Dec-06	835	14041		520		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	03-Apr-07	817	24101		337		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	07-May-07	954	24119		430		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	11-Jul-07	958	24136		510		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	14-Aug-07	854	24146		500		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	29-Aug-07	944	24163		506		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	11-Sep-07	958	24172		476		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	26-Sep-07	1001	24189		506		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	09-Oct-07	1001	24198		517		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	12-Nov-07	1045	24215		472		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	20-Nov-07	930	24224		467		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	29-Apr-08	945	13951		541		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	29-May-08	940	13968		525		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	11-Jun-08	944	13986		520		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	21-Jul-08	958	13995		505		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	21-Aug-08	922	14012		518		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	09-Sep-08	906	14012		506		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	22-Oct-08	859	14038		514		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	27-Oct-08	849	14021		523		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	06-Nov-08	843	14047		526		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	24-Nov-08	900	14064		563		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	21-Apr-09	939	23951		487		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	28-May-09	902	23986		494		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	04-Jun-09	840	23994		506		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	23-Jul-09	854	24003		500		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	11-Aug-09	848	24020		505		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	17-Aug-09	840	24029		510		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	28-Sep-09	918	24047		504		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	15-Oct-09	905	24065		530		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-04-14	846	33950		533.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-05-19	824	3959		525.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-06-01	848	33977		513.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-06-23	835	33995		454.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-08-10	933	34013		493.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-08-18	903	34030		502.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-09-29	840	34039		432.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-10-06	840	34057		483.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2010-11-17	1257	34073		480.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-05-18	837	45401		500.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-06-02	905	45418		493.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-06-14	846	45427		471.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-07-25	855	45445		478.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-08-03	859	45462		481.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-08-31	827	4527		503.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-09-20	937	45462		501.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-10-20	854	45571		473.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-10-26	903	45589		455.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2011-11-01	843	45607		470.0000		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-05-29	915	53401		496		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-06-07	937	53436		499		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-06-25	0	53419		491		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-07-11	906	53453		520		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-07-26	908	52444		469		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-08-15	840	53471		513		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-09-13	850	53497		533		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-09-19	917	53488		467		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-10-15	856	53532		488		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2012-10-30	854	53515		474		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-04-25	830	00063400		507		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-05-27	900	00063409		507		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-06-11	933	00063427		481		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-07-08	928	00063462		505		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-08-08	855	00063445		501		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-08-15	850	00063471		509		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-10-07	845	00063506		459		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-10-29	920	00063523		510		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2013-11-07	920	00063514		514		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-05-20	930	C211220		519		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-05-27	900	C211422		523		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-06-12	852	C211956		495		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-08-13	850	C213720		496		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-08-19	843	C213855		491		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-09-02	908	C214237		513		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-10-15	1345	C215560		512		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-10-21	857	C215770		511		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-11-05	905	C216211		601		FIELD	MICROMHOS/CM
CONDUCTIVITY, AMBIENT	030057030	CONDAM	2014-11-13	925	C216400		555		FIELD	MICROMHOS/CM
COPPER, UNFILTERED TOTAL	030057030	CUUT	04-Jul-02	943	10700	+/-0.6	0.515	+/-0.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	15-Aug-02	954	10711	+/-0.6	0.443	+/-0.6	E3386A	MICROGRAM PER LITER

COPPER, UNFILTERED TOTAL	030057030	CUUT	10-Sep-02	845	10722	+/-0.6	0.434	+/-0.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	22-Oct-02	1723	10733	+/-0.6	0.0766	+/-0.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	05-May-03	914	13950	+/-0.6	0.514	+/-0.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	10-Jun-03	942	13961	+/-0.6	0.925	+/-0.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	08-Jul-03	946	13972	+/-0.6	0.424	+/-0.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	13-Aug-03	1454	13983	+/-0.8	0.36	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	09-Sep-03	941	13994	+/-0.8	0.485	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	01-Oct-03	1037	14005	+/-0.8	0.0427	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	05-Nov-03	944	14016	+/-0.8	0.638	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	31-Mar-04	1040	23950	+/-0.8	1.92	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	25-May-04	1642	23961	+/-0.8	1.14	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	08-Jul-04	1035	23983	+/-0.8	1.45	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	24-Aug-04	1543	23994	+/-0.8	0.294	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	27-Oct-04	1052	24005	+/-0.8	-0.184	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	15-Nov-04	954	24016	+/-0.8	0.159	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	08-Dec-04	1025	24027	+/-0.8	0.816	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	06-Apr-05	949	33950	+/-0.8	1.83	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	09-May-05	947	33961	+/-0.8	0.462	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	06-Jun-05	1050	33972	+/-0.8	0.592	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	14-Jun-05	910	33983	+/-0.8	1.56	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	13-Jul-06	1651	13951	+/-0.8	0.733	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	12-Oct-06	710	14005	+/-0.8	-0.0259	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	23-Nov-06	847	14023	+/-0.8	0.976	+/-0.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	12-Dec-06	835	14041	+/-0.8	0.388046	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	03-Apr-07	817	24101	+/-0.8	1.28	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	07-May-07	954	24119	+/-0.8	0.748	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	14-Aug-07	854	24146	+/-0.8	0.195	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	11-Sep-07	958	24172	+/-0.8	1.08	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	09-Oct-07	1001	24198	+/-0.8	0.958	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	20-Nov-07	930	24224	+/-0.8	-0.0776	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	29-Apr-08	945	13951	+/-0.8	1.35	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	29-May-08	940	13968	+/-0.8	0.834	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	21-Jul-08	958	13995	+/-0.8	1.15	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	21-Aug-08	922	14012	+/-0.8	0.483	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	27-Oct-08	849	14021	+/-0.8	0.403	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	06-Nov-08	843	14047	+/-0.8	0.646	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	21-Apr-09	939	23951	+/-0.8	2.28	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	23-Jul-09	854	24003	+/-0.8	0.879	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	17-Aug-09	840	24029	+/-0.8	0.68	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	28-Sep-09	918	24047	+/-0.8	1.04	+/-0.80	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	15-Oct-09	905	24065	+/-5.5	1.32	+/-5.5	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2010-05-19	824	3959	+/-5.2	1.9200	+/-5.2	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2010-06-01	848	33977	+/-4.6	1.1100	+/-4.6	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2010-06-23	835	33995	+/-5.2	5.3000	+/-5.2	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2010-08-10	933	34013	+/-4.9	1.5000	+/-4.9	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2010-09-29	840	34039	+/-4.7	2.2600	+/-4.7	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2010-10-06	840	34057	+/-4.7	1.2400	+/-4.7	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2011-05-18	837	45401		1.2500	+/-5.5	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2011-06-14	846	45427		1.2300	+/-4.7	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2011-07-25	855	45445		1.3100	+/-5.0	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2011-08-31	827	4527		1.1100	+/-5.2	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2011-10-20	854	45571		1.4000	+/-4.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2011-10-26	903	45589		1.3100	+/-4.5	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2012-05-29	915	53401		0.555	+/-4.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2012-06-25	0	53419		0.942	+/-4.8	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2012-07-11	906	53453		0.814	+/-5.3	E3386A	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2012-08-15	840	53471		0.267	+/-0.33	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2012-09-13	850	53497		1.26	+/-0.36	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2012-10-30	854	53515	UAL	1.27	+/-0.36	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2013-05-27	900	00063409	+/-0.3	1.13	+/-0.35	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2013-06-11	933	00063427	+/-0.3	1.07	+/-0.35	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2013-08-08	855	00063445	+/-0.3	1.02	+/-0.35	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2013-08-15	850	00063471	+/-0.3	0.926	+/-0.35	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2013-10-29	920	00063523	+/-0.3	1.65	+/-0.37	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2014-05-27	900	C211422		1.61	+/-0.37	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2014-06-12	852	C211956		1.76	+/-0.38	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2014-08-13	850	C213720		1.36	+/-0.36	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2014-08-19	843	C213855		0.563	+/-0.34	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2014-10-21	857	C215770		1.3	+/-0.36	E3497	MICROGRAM PER LITER
COPPER, UNFILTERED TOTAL	030057030	CUUT	2014-11-05	905	C216211		0.0827	+/-0.33	E3497	MICROGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	05-May-03	914	13950		10.76		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	10-Jun-03	942	13961		10.2		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	08-Jul-03	946	13972		9.67		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	13-Aug-03	1454	13983		11.09		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	09-Sep-03	941	13994		10.98		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	01-Oct-03	1037	14005		12.99		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	31-Mar-04	1040	23950		4.88		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	25-May-04	1642	23961		12.48		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	07-Jun-04	1604	1		12.26		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	08-Jul-04	1035	23983		11.35		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	24-Aug-04	1543	23994		13.66		FIELD	MILLIGRAM PER LITER

DISSOLVED OXYGEN	030057030	DO	27-Oct-04	1052	24005		15.04		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	08-Dec-04	1025	24027		18.81		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	06-Apr-05	949	33950		13.27		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	06-Jun-05	1050	33972		9.27		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	14-Jun-05	910	33983		7.96		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	16-Nov-05	1013	34027		12.11		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	13-Jul-06	1651	13951		11.73		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	14-Aug-06	1440	13969		7.56		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	19-Sep-06	1019	13987		11.89		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	12-Oct-06	710	14005		10.8		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	03-Apr-07	817	24101		14.4		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	07-May-07	954	24119		13.8		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	11-Jul-07	958	24136		10.9		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	14-Aug-07	854	24146		10.5		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	29-Aug-07	944	24163		11.5		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	11-Sep-07	958	24172		12.4		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	26-Sep-07	1001	24189		11.5		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	09-Oct-07	1001	24198		9.4		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	29-Apr-08	945	13951		13.37		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	29-May-08	940	13968		11.18		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	11-Jun-08	944	13986		8.83		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	21-Jul-08	958	13995		10.35		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	21-Aug-08	922	14012		10.52		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	09-Sep-08	906	14012		11.17		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	22-Oct-08	859	14038		14.85		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	27-Oct-08	849	14021		13.87		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	06-Nov-08	843	14047		13.94		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	24-Nov-08	900	14064		17.04		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	21-Apr-09	939	23951		18.47		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	28-May-09	902	23986		10.5		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	04-Jun-09	840	23994		12.49		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	23-Jul-09	854	24003		8.92		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	11-Aug-09	848	24020		9.47		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	17-Aug-09	840	24029		8.98		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	28-Sep-09	918	24047		8.88		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	15-Oct-09	905	24065		12.46		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-04-14	846	33950		19.6500		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-05-19	824	3959		9.0000		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-06-01	848	33977		8.6800		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-06-23	835	33995		10.0000		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-08-10	933	34013		9.3700		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-09-29	840	34039		9.7600		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-10-06	840	34057		10.7300		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2010-11-17	1257	34073		13.7200		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-05-18	837	45401		10.3200		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-06-02	905	45418		11.9200		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-06-14	846	45427		10.7700		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-07-25	855	45445		9.9500		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-08-03	859	45462		9.3100		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-08-31	827	4527		9.7000		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-09-20	937	45462		10.3900		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-10-20	854	45571		11.6400		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-10-26	903	45589		12.1000		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2011-11-01	843	45607		13.9300		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-05-29	915	53401		10.06		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-06-07	937	53436		11.84		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-06-25	0	53419		12.71		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-07-11	906	53453		10.16		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-07-26	908	52444		6.29		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-08-15	840	53471		10.99		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-09-13	850	53497		10.14		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-09-19	917	53488		12.87		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2012-10-30	854	53515		15.83		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-04-25	830	00063400		13.43		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-05-27	900	00063409		10.89		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-06-11	933	00063427		11.4		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-07-08	928	00063462		12.61		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-08-08	855	00063445		10.81		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-08-15	850	00063471		12.53		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-10-07	845	00063506		13.02		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-10-29	920	00063523		14.99		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2013-11-07	920	00063514		14.22		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-05-20	930	C211220		12.25		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-05-27	900	C211422		11		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-06-12	852	C211956		11.53		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-08-13	850	C213720		9.52		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-08-19	843	C213855		10.55		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-09-02	908	C214237		10.69		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-10-15	1345	C215560		10.98		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-10-21	857	C215770		11.41		FIELD	MILLIGRAM PER LITER
DISSOLVED OXYGEN	030057030	DO	2014-11-05	905	C216211		11.18		FIELD	MILLIGRAM PER LITER

DISSOLVED OXYGEN	030057030	DO	2014-11-13	925	C216400		12.16		FIELD	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	04-Jul-02	943	10700		206		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	15-Aug-02	954	10711		194		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	10-Sep-02	845	10722		197		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	22-Oct-02	1723	10733		214		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	05-May-03	914	13950		196		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	10-Jun-03	942	13961		192		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	08-Jul-03	946	13972		195		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	13-Aug-03	1454	13983		209		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	09-Sep-03	941	13994		181		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	01-Oct-03	1037	14005		214		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	05-Nov-03	944	14016		181		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	31-Mar-04	1040	23950		132		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	25-May-04	1642	23961		150		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	07-Jun-04	1604	1		184		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	08-Jul-04	1035	23983		158		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	24-Aug-04	1543	23994		211		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	27-Oct-04	1052	24005		222		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	15-Nov-04	954	24016		306		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	08-Dec-04	1025	24027		175		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	06-Apr-05	949	33950		150		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	09-May-05	947	33961		188		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	06-Jun-05	1050	33972		213		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	14-Jun-05	910	33983		175		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	16-Nov-05	1013	34027		177		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	13-Jul-06	1651	13951		181		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	14-Aug-06	1440	13969		193		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	19-Sep-06	1019	13987		205		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	12-Oct-06	710	14005		201		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	23-Nov-06	847	14023		172		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	12-Dec-06	835	14041		195		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	03-Apr-07	817	24101		151		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	07-May-07	954	24119		185		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	14-Aug-07	854	24146		206		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	11-Sep-07	958	24172		196		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	09-Oct-07	1001	24198		208		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	20-Nov-07	930	24224		189		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	29-Apr-08	945	13951		167		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	29-May-08	940	13968		202		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	21-Jul-08	958	13995		212		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	21-Aug-08	922	14012		214		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	27-Oct-08	849	14021		216		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	06-Nov-08	843	14047		207		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	21-Apr-09	939	23951		180		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	21-Apr-09	939	23951		184		E3171A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	23-Jul-09	854	24003		197		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	17-Aug-09	840	24029		197		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	28-Sep-09	918	24047		191		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	15-Oct-09	905	24065		216		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2010-05-19	824	3959		207.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2010-06-01	848	33977		192.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2010-06-23	835	33995		201.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2010-08-10	933	34013		195.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2010-09-29	840	34039		184.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2010-10-06	840	34057		193.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2011-05-18	837	45401		211.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2011-06-14	846	45427		188.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2011-07-25	855	45445		207.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2011-08-31	827	4527		213.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2011-10-20	854	45571		195.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2011-10-26	903	45589		181.0000		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2012-05-29	915	53401		203		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2012-06-25	0	53419		196		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2012-07-11	906	53453		217		E3386A	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2013-05-27	900	00063409		179		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2013-06-11	933	00063427		191		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2013-08-08	855	00063445		191		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2013-08-15	850	00063471		217		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2013-10-29	920	00063523		189		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2014-05-27	900	C211422		209		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2014-06-12	852	C211956		225		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2014-08-13	850	C213720		222		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2014-08-19	843	C213855		196		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2014-10-21	857	C215770		208		E3497	MILLIGRAM PER LITER
HARDNESS, TOTAL	030057030	HARDT	2014-11-05	905	C216211		220		E3497	MILLIGRAM PER LITER
IRON, UNFILTERED TOTAL	030057030	FEUT	04-Jul-02	943	10700	+/-8.1	162	+/-8.1	E3386A	MICROGRAM PER LITER
IRON, UNFILTERED TOTAL	030057030	FEUT	15-Aug-02	954	10711	+/-11.	226	+/-11.3	E3386A	MICROGRAM PER LITER
IRON, UNFILTERED TOTAL	030057030	FEUT	10-Sep-02	845	10722	+/-7.6	153	+/-7.6	E3386A	MICROGRAM PER LITER
IRON, UNFILTERED TOTAL	030057030	FEUT	22-Oct-02	1723	10733	+/-6.8	136	+/-6.8	E3386A	MICROGRAM PER LITER
IRON, UNFILTERED TOTAL	030057030	FEUT	05-May-03	914	13950	+/-8.3	166	+/-8.3	E3386A	MICROGRAM PER LITER
IRON, UNFILTERED TOTAL	030057030	FEUT	10-Jun-03	942	13961	+/-14.	295	+/-14.8	E3386A	MICROGRAM PER LITER

IRON,	UNFILTERED TOTAL	030057030	FEUT	08-Jul-03	946	13972	+/-6.7	133	+/-6.7	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	13-Aug-03	1454	13983	+/-12.	162	+/-12.9	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	09-Sep-03	941	13994	+/-6.9	86.2	+/-6.9	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	01-Oct-03	1037	14005	+/-7.7	95.7	+/-7.7	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	05-Nov-03	944	14016	+/-17.	217	+/-17.3	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	31-Mar-04	1040	23950	+/-101	1270	+/-101.5	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	25-May-04	1642	23961	+/-42.	531	+/-42.5	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	08-Jul-04	1035	23983	+/-48.	610	+/-48.8	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	24-Aug-04	1543	23994	+/-8.1	102	+/-8.1	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	27-Oct-04	1052	24005	+/-9.5	119	+/-9.5	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	15-Nov-04	954	24016	+/-7.1	89.1	+/-7.1	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	08-Dec-04	1025	24027	+/-18.	230	+/-18.4	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	06-Apr-05	949	33950	+/-55.	693	+/-55.5	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	09-May-05	947	33961	+/-9.8	122	+/-9.8	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	06-Jun-05	1050	33972	+/-11.	148	+/-11.8	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	14-Jun-05	910	33983	+/-32.	408	+/-32.7	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	13-Jul-06	1651	13951	+/-23.	288	+/-23.0	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	12-Oct-06	710	14005	+/-11.	149	+/-11.9	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	23-Nov-06	847	14023	+/-12.	159	+/-12.7	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	12-Dec-06	835	14041	+/-20	225.3553	+/-20	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	03-Apr-07	817	24101	+/-42	463	+/-42	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	07-May-07	954	24119	+/-9.2	102	+/-9.2	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	14-Aug-07	854	24146	+/-10	111	+/-10	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	11-Sep-07	958	24172	+/-32	358	+/-32	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	09-Oct-07	1001	24198	+/-24	262	+/-24	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	20-Nov-07	930	24224	+/-12	138	+/-12	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	29-Apr-08	945	13951	+/-21	232	+/-21	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	29-May-08	940	13968	+/-12	132	+/-12	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	21-Jul-08	958	13995	+/-31	346	+/-31	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	21-Aug-08	922	14012	+/-9.4	104	+/-9.4	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	27-Oct-08	849	14021	+/-11	122	+/-11	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	06-Nov-08	843	14047	+/-10	116	+/-10	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	21-Apr-09	939	23951	+/-20	221	+/-20	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	23-Jul-09	854	24003	+/-10	112	+/-10	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	17-Aug-09	840	24029	+/-11	122	+/-11	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	28-Sep-09	918	24047	+/-12	139	+/-12	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	15-Oct-09	905	24065	+/-16	104	+/-16	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2010-05-19	824	3959	+/-38	253.0000	+/-38	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2010-06-01	848	33977	+/-25	162.0000	+/-25	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2010-06-23	835	33995	+/-90	595.0000	+/-90	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2010-08-10	933	34013	+/-53	350.0000	+/-53	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2010-09-29	840	34039	+/-171	########	+/-171	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2010-10-06	840	34057	+/-30	198.0000	+/-30	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2011-05-18	837	45401		274.0000	+/-41	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2011-06-14	846	45427		186.0000	+/-28	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2011-07-25	855	45445		191.0000	+/-29	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2011-08-31	827	4527		131.0000	+/-20	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2011-10-20	854	45571		353.0000	+/-53	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2011-10-26	903	45589		219.0000	+/-33	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2012-05-29	915	53401		158	+/-24	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2012-06-25	0	53419		139	+/-21	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2012-07-11	906	53453		133	+/-20	E3386A	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2012-08-15	840	53471		209	+/-21	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2012-09-13	850	53497		205	+/-21	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2012-10-30	854	53515	UAL	316	+/-32	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2013-05-27	900	00063409	+/-20	202	+/-20	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2013-06-11	933	00063427	+/-16	157	+/-16	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2013-08-08	855	00063445	+/-17	172	+/-17	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2013-08-15	850	00063471	+/-11	106	+/-11	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2013-10-29	920	00063523	+/-19	192	+/-19	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2014-05-27	900	C211422		171	+/-17	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2014-06-12	852	C211956		194	+/-20	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2014-08-13	850	C213720		287	+/-29	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2014-08-19	843	C213855		219	+/-22	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2014-10-21	857	C215770		245	+/-25	E3497	MICROGRAM PER LITER
IRON,	UNFILTERED TOTAL	030057030	FEUT	2014-11-05	905	C216211		161	+/-16	E3497	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	04-Jul-02	943	10700	+/-11	3.47	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	15-Aug-02	954	10711	+/-11	-2.43	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	10-Sep-02	845	10722	+/-11	0.869	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	22-Oct-02	1723	10733	+/-11	3.21	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	05-May-03	914	13950	+/-11	-0.943	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	10-Jun-03	942	13961	+/-18	-0.168	+/-18	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	08-Jul-03	946	13972	+/-11	-3.75	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	13-Aug-03	1454	13983	+/-11	-2.6	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	09-Sep-03	941	13994	+/-11	6.9	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	01-Oct-03	1037	14005	+/-11	-1.81	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	05-Nov-03	944	14016	+/-11	-11.8	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	31-Mar-04	1040	23950	+/-11	14.3	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	25-May-04	1642	23961	+/-11	-5.56	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	08-Jul-04	1035	23983	+/-11	-0.665	+/-11	E3386A	MICROGRAM PER LITER
LEAD,	UNFILTERED TOTAL	030057030	PBUT	24-Aug-04	1543	23994	+/-11	12.5	+/-11	E3386A	MICROGRAM PER LITER

LEAD, UNFILTERED TOTAL	030057030	PBUT	27-Oct-04	1052	24005	+/-11	0.337	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	15-Nov-04	954	24016	+/-11	15.4	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	08-Dec-04	1025	24027	+/-11	0.641	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	06-Apr-05	949	33950	+/-11	-0.731	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	09-May-05	947	33961	+/-11	-1.28	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	06-Jun-05	1050	33972	+/-11	3.79	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	14-Jun-05	910	33983	+/-11	-2.02	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	13-Jul-06	1651	13951	+/-11	-1.76	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	12-Oct-06	710	14005	+/-11	-3.8	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	23-Nov-06	847	14023	+/-11	-3.94	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	12-Dec-06	835	14041	+/-11	-5.45	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	03-Apr-07	817	24101	+/-11	-4.85	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	07-May-07	954	24119	+/-11	2.15	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	14-Aug-07	854	24146	+/-11	-2.17	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	11-Sep-07	958	24172	+/-11	1.24	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	09-Oct-07	1001	24198	+/-11	0.496	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	20-Nov-07	930	24224	+/-11	-6.49	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	29-Apr-08	945	13951	+/-11	1.82	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	29-May-08	940	13968	+/-11	0.978	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	21-Jul-08	958	13995	+/-11	5.25	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	21-Aug-08	922	14012	+/-11	-3.87	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	27-Oct-08	849	14021	+/-11	-0.581	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	06-Nov-08	843	14047	+/-11	-4.12	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	21-Apr-09	939	23951	+/-11	-8.49	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	23-Jul-09	854	24003	+/-11	-4.09	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	17-Aug-09	840	24029	+/-11	6.6	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	28-Sep-09	918	24047	+/-11	11.8	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	15-Oct-09	905	24065	+/-11	0.738	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2010-05-19	824	3959	+/-11	0.2590	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2010-06-01	848	33977	+/-11	-0.8940	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2010-06-23	835	33995	+/-11	-1.8500	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2010-08-10	933	34013	+/-11	2.1400	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2010-09-29	840	34039	+/-11	3.5000	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2010-10-06	840	34057	+/-11	0.6220	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2011-05-18	837	45401		-0.8270	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2011-06-14	846	45427		2.7700	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2011-07-25	855	45445		-0.1140	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2011-08-31	827	4527		-0.7720	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2011-10-20	854	45571		-1.9100	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2011-10-26	903	45589		-1.4900	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2012-05-29	915	53401		1.47	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2012-06-25	0	53419		5.36	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2012-07-11	906	53453		1.26	+/-11	E3386A	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2012-08-15	840	53471		-4.62	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2012-09-13	850	53497		-3.27	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2012-10-30	854	53515	UAL	-4.3	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2013-05-27	900	00063409	+/-4.7	-3.53	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2013-06-11	933	00063427	+/-4.7	-2.44	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2013-08-08	855	00063445	+/-4.7	-2.78	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2013-08-15	850	00063471	+/-4.7	-0.889	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2013-10-29	920	00063523	+/-4.7	-0.926	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2014-05-27	900	C211422		-6.13	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2014-06-12	852	C211956		-2	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2014-08-13	850	C213720		-4.01	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2014-08-19	843	C213855		-2.53	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2014-10-21	857	C215770		-4.04	+/-4.7	E3497	MICROGRAM PER LITER
LEAD, UNFILTERED TOTAL	030057030	PBUT	2014-11-05	905	C216211		-5.44	+/-4.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2012-08-15	840	53471		3.23	+/-3.4	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2012-09-13	850	53497		0.594	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2012-10-30	854	53515	UAL	0.375	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2013-05-27	900	00063409	+/-6.7	1.25	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2013-06-11	933	00063427	+/-6.7	9.49	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2013-08-08	855	00063445	+/-6.7	4.96	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2013-08-15	850	00063471	+/-6.7	5.57	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2013-10-29	920	00063523	+/-6.7	2.33	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2014-05-27	900	C211422		1.13	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2014-06-12	852	C211956		-1.27	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2014-08-13	850	C213720		0.592	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2014-08-19	843	C213855		1.71	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2014-10-21	857	C215770		-0.474	+/-6.7	E3497	MICROGRAM PER LITER
LITHIUM, UNFILTERED TOTAL	030057030	LIUT	2014-11-05	905	C216211		0.812	+/-6.7	E3497	MICROGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	04-Jul-02	943	10700	CALCR	20.1		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	04-Jul-02	943	10700	+/-0.5	10.2	+/-0.51	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	15-Aug-02	954	10711	CALCR	12.2		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	15-Aug-02	954	10711	+/-0.5	11.1	+/-0.55	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	10-Sep-02	845	10722	CALCR	12.7		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	10-Sep-02	845	10722	+/-0.5	11.6	+/-0.58	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	22-Oct-02	1723	10733	CALCR	12.6		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	22-Oct-02	1723	10733	+/-0.6	13.2	+/-0.66	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	05-May-03	914	13950	CALCR	10.5		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	05-May-03	914	13950	+/-0.4	9.56	+/-0.48	E3386A	MILLIGRAM PER LITER

MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	10-Jun-03	942	13961	CALCR	9.98		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	10-Jun-03	942	13961	+/-0.4	9.31	+/-0.47	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	08-Jul-03	946	13972	CALCR	12.3		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	08-Jul-03	946	13972	+/-0.5	11.8	+/-0.59	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	13-Aug-03	1454	13983	CALCR	12.8		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	13-Aug-03	1454	13983	+/-1.2	11.5	+/-1.26	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	09-Sep-03	941	13994	CALCR	12.6		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	09-Sep-03	941	13994	+/-1.2	11.3	+/-1.24	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	01-Oct-03	1037	14005	CALCR	13.1		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	01-Oct-03	1037	14005	+/-1.2	11.6	+/-1.28	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	05-Nov-03	944	14016	CALCR	10.2		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	05-Nov-03	944	14016	+/-1.0	9.69	+/-1.07	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	31-Mar-04	1040	23950	CALCR	5.54		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	31-Mar-04	1040	23950	+/-0.7	6.43	+/-0.71	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	25-May-04	1642	23961	CALCR	6.96		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	25-May-04	1642	23961	+/-0.7	6.89	+/-0.76	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	07-Jun-04	1604	1	CALCR	9.44		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	08-Jul-04	1035	23983	CALCR	8.04		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	08-Jul-04	1035	23983	+/-0.8	7.38	+/-0.81	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	24-Aug-04	1543	23994	CALCR	13.7		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	24-Aug-04	1543	23994	+/-1.3	12.1	+/-1.33	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	27-Oct-04	1052	24005	CALCR	13.2		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	27-Oct-04	1052	24005	+/-1.3	12	+/-1.32	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	15-Nov-04	954	24016	+/-1.1	10	+/-1.10	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	15-Nov-04	954	24016	CALCR	18.7		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	08-Dec-04	1025	24027	+/-1.0	9.35	+/-1.03	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	08-Dec-04	1025	24027	CALCR	9.96		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	06-Apr-05	949	33950	CALCR	6.48		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	06-Apr-05	949	33950	+/-0.7	7.15	+/-0.79	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	09-May-05	947	33961	+/-0.9	9	+/-0.99	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	09-May-05	947	33961	CALCR	9.64		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	06-Jun-05	1050	33972	CALCR	12.5		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	06-Jun-05	1050	33972	+/-1.3	12.2	+/-1.34	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	14-Jun-05	910	33983	CALCR	9.94		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	14-Jun-05	910	33983	+/-1.1	10.1	+/-1.11	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	16-Nov-05	1013	34027	CALCR	11.2		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	13-Jul-06	1651	13951	CALCR	10.5		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	13-Jul-06	1651	13951	+/-1.1	10.4	+/-1.15	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	14-Aug-06	1440	13969	CALCR	12.2		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	19-Sep-06	1019	13987	CALCR	12.8		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	12-Oct-06	710	14005	CALCR	12.4		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	12-Oct-06	710	14005	+/-1.2	11.4	+/-1.26	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	23-Nov-06	847	14023	CALCR	9.56		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	23-Nov-06	847	14023	+/-1.0	9.41	+/-1.04	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	12-Dec-06	835	14041	CALCR	9.64		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	12-Dec-06	835	14041	+/-1.0	9.271143	+/-1.0	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	03-Apr-07	817	24101	CALCR	6.66		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	03-Apr-07	817	24101	+/-0.8	7.39	+/-0.81	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	07-May-07	954	24119	CALCR	10.4		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	07-May-07	954	24119	+/-1.1	10.3	+/-1.1	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	14-Aug-07	854	24146	+/-1.5	13.8	+/-1.5	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	11-Sep-07	958	24172	CALCR	12.4		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	11-Sep-07	958	24172	+/-1.4	12.9	+/-1.4	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	09-Oct-07	1001	24198	CALCR	11.6		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	09-Oct-07	1001	24198	+/-1.2	11	+/-1.2	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	20-Nov-07	930	24224	CALCR	12.2		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	20-Nov-07	930	24224	+/-1.3	12.1	+/-1.3	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	29-Apr-08	945	13951	CALCR	8.6		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	29-Apr-08	945	13951	+/-0.9	8.22	+/-0.90	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	29-May-08	940	13968	CALCR	11		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	29-May-08	940	13968	+/-1.1	9.79	+/-1.1	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	21-Jul-08	958	13995	CALCR	11.6		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	21-Jul-08	958	13995	+/-1.3	11.8	+/-1.3	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	21-Aug-08	922	14012	CALCR	13		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	21-Aug-08	922	14012	+/-1.4	12.4	+/-1.4	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	27-Oct-08	849	14021	CALCR	12.6		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	27-Oct-08	849	14021	+/-1.1	11.9	+/-1.1	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	06-Nov-08	843	14047	CALCR	11.8		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	06-Nov-08	843	14047	+/-1.0	11.5	+/-1.0	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	21-Apr-09	939	23951	+/-0.7	8.53	+/-0.77	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	21-Apr-09	939	23951	CALCR	9.04		E3171A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	23-Jul-09	854	24003	+/-1.1	11.7	+/-1.1	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	17-Aug-09	840	24029	+/-1.1	11.7	+/-1.1	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	28-Sep-09	918	24047	+/-1.0	11.1	+/-1.0	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	15-Oct-09	905	24065	+/-1.6	11.8	+/-1.6	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2010-05-19	824	3959	+/-1.6	12.0000	+/-1.6	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2010-06-01	848	33977	+/-1.7	12.5000	+/-1.7	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2010-06-23	835	33995	+/-1.3	9.9000	+/-1.3	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2010-08-10	933	34013	+/-1.4	10.8000	+/-1.4	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2010-09-29	840	34039	+/-1.3	10.0000	+/-1.3	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2010-10-06	840	34057	+/-1.7	12.4000	+/-1.7	E3386A	MILLIGRAM PER LITER

MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2011-05-18	837	45401		10.5000	+/-1.4	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2011-06-14	846	45427		10.9000	+/-1.5	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2011-07-25	855	45445		13.3000	+/-1.8	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2011-08-31	827	4527		13.0000	+/-1.7	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2011-10-20	854	45571		11.8000	+/-1.6	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2011-10-26	903	45589		10.9000	+/-1.5	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2012-05-29	915	53401		13.4	+/-1.8	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2012-06-25	0	53419		12.1	+/-1.6	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2012-07-11	906	53453		13.4	+/-1.8	E3386A	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2012-08-15	840	53471		13.4	+/-1.3	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2012-09-13	850	53497		13.2	+/-1.3	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2012-10-30	854	53515	UAL	8.72	+/-0.87	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2013-05-27	900	00063409	+/-0.8	8.86	+/-0.89	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2013-06-11	933	00063427	+/-1.0	10.2	+/-1.0	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2013-08-08	855	00063445	+/-1.0	10.2	+/-1.0	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2013-08-15	850	00063471	+/-1.4	14	+/-1.4	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2013-10-29	920	00063523	+/-0.9	9.07	+/-0.91	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2014-05-27	900	C211422		10.8	+/-1.1	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2014-06-12	852	C211956		12.5	+/-1.3	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2014-08-13	850	C213720		12.3	+/-1.2	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2014-08-19	843	C213855		10.4	+/-1.0	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2014-10-21	857	C215770		11.2	+/-1.1	E3497	MILLIGRAM PER LITER
MAGNESIUM,UNFILTERED TOTAL	030057030	MGUT	2014-11-05	905	C216211		11.3	+/-1.1	E3497	MILLIGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	04-Jul-02	943	10700	+/-1.4	27.6	+/-1.4	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	15-Aug-02	954	10711	+/-2.0	40.9	+/-2.0	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	10-Sep-02	845	10722	+/-1.0	20.8	+/-1.0	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	22-Oct-02	1723	10733	+/-0.8	16.6	+/-0.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	05-May-03	914	13950	+/-1.8	36.3	+/-1.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	10-Jun-03	942	13961	+/-2.8	56.8	+/-2.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	08-Jul-03	946	13972	+/-1.3	25.6	+/-1.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	13-Aug-03	1454	13983	+/-2.1	26.7	+/-2.1	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	09-Sep-03	941	13994	+/-1.3	16	+/-1.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	01-Oct-03	1037	14005	+/-1.4	17	+/-1.4	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	05-Nov-03	944	14016	+/-3.3	40.7	+/-3.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	31-Mar-04	1040	23950	+/-9.1	114	+/-9.1	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	25-May-04	1642	23961	+/-6.8	85.2	+/-6.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	08-Jul-04	1035	23983	+/-12.	152	+/-12.2	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	24-Aug-04	1543	23994	+/-1.3	16	+/-1.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	27-Oct-04	1052	24005	+/-1.2	15.3	+/-1.2	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	15-Nov-04	954	24016	+/-1.1	13.7	+/-1.1	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	08-Dec-04	1025	24027	+/-2.6	32	+/-2.6	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	06-Apr-05	949	33950	+/-7.3	91	+/-7.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	09-May-05	947	33961	+/-2.3	29.2	+/-2.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	06-Jun-05	1050	33972	+/-3.0	37.5	+/-3.0	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	14-Jun-05	910	33983	+/-10.	128	+/-10.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	13-Jul-06	1651	13951	+/-2.7	34	+/-2.7	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	12-Oct-06	710	14005	+/-1.6	19.9	+/-1.6	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	23-Nov-06	847	14023	+/-2.2	27.3	+/-2.2	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	12-Dec-06	835	14041	+/-3.6	36.17396	+/-3.6	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	03-Apr-07	817	24101	+/-4.5	45.3	+/-4.5	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	07-May-07	954	24119	+/-2.7	26.7	+/-2.7	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	14-Aug-07	854	24146	+/-2.3	23.1	+/-2.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	11-Sep-07	958	24172	+/-4.4	44.4	+/-4.4	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	09-Oct-07	1001	24198	+/-3.6	35.8	+/-3.6	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	20-Nov-07	930	24224	+/-2.1	21.4	+/-2.1	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	29-Apr-08	945	13951	+/-3.8	38.4	+/-3.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	29-May-08	940	13968	+/-2.8	28.2	+/-2.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	21-Jul-08	958	13995	+/-4.8	47.8	+/-4.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	21-Aug-08	922	14012	+/-1.9	19.5	+/-1.9	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	27-Oct-08	849	14021	+/-2.3	17.7	+/-2.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	06-Nov-08	843	14047	+/-2.5	18.9	+/-2.5	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	21-Apr-09	939	23951	+/-4.4	34.1	+/-4.4	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	23-Jul-09	854	24003	+/-2.7	20.6	+/-2.7	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	17-Aug-09	840	24029	+/-3.3	25.7	+/-3.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	28-Sep-09	918	24047	+/-3.0	23	+/-3.0	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	15-Oct-09	905	24065	+/-1.5	20.3	+/-1.5	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2010-05-19	824	3959	+/-3.5	49.7000	+/-3.5	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2010-06-01	848	33977	+/-2.6	36.9000	+/-2.6	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2010-06-23	835	33995	+/-5.3	75.7000	+/-5.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2010-08-10	933	34013	+/-3.3	46.3000	+/-3.3	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2010-09-29	840	34039	+/-9.2	131.0000	+/-9.2	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2010-10-06	840	34057	+/-2.1	29.4000	+/-2.1	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2011-05-18	837	45401		45.8000	+/-3.2	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2011-06-14	846	45427		33.7000	+/-2.4	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2011-07-25	855	45445		40.1000	+/-2.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2011-08-31	827	4527		24.5000	+/-1.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2011-10-20	854	45571		53.4000	+/-3.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2011-10-26	903	45589		39.0000	+/-2.8	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2012-05-29	915	53401		37.3	+/-2.6	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2012-06-25	0	53419		26	+/-1.9	E3386A	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2012-07-11	906	53453		28.1	+/-2.0	E3386A	MICROGRAM PER LITER

MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2012-08-15	840	53471		27.9	+/-2.8	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2012-09-13	850	53497		25.3	+/-2.6	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2012-10-30	854	53515	UAL	44.4	+/-4.5	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2013-05-27	900	00063409	+/-4.2	42.2	+/-4.2	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2013-06-11	933	00063427	+/-2.9	28.7	+/-2.9	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2013-08-08	855	00063445	+/-2.8	28	+/-2.8	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2013-08-15	850	00063471	+/-2.2	21.8	+/-2.2	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2013-10-29	920	00063523	+/-2.9	28.5	+/-2.9	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2014-05-27	900	C211422		32.1	+/-3.2	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2014-06-12	852	C211956		34.2	+/-3.4	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2014-08-13	850	C213720		54.7	+/-5.5	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2014-08-19	843	C213855		38.3	+/-3.8	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2014-10-21	857	C215770		37	+/-3.7	E3497	MICROGRAM PER LITER
MANGANESE,UNFILTERED TOTAL	030057030	MNUT	2014-11-05	905	C216211		24.3	+/-2.5	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	04-Jul-02	943	10700	+/-2.3	-0.851	+/-2.3	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	15-Aug-02	954	10711	+/-0.8	-0.718	+/-0.8	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	10-Sep-02	845	10722	+/-0.8	0.0448	+/-0.8	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	22-Oct-02	1723	10733	+/-0.8	-0.177	+/-0.8	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	05-May-03	914	13950	+/-1.2	-0.0901	+/-1.2	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	10-Jun-03	942	13961	+/-0.8	-0.183	+/-0.8	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	08-Jul-03	946	13972	+/-1.3	-1.34	+/-1.3	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	13-Aug-03	1454	13983	+/-1.5	-0.688	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	09-Sep-03	941	13994	+/-1.5	-0.563	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	01-Oct-03	1037	14005	+/-1.5	-0.748	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	05-Nov-03	944	14016	+/-1.5	-0.217	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	31-Mar-04	1040	23950	+/-1.5	-0.179	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	25-May-04	1642	23961	+/-1.5	-0.349	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	08-Jul-04	1035	23983	+/-1.5	1.86	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	24-Aug-04	1543	23994	+/-1.5	-0.136	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	27-Oct-04	1052	24005	+/-1.5	1.85	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	15-Nov-04	954	24016	+/-1.5	-0.298	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	08-Dec-04	1025	24027	+/-1.5	-1.16	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	06-Apr-05	949	33950	+/-1.5	-0.00479	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	09-May-05	947	33961	+/-1.5	-1.01	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	06-Jun-05	1050	33972	+/-1.5	-0.385	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	14-Jun-05	910	33983	+/-1.5	-0.547	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	13-Jul-06	1651	13951	+/-1.5	-0.0112	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	12-Oct-06	710	14005	+/-1.5	-1.5	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	23-Nov-06	847	14023	+/-1.5	-0.908	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	12-Dec-06	835	14041	+/-1.5	-0.0518	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	03-Apr-07	817	24101	+/-1.5	-0.222	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	07-May-07	954	24119	+/-1.5	0.949	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	14-Aug-07	854	24146	+/-1.5	0.936	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	11-Sep-07	958	24172	+/-1.5	1.13	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	09-Oct-07	1001	24198	+/-1.5	0.236	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	20-Nov-07	930	24224	+/-1.5	-0.693	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	29-Apr-08	945	13951	+/-1.5	1.08	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	29-May-08	940	13968	+/-1.5	-0.943	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	21-Jul-08	958	13995	+/-1.5	1.28	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	21-Aug-08	922	14012	+/-1.5	0.759	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	27-Oct-08	849	14021	+/-1.5	-1.45	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	06-Nov-08	843	14047	+/-1.5	0.963	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	21-Apr-09	939	23951	+/-1.5	0.714	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	23-Jul-09	854	24003	+/-1.5	1.1	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	17-Aug-09	840	24029	+/-1.5	0.857	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	28-Sep-09	918	24047	+/-1.5	-0.36	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	15-Oct-09	905	24065	+/-1.5	0.954	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2010-05-19	824	3959	+/-1.5	1.3200	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2010-06-01	848	33977	+/-1.5	1.1500	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2010-06-23	835	33995	+/-1.5	1.8900	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2010-08-10	933	34013	+/-1.5	0.6980	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2010-09-29	840	34039	+/-1.5	0.4480	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2010-10-06	840	34057	+/-1.5	0.9900	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2011-05-18	837	45401		1.0600	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2011-06-14	846	45427		2.2300	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2011-07-25	855	45445		0.5190	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2011-08-31	827	4527		0.5160	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2011-10-20	854	45571		0.1930	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2011-10-26	903	45589		-0.1680	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2012-05-29	915	53401		-0.108	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2012-06-25	0	53419		-0.318	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2012-07-11	906	53453		0.212	+/-1.5	E3386A	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2012-08-15	840	53471		0.926	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2012-09-13	850	53497		1.82	+/-1.4	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2012-10-30	854	53515	UAL	1.71	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2013-05-27	900	00063409	+/-1.3	0.978	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2013-06-11	933	00063427	+/-1.3	0.818	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2013-08-08	855	00063445	+/-1.3	1.18	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2013-08-15	850	00063471	+/-1.3	0.947	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2013-10-29	920	00063523	+/-1.3	0.707	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2014-05-27	900	C211422		1.39	+/-1.3	E3497	MICROGRAM PER LITER

MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2014-06-12	852	C211956		1.16	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2014-08-13	850	C213720		0.681	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2014-08-19	843	C213855		1.29	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2014-10-21	857	C215770		0.677	+/-1.3	E3497	MICROGRAM PER LITER
MOLYBDENUM,UNFILTERED TOTAL	030057030	MOUT	2014-11-05	905	C216211		0.807	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	04-Jul-02	943	10700	+/-1.5	0.464	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	15-Aug-02	954	10711	+/-1.5	0.283	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	10-Sep-02	845	10722	+/-1.5	-0.15	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	22-Oct-02	1723	10733	+/-1.5	0.417	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	05-May-03	914	13950	+/-1.5	0.442	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	10-Jun-03	942	13961	+/-1.5	0.575	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	08-Jul-03	946	13972	+/-1.5	0.216	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	13-Aug-03	1454	13983	+/-1.5	0.165	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	09-Sep-03	941	13994	+/-1.5	-0.29	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	01-Oct-03	1037	14005	+/-1.5	0.0399	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	05-Nov-03	944	14016	+/-2.8	1.08	+/-2.8	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	31-Mar-04	1040	23950	+/-2.7	0.338	+/-2.7	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	25-May-04	1642	23961	+/-1.5	1.41	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	08-Jul-04	1035	23983	+/-1.5	0.473	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	24-Aug-04	1543	23994	+/-1.5	-0.78	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	27-Oct-04	1052	24005	+/-1.5	-0.0747	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	15-Nov-04	954	24016	+/-1.5	-0.775	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	08-Dec-04	1025	24027	+/-1.5	0.194	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	06-Apr-05	949	33950	+/-1.5	0.59	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	09-May-05	947	33961	+/-1.5	0.316	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	06-Jun-05	1050	33972	+/-1.5	0.748	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	14-Jun-05	910	33983	+/-1.5	0.529	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	13-Jul-06	1651	13951	+/-1.5	0.653	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	12-Oct-06	710	14005	+/-1.5	0.0465	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	23-Nov-06	847	14023	+/-1.5	0.263	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	12-Dec-06	835	14041	+/-1.5	-0.499	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	03-Apr-07	817	24101	+/-1.5	-0.198	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	07-May-07	954	24119	+/-1.5	-1.01	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	14-Aug-07	854	24146	+/-1.5	-0.0543	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	11-Sep-07	958	24172	+/-1.5	0.865	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	09-Oct-07	1001	24198	+/-1.5	-0.121	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	20-Nov-07	930	24224	+/-1.5	0.169	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	29-Apr-08	945	13951	+/-1.5	-0.234	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	29-May-08	940	13968	+/-1.5	0.335	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	21-Jul-08	958	13995	+/-1.5	0.355	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	21-Aug-08	922	14012	+/-1.5	0.0343	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	27-Oct-08	849	14021	+/-1.5	-0.195	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	06-Nov-08	843	14047	+/-1.5	-0.942	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	21-Apr-09	939	23951	+/-1.5	0.15	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	23-Jul-09	854	24003	+/-1.5	0.946	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	17-Aug-09	840	24029	+/-1.5	-0.27	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	28-Sep-09	918	24047	+/-1.5	1.12	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	15-Oct-09	905	24065	+/-1.5	0.266	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2010-05-19	824	3959	+/-1.5	0.4000	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2010-06-01	848	33977	+/-1.5	-0.1010	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2010-06-23	835	33995	+/-1.5	-0.0490	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2010-08-10	933	34013	+/-1.5	-0.1600	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2010-09-29	840	34039	+/-1.5	1.7500	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2010-10-06	840	34057	+/-1.5	1.1900	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2011-05-18	837	45401		0.5290	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2011-06-14	846	45427		0.6980	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2011-07-25	855	45445		0.8330	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2011-08-31	827	4527		0.4330	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2011-10-20	854	45571		-0.0550	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2011-10-26	903	45589		0.9600	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2012-05-29	915	53401		1.39	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2012-06-25	0	53419		0.261	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2012-07-11	906	53453		1.88	+/-1.5	E3386A	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2012-08-15	840	53471		-2.81	+/-1.4	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2012-10-30	854	53515	UAL	-2.53	+/-1.4	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2013-05-27	900	00063409	+/-1.3	0.21	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2013-06-11	933	00063427	+/-1.3	-0.0355	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2013-08-08	855	00063445	+/-1.3	-0.531	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2013-08-15	850	00063471	+/-1.3	-1.19	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2013-10-29	920	00063523	+/-1.3	0.237	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2014-05-27	900	C211422		-0.713	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2014-06-12	852	C211956		-1.46	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2014-08-13	850	C213720		-0.894	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2014-08-19	843	C213855		-1.83	+/-1.4	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2014-10-21	857	C215770		-1.74	+/-1.3	E3497	MICROGRAM PER LITER
NICKEL, UNFILTERED TOTAL	030057030	NIUT	2014-11-05	905	C216211		-1.69	+/-1.3	E3497	MICROGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	04-Jul-02	943	10700		0.696		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	15-Aug-02	954	10711		0.825		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	10-Sep-02	845	10722		0.807		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	22-Oct-02	1723	10733		0.72		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	05-May-03	914	13950		0.637		E3364A	MILLIGRAM PER LITER

NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	10-Jun-03	942	13961		0.454		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	08-Jul-03	946	13972		0.872		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	13-Aug-03	1454	13983		0.674		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	09-Sep-03	941	13994		0.871		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	01-Oct-03	1037	14005		0.762		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	05-Nov-03	944	14016		0.453		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	31-Mar-04	1040	23950		0.891		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	25-May-04	1642	23961		0.219		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	07-Jun-04	1604	1		0.541		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	08-Jul-04	1035	23983		0.419		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	24-Aug-04	1543	23994		1.03		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	27-Oct-04	1052	24005		0.894		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	15-Nov-04	954	24016		0.823		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	08-Dec-04	1025	24027		0.618		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	06-Apr-05	949	33950		0.951		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	09-May-05	947	33961		0.558		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	06-Jun-05	1050	33972		0.926		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	14-Jun-05	910	33983		0.453		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	16-Nov-05	1013	34027		0.867		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	13-Jul-06	1651	13951		0.472		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	14-Aug-06	1440	13969		0.851		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	19-Sep-06	1019	13987		0.841		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	12-Oct-06	710	14005		0.762		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	12-Dec-06	835	14041		0.908		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	03-Apr-07	817	24101		0.941		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	07-May-07	954	24119		0.701		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	11-Jul-07	958	24136		0.804		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	14-Aug-07	854	24146		1.01		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	29-Aug-07	944	24163		0.864		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	11-Sep-07	958	24172		0.978		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	26-Sep-07	1001	24189		0.951		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	09-Oct-07	1001	24198		0.562		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	12-Nov-07	1045	24215		0.757		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	20-Nov-07	930	24224		0.871		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	29-Apr-08	945	13951		0.485		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	29-May-08	940	13968		0.665		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	11-Jun-08	944	13986		0.527		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	21-Jul-08	958	13995		0.605		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	21-Aug-08	922	14012		0.783		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	09-Sep-08	906	14012		0.978		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	22-Oct-08	859	14038		0.778		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	27-Oct-08	849	14021		0.748		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	06-Nov-08	843	14047		0.613		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	24-Nov-08	900	14064		0.547		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	21-Apr-09	939	23951		0.585		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	28-May-09	902	23986		0.716		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	04-Jun-09	840	23994		0.683		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	23-Jul-09	854	24003		0.905		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	11-Aug-09	848	24020		0.647		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	17-Aug-09	840	24029		0.803		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	28-Sep-09	918	24047		0.941		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	15-Oct-09	905	24065		0.775		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-04-14	846	33950		0.4830		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-06-01	848	33977		0.7040		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-06-23	835	33995		0.5190		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-08-10	933	34013		0.4160		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-08-18	903	34030		0.6350		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-09-29	840	34039		0.2780		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-10-06	840	34057		0.5080		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2010-11-17	1257	34073		0.6640		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-05-18	837	45401		0.5400		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-06-02	905	45418		0.5550		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-06-14	846	45427		0.6470		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-07-25	855	45445		0.9030		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-08-03	859	45462		0.7440		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-08-31	827	4527		0.8750		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-09-20	937	45462		0.9460		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-10-20	854	45571		0.6690		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-10-26	903	45589		0.5910		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2011-11-01	843	45607		0.3940		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-05-29	915	53401		0.747		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-06-07	937	53436		0.674		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-06-25	0	53419		0.774		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-07-11	906	53453		0.49		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-07-26	908	52444		0.935		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-08-15	840	53471		0.789		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-09-13	850	53497		0.704		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-09-19	917	53488		0.341		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-10-15	856	53532		0.388		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2012-10-30	854	53515		0.371		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-04-25	830	00063400		0.593		E3364A	MILLIGRAM PER LITER

NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-05-27	900	00063409		0.384		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-06-11	933	00063427		0.634		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-07-08	928	00063462		0.884		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-08-08	855	00063445		0.574		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-08-15	850	00063471		0.942		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-10-07	845	00063506		0.475		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-10-29	920	00063523		0.477		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2013-11-07	920	00063514		0.584		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-05-20	930	C211220		0.627		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-05-27	900	C211422		0.708		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-06-12	852	C211956		0.951		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-08-19	843	C213855		0.491		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-09-02	908	C214237	RRV	0.697		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-10-15	1345	C215560		0.595		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-10-21	857	C215770		0.546		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-11-05	905	C216211		0.571		E3364A	MILLIGRAM PER LITER
NITRATES TOTAL, UNFIL.REAC	030057030	NNOTUR	2014-11-13	925	C216400		0.624		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	04-Jul-02	943	10700		0.012		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	15-Aug-02	954	10711		0.009		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	10-Sep-02	845	10722		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	22-Oct-02	1723	10733	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	05-May-03	914	13950		0.011		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	10-Jun-03	942	13961		0.009		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	08-Jul-03	946	13972		0.011		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	13-Aug-03	1454	13983		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	09-Sep-03	941	13994		0.014		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	01-Oct-03	1037	14005	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	05-Nov-03	944	14016		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	31-Mar-04	1040	23950		0.017		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	25-May-04	1642	23961		0.012		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	07-Jun-04	1604	1		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	08-Jul-04	1035	23983		0.01		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	24-Aug-04	1543	23994		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	27-Oct-04	1052	24005	<T	0.002	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	15-Nov-04	954	24016	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	08-Dec-04	1025	24027		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	06-Apr-05	949	33950		0.013		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	09-May-05	947	33961		0.009		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	06-Jun-05	1050	33972		0.009		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	14-Jun-05	910	33983		0.012		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	16-Nov-05	1013	34027	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	13-Jul-06	1651	13951		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	14-Aug-06	1440	13969		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	19-Sep-06	1019	13987		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	12-Oct-06	710	14005	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	12-Dec-06	835	14041		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	03-Apr-07	817	24101		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	07-May-07	954	24119		0.012		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	11-Jul-07	958	24136		0.009		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	14-Aug-07	854	24146		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	29-Aug-07	944	24163		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	11-Sep-07	958	24172		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	26-Sep-07	1001	24189	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	09-Oct-07	1001	24198	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	12-Nov-07	1045	24215	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	20-Nov-07	930	24224	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	29-Apr-08	945	13951		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	29-May-08	940	13968		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	11-Jun-08	944	13986		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	21-Jul-08	958	13995		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	21-Aug-08	922	14012	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	09-Sep-08	906	14012		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	22-Oct-08	859	14038	<T	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	27-Oct-08	849	14021	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	06-Nov-08	843	14047	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	24-Nov-08	900	14064		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	21-Apr-09	939	23951		0.008		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	28-May-09	902	23986		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	04-Jun-09	840	23994	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	23-Jul-09	854	24003		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	11-Aug-09	848	24020		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	17-Aug-09	840	24029		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	28-Sep-09	918	24047	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	15-Oct-09	905	24065	<T	0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-04-14	846	33950		0.0080		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-05-19	824	3959		0.0050		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-06-01	848	33977		0.0070		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-06-23	835	33995		0.0090		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-08-10	933	34013		0.0060		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-08-18	903	34030		0.0050		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-09-29	840	34039		0.0070		E3364A	MILLIGRAM PER LITER

NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-10-06	840	34057	<T	0.0040	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2010-11-17	1257	34073		0.0050		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-05-18	837	45401		0.0070		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-06-02	905	45418		0.0130		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-06-14	846	45427		0.0050		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-07-25	855	45445		0.0100		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-08-03	859	45462		0.0070		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-08-31	827	4527		0.0080		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-09-20	937	45462		0.0080		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-10-20	854	45571		0.0080		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-10-26	903	45589		0.0040	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2011-11-01	843	45607		0.0060		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-05-29	915	53401		0.008		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-06-07	937	53436		0.011		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-06-25	0	53419		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-07-11	906	53453		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-07-26	908	52444		0.011		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-08-15	840	53471		0.012		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-09-13	850	53497		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-09-19	917	53488		0.008		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-10-15	856	53532		0.015		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2012-10-30	854	53515		0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-04-25	830	00063400		0.008		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-05-27	900	00063409		0.009		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-06-11	933	00063427		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-07-08	928	00063462		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-08-08	855	00063445		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-08-15	850	00063471		0.005		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-10-07	845	00063506		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-10-29	920	00063523		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2013-11-07	920	00063514		0.006		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-05-20	930	C211220		0.01		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-05-27	900	C211422		0.018		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-06-12	852	C211956		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-08-13	850	C213720		0.007		E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-08-19	843	C213855		0.004	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-09-02	908	C214237	RRV	0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-10-15	1345	C215560		0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-10-21	857	C215770		0.003	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-11-05	905	C216211		0.002	<T	E3364A	MILLIGRAM PER LITER
NITRITE, UNFILTERED REACTIVE	030057030	NNO2UR	2014-11-13	925	C216400		0.004	<T	E3364A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	04-Jul-02	943	10700		0.43		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	15-Aug-02	954	10711		0.39		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	10-Sep-02	845	10722		0.31		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	22-Oct-02	1723	10733		0.33		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	05-May-03	914	13950		0.44		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	10-Jun-03	942	13961		0.53		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	08-Jul-03	946	13972		0.38		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	13-Aug-03	1454	13983		0.39		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	09-Sep-03	941	13994		0.24		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	01-Oct-03	1037	14005		0.23		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	05-Nov-03	944	14016		0.51		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	31-Mar-04	1040	23950		0.86		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	25-May-04	1642	23961		0.78		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	07-Jun-04	1604	1		0.51		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	08-Jul-04	1035	23983		1.04		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	24-Aug-04	1543	23994		0.19		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	27-Oct-04	1052	24005		0.24		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	15-Nov-04	954	24016		0.26		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	08-Dec-04	1025	24027		0.47		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	06-Apr-05	949	33950		0.81		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	09-May-05	947	33961		0.44		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	06-Jun-05	1050	33972		0.33		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	14-Jun-05	910	33983		0.68		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	16-Nov-05	1013	34027		0.63		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	13-Jul-06	1651	13951		0.55		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	14-Aug-06	1440	13969		0.29		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	19-Sep-06	1019	13987		0.32		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	12-Oct-06	710	14005		0.29		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	23-Nov-06	847	14023		0.89		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	12-Dec-06	835	14041		0.56		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	03-Apr-07	817	24101		0.62		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	07-May-07	954	24119		0.36		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	11-Jul-07	958	24136		0.46		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	14-Aug-07	854	24146		0.2		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	29-Aug-07	944	24163		0.32		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	11-Sep-07	958	24172		0.34		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	26-Sep-07	1001	24189		0.18		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	09-Oct-07	1001	24198		0.45		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	12-Nov-07	1045	24215		0.37		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	20-Nov-07	930	24224		0.34		E3367A	MILLIGRAM PER LITER

NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	29-Apr-08	945	13951		0.47		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	29-May-08	940	13968		0.41		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	11-Jun-08	944	13986		0.52		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	21-Jul-08	958	13995		0.41		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	21-Aug-08	922	14012		0.35		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	09-Sep-08	906	14012		0.22		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	22-Oct-08	859	14038		0.33		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	27-Oct-08	849	14021		0.34		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	06-Nov-08	843	14047		0.37		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	24-Nov-08	900	14064		0.55		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	21-Apr-09	939	23951		0.43		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	28-May-09	902	23986		0.41		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	04-Jun-09	840	23994		0.41		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	23-Jul-09	854	24003		0.27		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	11-Aug-09	848	24020		0.33		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	17-Aug-09	840	24029		0.32		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	28-Sep-09	918	24047		0.25		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	15-Oct-09	905	24065		0.35		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-04-14	846	33950		0.3600		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-05-19	824	3959		0.4900		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-06-01	848	33977	AIN	0.3000		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-06-23	835	33995		0.5700		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-08-10	933	34013		0.4900		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-08-18	903	34030		0.4000		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-09-29	840	34039		0.8900		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2010-10-06	840	34057		0.5000		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-05-18	837	45401		0.4500		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-06-02	905	45418		0.4900		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-06-14	846	45427		0.3700		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-07-25	855	45445		0.3300		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-08-03	859	45462		0.4100		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-08-31	827	4527		0.3300		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-09-20	937	45462		0.2900		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-10-20	854	45571		0.6500		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-10-26	903	45589		0.5600		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2011-11-01	843	45607		0.4900		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-05-29	915	53401		0.38		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-06-07	937	53436		0.37		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-06-25	0	53419		0.36		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-07-11	906	53453		0.28		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-07-26	908	52444	UAL	0.39		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-08-15	840	53471		0.28		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-10-15	856	53532		0.36		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2012-10-30	854	53515	UAL	0.28		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-04-25	830	00063400		0.4		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-05-27	900	00063409		0.51		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-06-11	933	00063427		0.55		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-07-08	928	00063462		0.35		E3367A	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-08-08	855	00063445	CRO	0.37		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-08-15	850	00063471	CRO	0.26		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-10-07	845	00063506	CRO	0.64		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-10-29	920	00063523	CRO	0.54		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2013-11-07	920	00063514	CRO	0.45		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-05-20	930	C211220	CRO	0.46		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-05-27	900	C211422	CRO	0.57		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-06-12	852	C211956	CRO	0.35		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-08-13	850	C213720	CRO	0.2		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-08-19	843	C213855	CRO	0.47		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-09-02	908	C214237	CRO	0.36		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-10-15	1345	C215560	CRO	0.57		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-10-21	857	C215770	CRO	0.56		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-11-05	905	C216211	CRO	0.33		E3516	MILLIGRAM PER LITER
NITROGEN,TOT,KJELDAHL/UNF.REA	030057030	NNTKUR	2014-11-13	925	C216400	CRO	0.37		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2013-08-08	855	00063445		0.86		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2013-08-15	850	00063471		1.07		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2013-10-07	845	00063506		1		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2013-10-29	920	00063523		0.97		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2013-11-07	920	00063514		0.98		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-05-20	930	C211220		0.94		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-05-27	900	C211422		1.03		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-06-12	852	C211956		1.16		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-08-13	850	C213720		1.31		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-08-19	843	C213855		0.94		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-09-02	908	C214237		0.95		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-10-15	1345	C215560		0.9		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-10-21	857	C215770		0.9		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-11-05	905	C216211		0.86		E3516	MILLIGRAM PER LITER
NITROGEN; TOTAL	030057030	NTOT	2014-11-13	925	C216400		0.78		E3516	MILLIGRAM PER LITER
PH (-LOG H+ CONCN)	030057030	PH	04-Jul-02	943	10700		8.2		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	15-Aug-02	954	10711		8.33		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	10-Sep-02	845	10722		8.29		E3218A	NO DIMENSION/SCALE

PH (-LOG H+ CONCN)	030057030	PH	22-Oct-02	1723	10733		8.2		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	05-May-03	914	13950		8.18		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	10-Jun-03	942	13961		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	08-Jul-03	946	13972		8.37		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	13-Aug-03	1454	13983		8.36		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	09-Sep-03	941	13994		8.41		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	01-Oct-03	1037	14005		8.35		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	05-Nov-03	944	14016		8.22		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	31-Mar-04	1040	23950		8.18		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	25-May-04	1642	23961		8.18		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	07-Jun-04	1604	1		8.23		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	08-Jul-04	1035	23983		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	24-Aug-04	1543	23994		8.41		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	27-Oct-04	1052	24005		8.15		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	15-Nov-04	954	24016		8.44		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	08-Dec-04	1025	24027		8.4		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	06-Apr-05	949	33950		8.11		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	09-May-05	947	33961		8.49		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	06-Jun-05	1050	33972		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	14-Jun-05	910	33983		8.35		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	16-Nov-05	1013	34027		8.14		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	13-Jul-06	1651	13951		8.42		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	14-Aug-06	1440	13969		8.49		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	19-Sep-06	1019	13987		8.27		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	12-Oct-06	710	14005		8.49		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	23-Nov-06	847	14023		8.38		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	12-Dec-06	835	14041		8.19		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	03-Apr-07	817	24101		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	07-May-07	954	24119		8.48		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	14-Aug-07	854	24146		8.49		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	11-Sep-07	958	24172		8.34		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	09-Oct-07	1001	24198		8.36		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	20-Nov-07	930	24224		7.83		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	29-Apr-08	945	13951		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	29-May-08	940	13968		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	21-Jul-08	958	13995		8.31		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	21-Aug-08	922	14012		8.39		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	27-Oct-08	849	14021		8.6		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	06-Nov-08	843	14047		8.2		P2046	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	21-Apr-09	939	23951		8.12		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	23-Jul-09	854	24003		8.25		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	17-Aug-09	840	24029		8.27		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	28-Sep-09	918	24047		8.24		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	15-Oct-09	905	24065		8.33		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2010-05-19	824	3959		8.3000		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2010-06-01	848	33977		8.3300		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2010-06-23	835	33995		8.2300		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2010-08-10	933	34013		8.2500		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2010-09-29	840	34039		8.2100		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2010-10-06	840	34057		8.2800		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2011-05-18	837	45401		8.3900		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2011-07-25	855	45445		8.5500		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2011-08-31	827	4527		8.3900		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2011-10-20	854	45571		8.3800		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2011-10-26	903	45589		8.3600		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2012-05-29	915	53401		8.35		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2012-06-25	0	53419		8.36		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2012-07-11	906	53453		8.37		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2012-08-15	840	53471		8.32		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2012-09-13	850	53497		8.3		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2012-10-30	854	53515		8.28		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2013-05-27	900	00063409		8.16		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2013-06-11	933	00063427		8.2		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2013-08-08	855	00063445		8.38		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2013-08-15	850	00063471		8.52		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2013-10-29	920	00063523		8.21		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2014-05-27	900	C211422		8.31		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2014-06-12	852	C211956		8.26		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2014-08-13	850	C213720		8.74		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2014-08-19	843	C213855		8.14		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2014-10-21	857	C215770		8.47		E3218A	NO DIMENSION/SCALE
PH (-LOG H+ CONCN)	030057030	PH	2014-11-05	905	C216211		8.44		E3218A	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	05-May-03	914	13950		7.88		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	10-Jun-03	942	13961		8.01		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	08-Jul-03	946	13972		7.97		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	13-Aug-03	1454	13983		8.14		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	09-Sep-03	941	13994		8.07		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	01-Oct-03	1037	14005		8.27		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	05-Nov-03	944	14016		7.88		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	31-Mar-04	1040	23950		8.07		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	25-May-04	1642	23961		7.74		FIELD	NO DIMENSION/SCALE

PH FIELD	030057030	FWPH	07-Jun-04	1604	1		8.1		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	08-Jul-04	1035	23983		7.39		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	24-Aug-04	1543	23994		8.09		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	27-Oct-04	1052	24005		8.08		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	08-Dec-04	1025	24027		9		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	06-Apr-05	949	33950		7.51		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	06-Jun-05	1050	33972		8.67		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	14-Jun-05	910	33983		8.4		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	16-Nov-05	1013	34027		8.23		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	13-Jul-06	1651	13951		8.33		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	14-Aug-06	1440	13969		8.43		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	19-Sep-06	1019	13987		8.34		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	12-Oct-06	710	14005		8.3		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	23-Nov-06	847	14023		13.64		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	03-Apr-07	817	24101		8.1		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	07-May-07	954	24119		8.41		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	11-Jul-07	958	24136		8.53		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	14-Aug-07	854	24146		8.43		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	29-Aug-07	944	24163		8.65		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	11-Sep-07	958	24172		8.42		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	26-Sep-07	1001	24189		8.56		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	09-Oct-07	1001	24198		8.1		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	29-Apr-08	945	13951		8.17		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	29-May-08	940	13968		8.1		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	11-Jun-08	944	13986		8.18		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	21-Jul-08	958	13995		8.17		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	21-Aug-08	922	14012		8.18		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	09-Sep-08	906	14012		8.49		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	22-Oct-08	859	14038		8.21		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	27-Oct-08	849	14021		8.12		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	06-Nov-08	843	14047		8.45		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	24-Nov-08	900	14064		8.23		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	21-Apr-09	939	23951		7.97		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	28-May-09	902	23986		8.07		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	04-Jun-09	840	23994		8.86		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	23-Jul-09	854	24003		8.59		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	11-Aug-09	848	24020		8.31		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	17-Aug-09	840	24029		8.2		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	28-Sep-09	918	24047		8.19		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	15-Oct-09	905	24065		8.19		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-04-14	846	33950		8.1000		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-05-19	824	3959		8.2900		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-06-01	848	33977		8.3800		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-06-23	835	33995		8.1800		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-08-10	933	34013		8.1700		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-08-18	903	34030		8.3800		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-09-29	840	34039		8.1200		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-10-06	840	34057		8.2800		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2010-11-17	1257	34073		8.3600		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-05-18	837	45401		7.9700		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-06-02	905	45418		8.2400		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-06-14	846	45427		8.0000		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-07-25	855	45445		9.3000		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-08-03	859	45462		10.1900		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-08-31	827	4527		8.9300		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-09-20	937	45462		9.3100		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-10-20	854	45571		9.0700		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-10-26	903	45589		9.2300		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2011-11-01	843	45607		9.8400		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-05-29	915	53401		8.36		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-06-07	937	53436		8.42		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-06-25	0	53419		8.51		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-07-11	906	53453		8.44		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-07-26	908	52444		8.2		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-08-15	840	53471		8.37		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-09-13	850	53497		8		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-09-19	917	53488		7.61		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-10-15	856	53532		7.6		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2012-10-30	854	53515		7.73		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-04-25	830	00063400		7.61		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-05-27	900	00063409		8.06		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-06-11	933	00063427		7.97		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-07-08	928	00063462		8.37		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-08-08	855	00063445		8.05		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-08-15	850	00063471		8.25		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-10-07	845	00063506		7.93		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-10-29	920	00063523		7.98		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2013-11-07	920	00063514		7.99		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-05-20	930	C211220		8.06		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-05-27	900	C211422		8.25		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-06-12	852	C211956		8.15		FIELD	NO DIMENSION/SCALE

PH FIELD	030057030	FWPH	2014-08-13	850	C213720		7.57		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-08-19	843	C213855		7.46		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-09-02	908	C214237		7.69		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-10-15	1345	C215560		8.05		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-10-21	857	C215770		7.68		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-11-05	905	C216211		7.92		FIELD	NO DIMENSION/SCALE
PH FIELD	030057030	FWPH	2014-11-13	925	C216400		8.14		FIELD	NO DIMENSION/SCALE
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	04-Jul-02	943	10700		0.0037		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	15-Aug-02	954	10711		0.0033		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	10-Sep-02	845	10722	<T	0.0006	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	22-Oct-02	1723	10733	<T	0.0019	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	05-May-03	914	13950	<T	0.0015	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	10-Jun-03	942	13961		0.0027		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	08-Jul-03	946	13972	<T	0.0015	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	13-Aug-03	1454	13983		0.0031		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	09-Sep-03	941	13994		0.0025		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	01-Oct-03	1037	14005	<T	0.0008	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	05-Nov-03	944	14016	<T	0.0013	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	31-Mar-04	1040	23950		0.0177		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	25-May-04	1642	23961		0.0111		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	07-Jun-04	1604	1	<=W	0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	08-Jul-04	1035	23983		0.0064		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	24-Aug-04	1543	23994	<=W	0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	27-Oct-04	1052	24005	<T	0.0015	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	15-Nov-04	954	24016	<=W	0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	08-Dec-04	1025	24027		0.0025		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	06-Apr-05	949	33950		0.0106		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	09-May-05	947	33961	<T	0.0017	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	06-Jun-05	1050	33972	<T	0.0008	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	14-Jun-05	910	33983		0.0042		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	16-Nov-05	1013	34027		0.0042		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	13-Jul-06	1651	13951		0.0041		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	14-Aug-06	1440	13969	<T	0.0015	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	19-Sep-06	1019	13987	<T	0.0022	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	12-Oct-06	710	14005	<T	0.0021	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	12-Dec-06	835	14041		0.0057		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	03-Apr-07	817	24101		0.0081		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	07-May-07	954	24119	<T	0.0006	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	11-Jul-07	958	24136		0.0033		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	14-Aug-07	854	24146	<T	0.0014	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	29-Aug-07	944	24163	<=W	0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	11-Sep-07	958	24172	<T	0.0021	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	26-Sep-07	1001	24189	<=W	0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	09-Oct-07	1001	24198	<T	0.0023	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	12-Nov-07	1045	24215	<T	0.002	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	20-Nov-07	930	24224	<=W	0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	29-Apr-08	945	13951	<T	0.0018	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	29-May-08	940	13968	<T	0.0008	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	11-Jun-08	944	13986		0.0042		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	21-Jul-08	958	13995	<T	0.0009	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	21-Aug-08	922	14012	<T	0.0006	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	09-Sep-08	906	14012		0.0046		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	22-Oct-08	859	14038		0.0035		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	27-Oct-08	849	14021		0.0028		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	06-Nov-08	843	14047	<T	0.0007	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	24-Nov-08	900	14064		0.0027		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	21-Apr-09	939	23951		0.0027		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	28-May-09	902	23986	<T	0.002	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	04-Jun-09	840	23994	<T	0.0019	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	23-Jul-09	854	24003	<T	0.0023	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	11-Aug-09	848	24020		0.0041		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	17-Aug-09	840	24029		0.0034		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	28-Sep-09	918	24047	<T	0.002	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	15-Oct-09	905	24065	<T	0.0019	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-04-14	846	33950		0.0041		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-05-19	824	3959	<T	0.0014	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-06-01	848	33977		0.0026		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-06-23	835	33995		0.0078		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-08-10	933	34013		0.0062		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-08-18	903	34030		0.0046		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-09-29	840	34039		0.0171		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-10-06	840	34057		0.0053		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2010-11-17	1257	34073		0.0082		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-05-18	837	45401		0.0057		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-06-02	905	45418		0.0053		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-06-14	846	45427		0.0047		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-07-25	855	45445		0.0074		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-08-03	859	45462		0.0078		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-08-31	827	4527		0.0048		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-09-20	937	45462		0.0207		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-10-20	854	45571		0.0019	<T	E3364A	MILLIGRAM PER LITER

PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-10-26	903	45589		0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2011-11-01	843	45607		0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-05-29	915	53401		0.0021	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-06-07	937	53436		0.0013	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-06-25	0	53419		0.0033		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-07-11	906	53453		0.0026		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-07-26	908	52444		0.0058		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-08-15	840	53471		0.0043		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-09-13	850	53497		0.002	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-09-19	917	53488		0.0005	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-10-15	856	53532		0.0039		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2012-10-30	854	53515		0.0044		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-04-25	830	00063400		0.0031		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-05-27	900	00063409		0.0031		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-06-11	933	00063427		0.0061		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-07-08	928	00063462	<=W	0.001	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-08-08	855	00063445	<=W	0.001	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-08-15	850	00063471	<T	0.0032	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-10-07	845	00063506		0.0151		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-10-29	920	00063523	<T	0.002	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2013-11-07	920	00063514	<T	0.0047	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-05-20	930	C211220		0.0039	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-05-27	900	C211422		0.006		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-06-12	852	C211956		0.001	<=W	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-08-13	850	C213720		0.0057		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-08-19	843	C213855		0.0075		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-09-02	908	C214237	RRV	0.0034	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-10-15	1345	C215560		0.0042	<T	E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-10-21	857	C215770		0.0056		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-11-05	905	C216211		0.0059		E3364A	MILLIGRAM PER LITER
PHOSPHATE,FILTERED REACTIVE	030057030	PPO4FR	2014-11-13	925	C216400		0.0047	<T	E3364A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	04-Jul-02	943	10700		0.024		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	15-Aug-02	954	10711		0.035		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	10-Sep-02	845	10722		0.017		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	22-Oct-02	1723	10733		0.01		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	05-May-03	914	13950		0.039		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	10-Jun-03	942	13961		0.055		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	08-Jul-03	946	13972		0.023		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	13-Aug-03	1454	13983		0.021		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	09-Sep-03	941	13994		0.01		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	01-Oct-03	1037	14005		0.01		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	05-Nov-03	944	14016		0.037		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	31-Mar-04	1040	23950		0.286		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	25-May-04	1642	23961		0.113		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	07-Jun-04	1604	1		0.024		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	08-Jul-04	1035	23983		0.176		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	24-Aug-04	1543	23994		0.012		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	27-Oct-04	1052	24005		0.014		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	15-Nov-04	954	24016		0.013		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	08-Dec-04	1025	24027		0.029		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	06-Apr-05	949	33950		0.152		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	09-May-05	947	33961		0.024		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	06-Jun-05	1050	33972		0.026		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	14-Jun-05	910	33983		0.104		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	16-Nov-05	1013	34027		0.096		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	13-Jul-06	1651	13951		0.053		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	14-Aug-06	1440	13969		0.01		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	19-Sep-06	1019	13987		0.017		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	12-Oct-06	710	14005		0.01		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	23-Nov-06	847	14023		0.039		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	12-Dec-06	835	14041		0.037		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	03-Apr-07	817	24101		0.081		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	07-May-07	954	24119		0.013		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	11-Jul-07	958	24136		0.026		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	14-Aug-07	854	24146		0.011		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	29-Aug-07	944	24163		0.022		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	11-Sep-07	958	24172		0.033		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	26-Sep-07	1001	24189	<T	0.009	<T	E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	09-Oct-07	1001	24198		0.022		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	12-Nov-07	1045	24215	<T	0.007	<T	E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	29-Apr-08	945	13951		0.03		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	29-May-08	940	13968		0.019		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	11-Jun-08	944	13986		0.035		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	21-Jul-08	958	13995		0.028		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	21-Aug-08	922	14012	<T	0.008	<T	E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	09-Sep-08	906	14012		0.011		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	22-Oct-08	859	14038	<T	0.008	<T	E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	27-Oct-08	849	14021		0.012		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	24-Nov-08	900	14064		0.023		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	21-Apr-09	939	23951		0.04		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	28-May-09	902	23986		0.025		E3367A	MILLIGRAM PER LITER

PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	04-Jun-09	840	23994		0.016		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	23-Jul-09	854	24003		0.011		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	11-Aug-09	848	24020		0.02		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	17-Aug-09	840	24029		0.014		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	28-Sep-09	918	24047		0.013		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	15-Oct-09	905	24065	<T	0.005	<T	E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-04-14	846	33950		0.0150		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-05-19	824	3959		0.0250		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-06-01	848	33977	AIN	0.0370		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-06-23	835	33995		0.0490		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-08-10	933	34013		0.0250		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-08-18	903	34030		0.0140		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-09-29	840	34039		0.1050		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2010-10-06	840	34057		0.0310		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-05-18	837	45401		0.0270		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-06-02	905	45418		0.0310		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-06-14	846	45427		0.0180		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-07-25	855	45445		0.0210		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-08-03	859	45462		0.0190		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-08-31	827	4527		0.0140		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-09-20	937	45462		0.0190		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-10-20	854	45571		0.0660		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-10-26	903	45589		0.0350		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2011-11-01	843	45607		0.0180		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-05-29	915	53401		0.017		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-06-07	937	53436		0.017		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-06-25	0	53419		0.014		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-07-11	906	53453		0.013		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-07-26	908	52444	UAL	0.044		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-08-15	840	53471		0.02		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-10-15	856	53532		0.012		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2012-10-30	854	53515	UAL	0.002	<=W	E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-04-25	830	00063400		0.035		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-05-27	900	00063409		0.02		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-06-11	933	00063427		0.016		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-07-08	928	00063462		0.015		E3367A	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-08-08	855	00063445		0.015		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-08-15	850	00063471		0.011		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-10-07	845	00063506		0.079		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-10-29	920	00063523		0.019		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2013-11-07	920	00063514		0.019		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-05-20	930	C211220		0.013		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-05-27	900	C211422		0.014		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-06-12	852	C211956		0.007		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-08-13	850	C213720		0.025		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-08-19	843	C213855		0.022		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-09-02	908	C214237		0.009		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-10-15	1345	C215560		0.01		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-10-21	857	C215770		0.017		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-11-05	905	C216211		0.01		E3516	MILLIGRAM PER LITER
PHOSPHORUS,UNFILTERED TOTAL	030057030	PPUT	2014-11-13	925	C216400		0.01		E3516	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	04-Jul-02	943	10700	CALCR	1.28		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	15-Aug-02	954	10711	CALCR	1.71		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	10-Sep-02	845	10722	CALCR	1.5		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	22-Oct-02	1723	10733	CALCR	1.66		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	05-May-03	914	13950	CALCR	1.75		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	10-Jun-03	942	13961	CALCR	1.25		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	08-Jul-03	946	13972	CALCR	1.42		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	13-Aug-03	1454	13983	CALCR	1.58		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	09-Sep-03	941	13994	CALCR	1.54		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	01-Oct-03	1037	14005	CALCR	1.49		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	05-Nov-03	944	14016	CALCR	1.8		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	31-Mar-04	1040	23950	CALCR	2		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	25-May-04	1642	23961	CALCR	1.46		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	07-Jun-04	1604	1	CALCR	1.56		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	08-Jul-04	1035	23983	CALCR	1.37		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	24-Aug-04	1543	23994	CALCR	1.51		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	27-Oct-04	1052	24005	CALCR	1.67		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	15-Nov-04	954	24016	CALCR	1.53		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	08-Dec-04	1025	24027	CALCR	1.85		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	06-Apr-05	949	33950	CALCR	2.15		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	09-May-05	947	33961	CALCR	1.71		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	06-Jun-05	1050	33972	CALCR	1.41		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	14-Jun-05	910	33983	CALCR	1.62		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	16-Nov-05	1013	34027	CALCR	2.27		E3171A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2010-05-19	824	3959	+/-0.2	1.8200	+/-0.28	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2010-06-01	848	33977	+/-0.2	1.6200	+/-0.25	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2010-06-23	835	33995	+/-0.2	1.6000	+/-0.25	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2010-08-10	933	34013	+/-0.2	1.5900	+/-0.25	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2010-09-29	840	34039	+/-0.3	2.2000	+/-0.34	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2010-10-06	840	34057	+/-0.3	1.9600	+/-0.30	E3386A	MILLIGRAM PER LITER

POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2011-05-18	837	45401		1.6600	+/-0.26	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2011-06-14	846	45427		1.3300	+/-0.21	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2011-07-25	855	45445		1.9700	+/-0.30	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2011-08-31	827	4527		1.6900	+/-0.26	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2011-10-20	854	45571		2.1500	+/-0.33	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2011-10-26	903	45589		2.1700	+/-0.33	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2012-05-29	915	53401		1.65	+/-0.25	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2012-06-25	0	53419		1.58	+/-0.25	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2012-07-11	906	53453		1.8	+/-0.28	E3386A	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2012-08-15	840	53471		1.51	+/-0.15	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2012-09-13	850	53497		1.64	+/-0.16	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2012-10-30	854	53515	UAL	1.64	+/-0.16	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2013-05-27	900	00063409	+/-0.1	1.39	+/-0.14	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2013-06-11	933	00063427	+/-0.1	1.37	+/-0.14	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2013-08-08	855	00063445	+/-0.1	1.44	+/-0.14	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2013-08-15	850	00063471	+/-0.1	1.45	+/-0.15	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2013-10-29	920	00063523	+/-0.1	1.78	+/-0.18	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2014-05-27	900	C211422		1.55	+/-0.16	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2014-06-12	852	C211956		1.37	+/-0.14	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2014-08-13	850	C213720		1.56	+/-0.16	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2014-08-19	843	C213855		1.28	+/-0.13	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2014-10-21	857	C215770		1.97	+/-0.20	E3497	MILLIGRAM PER LITER
POTASSIUM,UNFILTERED TOTAL	030057030	KKUT	2014-11-05	905	C216211		1.59	+/-0.16	E3497	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	04-Jul-02	943	10700	CRO	263		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	15-Aug-02	954	10711	CRO	265		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	10-Sep-02	845	10722	CRO	310		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	22-Oct-02	1723	10733	CRO	317		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	05-May-03	914	13950	CRO	346		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	10-Jun-03	942	13961	CRO	369		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	08-Jul-03	946	13972	CRO	311		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	13-Aug-03	1454	13983	CRO	337		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	09-Sep-03	941	13994	CRO	312		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	01-Oct-03	1037	14005	CRO	308		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	05-Nov-03	944	14016	CRO	304		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	31-Mar-04	1040	23950	CRO	218		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	25-May-04	1642	23961	CRO	270		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	07-Jun-04	1604	1	CRO	296		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	08-Jul-04	1035	23983	CRO	261		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	24-Aug-04	1543	23994	CRO	314		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	27-Oct-04	1052	24005	CRO	309		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	15-Nov-04	954	24016	CRO	316		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	08-Dec-04	1025	24027	CRO	328		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	06-Apr-05	949	33950	CRO	266		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	09-May-05	947	33961	CRO	342		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	06-Jun-05	1050	33972	CRO	310		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	14-Jun-05	910	33983	CRO	314		E3188B	MILLIGRAM PER LITER
RESIDUE,FILTERED	030057030	RSF	16-Nov-05	1013	34027	CRO	294		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	04-Jul-02	943	10700		9.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	15-Aug-02	954	10711		24.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	10-Sep-02	845	10722		8.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	22-Oct-02	1723	10733		4.2		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	05-May-03	914	13950		16.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	10-Jun-03	942	13961		21.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	08-Jul-03	946	13972		10.6		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	13-Aug-03	1454	13983		6.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	09-Sep-03	941	13994		5.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	01-Oct-03	1037	14005		3.2		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	05-Nov-03	944	14016		15.2		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	31-Mar-04	1040	23950		146		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	25-May-04	1642	23961		79		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	07-Jun-04	1604	1		21.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	08-Jul-04	1035	23983		126		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	24-Aug-04	1543	23994		2.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	27-Oct-04	1052	24005		4.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	15-Nov-04	954	24016		4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	08-Dec-04	1025	24027		14.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	06-Apr-05	949	33950		126		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	09-May-05	947	33961		5.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	06-Jun-05	1050	33972		9.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	14-Jun-05	910	33983		58		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	16-Nov-05	1013	34027		59.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	13-Jul-06	1651	13951		16.2		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	14-Aug-06	1440	13969		6.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	23-Nov-06	847	14023		9.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	12-Dec-06	835	14041		16.6		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	03-Apr-07	817	24101		53.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	07-May-07	954	24119		4.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	11-Jul-07	958	24136		9.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	14-Aug-07	854	24146		5.6		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	29-Aug-07	944	24163		9.6		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	11-Sep-07	958	24172		22.3		E3188B	MILLIGRAM PER LITER

RESIDUE,PARTICULATE	030057030	RSP	26-Sep-07	1001	24189		4.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	09-Oct-07	1001	24198		13.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	12-Nov-07	1045	24215		2.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	20-Nov-07	930	24224		4.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	29-Apr-08	945	13951		12.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	29-May-08	940	13968		6.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	11-Jun-08	944	13986		13		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	21-Jul-08	958	13995		18.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	21-Aug-08	922	14012		2.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	09-Sep-08	906	14012		4.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	22-Oct-08	859	14038		3.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	27-Oct-08	849	14021		3.2		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	06-Nov-08	843	14047		3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	24-Nov-08	900	14064		5.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	21-Apr-09	939	23951		10.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	23-Jul-09	854	24003		4.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	11-Aug-09	848	24020		6.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	17-Aug-09	840	24029		4.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	28-Sep-09	918	24047		5.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	15-Oct-09	905	24065	<T	2.1	<T	E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-04-14	846	33950		9.9000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-05-19	824	3959		19.9000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-06-01	848	33977		8.2000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-06-23	835	33995		27.6000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-08-10	933	34013		13.8000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-08-18	903	34030		5.6000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2010-11-17	1257	34073		11.6000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-05-18	837	45401		15.6000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-06-02	905	45418		12.9000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-06-14	846	45427		6.1000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-07-25	855	45445		9.1000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-08-03	859	45462		8.8000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-08-31	827	4527		5.7000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-09-20	937	45462		11.0000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-10-20	854	45571		22.8000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-10-26	903	45589		14.6000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2011-11-01	843	45607		7.4000		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-05-29	915	53401		7.8		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-06-07	937	53436		6.7		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-06-25	0	53419		4.7		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-07-11	906	53453		7.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-07-26	908	52444		26.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-08-15	840	53471	UAL	9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-09-13	850	53497		6.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-09-19	917	53488		14.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-10-15	856	53532	UAL	13.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2012-10-30	854	53515		16.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-04-25	830	00063400		30.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-05-27	900	00063409		17.3		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-06-11	933	00063427		11		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-07-08	928	00063462	<T	2.3	<T	E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-08-08	855	00063445		10.1		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-08-15	850	00063471		3.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-10-07	845	00063506		58.6		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-10-29	920	00063523		7.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2013-11-07	920	00063514		9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-05-20	930	C211220		7.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-05-27	900	C211422		12.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-06-12	852	C211956		5.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-08-13	850	C213720		21.4		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-08-19	843	C213855		14.7		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-09-02	908	C214237		7.9		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-10-15	1345	C215560		5.5		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-10-21	857	C215770		11		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-11-05	905	C216211		5.2		E3188B	MILLIGRAM PER LITER
RESIDUE,PARTICULATE	030057030	RSP	2014-11-13	925	C216400		4		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	04-Jul-02	943	10700	CRO	272		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	15-Aug-02	954	10711	CRO	289		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	10-Sep-02	845	10722	CRO	319		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	22-Oct-02	1723	10733	CRO	321		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	05-May-03	914	13950	CRO	363		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	10-Jun-03	942	13961	CRO	390		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	08-Jul-03	946	13972	CRO	322		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	13-Aug-03	1454	13983	CRO	344		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	09-Sep-03	941	13994	CRO	317		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	01-Oct-03	1037	14005	CRO	311		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	05-Nov-03	944	14016	CRO	319		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	31-Mar-04	1040	23950	CRO	363		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	25-May-04	1642	23961	CRO	349		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	07-Jun-04	1604	1	CRO	317		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	08-Jul-04	1035	23983	CRO	386		E3188B	MILLIGRAM PER LITER

RESIDUE,TOTAL	030057030	RST	24-Aug-04	1543	23994	CRO	317		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	27-Oct-04	1052	24005	CRO	314		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	15-Nov-04	954	24016	CRO	320		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	08-Dec-04	1025	24027	CRO	343		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	06-Apr-05	949	33950	CRO	392		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	09-May-05	947	33961	CRO	347		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	06-Jun-05	1050	33972	CRO	320		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	14-Jun-05	910	33983	CRO	372		E3188B	MILLIGRAM PER LITER
RESIDUE,TOTAL	030057030	RST	16-Nov-05	1013	34027	CRO	353		E3188B	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	13-Jul-06	1651	13951		4.16		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	14-Aug-06	1440	13969		4.36		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	19-Sep-06	1019	13987		5.42		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	12-Oct-06	710	14005		5		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	23-Nov-06	847	14023		3.34		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	12-Dec-06	835	14041		3.86		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	03-Apr-07	817	24101		2.86		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	07-May-07	954	24119		2.74		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	14-Aug-07	854	24146		5.32		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	11-Sep-07	958	24172		5.24		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	09-Oct-07	1001	24198		5.4		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	20-Nov-07	930	24224		4.5		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	29-Apr-08	945	13951		2.96		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	29-May-08	940	13968		3.34		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	21-Jul-08	958	13995		5.08		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	21-Aug-08	922	14012		4.68		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	06-Nov-08	843	14047		4.76		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	21-Apr-09	939	23951		2.36		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	23-Jul-09	854	24003		4.38		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	17-Aug-09	840	24029		5.02		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	28-Sep-09	918	24047		5.06		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	15-Oct-09	905	24065		5.06		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2010-05-19	824	3959		2.2800		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2010-06-01	848	33977		3.8800		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2010-06-23	835	33995		4.3000		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2010-08-10	933	34013		5.0800		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2010-09-29	840	34039		4.1800		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2011-05-18	837	45401		2.8000		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2011-07-25	855	45445		4.6800		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2011-08-31	827	4527		4.5600		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2011-10-20	854	45571		4.3600		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2011-10-26	903	45589		3.3400		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2012-05-29	915	53401		3.96		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2012-06-25	0	53419		4.56		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2012-07-11	906	53453		4.76		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2012-08-15	840	53471		5.72		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2012-09-13	850	53497	UAL	5.52		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2012-10-30	854	53515	UAL	3.84		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2013-05-27	900	00063409		2.24		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2013-06-11	933	00063427		3.42		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2013-08-08	855	00063445		4.8		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2013-08-15	850	00063471		5.04		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2013-10-29	920	00063523		4.32		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2014-05-27	900	C211422		3.12		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2014-06-12	852	C211956		4.72		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2014-08-13	850	C213720		4.96		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2014-08-19	843	C213855		5.84		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2014-10-21	857	C215770		5.84		E3370A	MILLIGRAM PER LITER
SILICATES,UNFILTERED REACTIVE	030057030	SIO3UR	2014-11-05	905	C216211		5.56		E3370A	MILLIGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2012-08-15	840	53471		0.0766	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2012-09-13	850	53497		0.244	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2012-10-30	854	53515	UAL	3.66	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2013-05-27	900	00063409	+/-6.0	0.889	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2013-06-11	933	00063427	+/-6.0	0.647	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2013-08-08	855	00063445	+/-6.0	0.719	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2013-08-15	850	00063471	+/-6.0	0.448	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2013-10-29	920	00063523	+/-6.0	1.3	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2014-05-27	900	C211422		1.35	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2014-06-12	852	C211956		0.921	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2014-08-13	850	C213720		0.893	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2014-08-19	843	C213855		0.927	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2014-10-21	857	C215770		-2.74	+/-6.0	E3497	MICROGRAM PER LITER
SILVER, UNFILTERED TOTAL	030057030	AGUT	2014-11-05	905	C216211		0.161	+/-6.0	E3497	MICROGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	04-Jul-02	943	10700	CALCR	20.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	15-Aug-02	954	10711	CALCR	14.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	10-Sep-02	845	10722	CALCR	18.6		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	22-Oct-02	1723	10733	CALCR	20.3		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	05-May-03	914	13950	CALCR	34.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	10-Jun-03	942	13961	CALCR	42.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	08-Jul-03	946	13972	CALCR	21.3		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	13-Aug-03	1454	13983	CALCR	22.7		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	09-Sep-03	941	13994	CALCR	16.9		E3171A	MILLIGRAM PER LITER

SODIUM, UNFILTERED TOTAL	030057030	NAUT	01-Oct-03	1037	14005	CALCR	17.9		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	05-Nov-03	944	14016	CALCR	29.3		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	31-Mar-04	1040	23950	CALCR	18.3		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	25-May-04	1642	23961	CALCR	27.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	07-Jun-04	1604	1	CALCR	25.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	08-Jul-04	1035	23983	CALCR	21.2		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	24-Aug-04	1543	23994	CALCR	17.6		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	27-Oct-04	1052	24005	CALCR	18.1		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	15-Nov-04	954	24016	CALCR	27.2		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	08-Dec-04	1025	24027	CALCR	31.4		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	06-Apr-05	949	33950	CALCR	25.5		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	09-May-05	947	33961	CALCR	36.7		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	06-Jun-05	1050	33972	CALCR	20.5		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	14-Jun-05	910	33983	CALCR	29.4		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	16-Nov-05	1013	34027	CALCR	21.4		E3171A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2010-05-19	824	3959	+/-4.9	32.8000	+/-4.9	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2010-06-01	848	33977	+/-3.8	25.1000	+/-3.8	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2010-06-23	835	33995	+/-3.4	22.5000	+/-3.4	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2010-08-10	933	34013	+/-4.2	28.2000	+/-4.2	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2010-09-29	840	34039	+/-3.5	23.5000	+/-3.5	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2010-10-06	840	34057	+/-4.3	28.5000	+/-4.3	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2011-05-18	837	45401		28.6000	+/-4.3	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2011-06-14	846	45427		25.6000	+/-3.8	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2011-07-25	855	45445		23.4000	+/-3.5	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2011-08-31	827	4527		24.0000	+/-3.6	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2011-10-20	854	45571		22.9000	+/-3.4	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2011-10-26	903	45589		26.0000	+/-3.9	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2012-05-29	915	53401		29.1	+/-4.4	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2012-06-25	0	53419		29.2	+/-4.4	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2012-07-11	906	53453		28.3	+/-4.2	E3386A	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2012-08-15	840	53471		22.6	+/-2.3	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2012-09-13	850	53497		28.5	+/-2.9	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2012-10-30	854	53515	UAL	31.3	+/-3.1	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2013-05-27	900	00063409	+/-3.5	34.9	+/-3.5	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2013-06-11	933	00063427	+/-2.8	28	+/-2.8	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2013-08-08	855	00063445	+/-2.8	28.2	+/-2.8	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2013-08-15	850	00063471	+/-2.3	23.3	+/-2.3	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2013-10-29	920	00063523	+/-3.3	32.6	+/-3.3	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2014-05-27	900	C211422		28	+/-2.8	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2014-06-12	852	C211956		19.6	+/-2.0	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2014-08-13	850	C213720		21.9	+/-2.2	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2014-08-19	843	C213855		27.2	+/-2.7	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2014-10-21	857	C215770		25.1	+/-2.5	E3497	MILLIGRAM PER LITER
SODIUM, UNFILTERED TOTAL	030057030	NAUT	2014-11-05	905	C216211		27.5	+/-2.8	E3497	MILLIGRAM PER LITER
STREAM CONDITION	030057030	FWSTRC	10-Jun-03	942	13961		0.5		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	14-Aug-06	1440	13969		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	12-Oct-06	710	14005		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	12-Dec-06	835	14041		0.113		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	03-Apr-07	817	24101		0.3		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	07-May-07	954	24119		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	11-Jul-07	958	24136		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	29-Aug-07	944	24163		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	26-Sep-07	1001	24189		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	09-Oct-07	1001	24198		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	12-Nov-07	1045	24215		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	20-Nov-07	930	24224		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	29-Apr-08	945	13951		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	29-May-08	940	13968		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	11-Jun-08	944	13986		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	21-Jul-08	958	13995		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	21-Aug-08	922	14012		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	09-Sep-08	906	14012		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	22-Oct-08	859	14038		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	27-Oct-08	849	14021		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	06-Nov-08	843	14047		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	24-Nov-08	900	14064		0.8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	21-Apr-09	939	23951		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	28-May-09	902	23986		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	04-Jun-09	840	23994		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	23-Jul-09	854	24003		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	11-Aug-09	848	24020		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	17-Aug-09	840	24029		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	28-Sep-09	918	24047		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	15-Oct-09	905	24065		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-04-14	846	33950		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-05-19	824	3959		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-06-01	848	33977		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-06-23	835	33995		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-08-10	933	34013		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-08-18	903	34030		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-09-29	840	34039		8.0000		FIELD	NO DIMENSION/SCALE

STREAM CONDITION	030057030	FWSTRC	2010-10-06	840	34057		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2010-11-17	1257	34073		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-05-18	837	45401		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-06-02	905	45418		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-06-14	846	45427		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-07-25	855	45445		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-08-03	859	45462		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-08-31	827	4527		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-09-20	937	45462		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-10-20	854	45571		3.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-10-26	903	45589		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2011-11-01	843	45607		8.0000		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-05-29	915	53401		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-06-07	937	53436		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-06-25	0	53419		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-07-11	906	53453		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-07-26	908	52444		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-08-15	840	53471		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-09-13	850	53497		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-09-19	917	53488		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-10-15	856	53532		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2012-10-30	854	53515		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-04-25	830	00063400		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-05-27	900	00063409		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-06-11	933	00063427		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-07-08	928	00063462		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-08-08	855	00063445		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-08-15	850	00063471		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-10-07	845	00063506		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-10-29	920	00063523		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2013-11-07	920	00063514		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-05-20	930	C211220		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-05-27	900	C211422		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-06-12	852	C211956		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-08-13	850	C213720		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-08-19	843	C213855		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-09-02	908	C214237		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-10-15	1345	C215560		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-10-21	857	C215770		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-11-05	905	C216211		8		FIELD	NO DIMENSION/SCALE
STREAM CONDITION	030057030	FWSTRC	2014-11-13	925	C216400		8		FIELD	NO DIMENSION/SCALE
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	04-Jul-02	943	10700	+/-5.7	143	+/-5.7	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	15-Aug-02	954	10711	+/-5.8	146	+/-5.8	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	10-Sep-02	845	10722	+/-6.3	157	+/-6.3	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	22-Oct-02	1723	10733	+/-7.1	178	+/-7.1	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	05-May-03	914	13950	+/-6.0	151	+/-6.0	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	10-Jun-03	942	13961	+/-6.1	153	+/-6.1	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	08-Jul-03	946	13972	+/-6.5	163	+/-6.5	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	13-Aug-03	1454	13983	+/-13.	166	+/-13.2	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	09-Sep-03	941	13994	+/-12.	158	+/-12.7	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	01-Oct-03	1037	14005	+/-12.	157	+/-12.6	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	05-Nov-03	944	14016	+/-11.	139	+/-11.2	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	31-Mar-04	1040	23950	+/-8.7	109	+/-8.7	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	25-May-04	1642	23961	+/-8.8	110	+/-8.8	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	08-Jul-04	1035	23983	+/-9.1	114	+/-9.1	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	24-Aug-04	1543	23994	+/-13.	169	+/-13.5	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	27-Oct-04	1052	24005	+/-13.	168	+/-13.4	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	15-Nov-04	954	24016	+/-11.	137	+/-11.0	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	08-Dec-04	1025	24027	+/-11.	141	+/-11.3	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	06-Apr-05	949	33950	+/-10.	136	+/-10.9	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	09-May-05	947	33961	+/-13.	167	+/-13.3	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	06-Jun-05	1050	33972	+/-14.	185	+/-14.8	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	14-Jun-05	910	33983	+/-13.	170	+/-13.6	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	13-Jul-06	1651	13951	+/-13.	164	+/-13.1	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	12-Oct-06	710	14005	+/-14.	183	+/-14.6	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	23-Nov-06	847	14023	+/-12.	158	+/-12.6	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	12-Dec-06	835	14041	+/-15	161.1909	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	03-Apr-07	817	24101	+/-12	130	+/-12	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	07-May-07	954	24119	+/-15	161	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	14-Aug-07	854	24146	+/-19	206	+/-19	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	11-Sep-07	958	24172	+/-17	183	+/-17	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	09-Oct-07	1001	24198	+/-16	180	+/-16	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	20-Nov-07	930	24224	+/-17	184	+/-17	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	29-Apr-08	945	13951	+/-14	153	+/-14	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	29-May-08	940	13968	+/-15	164	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	21-Jul-08	958	13995	+/-16	177	+/-16	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	21-Aug-08	922	14012	+/-16	182	+/-16	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	27-Oct-08	849	14021	+/-19	177	+/-19	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	06-Nov-08	843	14047	+/-19	173	+/-19	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	21-Apr-09	939	23951	+/-17	155	+/-17	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	23-Jul-09	854	24003	+/-20	179	+/-20	E3386A	MICROGRAM PER LITER

STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	17-Aug-09	840	24029	+/-21	190	+/-21	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	28-Sep-09	918	24047	+/-21	187	+/-21	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	15-Oct-09	905	24065	+/-14	180	+/-14	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2010-05-19	824	3959	+/-15	187.0000	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2010-06-01	848	33977	+/-14	179.0000	+/-14	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2010-06-23	835	33995	+/-13	160.0000	+/-13	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2010-08-10	933	34013	+/-14	182.0000	+/-14	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2010-09-29	840	34039	+/-13	162.0000	+/-13	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2010-10-06	840	34057	+/-15	185.0000	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2011-05-18	837	45401		175.0000	+/-14	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2011-06-14	846	45427		171.0000	+/-13	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2011-07-25	855	45445		188.0000	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2011-08-31	827	4527		193.0000	+/-15	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2011-10-20	854	45571		158.0000	+/-12	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2011-10-26	903	45589		137.0000	+/-11	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2012-05-29	915	53401		177	+/-14	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2012-06-25	0	53419		163	+/-13	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2012-07-11	906	53453		206	+/-16	E3386A	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2012-08-15	840	53471		191	+/-19	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2012-09-13	850	53497		189	+/-19	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2012-10-30	854	53515	UAL	153	+/-15	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2013-05-27	900	00063409	+/-16	163	+/-16	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2013-06-11	933	00063427	+/-17	173	+/-17	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2013-08-08	855	00063445	+/-18	177	+/-18	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2013-08-15	850	00063471	+/-19	193	+/-19	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2013-10-29	920	00063523	+/-17	165	+/-17	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2014-05-27	900	C211422		180	+/-18	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2014-06-12	852	C211956		180	+/-18	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2014-08-13	850	C213720		188	+/-19	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2014-08-19	843	C213855		171	+/-17	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2014-10-21	857	C215770		178	+/-18	E3497	MICROGRAM PER LITER
STRONTIUM, UNFILTERED TOTAL	030057030	SRUT	2014-11-05	905	C216211		179	+/-18	E3497	MICROGRAM PER LITER
TEMPERATURE, WATER	030057030	FWTEMP	04-Jul-02	943	10700		24		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	15-Aug-02	954	10711		19		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	10-Sep-02	845	10722		16		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	05-May-03	914	13950		10.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	10-Jun-03	942	13961		13.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	08-Jul-03	946	13972		18.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	13-Aug-03	1454	13983		24		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	09-Sep-03	941	13994		13.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	01-Oct-03	1037	14005		7.9		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	05-Nov-03	944	14016		6.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	31-Mar-04	1040	23950		2.9		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	25-May-04	1642	23961		13.1		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	07-Jun-04	1604	1		17.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	08-Jul-04	1035	23983		16.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	24-Aug-04	1543	23994		18.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	27-Oct-04	1052	24005		9.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	15-Nov-04	954	24016		1.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	08-Dec-04	1025	24027		19.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	06-Apr-05	949	33950		2.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	09-May-05	947	33961		13		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	06-Jun-05	1050	33972		19.9		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	14-Jun-05	910	33983		20.1		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	16-Nov-05	1013	34027		6.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	13-Jul-06	1651	13951		22.2		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	14-Aug-06	1440	13969		16.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	19-Sep-06	1019	13987		13.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	12-Oct-06	710	14005		10.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	23-Nov-06	847	14023		2		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	12-Dec-06	835	14041		2.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	03-Apr-07	817	24101		4.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	07-May-07	954	24119		10.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	11-Jul-07	958	24136		19.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	14-Aug-07	854	24146		15.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	29-Aug-07	944	24163		17.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	11-Sep-07	958	24172		14.1		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	26-Sep-07	1001	24189		15.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	09-Oct-07	1001	24198		15.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	12-Nov-07	1045	24215		79.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	29-Apr-08	945	13951		7.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	29-May-08	940	13968		10.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	11-Jun-08	944	13986		15.9		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	21-Jul-08	958	13995		16.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	21-Aug-08	922	14012		14.2		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	09-Sep-08	906	14012		12.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	22-Oct-08	859	14038		4.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	27-Oct-08	849	14021		6.2		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	06-Nov-08	843	14047		6.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	24-Nov-08	900	14064		0.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	21-Apr-09	939	23951		6.3		FIELD	DEGREES CELSIUS

TEMPERATURE, WATER	030057030	FWTEMP	28-May-09	902	23986		12.2		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	04-Jun-09	840	23994		11.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	23-Jul-09	854	24003		16.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	11-Aug-09	848	24020		15.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	17-Aug-09	840	24029		18.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	28-Sep-09	918	24047		12.2		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	15-Oct-09	905	24065		4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-04-14	846	33950		7.0000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-05-19	824	3959		13.1000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-06-01	848	33977		17.9000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-06-23	835	33995		16.0000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-08-10	933	34013		17.3000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-08-18	903	34030		16.5000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-09-29	840	34039		12.4000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-10-06	840	34057		10.6000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2010-11-17	1257	34073		5.5000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-05-18	837	45401		11.5000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-06-02	905	45418		15.4000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-06-14	846	45427		12.5000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-07-25	855	45445		19.5000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-08-03	859	45462		18.7000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-08-31	827	4527		15.1000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-09-20	937	45462		11.4000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-10-20	854	45571		8.7000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-10-26	903	45589		7.9000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2011-11-01	843	45607		5.4000		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-05-29	915	53401		18.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-06-07	937	53436		14.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-06-25	0	53419		14.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-07-11	906	53453		16.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-07-26	908	52444		17		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-08-15	840	53471		14.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-09-13	850	53497		13.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-09-19	917	53488		10.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-10-15	856	53532		8.7		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2012-10-30	854	53515		5.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-04-25	830	00063400		5.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-05-27	900	00063409		11.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-06-11	933	00063427		14.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-07-08	928	00063462		17.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-08-08	855	00063445		15.6		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-08-15	850	00063471		13		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-10-07	845	00063506		12.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-10-29	920	00063523		4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2013-11-07	920	00063514		6.3		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-05-20	930	C211220		12		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-05-27	900	C211422		16		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-06-12	852	C211956		14.9		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-08-13	850	C213720		15.4		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-08-19	843	C213855		13.5		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-09-02	908	C214237		17		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-10-15	1345	C215560		12		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-10-21	857	C215770		8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-11-05	905	C216211		6.8		FIELD	DEGREES CELSIUS
TEMPERATURE, WATER	030057030	FWTEMP	2014-11-13	925	C216400		4.4		FIELD	DEGREES CELSIUS
TIN UNFILTERED TOTAL	030057030	SNUT	2012-09-13	850	53497		-2.18	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2012-10-30	854	53515	UAL	8.66	+/-6.1	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2013-05-27	900	00063409	+/-6.0	-6.08	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2013-06-11	933	00063427	+/-6.0	1.02	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2013-08-08	855	00063445	+/-6.0	2.86	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2013-08-15	850	00063471	+/-6.0	-4.43	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2013-10-29	920	00063523	+/-6.0	-5.07	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2014-05-27	900	C211422		-5.26	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2014-06-12	852	C211956		-2.59	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2014-08-13	850	C213720		-5.26	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2014-08-19	843	C213855		-5.28	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2014-10-21	857	C215770		-4.91	+/-6.0	E3497	MICROGRAM PER LITER
TIN UNFILTERED TOTAL	030057030	SNUT	2014-11-05	905	C216211		-6.6	+/-6.0	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	04-Jul-02	943	10700	+/-0.3	2.65	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	15-Aug-02	954	10711	+/-0.3	3.29	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	10-Sep-02	845	10722	+/-0.3	2.41	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	22-Oct-02	1723	10733	+/-0.3	1.69	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	05-May-03	914	13950	+/-0.3	3.09	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	10-Jun-03	942	13961	+/-0.3	5.25	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	08-Jul-03	946	13972	+/-0.3	2.32	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	13-Aug-03	1454	13983	+/-0.3	2.37	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	09-Sep-03	941	13994	+/-0.3	1.73	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	01-Oct-03	1037	14005	+/-0.3	1	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	05-Nov-03	944	14016	+/-0.3	2.8	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	31-Mar-04	1040	23950	+/-1.2	15	+/-1.2	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	25-May-04	1642	23961	+/-1.0	12.6	+/-1.0	E3386A	MICROGRAM PER LITER

TITANIUM, UNFILTERED TOTAL	030057030	TIUT	08-Jul-04	1035	23983	+/-1.2	15.3	+/-1.2	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	24-Aug-04	1543	23994	+/-0.3	1.9	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	27-Oct-04	1052	24005	+/-0.3	2.13	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	15-Nov-04	954	24016	+/-0.3	1.07	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	08-Dec-04	1025	24027	+/-0.3	4.03	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	06-Apr-05	949	33950	+/-2.3	28.1	+/-2.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	09-May-05	947	33961	+/-0.3	1.88	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	06-Jun-05	1050	33972	+/-0.3	2.62	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	14-Jun-05	910	33983	+/-0.5	6.81	+/-0.5	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	13-Jul-06	1651	13951	+/-0.4	4.87	+/-0.4	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	12-Oct-06	710	14005	+/-0.3	1.73	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	23-Nov-06	847	14023	+/-0.3	3.15	+/-0.3	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	12-Dec-06	835	14041	+/-0.4	4.404659	+/-0.40	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	03-Apr-07	817	24101	+/-0.7	8.33	+/-0.75	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	07-May-07	954	24119	+/-0.3	2.54	+/-0.30	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	14-Aug-07	854	24146	+/-0.3	3.02	+/-0.30	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	11-Sep-07	958	24172	+/-0.6	7.47	+/-0.67	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	09-Oct-07	1001	24198	+/-0.4	5.03	+/-0.45	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	20-Nov-07	930	24224	+/-0.3	2.7	+/-0.30	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	29-Apr-08	945	13951	+/-0.6	7.27	+/-0.65	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	29-May-08	940	13968	+/-0.3	3.2	+/-0.30	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	21-Jul-08	958	13995	+/-0.7	7.8	+/-0.70	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	21-Aug-08	922	14012	+/-0.3	2.43	+/-0.30	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	27-Oct-08	849	14021	+/-0.4	3.45	+/-0.45	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	06-Nov-08	843	14047	+/-0.3	2.5	+/-0.32	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	21-Apr-09	939	23951	+/-1.0	7.74	+/-1.0	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	23-Jul-09	854	24003	+/-0.3	3.03	+/-0.39	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	17-Aug-09	840	24029	+/-0.4	3.23	+/-0.42	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	28-Sep-09	918	24047	+/-0.4	3.6	+/-0.47	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	15-Oct-09	905	24065	+/-0.3	1.86	+/-0.33	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2010-05-19	824	3959	+/-0.4	4.6300	+/-0.46	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2010-06-01	848	33977	+/-0.4	3.3900	+/-0.40	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2010-06-23	835	33995	+/-0.9	12.2000	+/-0.98	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2010-08-10	933	34013	+/-0.6	7.2700	+/-0.63	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2010-09-29	840	34039	+/-1.6	20.8000	+/-1.6	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2010-10-06	840	34057	+/-0.4	4.1400	+/-0.44	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2011-05-18	837	45401		6.2500	+/-0.56	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2011-06-14	846	45427		4.0900	+/-0.43	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2011-07-25	855	45445		4.0700	+/-0.43	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2011-08-31	827	4527		2.7500	+/-0.37	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2011-10-20	854	45571		5.2300	+/-0.50	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2011-10-26	903	45589		4.6300	+/-0.46	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2012-05-29	915	53401		3.57	+/-0.41	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2012-06-25	0	53419		2.87	+/-0.37	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2012-07-11	906	53453		2.99	+/-0.38	E3386A	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2012-08-15	840	53471		3.71	+/-0.50	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2012-09-13	850	53497		2.7	+/-0.43	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2012-10-30	854	53515	UAL	5.48	+/-0.64	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2013-05-27	900	00063409	+/-0.7	6.39	+/-0.72	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2013-06-11	933	00063427	+/-0.6	5.2	+/-0.62	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2013-08-08	855	00063445	+/-0.6	5.48	+/-0.64	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2013-08-15	850	00063471	+/-0.4	3.24	+/-0.47	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2013-10-29	920	00063523	+/-0.5	4.34	+/-0.55	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2014-05-27	900	C211422		5.15	+/-0.61	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2014-06-12	852	C211956		5.78	+/-0.67	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2014-08-13	850	C213720		7.17	+/-0.79	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2014-08-19	843	C213855		6.04	+/-0.69	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2014-10-21	857	C215770		4.81	+/-0.59	E3497	MICROGRAM PER LITER
TITANIUM, UNFILTERED TOTAL	030057030	TIUT	2014-11-05	905	C216211		2.87	+/-0.44	E3497	MICROGRAM PER LITER
TURBIDITY	030057030	TURB	04-Jul-02	943	10700	S46	5.53		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	15-Aug-02	954	10711	S24	11.9		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	10-Sep-02	845	10722		6.4		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	22-Oct-02	1723	10733		2.7		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	05-May-03	914	13950	S24	6.21		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	10-Jun-03	942	13961	S46	12.4		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	08-Jul-03	946	13972	S24	6.06		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	13-Aug-03	1454	13983		6.18		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	09-Sep-03	941	13994		5.22		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	01-Oct-03	1037	14005		2.65		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	05-Nov-03	944	14016	S24	9.39		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	31-Mar-04	1040	23950		111		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	25-May-04	1642	23961		50.2		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	07-Jun-04	1604	1	S6+	6.68		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	08-Jul-04	1035	23983		65.1		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	24-Aug-04	1543	23994		2		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	27-Oct-04	1052	24005		2.89		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	15-Nov-04	954	24016	S46	3.3		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	08-Dec-04	1025	24027		10.6		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	06-Apr-05	949	33950	S24	69.1		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	09-May-05	947	33961		3.81		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	06-Jun-05	1050	33972	S24	6.71		E3311A	FORMAZIN TURBIDITY UNIT

TURBIDITY	030057030	TURB	14-Jun-05	910	33983	S24	24.3		E3311A	FORMAZIN TURBIDITY UNIT
TURBIDITY	030057030	TURB	16-Nov-05	1013	34027		36.7		E3311A	FORMAZIN TURBIDITY UNIT
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2012-08-15	840	53471		-0.557	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2012-09-13	850	53497		1.02	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2012-10-30	854	53515	UAL	1.15	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2013-05-27	900	00063409	+/-2.0	0.408	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2013-06-11	933	00063427	+/-2.0	0.323	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2013-08-08	855	00063445	+/-2.0	2.03	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2013-08-15	850	00063471	+/-2.0	-0.647	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2013-10-29	920	00063523	+/-2.0	-0.114	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2014-05-27	900	C211422		-1.3	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2014-06-12	852	C211956		-2.34	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2014-08-13	850	C213720		-2.44	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2014-08-19	843	C213855		-2.25	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2014-10-21	857	C215770		-1.59	+/-2.0	E3497	MICROGRAM PER LITER
URANIUM, UNFILTERED TOTAL	030057030	UUUT	2014-11-05	905	C216211		-2.29	+/-2.0	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	04-Jul-02	943	10700	+/-0.9	1.32	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	15-Aug-02	954	10711	+/-0.9	0.783	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	10-Sep-02	845	10722	+/-0.9	1.02	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	22-Oct-02	1723	10733	+/-0.9	-0.169	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	05-May-03	914	13950	+/-0.9	1.08	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	10-Jun-03	942	13961	+/-0.9	1.06	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	08-Jul-03	946	13972	+/-0.9	0.859	+/-0.9	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	13-Aug-03	1454	13983	+/-1.6	0.176	+/-1.6	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	09-Sep-03	941	13994	+/-1.6	1.42	+/-1.6	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	01-Oct-03	1037	14005	+/-1.0	0.896	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	05-Nov-03	944	14016	+/-1.0	1.18	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	31-Mar-04	1040	23950	+/-2.0	1.56	+/-2.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	25-May-04	1642	23961	+/-1.0	1.68	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	08-Jul-04	1035	23983	+/-1.0	0.871	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	24-Aug-04	1543	23994	+/-2.2	0.608	+/-2.2	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	27-Oct-04	1052	24005	+/-1.0	-1.28	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	15-Nov-04	954	24016	+/-1.0	0.376	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	08-Dec-04	1025	24027	+/-1.0	0.47	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	06-Apr-05	949	33950	+/-1.0	2.13	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	09-May-05	947	33961	+/-1.0	0.548	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	06-Jun-05	1050	33972	+/-1.0	0.709	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	14-Jun-05	910	33983	+/-1.0	2.38	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	13-Jul-06	1651	13951	+/-1.6	1.71	+/-1.6	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	12-Oct-06	710	14005	+/-1.0	0.194	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	23-Nov-06	847	14023	+/-1.7	0.881	+/-1.7	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	12-Dec-06	835	14041	+/-1.0	0.441926	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	03-Apr-07	817	24101	+/-1.0	2.26	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	07-May-07	954	24119	+/-1.0	0.0896	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	14-Aug-07	854	24146	+/-1.0	1.47	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	11-Sep-07	958	24172	+/-1.0	1.87	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	09-Oct-07	1001	24198	+/-1.0	2.49	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	20-Nov-07	930	24224	+/-1.0	0.922	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	29-Apr-08	945	13951	+/-1.0	1.34	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	29-May-08	940	13968	+/-1.0	0.111	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	21-Jul-08	958	13995	+/-1.0	1.56	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	21-Aug-08	922	14012	+/-1.0	1.74	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	27-Oct-08	849	14021	+/-1.0	1.57	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	06-Nov-08	843	14047	+/-1.0	1.39	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	21-Apr-09	939	23951	+/-1.0	1.13	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	23-Jul-09	854	24003	+/-1.0	2.11	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	17-Aug-09	840	24029	+/-1.0	2.7	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	28-Sep-09	918	24047	+/-1.0	2.05	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	15-Oct-09	905	24065	+/-1.0	0.559	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2010-05-19	824	3959	+/-1.0	1.1100	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2010-06-01	848	33977	+/-1.0	0.5970	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2010-06-23	835	33995	+/-1.0	1.6100	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2010-08-10	933	34013	+/-1.2	7.2200	+/-1.2	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2010-09-29	840	34039	+/-1.1	3.7200	+/-1.1	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2010-10-06	840	34057	+/-1.1	3.5700	+/-1.1	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2011-05-18	837	45401		2.9500	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2011-06-14	846	45427		3.0400	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2011-07-25	855	45445		3.0600	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2011-08-31	827	4527		2.6500	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2011-10-20	854	45571		2.2600	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2011-10-26	903	45589		1.4900	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2012-05-29	915	53401		1.61	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2012-06-25	0	53419		1.85	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2012-07-11	906	53453		1.63	+/-1.0	E3386A	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2012-08-15	840	53471		1.07	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2012-09-13	850	53497		0.817	+/-0.34	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2012-10-30	854	53515	UAL	0.912	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2013-05-27	900	00063409	+/-0.3	0.873	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2013-06-11	933	00063427	+/-0.3	0.786	+/-0.34	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2013-08-08	855	00063445	+/-0.3	0.953	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2013-08-15	850	00063471	+/-0.3	0.778	+/-0.34	E3497	MICROGRAM PER LITER

VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2013-10-29	920	00063523	+/-0.3	0.598	+/-0.34	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2014-05-27	900	C211422		0.904	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2014-06-12	852	C211956		1.01	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2014-08-13	850	C213720		1.11	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2014-08-19	843	C213855		0.935	+/-0.35	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2014-10-21	857	C215770		0.489	+/-0.34	E3497	MICROGRAM PER LITER
VANADIUM, UNFILTERED TOTAL	030057030	VVUT	2014-11-05	905	C216211		0.501	+/-0.34	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	04-Jul-02	943	10700	+/-0.6	1.09	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	15-Aug-02	954	10711	+/-0.6	1.39	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	10-Sep-02	845	10722	+/-0.6	0.397	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	22-Oct-02	1723	10733	+/-0.6	0.587	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	05-May-03	914	13950	+/-0.6	1	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	10-Jun-03	942	13961	+/-0.6	1.13	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	08-Jul-03	946	13972	+/-0.6	0.478	+/-0.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	13-Aug-03	1454	13983	+/-0.7	0.825	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	09-Sep-03	941	13994	+/-0.7	0.588	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	01-Oct-03	1037	14005	+/-0.7	0.124	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	05-Nov-03	944	14016	+/-0.7	1.6	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	31-Mar-04	1040	23950	+/-0.7	5.32	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	25-May-04	1642	23961	+/-0.7	3.84	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	08-Jul-04	1035	23983	+/-0.7	4.2	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	24-Aug-04	1543	23994	+/-0.7	-0.109	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	27-Oct-04	1052	24005	+/-0.7	0.782	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	15-Nov-04	954	24016	+/-0.7	0.359	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	08-Dec-04	1025	24027	+/-0.7	6.8	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	06-Apr-05	949	33950	+/-1.0	9.73	+/-1.0	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	09-May-05	947	33961	+/-0.7	0.0928	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	06-Jun-05	1050	33972	+/-0.7	0.321	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	14-Jun-05	910	33983	+/-0.7	2.11	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	13-Jul-06	1651	13951	+/-0.7	0.255	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	12-Oct-06	710	14005	+/-0.7	-0.493	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	23-Nov-06	847	14023	+/-0.7	-0.306	+/-0.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	12-Dec-06	835	14041	+/-0.7	0.889683	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	03-Apr-07	817	24101	+/-0.7	2.58	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	07-May-07	954	24119	+/-0.7	1	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	14-Aug-07	854	24146	+/-0.7	0.425	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	11-Sep-07	958	24172	+/-3.2	24.5	+/-3.2	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	09-Oct-07	1001	24198	+/-0.7	1.4	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	20-Nov-07	930	24224	+/-0.7	1.43	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	29-Apr-08	945	13951	+/-0.7	1.84	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	29-May-08	940	13968	+/-0.7	0.541	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	21-Jul-08	958	13995	+/-0.7	0.146	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	21-Aug-08	922	14012	+/-0.7	-0.945	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	27-Oct-08	849	14021	+/-0.7	0.0721	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	06-Nov-08	843	14047	+/-0.7	-0.0603	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	21-Apr-09	939	23951	+/-0.7	-0.273	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	23-Jul-09	854	24003	+/-0.7	-0.832	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	17-Aug-09	840	24029	+/-0.7	-0.959	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	28-Sep-09	918	24047	+/-0.7	2.22	+/-0.70	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	15-Oct-09	905	24065	+/-2.9	1.45	+/-2.9	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2010-05-19	824	3959	+/-2.7	3.4100	+/-2.7	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2010-06-01	848	33977	+/-2.4	2.2400	+/-2.4	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2010-06-23	835	33995	+/-2.8	12.0000	+/-2.8	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2010-08-10	933	34013	+/-2.6	1.3600	+/-2.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2010-09-29	840	34039	+/-2.5	4.3600	+/-2.5	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2010-10-06	840	34057	+/-2.5	0.7800	+/-2.5	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2011-05-18	837	45401		1.0400	+/-2.9	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2011-06-14	846	45427		2.0000	+/-2.5	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2011-07-25	855	45445		2.0300	+/-2.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2011-08-31	827	4527		2.3700	+/-2.8	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2011-10-20	854	45571		2.2700	+/-2.5	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2011-10-26	903	45589		2.8900	+/-0.85	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2012-05-29	915	53401		1.78	+/-2.6	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2012-06-25	0	53419		3.95	+/-2.5	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2012-07-11	906	53453		2.62	+/-2.8	E3386A	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2012-08-15	840	53471		4.64	+/-1.4	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2012-09-13	850	53497		6.02	+/-1.5	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2012-10-30	854	53515	UAL	6.8	+/-1.5	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2013-05-27	900	00063409	+/-1.6	8.02	+/-1.6	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2013-06-11	933	00063427	+/-1.6	8.26	+/-1.6	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2013-08-08	855	00063445	+/-1.6	7.91	+/-1.6	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2013-08-15	850	00063471	+/-1.6	8.22	+/-1.6	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2013-10-29	920	00063523	+/-1.4	4.29	+/-1.4	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2014-05-27	900	C211422		9.6	+/-1.6	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2014-06-12	852	C211956		10.5	+/-1.7	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2014-08-13	850	C213720		11.7	+/-1.8	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2014-08-19	843	C213855		10.8	+/-1.7	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2014-10-21	857	C215770		9.6	+/-1.6	E3497	MICROGRAM PER LITER
ZINC, UNFILTERED TOTAL	030057030	ZNUT	2014-11-05	905	C216211		0.731	+/-1.3	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2012-08-15	840	53471		-0.207	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2012-09-13	850	53497		-0.207	+/-0.67	E3497	MICROGRAM PER LITER

ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2012-10-30	854	53515	UAL	-0.0337	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2013-05-27	900	00063409	+/-0.6	-0.0489	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2013-06-11	933	00063427	+/-0.6	-0.0671	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2013-08-08	855	00063445	+/-0.6	-0.158	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2013-08-15	850	00063471	+/-0.6	-0.0501	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2013-10-29	920	00063523	+/-0.6	-0.104	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2014-05-27	900	C211422		-0.132	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2014-06-12	852	C211956		-0.056	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2014-08-13	850	C213720		0.0212	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2014-08-19	843	C213855		0.00341	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2014-10-21	857	C215770		-0.0231	+/-0.67	E3497	MICROGRAM PER LITER
ZIRCONIUM, UNFILTERED TOTAL	030057030	ZRUT	2014-11-05	905	C216211		-0.102	+/-0.67	E3497	MICROGRAM PER LITER

Appendix E. Calculations for Determining Dye Concentrations

Tracer - Slug Injection Calculations - Project 115290/115291 - Nov 2/09

Reach 1

(A) Flow - Oct 29/09 @ Golf Course Rd = $1.43 m^3/s$.

$$V_s = 3.79 \times 10^{-5} \frac{QL}{V} C_p$$

→ To determine volume of rhodamine dye req'd. in order to get a 10 ppm peak at Stn #3 (500m d/s)

$Q = 1.43 m^3/s = 50.5 ft^3/s$
$L = 500m = 1640.4 ft$
$C_p = 10 ppm$
$V = 0.28 m/s = 0.92 ft/s$ (based on 8.3m wide × 0.61m avg depth)

$$V_s = \frac{(3.79 \times 10^{-5})(50.5 ft^3/s)(1640.4 ft)(10_{ppm})}{0.92 ft/s}$$

$V_s = 34 mL$ ←

(B) Check what peak will be at Stn #1 (50m d/s).

$L = 50m = 164 ft$.

$$C_p = \frac{V_s \cdot V}{3.79 \times 10^{-5} (QL)}$$

$$= \frac{(34mL)(0.92 ft/s)}{3.79 \times 10^{-5} (50.5 ft^3/s)(164 ft)}$$

$C_p = 99.6 ppm$ ← good! (within range)

Reach 2

(A) Flow - Oct 29/09 @ Vespa Valley Rd = 1.28 m^3/s

$$V_s = 3.79 \times 10^{-5} \frac{Q L C_p}{v}$$ → To determine volume of rhodamine dye reqd in order to get a 10 ppm peak at Stn #3 (520m d/s).

$Q = 1.28 m^3/s = 45.2 ft^3/s$
$L = 520m = 1706 ft$
$C_p = 10 ppm$
$v = 0.27 m/s = 0.89 ft/s$ (based on 6.6m width × 0.73m avg depth)

$$V_s = \frac{(3.79 \times 10^{-5})(45.2 ft^3/s)(1706 ft)(10 ppm)}{0.89 ft/s}$$

$V_s = 33 mL$ ←

(B) Check what peak will be at Stn #1 (50m d/s).

$$C_p = \frac{V_s \cdot v}{3.79 \times 10^{-5} Q L}$$ $L = 50m = 164 ft$

$$= \frac{(33 mL)(0.89 ft/s)}{3.79 \times 10^{-5} (45.2 ft^3/s)(164 ft)}$$

$C_p = 104.5 ppm$ ← good! (within range).

Reach 3

(A) Flow - Oct 29/09 @ George Johnston Rd = $1.38 m^3/s$

$$V_s = 3.79 \times 10^{-5} \frac{Q L C_p}{v}$$

→ To determine volume of rhodamine dye req'd in order to set a 10 ppm peak @ Stn #3 (475 m d/s)

$Q = 1.38 m^3/s = 48.7 ft^3/s$

$L = 475 m = 1558.4 ft$

$C_p = 10 ppm$

$v = 0.20 m/s = 0.66 ft/s$ (based on 11.2 m wide x 0.63 avg depth)

$$V_s = \frac{(3.79 \times 10^{-5})(48.7 ft^3/s)(1558.4 ft)(10 ppm)}{0.66 ft/s}$$

$V_s = 44 mL$ ←

(B) Check what peak will be at Stn #1 (50 m d/s)

$$C_p = \frac{V_s \cdot v}{(3.79 \times 10^{-5})(QL)} \qquad L = 50 m = 164 ft.$$

$$C_p = \frac{(44 mL)(0.66 ft/s)}{(3.79 \times 10^{-5})(48.7 ft^3/s)(164 ft)}$$

$C_p = 95.9 ppm$ ← good! (within range)

Appendix F. Dye Study Data

Tracer Injected at 16:00 hrs on Thursday November 5, 2009

Reach 1, Station 1			**Reach 1, Station 3**		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
16:00:00	0.8	0	16:00:00	0.9	0
16:00:10	0.8	0	16:00:10	1	0.1
16:00:20	0.7	0	16:00:20	0.8	0
16:00:30	0.9	0	16:00:30	0.8	0
16:00:40	0.8	0	16:00:40	0.9	0
16:00:50	0.7	0	16:00:50	0.7	0
16:01:00	0.8	0	16:01:00	0.9	0
16:01:10	0.7	0	16:01:10	0.9	0
16:01:20	0.6	0	16:01:20	1.1	0.2
16:01:30	0.7	0	16:01:30	1.1	0.2
16:01:40	0.8	0.8	16:01:40	0.8	0
16:01:50	18	17.2	16:01:50	1.1	0.2
16:02:00	24.7	23.9	16:02:00	0.9	0
16:02:10	21.2	20.4	16:02:10	0.7	0
16:02:20	19	18.2	16:02:20	0.7	0
16:02:30	13.9	13.1	16:02:30	0.7	0
16:02:40	10.2	9.4	16:02:40	0.9	0
16:02:50	9.2	8.4	16:02:50	0.9	0
16:03:00	7.8	7	16:03:00	1	0.1
16:03:10	6.2	5.4	16:03:10	0.7	0
16:03:20	4.3	3.5	16:03:20	0.9	0
16:03:30	4.8	4	16:03:30	0.8	0
16:03:40	3.9	3.1	16:03:40	0.8	0
16:03:50	4.1	3.3	16:03:50	0.8	0
16:04:00	3.6	2.8	16:04:00	0.8	0
16:04:10	3.9	3.1	16:04:10	0.7	0
16:04:20	3.9	3.1	16:04:20	0.9	0
16:04:30	3.8	3	16:04:30	0.7	0
16:04:40	3.7	2.9	16:04:40	0.9	0
16:04:50	3.8	3	16:04:50	0.9	0
16:05:31	3	2.2	16:05:00	1	0.1
16:05:40	3.2	2.4	16:05:10	1	0.1
16:05:50	3.3	2.5	16:05:48	1	0.1
16:06:00	3.4	2.6	16:05:50	1	0.1
16:06:10	3.2	2.4	16:06:00	0.9	0
16:06:20	3.1	2.3	16:06:10	0.9	0
16:06:30	3	2.2	16:06:20	0.9	0
16:06:40	2.9	2.1	16:06:30	0.8	0
16:06:50	2.6	1.8	16:06:40	0.8	0
16:07:00	2.6	1.8	16:06:50	1	0.1
16:07:10	2.7	1.9	16:07:00	1	0.1
16:07:20	2.6	1.8	16:07:10	0.8	0
16:07:30	2.6	1.8	16:07:20	0.6	0
16:07:40	2.6	1.8	16:07:30	0.8	0
16:07:50	2.6	1.8	16:07:40	0.8	0
16:08:00	2.4	1.6	16:07:50	0.7	0
16:08:10	2.5	1.7	16:08:00	0.7	0
16:08:20	2.2	1.4	16:08:10	0.6	0
16:08:30	2.1	1.3	16:08:20	1	0.1
16:08:40	2.2	1.4	16:08:30	0.7	0
16:08:50	2.1	1.3	16:08:40	0.8	0
16:09:00	1.8	1	16:08:50	0.9	0
16:09:10	1.9	1.1	16:09:00	0.9	0
16:09:20	1.9	1.1	16:09:10	0.9	0
16:09:30	1.8	1	16:09:20	1	0.1
16:09:40	1.6	0.8	16:09:30	1	0.1
16:09:50	1.5	0.7	16:09:40	1	0.1
16:10:00	1.6	0.8	16:09:50	1	0.1
16:10:10	1.4	0.6	16:10:00	0.8	0
16:10:20	1.5	0.7	16:10:10	1	0.1
16:10:30	1.6	0.8	16:10:20	1.1	0.2
16:10:40	1.6	0.8	16:10:30	1	0.1
16:10:50	1.6	0.8	16:10:40	0.9	0

Reach 1, Station 1			Reach 1, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
16:11:00	1.5	0.7	16:10:50	0.8	0
16:11:10	1.6	0.8	16:11:00	0.6	0
16:11:20	1.5	0.7	16:11:10	0.8	0
16:11:30	1.5	0.7	16:11:20	0.7	0
16:11:40	1.6	0.8	16:11:30	0.8	0
16:11:50	1.2	0.4	16:11:40	0.7	0
16:12:00	1.4	0.6	16:11:50	0.8	0
16:12:10	1.4	0.6	16:12:00	0.7	0
16:12:20	1.4	0.6	16:12:10	0.8	0
16:12:30	1.4	0.6	16:12:20	0.9	0
16:12:40	1.3	0.5	16:12:30	1	0.1
16:12:50	1.5	0.7	16:12:40	1	0.1
16:13:00	1.2	0.4	16:12:50	1	0.1
16:13:10	1.2	0.4	16:13:00	1	0.1
16:13:20	1.2	0.4	16:13:10	1.1	0.2
16:13:30	1.2	0.4	16:13:20	1	0.1
16:13:40	1.2	0.4	16:13:30	0.9	0
16:13:50	1	0.2	16:13:40	0.7	0
16:14:00	1.2	0.4	16:13:50	0.8	0
16:14:10	1.1	0.3	16:14:00	0.7	0
16:14:20	1.1	0.3	16:14:10	0.7	0
16:14:30	1.1	0.3	16:14:20	0.9	0
16:14:40	1.1	0.3	16:14:30	0.9	0
16:14:50	1	0.2	16:14:40	0.8	0
16:15:31	0.8	0	16:14:50	0.8	0
16:15:40	0.8	0	16:15:00	1	0.1
16:15:50	0.9	0.1	16:15:10	0.8	0
16:16:00	1	0.2	16:15:48	0.8	0
16:16:10	1.1	0.3	16:15:50	0.7	0
16:16:20	1	0.2	16:16:00	0.7	0
16:16:30	1	0.2	16:16:10	0.8	0
16:16:40	1.1	0.3	16:16:20	0.8	0
16:16:50	0.9	0.1	16:16:30	0.9	0
16:17:00	1.1	0.3	16:16:40	1	0.1
16:17:10	1	0.2	16:16:50	0.8	0
16:17:20	0.9	0.1	16:17:00	0.8	0
16:17:30	1	0.2	16:17:10	0.9	0
16:17:40	0.8	0	16:17:20	1	0.1
16:17:50	1	0.2	16:17:30	0.9	0
16:18:00	0.9	0.1	16:17:40	0.9	0
16:18:10	0.9	0.1	16:17:50	0.7	0
16:18:20	0.9	0.1	16:18:00	0.7	0
16:18:30	1	0.2	16:18:10	0.9	0
16:18:40	1	0.2	16:18:20	0.9	0
16:18:50	1.1	0.3	16:18:30	0.9	0
16:19:00	1	0.2	16:18:40	0.8	0
16:19:10	0.9	0.1	16:18:50	1	0.1
16:19:20	0.9	0.1	16:19:00	1	0.1
16:19:30	0.9	0.1	16:19:10	1.1	0.2
16:19:40	0.9	0.1	16:19:20	1.1	0.2
16:19:50	1	0.2	16:19:30	1	0.1
16:20:00	1	0.2	16:19:40	1.2	0.3
16:20:10	1.1	0.3	16:19:50	1.4	0.5
16:20:20	1.1	0.3	16:20:00	1.6	0.7
16:20:30	0.9	0.1	16:20:10	1.6	0.7
16:20:40	0.9	0.1	16:20:20	1.6	0.7
16:20:50	0.8	0	16:20:30	1.9	1
16:21:00	0.9	0.1	16:20:40	2.1	1.2
16:21:10	1	0.2	16:20:50	2.1	1.2
16:21:20	1.1	0.3	16:21:00	2.3	1.4
16:21:30	1	0.2	16:21:10	2.5	1.6
16:21:40	0.8	0	16:21:20	2.6	1.7
16:21:50	0.9	0.1	16:21:30	2.7	1.8
16:22:00	1	0.2	16:21:40	2.9	2
16:22:10	0.9	0.1	16:21:50	2.9	2

Reach 1, Station 1			Reach 1, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
16:22:20	0.8	0	16:22:00	3.2	2.3
16:22:30	0.9	0.1	16:22:10	3.3	2.4
16:22:40	0.9	0.1	16:22:20	3.3	2.4
16:22:50	0.9	0.1	16:22:30	3.6	2.7
16:23:00	0.8	0	16:22:40	3.6	2.7
16:23:10	0.9	0.1	16:22:50	3.9	3
16:23:20	1	0.2	16:23:00	4	3.1
16:23:30	0.9	0.1	16:23:10	4.1	3.2
16:23:40	0.8	0	16:23:20	4	3.1
16:23:50	0.9	0.1	16:23:30	4.1	3.2
16:24:00	0.8	0	16:23:40	4.2	3.3
16:24:10	1	0.2	16:23:50	4.2	3.3
16:24:20	1	0.2	16:24:00	4.2	3.3
16:24:30	1	0.2	16:24:10	4.4	3.5
16:24:40	0.9	0.1	16:24:20	4.4	3.5
16:24:50	0.9	0.1	16:24:30	4.5	3.6
16:25:31	0.9	0.1	16:24:40	4.3	3.4
16:25:40	1.7	0.9	16:24:50	4.3	3.4
16:25:50	0.9	0.1	16:25:00	4.3	3.4
16:26:00	0.5	0	16:25:10	4.4	3.5
16:26:10	0.5	0	16:25:48	4.1	3.2
16:26:20	0.6	0	16:25:50	4.2	3.3
16:26:30	0.6	0	16:26:00	4.2	3.3
16:26:40	0.5	0	16:26:10	4.2	3.3
16:26:50	0.5	0	16:26:20	4.3	3.4
16:27:00	0.4	0	16:26:30	4.2	3.3
16:27:10	0.4	0	16:26:40	4.3	3.4
16:27:20	0.4	0	16:26:50	4	3.1
16:27:30	0.2	0	16:27:00	4	3.1
16:27:40	0.4	0	16:27:10	3.9	3
16:27:50	0.5	0	16:27:20	4	3.1
16:28:00	0.5	0	16:27:30	3.8	2.9
16:28:10	0.3	0	16:27:40	3.8	2.9
16:28:20	0.4	0	16:27:50	3.9	3
16:28:30	0.5	0	16:28:00	3.9	3
16:28:40	0.5	0	16:28:10	3.6	2.7
16:28:50	0.6	0	16:28:20	3.9	3
16:29:00	0.5	0	16:28:30	3.7	2.8
16:29:10	0.4	0	16:28:40	3.5	2.6
16:29:20	0.7	0	16:28:50	3.6	2.7
16:29:30	0.5	0	16:29:00	3.6	2.7
16:29:40	0.5	0	16:29:10	3.6	2.7
16:29:50	0.6	0	16:29:20	3.4	2.5
16:30:00	0.5	0	16:29:30	3.5	2.6
16:30:10	0.5	0	16:29:40	3.5	2.6
16:30:20	0.5	0	16:29:50	3.6	2.7
16:30:30	0.5	0	16:30:00	3.7	2.8
16:30:40	0.4	0	16:30:10	3.2	2.3
16:30:50	0.5	0	16:30:20	3.2	2.3
16:31:00	0.5	0	16:30:30	3	2.1
16:31:10	0.5	0	16:30:40	3.1	2.2
16:31:20	0.6	0	16:30:50	3	2.1
16:31:30	0.4	0	16:31:00	3	2.1
16:31:40	0.5	0	16:31:10	2.8	1.9
16:31:50	0.4	0	16:31:20	3	2.1
16:32:00	0.6	0	16:31:30	3.1	2.2
16:32:10	0.7	0	16:31:40	2.9	2
16:32:20	0.8	0	16:31:50	3	2.1
16:32:30	0.7	0	16:32:00	2.7	1.8
16:32:40	0.7	0	16:32:10	2.6	1.7
16:32:50	0.7	0	16:32:20	2.7	1.8
16:33:00	0.7	0	16:32:30	2.7	1.8
16:33:10	0.4	0	16:32:40	2.5	1.6
16:33:20	0.3	0	16:32:50	2.4	1.5
16:33:30	0.3	0	16:33:00	2.5	1.6

Reach 1, Station 1			Reach 1, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
16:33:40	0.4	0	16:33:10	2.6	1.7
16:33:50	0.7	0	16:33:20	2.4	1.5
16:34:00	0.6	0	16:33:30	2.3	1.4
16:34:10	0.7	0	16:33:40	2.2	1.3
16:34:20	0.7	0	16:33:50	2.3	1.4
16:34:30	0.7	0	16:34:00	2.5	1.6
16:34:40	0.5	0	16:34:10	2.4	1.5
16:34:50	0.5	0	16:34:20	2.4	1.5
16:35:31	0.4	0	16:34:30	2.4	1.5
16:35:40	0.6	0	16:34:40	2.3	1.4
16:35:50	0.5	0	16:34:50	2.2	1.3
16:36:00	0.6	0	16:35:00	2.3	1.4
16:36:10	0.3	0	16:35:10	2.2	1.3
16:36:20	0.3	0	16:35:48	1.5	0.6
16:36:30	0.5	0	16:35:50	1.7	0.8
16:36:40	0.5	0	16:36:00	1.8	0.9
16:36:50	0.3	0	16:36:10	1.9	1
16:37:00	0.5	0	16:36:20	1.7	0.8
16:37:10	0.4	0	16:36:30	1.7	0.8
16:37:20	0.6	0	16:36:40	1.6	0.7
16:37:30	0.6	0	16:36:50	1.5	0.6
16:37:40	0.6	0	16:37:00	1.8	0.9
16:37:50	0.7	0	16:37:10	1.8	0.9
16:38:00	0.6	0	16:37:20	1.7	0.8
16:38:10	0.6	0	16:37:30	1.5	0.6
16:38:20	0.5	0	16:37:40	1.4	0.5
16:38:30	0.4	0	16:37:50	1.5	0.6
16:38:40	0.5	0	16:38:00	1.3	0.4
16:38:50	0.7	0	16:38:10	1.5	0.6
16:39:00	0.7	0	16:38:20	1.5	0.6
16:39:10	0.9	0	16:38:30	1.6	0.7
16:39:20	0.7	0	16:38:40	1.2	0.3
16:39:30	0.5	0	16:38:50	1.4	0.5
16:39:40	0.6	0	16:39:00	1.5	0.6
16:39:50	0.8	0	16:39:10	1.5	0.6
16:40:00	0.8	0	16:39:20	1.6	0.7
16:40:10	0.6	0	16:39:30	1.4	0.5
16:40:20	0.6	0	16:39:40	1.4	0.5
16:40:30	0.4	0	16:39:50	1.1	0.2
16:40:40	0.4	0	16:40:00	1.4	0.5
16:40:50	0.3	0	16:40:10	1.3	0.4
16:41:00	0.2	0	16:40:20	1.3	0.4
16:41:10	0.5	0	16:40:30	1.2	0.3
16:41:20	0.7	0	16:40:40	1.2	0.3
16:41:30	0.5	0	16:40:50	1.3	0.4
16:41:40	0.6	0	16:41:00	1.5	0.6
16:41:50	0.5	0	16:41:10	1.3	0.4
16:42:00	0.5	0	16:41:20	1.2	0.3
16:42:10	0.5	0	16:41:30	1.3	0.4
16:42:20	0.6	0	16:41:40	1.2	0.3
16:42:30	0.6	0	16:41:50	1.2	0.3
16:42:40	0.6	0	16:42:00	1.3	0.4
16:42:50	0.6	0	16:42:10	1	0.1
16:43:00	0.5	0	16:42:20	1.1	0.2
16:43:10	0.5	0	16:42:30	1.1	0.2
16:43:20	0.5	0	16:42:40	1.3	0.4
16:43:30	0.6	0	16:42:50	1.2	0.3
16:43:40	0.7	0	16:43:00	1.2	0.3
16:43:50	0.7	0	16:43:10	1.3	0.4
16:44:00	0.5	0	16:43:20	1	0.1
16:44:10	0.6	0	16:43:30	1.1	0.2
16:44:20	0.6	0	16:43:40	1.1	0.2
16:44:30	0.7	0	16:43:50	1.3	0.4
16:44:40	0.5	0	16:44:00	1.1	0.2
16:44:50	0.5	0	16:44:10	0.9	0

Reach 1, Station 1

Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
16:45:31	0.6	0
16:45:40	0.6	0
16:45:50	0.6	0
16:46:00	0.6	0
16:46:10	0.6	0
16:46:20	0.5	0
16:46:30	0.6	0
16:46:40	0.5	0
16:46:50	0.4	0
16:47:00	0.4	0
16:47:10	0.6	0
16:47:20	0.5	0
16:47:30	0.7	0
16:47:40	0.5	0
16:47:50	0.5	0
16:48:00	0.5	0
16:48:10	0.4	0

Reach 1, Station 3

Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
16:44:20	1.1	0.2
16:44:30	1	0.1
16:44:40	1.1	0.2
16:44:50	1.1	0.2
16:45:00	1.1	0.2
16:45:10	1.3	0.4
16:45:48	1	0.1
16:45:50	1	0.1
16:46:00	1	0.1
16:46:10	1.1	0.2
16:46:20	1.1	0.2
16:46:30	0.8	0
16:46:40	0.8	0
16:46:50	0.7	0
16:47:00	0.8	0
16:47:10	0.8	0
16:47:20	0.7	0

Tracer Injected at **13:15** hrs on Thursday November 5, 2009

Reach 2, Station 1			**Reach 2, Station 2**			**Reach 2, Station 3**		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
13:15:00	0.7	0	13:15:00		0	13:15:00	0.6	0
13:15:31	0.7	0	13:15:30	-0.3	0	13:15:10	0.8	0
13:15:40	0.7	0	13:15:40	-0.4	0	13:15:47	0.6	0
13:15:50	0.6	0	13:15:50	-0.5	0	13:15:50	0.7	0
13:16:00	0.8	0	13:16:00	-0.5	0	13:16:00	1	0
13:16:10	0.8	0	13:16:10	-0.4	0	13:16:10	1	0
13:16:20	0.9	0	13:16:20	-0.5	0	13:16:20	1.1	0
13:16:30	0.8	0	13:16:30	-0.6	0	13:16:30	1.1	0
13:16:40	1	0	13:16:40	-0.6	0	13:16:40	0.8	0
13:16:50	0.8	0	13:16:50	-0.7	0	13:16:50	0.8	0
13:17:00	0.9	0	13:17:00	-0.9	0	13:17:00	0.8	0
13:17:10	5.6	4.8	13:17:10	-1	0	13:17:10	0.8	0
13:17:20	12.9	12.1	13:17:20	-0.8	0	13:17:20	1	0
13:17:30	12.5	11.7	13:17:30	-0.7	0	13:17:30	1	0
13:17:40	17.1	16.3	13:17:40	-0.5	0	13:17:40	0.8	0
13:17:50	22.9	22.1	13:17:50	-0.7	0	13:17:50	1	0
13:18:00	23.6	22.8	13:18:00	-0.4	0	13:18:00	0.8	0
13:18:10	20.5	19.7	13:18:10	-0.6	0	13:18:10	0.8	0
13:18:20	16.7	15.9	13:18:20	-0.3	0	13:18:20	0.9	0
13:18:30	14.4	13.6	13:18:30	-0.6	0	13:18:30	0.8	0
13:18:40	11.8	11	13:18:40	-0.6	0	13:18:40	0.9	0
13:18:50	10.1	9.3	13:18:50	-0.8	0	13:18:50	0.9	0
13:19:00	8.3	7.5	13:19:00	-0.7	0	13:19:00	1	0
13:19:10	6.5	5.7	13:19:10	-0.7	0	13:19:10	0.9	0
13:19:20	6.9	6.1	13:19:20	-0.6	0	13:19:20	0.9	0
13:19:30	6	5.2	13:19:30	-0.6	0	13:19:30	0.9	0
13:19:40	5.2	4.4	13:19:40	-0.6	0	13:19:40	0.5	0
13:19:50	4.8	4	13:19:50	-0.7	0	13:19:50	0.7	0
13:20:00	4.8	4	13:20:31	-0.8	0	13:20:00	0.9	0
13:20:10	4	3.2	13:20:40	-0.7	0	13:20:10	0.9	0
13:20:20	3.6	2.8	13:20:50	-0.7	0	13:20:20	0.8	0
13:20:30	3.9	3.1	13:21:00	-0.8	0	13:20:30	0.9	0
13:20:40	3.5	2.7	13:21:10	-0.4	0	13:20:40	0.7	0
13:20:50	3.4	2.6	13:21:20	0.4	-3.6	13:20:50	0.7	0
13:21:00	2.9	2.1	13:21:30	1.4	-2.6	13:21:00	1.1	0
13:21:10	2.6	1.8	13:21:40	3.1	-0.9	13:21:10	1	0
13:21:20	2.9	2.1	13:21:50	5.8	1.8	13:21:20	0.9	0
13:21:30	2.4	1.6	13:22:00	8.5	4.5	13:21:30	0.8	0
13:21:40	2.1	1.3	13:22:10	10.5	6.5	13:21:40	1	0
13:21:50	2.3	1.5	13:22:20	12.2	8.2	13:21:50	0.9	0
13:22:00	2.3	1.5	13:22:30	13.3	9.3	13:22:00	0.7	0
13:22:10	2	1.2	13:22:40	13.6	9.6	13:22:10	0.7	0
13:22:20	2	1.2	13:22:50	13.4	9.4	13:22:20	0.8	0
13:22:30	1.7	0.9	13:23:00	12.9	8.9	13:22:30	0.9	0
13:22:40	1.7	0.9	13:23:10	11.9	7.9	13:22:40	1.1	0
13:22:50	1.7	0.9	13:23:20	11.1	7.1	13:22:50	1	0
13:23:00	1.7	0.9	13:23:30	10.3	6.3	13:23:00	1.1	0
13:23:10	1.6	0.8	13:23:40	9.3	5.3	13:23:10	0.9	0
13:23:20	1.6	0.8	13:23:50	8.6	4.6	13:23:20	0.7	0
13:23:30	1.6	0.8	13:24:00	7.7	3.7	13:23:30	0.8	0
13:23:40	1.4	0.6	13:24:10	7.3	3.3	13:23:40	0.6	0
13:23:50	1.3	0.5	13:24:20	6.5	2.5	13:23:50	0.9	0
13:24:00	1.2	0.4	13:24:30	5.9	1.9	13:24:00	0.7	0
13:24:10	1.3	0.5	13:24:40	5.4	1.4	13:24:10	0.9	0
13:24:20	1.2	0.4	13:24:50	5.1	1.1	13:24:20	0.8	0
13:24:30	1.3	0.5	13:25:31	3.4	-0.6	13:24:30	0.7	0
13:24:40	1.2	0.4	13:25:40	3.3	-0.7	13:24:40	0.8	0
13:24:50	1.1	0.3	13:25:50	2.7	-1.3	13:24:50	0.7	0
13:25:31	1	0.2	13:26:00	2.6	-1.4	13:25:00	0.9	0
13:25:40	1.1	0.3	13:26:10	2.3	-1.7	13:25:10	0.7	0
13:25:50	1	0.2	13:26:20	2.2	-1.8	13:25:47	0.7	0
13:26:00	1.2	0.4	13:26:30	2.1	-1.9	13:25:50	0.6	0
13:26:10	1.3	0.5	13:26:40	1.7	-2.3	13:26:00	0.6	0

Reach 2, Station 1			Reach 2, Station 2			Reach 2, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
13:26:20	1.2	0.4	13:26:50	1.6	-2.4	13:26:10	0.8	0
13:26:30	0.9	0.1	13:27:00	1.2	-2.8	13:26:20	0.8	0
13:26:40	1	0.2	13:27:10	1.4	-2.6	13:26:30	0.7	0
13:26:50	1	0.2	13:27:20	1.4	-2.6	13:26:40	0.6	0
13:27:00	0.9	0.1	13:27:30	1	-3	13:26:50	0.8	0
13:27:10	0.9	0.1	13:27:40	0.8	-3.2	13:27:00	0.8	0
13:27:20	1.1	0.3	13:27:50	1	-3	13:27:10	0.7	0
13:27:30	1.2	0.4	13:28:00	1	-3	13:27:20	0.8	0
13:27:40	1.1	0.3	13:28:10	0.6	-3.4	13:27:30	0.9	0
13:27:50	1	0.2	13:28:20	0.5	-3.5	13:27:40	0.8	0
13:28:00	1	0.2	13:28:30	0.3	-3.7	13:27:50	0.7	0
13:28:10	0.9	0.1	13:28:40	0.4	-3.6	13:28:00	0.9	0
13:28:20	0.9	0.1	13:28:50	0.3	-3.7	13:28:10	0.8	0
13:28:30	0.9	0.1	13:29:00	0.3	-3.7	13:28:20	0.9	0
13:28:40	0.8	0	13:29:10	0	-4	13:28:30	0.7	0
13:28:50	0.8	0	13:29:20	0	-4	13:28:40	0.7	0
13:29:00	0.8	0	13:29:30	0.1	-3.9	13:28:50	0.7	0
13:29:10	0.9	0.1	13:29:40	-0.1	-4.1	13:29:00	0.7	0
13:29:20	0.8	0	13:29:50	-0.1	-4.1	13:29:10	0.6	0
13:29:30	0.9	0.1	13:30:31	0	-4	13:29:20	0.8	0
13:29:40	1.1	0.3	13:30:40	-0.1	-4.1	13:29:30	0.6	0
13:29:50	0.8	0	13:30:50	-0.2	-4.2	13:29:40	0.8	0
13:30:00	0.8	0	13:31:00	-0.3	-4.3	13:29:50	0.6	0
13:30:10	1.1	0.3	13:31:10	-0.5	-4.5	13:30:00	0.7	0
13:30:20	0.9	0.1	13:31:20	-0.4	-4.4	13:30:10	0.6	0
13:30:30	1	0.2	13:31:30	-0.4	-4.4	13:30:20	0.8	0
13:30:40	1	0.2	13:31:40	-0.4	-4.4	13:30:30	0.9	0
13:30:50	0.8	0	13:31:50	-0.3	-4.3	13:30:40	0.8	0
13:31:00	0.9	0.1	13:32:00	-0.4	-4.4	13:30:50	1	0.6
13:31:10	1	0.2	13:32:10	-0.3	-4.3	13:31:00	1.2	0.8
13:31:20	0.8	0	13:32:20	-0.5	-4.5	13:31:10	1.4	1
13:31:30	1	0.2	13:32:30	-0.4	-4.4	13:31:20	1.6	1.2
13:31:40	0.9	0.1	13:32:40	-0.3	-4.3	13:31:30	2	1.6
13:31:50	0.7	0	13:32:50	-0.2	-4.2	13:31:40	2.4	2
13:32:00	0.8	0	13:33:00	-0.1	-4.1	13:31:50	3	2.6
13:32:10	0.9	0.1	13:33:10	-0.3	-4.3	13:32:00	3.4	3
13:32:20	0.9	0.1	13:33:20	-0.3	-4.3	13:32:10	3.8	3.4
13:32:30	0.8	0	13:33:30	-0.3	-4.3	13:32:20	4.1	3.7
13:32:40	0.8	0	13:33:40	-0.3	-4.3	13:32:30	4.6	4.2
13:32:50	0.8	0	13:33:50	-0.3	-4.3	13:32:40	5.3	4.9
13:33:00	0.8	0	13:34:00	-0.5	-4.5	13:32:50	6.1	5.7
13:33:10	0.8	0	13:34:10	-0.4	-4.4	13:33:00	6.4	6
13:33:20	0.8	0	13:34:20	-0.3	-4.3	13:33:10	6.8	6.4
13:33:30	1	0.2	13:34:30	-0.4	-4.4	13:33:20	7	6.6
13:33:40	0.9	0.1	13:34:40	-0.4	-4.4	13:33:30	7	6.6
13:33:50	0.9	0.1	13:34:50	-0.5	-4.5	13:33:40	7	6.6
13:34:00	0.9	0.1	13:35:31	-0.6	-4.6	13:33:50	7.1	6.7
13:34:10	1.1	0.3	13:35:40	-0.6	-4.6	13:34:00	7.4	7
13:34:20	1.2	0.4	13:35:50	-0.5	-4.5	13:34:10	7.5	7.1
13:34:30	1.1	0.3	13:36:00	-0.5	-4.5	13:34:20	7.6	7.2
13:34:40	0.9	0.1	13:36:10	-0.5	-4.5	13:34:30	7.6	7.2
13:34:50	0.8	0	13:36:20	-0.4	-4.4	13:34:40	7.1	6.7
13:35:31	0.8	0	13:36:30	-0.4	-4.4	13:34:50	6.9	6.5
13:35:40	0.9	0.1	13:36:40	-0.4	-4.4	13:35:00	6.8	6.4
13:35:50	0.7	0	13:36:50	-0.3	-4.3	13:35:10	6.7	6.3
13:36:00	0.9	0.1	13:37:00	-0.4	-4.4	13:35:47	5.9	5.5
13:36:10	0.9	0.1	13:37:10	-0.6	-4.6	13:35:50	6	5.6
13:36:20	0.9	0.1	13:37:20	-0.4	-4.4	13:36:00	5.8	5.4
13:36:30	0.8	0	13:37:30	-0.6	-4.6	13:36:10	5.7	5.3
13:36:40	0.9	0.1	13:37:40	-0.5	-4.5	13:36:20	5.5	5.1
13:36:50	0.9	0.1	13:37:50	-0.4	-4.4	13:36:30	5.5	5.1
13:37:00	0.9	0.1	13:38:00	-0.6	-4.6	13:36:40	5.2	4.8
13:37:10	0.8	0	13:38:10	-0.4	-4.4	13:36:50	5.1	4.7
13:37:20	0.8	0	13:38:20	-0.5	-4.5	13:37:00	5.1	4.7

Reach 2, Station 1			Reach 2, Station 2			Reach 2, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
13:37:30	0.8	0	13:38:30	-0.5	-4.5	13:37:10	4.7	4.3
13:37:40	0.8	0	13:38:40	-0.5	-4.5	13:37:20	4.7	4.3
13:37:50	0.6	0	13:38:50	-0.4	-4.4	13:37:30	4.4	4
13:38:00	0.7	0	13:39:00	-0.4	-4.4	13:37:40	4.2	3.8
13:38:10	0.7	0	13:39:10	-0.4	-4.4	13:37:50	4	3.6
13:38:20	0.9	0.1	13:39:20	-0.6	-4.6	13:38:00	3.9	3.5
13:38:30	0.8	0	13:39:30	-0.5	-4.5	13:38:10	3.9	3.5
13:38:40	0.8	0	13:39:40	-0.5	-4.5	13:38:20	3.8	3.4
13:38:50	0.9	0.1	13:39:50	-0.7	0	13:38:30	3.6	3.2
13:39:00	0.9	0.1	13:40:31	-0.6	-4.6	13:38:40	3.5	3.1
13:39:10	0.9	0.1	13:40:40	-0.7	0	13:38:50	3.3	2.9
13:39:20	1	0.2	13:40:50	-0.6	-4.6	13:39:00	3.5	3.1
13:39:30	1.1	0.3	13:41:00	-0.7	0	13:39:10	3.2	2.8
13:39:40	1	0.2	13:41:10	-0.6	-4.6	13:39:20	3.1	2.7
13:39:50	1	0.2	13:41:20	-0.4	-4.4	13:39:30	3	2.6
13:40:00	0.9	0.1	13:41:30	-0.4	-4.4	13:39:40	3	2.6
13:40:10	0.9	0.1	13:41:40	-0.4	-4.4	13:39:50	3.1	2.7
13:40:20	0.9	0.1	13:41:50	-0.5	-4.5	13:40:00	2.8	2.4
13:40:30	0.9	0.1	13:42:00	-0.6	-4.6	13:40:10	2.6	2.2
13:40:40	0.7	0	13:42:10	-0.5	-4.5	13:40:20	2.6	2.2
13:40:50	0.8	0	13:42:20	-0.5	-4.5	13:40:30	2.5	2.1
13:41:00	0.8	0	13:42:30	-0.7	0	13:40:40	2.4	2
13:41:10	0.9	0.1	13:42:40	-0.7	0	13:40:50	2.4	2
13:41:20	0.9	0.1	13:42:50	-0.6	-4.6	13:41:00	2.2	1.8
13:41:30	0.9	0.1	13:43:00	-0.5	-4.5	13:41:10	2.2	1.8
13:41:40	0.8	0	13:43:10	-0.5	-4.5	13:41:20	2.2	1.8
13:41:50	0.9	0.1	13:43:20	-0.5	-4.5	13:41:30	2.2	1.8
13:42:00	0.9	0.1	13:43:30	-0.5	-4.5	13:41:40	2.1	1.7
13:42:10	0.7	0	13:43:40	-0.4	-4.4	13:41:50	1.9	1.5
13:42:20	0.9	0.1	13:43:50	-0.5	-4.5	13:42:00	1.8	1.4
13:42:30	0.7	0	13:44:00	-0.4	-4.4	13:42:10	1.8	1.4
13:42:40	0.8	0	13:44:10	-0.4	-4.4	13:42:20	1.8	1.4
13:42:50	0.7	0	13:44:20	-0.4	-4.4	13:42:30	1.7	1.3
13:43:00	0.8	0	13:44:30	-0.5	-4.5	13:42:40	1.8	1.4
13:43:10	0.9	0.1	13:44:40	-0.4	-4.4	13:42:50	2	1.6
13:43:20	0.9	0.1	13:44:50	-0.4	-4.4	13:43:00	1.7	1.3
13:43:30	0.8	0	13:45:31	-0.8	0	13:43:10	1.8	1.4
13:43:40	0.9	0.1	13:45:40	-0.8	0	13:43:20	1.8	1.4
13:43:50	0.9	0.1	13:45:50	-0.9	0	13:43:30	1.5	1.1
13:44:00	0.8	0	13:46:00	-0.8	0	13:43:40	1.5	1.1
13:44:10	0.9	0.1	13:46:10	-0.7	0	13:43:50	1.6	1.2
13:44:20	1	0.2	13:46:20	-0.7	0	13:44:00	1.5	1.1
13:44:30	1.1	0.3	13:46:30	-0.7	0	13:44:10	1.5	1.1
13:44:40	1	0.2	13:46:40	-0.5	0	13:44:20	1.6	1.2
13:44:50	0.9	0.1	13:46:50	-0.6	0	13:44:30	1.6	1.2
13:45:31	0.7	0	13:47:00	-0.8	0	13:44:40	1.4	1
13:45:40	0.6	0	13:47:10	-0.7	0	13:44:50	1.6	1.2
13:45:50	0.8	0	13:47:20	-1	0	13:45:00	1.4	1
13:46:00	0.8	0	13:47:30	-0.9	0	13:45:10	1.4	1
13:46:10	0.9	0.1	13:47:40	-0.9	0	13:45:48	1.3	0.9
13:46:20	0.9	0.1	13:47:50	-0.7	0	13:45:50	1.3	0.9
13:46:30	0.6	0	13:48:00	-0.9	0	13:46:00	1.3	0.9
13:46:40	0.8	0	13:48:10	-0.6	-4.6	13:46:10	1.2	0.8
13:46:50	0.7	0	13:48:20	-0.6	-4.6	13:46:20	1.1	0.7
13:47:00	0.9	0.1	13:48:30	-0.6	-4.6	13:46:30	1.2	0.8
13:47:10	0.8	0	13:48:40	-0.5	0	13:46:40	1.2	0.8
13:47:20	0.7	0	13:48:50	-0.6	-4.6	13:46:50	1.2	0.8
13:47:30	0.8	0	13:49:00	-0.6	0	13:47:00	1.3	0.9
13:47:40	0.9	0.1	13:49:10	-0.6	0	13:47:10	1.3	0.9
13:47:50	1	0.2	13:49:20	-0.6	0	13:47:20	1.3	0.9
13:48:00	1	0.2	13:49:30	-0.8	0	13:47:30	1.4	1
13:48:10	1	0.2	13:49:40	-0.7	0	13:47:40	1.1	0.7
13:48:20	1.2	0.4	13:49:50	-0.6	0	13:47:50	1.1	0.7
13:48:30	1	0.2	13:50:31	-0.6	0	13:48:00	1.2	0.8

Reach 2, Station 1			Reach 2, Station 2			Reach 2, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
13:48:40	0.9	0.1	13:50:40	-0.7	0	13:48:10	1.3	0.9
13:48:50	0.7	0	13:50:50	-0.6	0	13:48:20	1.2	0.8
						13:48:30	1.3	0.9
						13:48:40	1	0.6
						13:48:50	1.2	0.8
						13:49:00	1.2	0.8
						13:49:10	0.9	0.5
						13:49:20	1	0.6
						13:49:30	1.1	0.7
						13:49:40	0.7	0.3
						13:49:50	0.7	0.3
						13:50:00	1.1	0.7
						13:50:10	1.1	0.7
						13:50:20	1	0.6
						13:50:30	0.8	0.4
						13:50:40	0.8	0.4
						13:50:50	0.9	0.5
						13:51:00	1.1	0.7
						13:51:10	1	0.6
						13:51:20	0.8	0.4
						13:51:30	0.8	0.4
						13:51:40	1.1	0.7
						13:51:50	1	0.6
						13:52:00	0.9	0.5
						13:52:10	0.7	0.3
						13:52:20	0.9	0.5
						13:52:30	1	0.6
						13:52:40	1	0.6
						13:52:50	1.1	0.7
						13:53:00	1.2	0.8
						13:53:10	1	0.6
						13:53:20	0.8	0.4
						13:53:30	0.9	0.5
						13:53:40	0.8	0.4
						13:53:50	0.7	0.3
						13:54:00	0.8	0.4
						13:54:10	0.9	0.5
						13:54:20	1.1	0.7
						13:54:30	0.9	0.5
						13:54:40	0.9	0.5
						13:54:50	0.7	0.3
						13:55:00	0.9	0.5
						13:55:10	0.8	0.4
						13:55:48	1.2	0.8
						13:55:50	1	0.6
						13:56:00	0.9	0.5
						13:56:10	0.8	0.4
						13:56:20	0.8	0.4
						13:56:30	0.8	0.4
						13:56:40	0.6	0.2
						13:56:50	0.7	0.3
						13:57:00	0.7	0.3
						13:57:10	1	0.6
						13:57:20	0.9	0.5
						13:57:30	1	0.6
						13:57:40	1.1	0.7
						13:57:50	1	0.6
						13:58:00	0.9	0.5
						13:58:10	0.8	0.4
						13:58:20	0.7	0.3
						13:58:30	0.9	0.5
						13:58:40	0.8	0.4
						13:58:50	0.7	0.3
						13:59:00	0.8	0.4

Reach 2, Station 1			Reach 2, Station 2			Reach 2, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
						13:59:10	0.8	0.4
						13:59:20	0.6	0.2
						13:59:30	0.6	0.2
						13:59:40	0.7	0.3
						13:59:50	0.9	0.5
						14:00:00	0.6	0.2
						14:00:10	0.9	0.5
						14:00:20	0.9	0.5
						14:00:30	0.8	0.4
						14:00:40	0.8	0.4
						14:00:50	0.7	0.3
						14:01:00	0.7	0.3
						14:01:10	0.7	0.3
						14:01:20	1	0.6
						14:01:30	0.9	0.5
						14:01:40	0.6	0.2
						14:01:50	0.8	0.4
						14:02:00	0.7	0.3
						14:02:10	0.8	0.4
						14:02:20	0.6	0.2
						14:02:30	0.7	0.3
						14:02:40	0.7	0.3
						14:02:50	0.8	0.4
						14:03:00	0.8	0.4
						14:03:10	0.9	0.5
						14:03:20	0.8	0.4
						14:03:30	0.7	0.3
						14:03:40	0.8	0.4
						14:03:50	1	0.6
						14:04:00	1	0.6
						14:04:10	0.8	0.4
						14:04:20	0.8	0.4
						14:04:30	0.7	0.3
						14:04:40	0.8	0.4
						14:04:50	0.9	0.5
						14:05:00	0.9	0.5
						14:05:10	1	0.6
						14:05:48	0.8	0.4
						14:05:50	0.8	0.4
						14:06:00	0.9	0.5
						14:06:10	0.8	0.4
						14:06:20	0.9	0.5
						14:06:30	0.9	0.5
						14:06:40	0.7	0.3
						14:06:50	1	0.6
						14:07:00	0.9	0.5
						14:07:10	1.1	0.7
						14:07:20	0.9	0.5
						14:07:30	1	0.6
						14:07:40	1.2	0.8
						14:07:50	1.2	0.8
						14:08:00	1.1	0.7
						14:08:10	0.9	0.5
						14:08:20	0.9	0.5
						14:08:30	0.8	0.4
						14:08:40	0.9	0.5
						14:08:50	0.8	0.4
						14:09:00	0.8	0.4
						14:09:10	0.9	0.5
						14:09:20	0.8	0.4
						14:09:30	0.8	0.4
						14:09:40	0.8	0.4
						14:09:50	0.7	0.3
						14:10:00	0.6	0.2

Reach 2, Station 1			Reach 2, Station 2			Reach 2, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
						14:10:10	0.7	0.3
						14:10:20	1	0.6
						14:10:30	1	0.6
						14:10:40	0.9	0.5
						14:10:50	0.9	0.5
						14:11:00	0.9	0.5
						14:11:10	0.8	0.4

Tracer Injected at **11:22** hrs on Thursday November 5, 2009

Reach 3, Station 1			**Reach 3, Station 2**			**Reach 3, Station 3**		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
11:22:00	0.8	0	11:22:00	-0.5	0	11:22:00	0.9	0
11:22:10	0.8	0	11:22:10	-0.3	0	11:22:10	0.7	0
11:22:20	0.8	0	11:22:20	-0.4	0	11:22:20	0.8	0
11:22:30	1	0	11:22:30	-0.4	0	11:22:30	0.9	0
11:22:40	0.8	0	11:22:40	-0.4	0	11:22:40	0.9	0
11:22:50	0.8	0	11:22:50	-0.5	0	11:22:50	0.7	0
11:23:00	0.9	0	11:23:00	-0.7	0	11:23:00	0.7	0
11:23:10	0.8	0	11:23:10	-0.6	0	11:23:10	0.8	0
11:23:20	0.8	0	11:23:20	-0.7	0	11:23:20	0.8	0
11:23:30	0.8	20	11:23:30	-0.7	0	11:23:30	0.6	0
11:23:40	20.9	51.5	11:23:40	-0.6	0	11:23:40	0.5	0
11:23:50	52.4	52.4	11:23:50	-0.4	0	11:23:50	0.7	0
11:24:00	53.3	49.9	11:24:00	-0.4	0	11:24:00	0.6	0
11:24:10	50.8	37.3	11:24:10	-0.4	0	11:24:10	0.9	0
11:24:20	38.2	23.5	11:24:20	-0.4	0	11:24:20	0.7	0
11:24:30	24.4	17.1	11:24:30	-0.5	0	11:24:30	0.8	0
11:24:40	18	12	11:24:40	-0.5	0	11:24:40	0.9	0
11:24:50	12.9	8.8	11:24:50	-0.5	0	11:24:50	1	0
11:25:30	9.7	3.6	11:25:30	-0.6	0	11:25:00	0.9	0
11:25:40	4.5	3.4	11:25:40	-0.5	0	11:25:10	0.9	0
11:25:50	4.3	2.8	11:25:50	-0.5	0	11:25:47	0.4	0
11:26:00	3.7	2.4	11:26:00	-0.7	0	11:25:50	0.6	0
11:26:10	3.3	2.3	11:26:10	-0.9	0	11:26:00	0.6	0
11:26:20	3.2	2	11:26:20	-0.7	0	11:26:10	0.7	0
11:26:30	2.9	1.8	11:26:30	-0.9	0	11:26:20	0.9	0
11:26:40	2.7	1.3	11:26:40	-0.6	0	11:26:30	0.9	0
11:26:50	2.2	1	11:26:50	-0.8	0	11:26:40	1.1	0
11:27:00	1.9	0.8	11:27:00	-0.6	0	11:26:50	1	0
11:27:10	1.7	1.6	11:27:10	-0.5	0	11:27:00	1	0
11:27:20	2.5	2.1	11:27:20	-0.7	0	11:27:10	0.8	0
11:27:30	3	2.3	11:27:30	-0.5	0	11:27:20	0.8	0
11:27:40	3.2	1.8	11:27:40	-0.6	0	11:27:30	0.6	0
11:27:50	2.7	1.3	11:27:50	-0.7	0	11:27:40	0.8	0
11:28:00	2.2	0.9	11:28:00	-0.5	0	11:27:50	0.8	0
11:28:10	1.8	0.8	11:28:10	-0.5	0	11:28:00	0.8	0
11:28:20	1.7	0.85	11:28:20	-0.7	0	11:28:10	0.5	0
11:28:30	1.7	1.1	11:28:30	-0.6	0	11:28:20	0.7	0
11:28:40	1.9	0.85	11:28:40	-0.5	0	11:28:30	0.8	0
11:28:50	1.7	0.6	11:28:50	-0.3	0	11:28:40	0.8	0
11:29:00	1.5	0.65	11:29:00	-0.4	0	11:28:50	1	0
11:29:10	1.5	1	11:29:10	-0.5	0	11:29:00	0.7	0
11:29:20	1.9	0.9	11:29:20	-0.5	0	11:29:10	0.7	0
11:29:30	1.8	0.6	11:29:30	-0.5	0	11:29:20	0.7	0
11:29:40	1.5	0.4	11:29:40	-0.3	0	11:29:30	0.7	0
11:29:50	1.3	0.6	11:29:50	-0.5	0	11:29:40	0.8	0
11:30:00	1.5	0.7	11:30:30	-0.5	0	11:29:50	0.8	0
11:30:10	1.6	0.4	11:30:40	-0.7	0	11:30:00	0.8	0
11:30:20	1.3	0.5	11:30:50	-0.5	0	11:30:10	0.6	0
11:30:30	1.4	0.5	11:31:00	-0.5	0	11:30:20	0.6	0
11:30:40	1.4	0.4	11:31:10	-0.7	0	11:30:30	0.7	0
11:30:50	1.3	0.4	11:31:20	-0.7	0	11:30:40	0.7	0
11:31:00	1.3	0.45	11:31:30	-0.7	0	11:30:50	1	0
11:31:10	1.3	0.3	11:31:40	-0.7	0	11:31:00	0.9	0
11:31:20	1.1	0.15	11:31:50	-0.7	0	11:31:10	0.9	0
11:31:30	1	0.3	11:32:00	-0.4	0	11:31:20	1	0
11:31:40	1.1	0.1	11:32:10	-0.4	0	11:31:30	0.9	0
11:31:50	0.9	0.1	11:32:20	0.1	-1.6	11:31:40	1	0
11:32:00	0.9	0	11:32:30	1.1	-0.6	11:31:50	0.9	0
11:32:10	0.8	0	11:32:40	2.8	1.1	11:32:00	0.8	0
11:32:20	0.8	0	11:32:50	5.8	4.1	11:32:10	0.8	0
11:32:30	0.8	0.2	11:33:00	8.9	7.2	11:32:20	0.8	0
11:32:40	1	0.2	11:33:10	11.9	10.2	11:32:30	0.7	0

Reach 3, Station 1			Reach 3, Station 2			Reach 3, Station 3		
Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted	Time hh:mm:ss	Rhodamine ug/L	Rhodamine adjusted
11:32:50	1	0.3	11:33:20	14.4	12.7	11:32:40	0.7	0
11:33:00	1.1	0.3	11:33:30	16.7	15	11:32:50	0.8	0
11:33:10	1.1	0.3	11:33:40	17.9	16.2	11:33:00	0.9	0
11:33:20	1.1	0.2	11:33:50	18.1	16.4	11:33:10	0.9	0
11:33:30	1	0.3	11:34:00	17.6	15.9	11:33:20	0.7	0
11:33:40	1.1	0.2	11:34:10	17.3	15.6	11:33:30	0.7	0
11:33:50	1	0.4	11:34:20	16.4	14.7	11:33:40	0.9	0
11:34:00	1.2	0.3	11:34:30	15	13.3	11:33:50	0.9	0
11:34:10	1.1	0.3	11:34:40	13.6	11.9	11:34:00	0.9	0
11:34:20	1.1	0.4	11:34:50	12.3	10.6	11:34:10	1.1	0
11:34:30	1.2	0.3	11:35:30	8.5	6.8	11:34:20	0.9	0
11:34:40	1.1	0.1	11:35:40	8.1	6.4	11:34:30	0.8	0
11:34:50	0.9	0.2	11:35:50	6.8	5.1	11:34:40	0.6	0
11:35:30	1	0.3	11:36:00	6.2	4.5	11:34:50	0.8	0
11:35:40	1.1	0.2	11:36:10	5.4	3.7	11:35:00	0.7	0
11:35:50	1	0.2	11:36:20	4.7	3	11:35:10	0.7	0
11:36:00	1	0.3	11:36:30	4.7	3	11:35:47	0.7	0
11:36:10	1.1	0	11:36:40	4.7	3	11:35:50	0.7	0
11:36:20	0.9	-0.3	11:36:50	4.2	2.5	11:36:00	0.7	0
11:36:30	1	0	11:37:00	4	2.3	11:36:10	0.9	0
11:36:40	0.8	0	11:37:10	3.7	2	11:36:20	0.9	0
11:36:50	0.8	0	11:37:20	3.4	1.7	11:36:30	0.9	0
11:37:00	0.9	0	11:37:30	3.4	1.7	11:36:40	0.8	0
11:37:10	0.8	0	11:37:40	3	1.3	11:36:50	0.8	0
11:37:20	0.8	0	11:37:50	2.8	1.1	11:37:00	0.8	0
11:37:30	1.1	0	11:38:00	2.5	0.8	11:37:10	0.9	0
11:37:40	0.8	0	11:38:10	2.1	0.4	11:37:20	0.8	0
11:37:50	0.9	0	11:38:20	2.1	0.4	11:37:30	0.8	0
11:38:00	0.8	0	11:38:30	1.9	0.2	11:37:40	0.9	0
11:38:10	0.8	0	11:38:40	1.9	0.2	11:37:50	0.9	0
11:38:20	0.8	0	11:38:50	2.2	0.5	11:38:00	1	0
11:38:30	1	0	11:39:00	1.9	0.2	11:38:10	0.8	0
11:38:40	1	0	11:39:10	1.6	-0.1	11:38:20	0.8	0
11:38:50	1	0	11:39:20	1.6	-0.1	11:38:30	0.9	0
11:39:00	0.9	0	11:39:30	1.4	-0.3	11:38:40	0.9	0
11:39:10	1	0	11:39:40	1.6	-0.1	11:38:50	0.7	0
11:39:20	0.8	0	11:39:50	1.2	-0.5	11:39:00	0.7	0
11:39:30	0.9	0	11:40:30	0.7	-1	11:39:10	0.7	0
11:39:40	0.9	0	11:40:40	0.9	-0.8	11:39:20	0.8	0
11:39:50	1	0	11:40:50	0.9	-0.8	11:39:30	0.8	0
11:40:00	0.9	0	11:41:00	0.6	-1.1	11:39:40	0.8	0
11:40:10	0.8	0	11:41:10	0.6	-1.1	11:39:50	0.9	0
11:40:20	0.9	0	11:41:20	0.7	-1	11:40:00	0.9	0
11:40:30	0.7	0	11:41:30	0.6	-1.1	11:40:10	0.7	0
11:40:40	0.6	0	11:41:40	0.7	-1	11:40:20	0.7	0
11:40:50	0.9	0	11:41:50	0.6	-1.1	11:40:30	0.7	0
11:41:00	0.8	0	11:42:00	0.5	-1.2	11:40:40	0.8	0
11:41:10	0.9	0	11:42:10	0.4	-1.3	11:40:50	0.7	0
11:41:20	0.8	0	11:42:20	0.4	-1.3	11:41:00	0.7	0
11:41:30	0.9	0	11:42:30	0.2	-1.5	11:41:10	0.7	0
11:41:40	0.8	0	11:42:40	0.2	-1.5	11:41:20	0.6	0
11:41:50	0.9	0	11:42:50	0.1	-1.6	11:41:30	0.6	0
11:42:00	0.8	0	11:43:00	0.2	-1.5	11:41:40	0.7	0
11:42:10	0.9	0	11:43:10	0.4	-1.3	11:41:50	0.5	0
11:42:20	1	0	11:43:20	0.7	-1	11:42:00	0.6	0
11:42:30	0.9	0	11:43:30	0.6	-1.1	11:42:10	0.7	0
11:42:40	1	0	11:43:40	0.4	-1.3	11:42:20	0.7	0
11:42:50	0.8	0	11:43:50	0.3	-1.4	11:42:30	0.7	0
11:43:00	0.9	0	11:44:00	0.3	-1.4	11:42:40	0.7	0
11:43:10	0.9	0	11:44:10	0.3	-1.4	11:42:50	0.8	0
11:43:20	1	0	11:44:20	-0.1	-1.8	11:43:00	0.7	0
11:43:30	0.9	0	11:44:30	-0.1	-1.8	11:43:10	0.8	-0.5
11:43:40	0.8	0	11:44:40	0	-1.7	11:43:20	0.9	-0.4
11:43:50	0.8	0	11:44:50	0.1	-1.6	11:43:30	0.9	-0.4

Reach 3, Station 1			Reach 3, Station 2			Reach 3, Station 3		
Time	Rhodamine	Rhodamine	Time	Rhodamine	Rhodamine	Time	Rhodamine	Rhodamine
hh:mm:ss	ug/L	adjusted	hh:mm:ss	ug/L	adjusted	hh:mm:ss	ug/L	adjusted
11:44:00	0.8	0	11:45:30	-0.4	-2.1	11:43:40	1.9	0.6
11:44:10	0.8	0	11:45:40	-0.2	-1.9	11:43:50	2.7	1.4
11:44:20	0.8	0	11:45:50	-0.3	-2	11:44:00	3	1.7
11:44:30	0.9	0	11:46:00	-0.4	-2.1	11:44:10	3.1	1.8
11:44:40	0.8	0	11:46:10	-0.3	-2	11:44:20	4.3	3
11:44:50	0.8	0	11:46:20	-0.4	-2.1	11:44:30	5.2	3.9
11:45:30	0.9	0	11:46:30	-0.5	-2.2	11:44:40	5.5	4.2
11:45:40	0.7	0	11:46:40	-0.5	-2.2	11:44:50	5.4	4.1
11:45:50	0.9	0	11:46:50	-0.6	-2.3	11:45:00	5.8	4.5
11:46:00	0.8	0	11:47:00	-0.4	-2.1	11:45:10	5.9	4.6
11:46:10	0.9	0	11:47:10	-0.2	-1.9	11:45:47	9.9	8.6
11:46:20	1	0	11:47:20	-0.1	-1.8	11:45:50	9.6	8.3
11:46:30	1	0	11:47:30	-0.3	-2	11:46:00	9.2	7.9
11:46:40	0.9	0	11:47:40	-0.3	-2	11:46:10	9.1	7.8
11:46:50	0.9	0	11:47:50	-0.3	-2	11:46:20	9.4	8.1
11:47:00	1.1	0	11:48:00	-0.4	-2.1	11:46:30	9.8	8.5
11:47:10	1.1	0	11:48:10	-0.2	-1.9	11:46:40	9.3	8
11:47:20	1	0	11:48:20	-0.2	-1.9	11:46:50	9	7.7
11:47:30	1	0	11:48:30	-0.4	-2.1	11:47:00	9	7.7
11:47:40	0.9	0	11:48:40	-0.4	-2.1	11:47:10	8.3	7
11:47:50	0.8	0	11:48:50	-0.4	-2.1	11:47:20	7.6	6.3
11:48:00	0.8	0	11:49:00	-0.4	-2.1	11:47:30	7.1	5.8
11:48:10	0.9	0	11:49:10	-0.2	-1.9	11:47:40	7	5.7
11:48:20	0.9	0	11:49:20	-0.3	-2	11:47:50	6.5	5.2
11:48:30	1	0	11:49:30	-0.2	-1.9	11:48:00	6.5	5.2
11:48:40	0.8	0	11:49:40	-0.5	-2.2	11:48:10	6.6	5.3
11:48:50	0.7	0	11:49:50	-0.5	-2.2	11:48:20	5.8	4.5
11:49:00	0.8	0	11:50:30	-0.5	-2.2	11:48:30	5.2	3.9
11:49:10	0.7	0	11:50:40	-0.5	-2.2	11:48:40	4.9	3.6
11:49:20	0.9	0	11:50:50	-0.3	-2	11:48:50	4.8	3.5
11:49:30	0.8	0	11:51:00	-0.5	-2.2	11:49:00	4.8	3.5
11:49:40	0.8	0	11:51:10	-0.7	0	11:49:10	4.6	3.3
11:49:50	0.9	0	11:51:20	-0.4	-2.1	11:49:20	4.5	3.2
11:50:00	0.9	0	11:51:30	-0.5	-2.2	11:49:30	4.5	3.2
11:50:10	1	0	11:51:40	-0.5	-2.2	11:49:40	4.4	3.1
11:50:20	1.1	0	11:51:50	-0.3	-2	11:49:50	4	2.7
11:50:30	0.9	0	11:52:00	-0.6	0	11:50:00	4.1	2.8
11:50:40	0.9	0	11:52:10	-0.4	-2.1	11:50:10	4.1	2.8
11:50:50	0.8	0	11:52:20	-0.6	0	11:50:20	3.9	2.6
11:51:00	0.8	0	11:52:30	-0.4	-2.1	11:50:30	3.8	2.5
11:51:10	0.9	0	11:52:40	-0.6	0	11:50:40	3.5	2.2
11:51:20	0.9	0	11:52:50	-0.5	-2.2	11:50:50	3.6	2.3
11:51:30	0.8	0	11:53:00	-0.5	-2.2	11:51:00	3.5	2.2
11:51:40	0.7	0	11:53:10	-0.6	0	11:51:10	3.4	2.1
11:51:50	0.7	0	11:53:20	-0.7	0	11:51:20	3.3	2
11:52:00	0.9	0	11:53:30	-0.6	0	11:51:30	3.3	2
11:52:10	1	0	11:53:40	-0.4	-2.1	11:51:40	3.2	1.9
11:52:20	0.8	0	11:53:50	-0.5	-2.2	11:51:50	3.4	2.1
11:52:30	0.8	0	11:54:00	-0.4	-2.1	11:52:00	3.2	1.9
11:52:40	0.7	0	11:54:10	-0.5	-2.2	11:52:10	2.9	1.6
11:52:50	0.8	0	11:54:20	-0.5	-2.2	11:52:20	3	1.7
11:53:00	0.7	0	11:54:30	-0.8	0	11:52:30	2.8	1.5
11:53:10	0.8	0	11:54:40	-0.6	0	11:52:40	2.6	1.3
11:53:20	0.8	0	11:54:50	-0.5	0	11:52:50	2.7	1.4
11:53:30	0.7	0	11:55:30	-1.1	0	11:53:00	2.6	1.3
11:53:40	0.8	0	11:55:40	-0.8	0	11:53:10	2.8	1.5
11:53:50	0.7	0	11:55:50	-0.8	0	11:53:20	2.8	1.5
11:54:00	0.8	0	11:56:00	-0.7	0	11:53:30	2.6	1.3
11:54:10	0.7	0	11:56:10	-0.5	0	11:53:40	2.5	1.2
11:54:20	0.8	0	11:56:20	-0.5	0	11:53:50	2.5	1.2
11:54:30	1.1	0	11:56:30	-0.7	0	11:54:00	2.3	1
11:54:40	0.8	0	11:56:40	-0.7	0	11:54:10	2.4	1.1
11:54:50	0.8	0	11:56:50	-0.5	0	11:54:20	2.3	1
			11:57:00	-0.5	0	11:54:30	2.2	0.9

Reach 3, Station 1			Reach 3, Station 2			Reach 3, Station 3		
Time	Rhodamine	Rhodamine	Time	Rhodamine	Rhodamine	Time	Rhodamine	Rhodamine
hh:mm:ss	ug/L	adjusted	hh:mm:ss	ug/L	adjusted	hh:mm:ss	ug/L	adjusted
			11:57:10	-0.6	0	11:54:40	2.3	1
			11:57:20	-0.5	0	11:54:50	2.5	1.2
			11:57:30	-0.3	0	11:55:00	2.3	1
			11:57:40	-0.2	0	11:55:10	2.5	1.2
			11:57:50	-0.4	0	11:55:48	2.3	1
			11:58:00	-0.4	0	11:55:50	2.2	0.9
			11:58:10	-0.5	0	11:56:00	2.1	0.8
			11:58:20	-0.7	0	11:56:10	2.3	1
			11:58:30	-0.7	0	11:56:20	1.9	0.6
			11:58:40	-0.6	0	11:56:30	1.8	0.5
			11:58:50	-0.5	0	11:56:40	1.9	0.6
			11:59:00	-0.4	0	11:56:50	1.8	0.5
			11:59:10	-0.7	0	11:57:00	1.9	0.6
			11:59:20	-0.6	0	11:57:10	2	0.7
			11:59:30	-0.5	0	11:57:20	1.9	0.6
			11:59:40	-0.8	0	11:57:30	2	0.7
			11:59:50	-0.7	0	11:57:40	1.8	0.5
			12:00:30	-0.3	0	11:57:50	1.9	0.6
			12:00:40	-0.5	0	11:58:00	1.7	0.4
			12:00:50	-0.5	0	11:58:10	1.4	0.1
			12:01:00	-0.7	0	11:58:20	1.7	0.4
			12:01:10	-0.7	0	11:58:30	1.7	0.4
			12:01:20	-0.6	0	11:58:40	1.7	0.4
			12:01:30	-0.7	0	11:58:50	1.8	0.5
			12:01:40	-0.5	0	11:59:00	1.7	0.4
			12:01:50	-0.8	0	11:59:10	1.8	0.5
			12:02:00	-0.7	0	11:59:20	1.8	0.5
			12:02:10	-0.5	0	11:59:30	1.6	0.3
			12:02:20	-0.6	0	11:59:40	1.5	0.2
			12:02:30	-0.6	0	11:59:50	1.4	0.1
			12:02:40	-0.7	0	12:00:00	1.4	0.1
			12:02:50	-0.8	0	12:00:10	1.3	0
			12:03:00	-0.5	0	12:00:20	1.1	-0.2
			12:03:10	-0.6	0	12:00:30	1.4	0.1
			12:03:20	-0.7	0	12:00:40	1.4	0.1
			12:03:30	-0.8	0	12:00:50	1.3	0
			12:03:40	-0.7	0	12:01:00	1.4	0.1
			12:03:50	-0.8	0	12:01:10	1.3	0
			12:04:00	-1	0	12:01:20	1.4	0.1
			12:04:10	-0.8	0	12:01:30	1.4	0.1
			12:04:20	-0.7	0	12:01:40	1.3	0
			12:04:30	-0.6	0	12:01:50	1.1	-0.2
			12:04:40	-0.3	0	12:02:00	0.9	-0.4
			12:04:50	-0.3	0	12:02:10	0.8	-0.5
			12:05:31	-0.7	0	12:02:20	0.7	0
			12:05:40	-0.8	0	12:02:30	0.7	0
			12:05:50	-0.8	0	12:02:40	0.5	0
			12:06:00	-0.9	0	12:02:50	0.6	0
			12:06:10	-0.9	0	12:03:00	0.6	0
			12:06:20	-0.9	0	12:03:10	0.5	0
			12:06:30	-0.9	0	12:03:20	0.5	0
			12:06:40	-1.1	0	12:03:30	0.7	0
			12:06:50	-0.6	0	12:03:40	0.8	-0.5
			12:07:00	-0.7	0	12:03:50	0.6	0
			12:07:10	-0.6	0	12:04:00	0.6	0
			12:07:20	-0.4	0	12:04:10	0.6	0
			12:07:30	-0.5	-2.2	12:04:20	0.6	0
			12:07:40	-0.7	0	12:04:30	0.6	0
			12:07:50	-0.7	0	12:04:40	0.5	0
			12:08:00	-0.7	0	12:04:50	0.6	0

Appendix G. Calculations for Extrapolating Time of Travel Results to Low Flow

Appendix G

Reach Calibration

	Reach	Flow m3/s	Tracer test length (m)	Travel time min	Travel time sec	Slope	Width (m)	Velocity (m/s)	W2	W1	Flow Area A (m^2)	Mannings n	Inactive area A0
Tracer Test	1	1.7	500	28.27	**1696**	0.00103	9.45	0.295	0.26	**8.23**	**5.77**	0.07	**0.38**
	2	1.7	520	22.31	**1338**	0.00019	6.49	0.389	0.26	**5.65**	**4.38**	0.025	**0.22**
	3	1.7	475	27.54	**1652**	0.00012	11.18	0.287	0.26	**9.74**	**5.91**	0.02	**0.74**

Extrapolation of Low-Flow Scenarios

	Reach	Flow m3/s	Tracer Test length (m)	Travel time min	Travel time sec	Slope	Width (m)	Velocity (m/s)	W2	W1	Flow Area A (m^2)	Mannings n	Inactive area A0
Phase 1	1	0.50465	500	**44.11**	**2646**	0.00103	**6.89**	**0.19**	0.26	8.23	**2.67**	0.07	0.38
	2	0.50465	520	**34.10**	**2046**	0.00019	**4.73**	**0.25**	0.26	5.65	**1.99**	0.025	0.22
	3	0.50465	475	**46.09**	**2765**	0.00012	**8.15**	**0.17**	0.26	9.74	**2.94**	0.02	0.74
Full Build Out	1	0.5725	500	**41.98**	**2519**	0.00103	**7.12**	**0.20**	0.26	8.23	**2.88**	0.07	0.38
	2	0.5725	520	**32.55**	**1953**	0.00019	**4.89**	**0.27**	0.26	5.65	**2.15**	0.025	0.22
	3	0.5725	475	**43.45**	**2607**	0.00012	**8.42**	**0.18**	0.26	9.74	**3.14**	0.02	0.74

Appendix H. Results of CORMIX Mixing Zone Modelling

CORMIX1 PREDICTION FILE:
1111111111

X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 50 display intervals per module

BEGIN MOD101: DISCHARGE MODULE

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.40	1.0	0.148E+01	0.11	2.068	.00000E+00

END OF MOD101: DISCHARGE MODULE

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

Jet-like motion in weak crossflow.
UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
Following MOD133 will include recirculation into jet region.

Zone of flow establishment: THETAE= -72.93 SIGMAE= 275.23
LE = 0.85 XE = 0.01 YE = -0.25 ZE = -0.41

Profile definitions:
B = Gaussian 1/e (37%) half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.40	1.0	0.148E+01	0.11	2.068	.00000E+00
0.01	-0.25	-0.41	1.0	0.148E+01	0.11	2.068	.00000E+00
0.01	-0.25	-0.41	1.0	0.148E+01	0.11	2.068	.00000E+00

Cumulative travel time = 0.0000 sec (0.00 hrs)

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

Control volume inflow:

X	Y	Z	S	C	B	TT
0.01	-0.25	-0.41	1.0	0.148E+01	0.11	.00000E+00

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
-0.10	-0.25	0.40	1.0	0.148E+01	0.00	0.00	0.40	0.40	.00000E+00
-0.05	-0.25	0.40	1.0	0.148E+01	0.40	0.31	0.40	0.00	

```
.00000E+00
      0.01    -0.25    0.40     1.0 0.148E+01   0.40     0.44    0.40    0.00
.00000E+00
      0.06    -0.25    0.40     1.0 0.145E+01   0.40     0.54    0.40    0.00
.33626E+00
      0.11    -0.25    0.40     1.1 0.136E+01   0.40     0.62    0.40    0.00
.71560E+00
      0.16    -0.25    0.40     1.2 0.127E+01   0.40     0.69    0.40    0.00
.10949E+01
      0.21    -0.25    0.40     1.2 0.118E+01   0.40     0.76    0.40    0.00
.14743E+01
      0.26    -0.25    0.40     1.3 0.112E+01   0.40     0.82    0.40    0.00
.18536E+01
      0.31    -0.25    0.40     1.4 0.109E+01   0.40     0.87    0.40    0.00
.22330E+01
      0.36    -0.25    0.40     1.4 0.107E+01   0.40     0.93    0.40    0.00
.26123E+01
      0.41    -0.25    0.40     1.4 0.105E+01   0.40     0.98    0.40    0.00
.29916E+01
 Cumulative travel time =           2.9916 sec  (    0.00 hrs)

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some lateral boundary interaction occurs at end of the near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Discharge is non-buoyant or weakly buoyant.
 Therefore BUOYANT SPREADING REGIME is ABSENT.

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Due to the attachment or proximity of the plume to the bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
-------------------------------------------------------------------------------
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.265E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.663E-02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
```

BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
0.41	0.12	0.40	1.4	0.105E+01	0.48	1.63	0.40	0.00	.29916E+01
10.40	0.12	0.40	1.7	0.858E+00	0.40	1.99	0.40	0.00	.66667E+02
20.39	0.12	0.40	2.0	0.740E+00	0.40	2.30	0.40	0.00	.13034E+03
30.39	0.12	0.40	2.2	0.659E+00	0.40	2.57	0.40	0.00	.19402E+03
40.38	0.12	0.40	2.4	0.600E+00	0.40	2.82	0.40	0.00	.25769E+03
50.37	0.12	0.40	2.6	0.553E+00	0.40	3.05	0.40	0.00	.32137E+03
60.36	0.12	0.40	2.8	0.516E+00	0.40	3.26	0.40	0.00	.38504E+03
70.35	0.12	0.40	3.0	0.484E+00	0.40	3.45	0.40	0.00	.44872E+03
80.35	0.12	0.40	3.1	0.458E+00	0.40	3.64	0.40	0.00	.51239E+03
90.34	0.12	0.40	3.3	0.435E+00	0.40	3.82	0.40	0.00	.57607E+03
100.33	0.12	0.40	3.4	0.415E+00	0.40	3.99	0.40	0.00	.63974E+03
110.32	0.12	0.40	3.6	0.397E+00	0.40	4.15	0.40	0.00	.70342E+03
120.31	0.12	0.40	3.7	0.381E+00	0.40	4.31	0.40	0.00	.76709E+03
130.30	0.12	0.40	3.8	0.367E+00	0.40	4.46	0.40	0.00	.83077E+03
140.30	0.12	0.40	4.0	0.354E+00	0.40	4.61	0.40	0.00	.89444E+03
150.29	0.12	0.40	4.1	0.342E+00	0.40	4.75	0.40	0.00	.95812E+03

WATER QUALITY STANDARD OR CCC HAS BEEN FOUND
The pollutant concentration in the plume falls below water quality standard
or CCC value of 0.336E+00 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality
standard or CCC value.

160.28	0.12	0.40	4.2	0.331E+00	0.40	4.88	0.40	0.00	.10218E+04
170.27	0.12	0.40	4.3	0.321E+00	0.40	5.02	0.40	0.00	.10855E+04
180.26	0.12	0.40	4.4	0.312E+00	0.40	5.15	0.40	0.00	.11491E+04
190.26	0.12	0.40	4.5	0.303E+00	0.40	5.28	0.40	0.00	.12128E+04
200.25	0.12	0.40	4.6	0.295E+00	0.40	5.40	0.40	0.00	.12765E+04
210.24	0.12	0.40	4.7	0.288E+00	0.40	5.52	0.40	0.00	.13402E+04
220.23	0.12	0.40	4.8	0.281E+00	0.40	5.64	0.40	0.00	.14038E+04
230.22	0.12	0.40	4.9	0.274E+00	0.40	5.76	0.40	0.00	

```
.14675E+04
    240.21     0.12    0.40     5.0 0.268E+00   0.40     5.87    0.40    0.00
.15312E+04
    250.21     0.12    0.40     5.1 0.262E+00   0.40     5.98    0.40    0.00
.15949E+04
    260.20     0.12    0.40     5.2 0.256E+00   0.40     6.09    0.40    0.00
.16585E+04
    270.19     0.12    0.40     5.3 0.251E+00   0.40     6.20    0.40    0.00
.17222E+04
    280.18     0.12    0.40     5.4 0.246E+00   0.40     6.31    0.40    0.00
.17859E+04
    290.17     0.12    0.40     5.5 0.241E+00   0.40     6.41    0.40    0.00
.18496E+04
    300.16     0.12    0.40     5.6 0.236E+00   0.40     6.51    0.40    0.00
.19132E+04
    310.16     0.12    0.40     5.7 0.232E+00   0.40     6.61    0.40    0.00
.19769E+04
 The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel
     width during the current prediction interval.
 The x-coordinate of bank attachment is     318.78 m.
    320.15     0.12    0.40     5.8 0.227E+00   0.40     6.70    0.40    0.00
.20406E+04
 Effluent is FULLY MIXED over the entire channel cross-section.
 Except for possible far-field decay or reaction processes, there are
     NO FURTHER CHANGES with downstream direction.
    330.14     0.12    0.40     5.8 0.227E+00   0.40     6.70    0.40    0.00
.21043E+04
    340.13     0.12    0.40     5.8 0.226E+00   0.40     6.70    0.40    0.00
.21679E+04
    350.12     0.12    0.40     5.8 0.225E+00   0.40     6.70    0.40    0.00
.22316E+04
    360.12     0.12    0.40     5.8 0.224E+00   0.40     6.70    0.40    0.00
.22953E+04
    370.11     0.12    0.40     5.8 0.224E+00   0.40     6.70    0.40    0.00
.23590E+04
    380.10     0.12    0.40     5.8 0.223E+00   0.40     6.70    0.40    0.00
.24226E+04
    390.09     0.12    0.40     5.8 0.222E+00   0.40     6.70    0.40    0.00
.24863E+04
    400.08     0.12    0.40     5.8 0.221E+00   0.40     6.70    0.40    0.00
.25500E+04
    410.07     0.12    0.40     5.8 0.220E+00   0.40     6.70    0.40    0.00
.26137E+04
    420.07     0.12    0.40     5.8 0.219E+00   0.40     6.70    0.40    0.00
.26773E+04
    430.06     0.12    0.40     5.8 0.219E+00   0.40     6.70    0.40    0.00
.27410E+04
    440.05     0.12    0.40     5.8 0.218E+00   0.40     6.70    0.40    0.00
.28047E+04
    450.04     0.12    0.40     5.8 0.217E+00   0.40     6.70    0.40    0.00
.28684E+04
    460.03     0.12    0.40     5.8 0.216E+00   0.40     6.70    0.40    0.00
.29320E+04
    470.02     0.12    0.40     5.8 0.215E+00   0.40     6.70    0.40    0.00
.29957E+04
    480.02     0.12    0.40     5.8 0.215E+00   0.40     6.70    0.40    0.00
.30594E+04
    490.01     0.12    0.40     5.8 0.214E+00   0.40     6.70    0.40    0.00
.31231E+04
    500.00     0.12    0.40     5.8 0.213E+00   0.40     6.70    0.40    0.00
.31867E+04
 Cumulative travel time =        3186.7371 sec  (    0.89 hrs)
```

 Simulation limit based on maximum specified distance = 500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX1: Single Port Discharges End of Prediction File
1111111111

```
CORMIX1 PREDICTION FILE:
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111
111111111111

                      CORMIX MIXING ZONE EXPERT SYSTEM
                  Subsystem CORMIX1: Single Port Discharges
                             CORMIX Version 9.0GT
                    HYDRO1 Version 9.0.0.0 September 2014
-------------------------------------------------------------------------------
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-------------------------------------------------------------------------------
-----------
CASE DESCRIPTION
 Site name/label:   Willow-Creek
 Design case:       Phase 1-Winter-Ammonia
 FILE NAME:         E:\Midhurst\Ph1-winter ammonia.prd
 Time stamp:        Tue Mar  8 12:41:19 2016

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =      8.10  AS    =      6.32  QA    =      0.90  ICHREG= 2
 HA    =      0.78  HD    =      0.55
 UA    =     0.142  F     =     0.418 USTAR =0.3255E-01
 UW    =     2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  999.9750

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  LEFT      DISTB =      0.12
 D0    =     0.214 A0    =     0.036 H0    =      0.55  SUB0  =      0.00
 THETA =      0.00  SIGMA =    270.00
 U0    =     2.068 Q0    =     0.075       =0.7465E-01
 RHO0  =  999.3789  DRHO0 =0.5961E+00  GP0   =0.5846E-02
 C0    =0.2976E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.7465E-01  M0    =0.1544E+00  J0    =0.4364E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =     0.19  LM    =     11.79  Lm    =      2.76  Lb    =      0.15
                                      Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     58.41  R     =     14.52

FLOW CLASSIFICATION
 11111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =    0.55   1
 1  Limiting Dilution S =QA/Q0=    13.06  1
 11111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.2976E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  1         CSTD  =0.9360E+00
 REGMZ =  0
 XINT  =    500.00  XMAX  =    500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.12 m  from the LEFT  bank/shore.
```

X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 50 display intervals per module

BEGIN MOD101: DISCHARGE MODULE

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.55	1.0	0.298E+01	0.11	2.068	.00000E+00

END OF MOD101: DISCHARGE MODULE

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

Jet-like motion in weak crossflow.
UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
Following MOD133 will include recirculation into jet region.

Zone of flow establishment: THETAE= -72.92 SIGMAE= 275.57
LE = 0.83 XE = 0.01 YE = -0.24 ZE = -0.25

Profile definitions:
B = Gaussian 1/e (37%) half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.55	1.0	0.298E+01	0.11	2.068	.00000E+00
0.01	-0.24	-0.25	1.0	0.298E+01	0.11	2.068	.00000E+00
0.01	-0.24	-0.25	1.0	0.298E+01	0.11	2.068	.00000E+00

Cumulative travel time = 0.0000 sec (0.00 hrs)

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

Control volume inflow:

X	Y	Z	S	C	B	TT
0.01	-0.24	-0.25	1.0	0.298E+01	0.11	.00000E+00

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
-0.10	-0.24	0.55	1.0	0.298E+01	0.00	0.00	0.55	0.55	.00000E+00
-0.03	-0.24	0.55	1.0	0.298E+01	0.55	0.21	0.55	0.00	

```
.00000E+00
      0.04    -0.24    0.55     1.0 0.297E+01   0.55     0.30    0.55    0.00
.17017E+00
      0.10    -0.24    0.55     1.0 0.286E+01   0.55     0.37    0.55    0.00
.63152E+00
      0.17    -0.24    0.55     1.1 0.268E+01   0.55     0.42    0.55    0.00
.10929E+01
      0.23    -0.24    0.55     1.2 0.250E+01   0.55     0.47    0.55    0.00
.15542E+01
      0.30    -0.24    0.55     1.3 0.235E+01   0.55     0.52    0.55    0.00
.20156E+01
      0.36    -0.24    0.55     1.3 0.225E+01   0.55     0.56    0.55    0.00
.24769E+01
      0.43    -0.24    0.55     1.4 0.219E+01   0.55     0.60    0.55    0.00
.29383E+01
      0.50    -0.24    0.55     1.4 0.215E+01   0.55     0.63    0.55    0.00
.33996E+01
      0.56    -0.24    0.55     1.4 0.213E+01   0.55     0.67    0.55    0.00
.38610E+01
 Cumulative travel time =           3.8610 sec  (    0.00 hrs)

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some lateral boundary interaction occurs at end of the near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
-------------------------------------------------------------------------------
-----------
BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.56     0.12    0.55     1.4 0.213E+01   0.71     1.03    0.55    0.00
.38610E+01
      0.60     0.12    0.55     1.4 0.212E+01   0.55     1.04    0.55    0.00
.40942E+01
      0.63     0.12    0.55     1.4 0.211E+01   0.55     1.05    0.55    0.00
.43273E+01
      0.67     0.12    0.55     1.4 0.211E+01   0.55     1.06    0.55    0.00
.45605E+01
      0.71     0.12    0.55     1.4 0.210E+01   0.55     1.06    0.55    0.00
```

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.47936E+01
      0.74     0.12     0.55      1.4 0.210E+01   0.55     1.07     0.55     0.00
.50268E+01
      0.78     0.12     0.55      1.4 0.209E+01   0.55     1.08     0.55     0.00
.52599E+01
      0.81     0.12     0.55      1.4 0.208E+01   0.55     1.09     0.55     0.00
.54931E+01
      0.85     0.12     0.55      1.4 0.208E+01   0.55     1.10     0.55     0.00
.57262E+01
      0.89     0.12     0.55      1.4 0.207E+01   0.55     1.10     0.55     0.00
.59594E+01
      0.92     0.12     0.55      1.4 0.207E+01   0.55     1.11     0.55     0.00
.61925E+01
      0.96     0.12     0.55      1.4 0.206E+01   0.55     1.12     0.55     0.00
.64257E+01
      0.99     0.12     0.55      1.4 0.206E+01   0.55     1.13     0.55     0.00
.66588E+01
      1.03     0.12     0.55      1.5 0.205E+01   0.55     1.13     0.55     0.00
.68920E+01
      1.07     0.12     0.55      1.5 0.204E+01   0.55     1.14     0.55     0.00
.71251E+01
      1.10     0.12     0.55      1.5 0.204E+01   0.55     1.15     0.55     0.00
.73583E+01
      1.14     0.12     0.55      1.5 0.203E+01   0.55     1.16     0.55     0.00
.75914E+01
      1.17     0.12     0.55      1.5 0.203E+01   0.55     1.16     0.55     0.00
.78246E+01
      1.21     0.12     0.55      1.5 0.202E+01   0.55     1.17     0.55     0.00
.80577E+01
      1.25     0.12     0.55      1.5 0.202E+01   0.55     1.18     0.55     0.00
.82909E+01
      1.28     0.12     0.55      1.5 0.201E+01   0.55     1.19     0.55     0.00
.85241E+01
      1.32     0.12     0.55      1.5 0.201E+01   0.55     1.19     0.55     0.00
.87572E+01
      1.35     0.12     0.55      1.5 0.200E+01   0.55     1.20     0.55     0.00
.89904E+01
      1.39     0.12     0.55      1.5 0.200E+01   0.55     1.21     0.55     0.00
.92235E+01
      1.43     0.12     0.55      1.5 0.199E+01   0.55     1.22     0.55     0.00
.94567E+01
      1.46     0.12     0.55      1.5 0.199E+01   0.55     1.22     0.55     0.00
.96898E+01
      1.50     0.12     0.55      1.5 0.198E+01   0.55     1.23     0.55     0.00
.99230E+01
      1.53     0.12     0.55      1.5 0.197E+01   0.55     1.24     0.55     0.00
.10156E+02
      1.57     0.12     0.55      1.5 0.197E+01   0.55     1.25     0.55     0.00
.10389E+02
      1.60     0.12     0.55      1.5 0.196E+01   0.55     1.25     0.55     0.00
.10622E+02
      1.64     0.12     0.55      1.5 0.196E+01   0.55     1.26     0.55     0.00
.10856E+02
      1.68     0.12     0.55      1.5 0.195E+01   0.55     1.27     0.55     0.00
.11089E+02
      1.71     0.12     0.55      1.5 0.195E+01   0.55     1.28     0.55     0.00
.11322E+02
      1.75     0.12     0.55      1.5 0.194E+01   0.55     1.28     0.55     0.00
.11555E+02
      1.78     0.12     0.55      1.5 0.194E+01   0.55     1.29     0.55     0.00
.11788E+02
      1.82     0.12     0.55      1.5 0.193E+01   0.55     1.30     0.55     0.00
.12021E+02
```

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      1.86     0.12    0.55     1.5 0.193E+01   0.55     1.30    0.55    0.00
.12254E+02
      1.89     0.12    0.55     1.5 0.192E+01   0.55     1.31    0.55    0.00
.12488E+02
      1.93     0.12    0.55     1.6 0.192E+01   0.55     1.32    0.55    0.00
.12721E+02
      1.96     0.12    0.55     1.6 0.191E+01   0.55     1.32    0.55    0.00
.12954E+02
      2.00     0.12    0.55     1.6 0.191E+01   0.55     1.33    0.55    0.00
.13187E+02
      2.04     0.12    0.55     1.6 0.190E+01   0.55     1.34    0.55    0.00
.13420E+02
      2.07     0.12    0.55     1.6 0.190E+01   0.55     1.35    0.55    0.00
.13653E+02
      2.11     0.12    0.55     1.6 0.189E+01   0.55     1.35    0.55    0.00
.13887E+02
      2.14     0.12    0.55     1.6 0.189E+01   0.55     1.36    0.55    0.00
.14120E+02
      2.18     0.12    0.55     1.6 0.188E+01   0.55     1.37    0.55    0.00
.14353E+02
      2.22     0.12    0.55     1.6 0.188E+01   0.55     1.37    0.55    0.00
.14586E+02
      2.25     0.12    0.55     1.6 0.187E+01   0.55     1.38    0.55    0.00
.14819E+02
      2.29     0.12    0.55     1.6 0.187E+01   0.55     1.39    0.55    0.00
.15052E+02
      2.32     0.12    0.55     1.6 0.186E+01   0.55     1.39    0.55    0.00
.15285E+02
      2.36     0.12    0.55     1.6 0.186E+01   0.55     1.40    0.55    0.00
.15519E+02
 Cumulative travel time =          15.5186 sec  (    0.00 hrs)

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Due to the attachment or proximity of the plume to the bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.358E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.895E-02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.36     0.12    0.55     1.6 0.186E+01   0.55     1.40    0.55    0.00
.15519E+02
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     12.31     0.12    0.55     2.2 0.134E+01   0.55     1.94    0.55    0.00
.80036E+02
     22.27     0.12    0.55     2.7 0.110E+01   0.55     2.36    0.55    0.00
.14455E+03
     32.22     0.12    0.55     3.1 0.956E+00   0.55     2.72    0.55    0.00
.20907E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.936E+00 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     42.17     0.12    0.55     3.5 0.857E+00   0.55     3.04    0.55    0.00
.27359E+03
     52.12     0.12    0.55     3.8 0.783E+00   0.55     3.32    0.55    0.00
.33811E+03
     62.08     0.12    0.55     4.1 0.726E+00   0.55     3.58    0.55    0.00
.40262E+03
     72.03     0.12    0.55     4.4 0.680E+00   0.55     3.83    0.55    0.00
.46714E+03
     81.98     0.12    0.55     4.6 0.641E+00   0.55     4.06    0.55    0.00
.53166E+03
     91.94     0.12    0.55     4.9 0.608E+00   0.55     4.28    0.55    0.00
.59617E+03
    101.89     0.12    0.55     5.1 0.580E+00   0.55     4.48    0.55    0.00
.66069E+03
    111.84     0.12    0.55     5.4 0.556E+00   0.55     4.68    0.55    0.00
.72521E+03
    121.79     0.12    0.55     5.6 0.534E+00   0.55     4.87    0.55    0.00
.78973E+03
    131.75     0.12    0.55     5.8 0.515E+00   0.55     5.05    0.55    0.00
.85424E+03
    141.70     0.12    0.55     6.0 0.497E+00   0.55     5.23    0.55    0.00
.91876E+03
    151.65     0.12    0.55     6.2 0.482E+00   0.55     5.40    0.55    0.00
.98328E+03
    161.60     0.12    0.55     6.4 0.467E+00   0.55     5.57    0.55    0.00
.10478E+04
    171.56     0.12    0.55     6.6 0.454E+00   0.55     5.73    0.55    0.00
.11123E+04
    181.51     0.12    0.55     6.7 0.442E+00   0.55     5.88    0.55    0.00
.11768E+04
    191.46     0.12    0.55     6.9 0.431E+00   0.55     6.04    0.55    0.00
.12413E+04
    201.42     0.12    0.55     7.1 0.421E+00   0.55     6.19    0.55    0.00
.13059E+04
    211.37     0.12    0.55     7.2 0.411E+00   0.55     6.33    0.55    0.00
.13704E+04
    221.32     0.12    0.55     7.4 0.402E+00   0.55     6.47    0.55    0.00
.14349E+04
    231.27     0.12    0.55     7.6 0.394E+00   0.55     6.61    0.55    0.00
.14994E+04
    241.23     0.12    0.55     7.7 0.386E+00   0.55     6.75    0.55    0.00
.15639E+04
    251.18     0.12    0.55     7.9 0.378E+00   0.55     6.88    0.55    0.00
.16285E+04
    261.13     0.12    0.55     8.0 0.371E+00   0.55     7.01    0.55    0.00
.16930E+04
    271.09     0.12    0.55     8.2 0.364E+00   0.55     7.14    0.55    0.00
.17575E+04
    281.04     0.12    0.55     8.3 0.358E+00   0.55     7.26    0.55    0.00
.18220E+04
    290.99     0.12    0.55     8.5 0.352E+00   0.55     7.39    0.55    0.00
.18865E+04
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    300.94     0.12    0.55     8.6 0.346E+00   0.55     7.51    0.55    0.00
.19510E+04
    310.90     0.12    0.55     8.7 0.341E+00   0.55     7.63    0.55    0.00
.20156E+04
    320.85     0.12    0.55     8.9 0.336E+00   0.55     7.75    0.55    0.00
.20801E+04
    330.80     0.12    0.55     9.0 0.331E+00   0.55     7.86    0.55    0.00
.21446E+04
    340.76     0.12    0.55     9.1 0.326E+00   0.55     7.98    0.55    0.00
.22091E+04
    350.71     0.12    0.55     9.3 0.322E+00   0.55     8.09    0.55    0.00
.22736E+04
 The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel
     width during the current prediction interval.
 The x-coordinate of bank attachment is     351.43 m.
    360.66     0.12    0.55     9.4 0.317E+00   0.55     8.10    0.55    0.00
.23381E+04
 Effluent is FULLY MIXED over the entire channel cross-section.
 Except for possible far-field decay or reaction processes, there are
     NO FURTHER CHANGES with downstream direction.
    370.61     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.24027E+04
    380.57     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.24672E+04
    390.52     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.25317E+04
    400.47     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.25962E+04
    410.42     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.26607E+04
    420.38     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.27252E+04
    430.33     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.27898E+04
    440.28     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.28543E+04
    450.24     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.29188E+04
    460.19     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.29833E+04
    470.14     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.30478E+04
    480.09     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.31123E+04
    490.05     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.31769E+04
    500.00     0.12    0.55     9.3 0.321E+00   0.55     8.10    0.55    0.00
.32414E+04
 Cumulative travel time =        3241.3823 sec  (    0.90 hrs)

 Simulation limit based on maximum specified distance =    500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
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CORMIX1 PREDICTION FILE:
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                      CORMIX MIXING ZONE EXPERT SYSTEM
                  Subsystem CORMIX1: Single Port Discharges
                             CORMIX Version 9.0GT
                    HYDRO1 Version 9.0.0.0 September 2014
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CASE DESCRIPTION
 Site name/label:   Willow-Creek
 Design case:       Phase 1-Summer-TP
 FILE NAME:         E:\Midhurst\Ph1-summer TP.prd
 Time stamp:        Wed Mar  9 02:10:29 2016

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =      6.70  AS    =      3.22  QA    =      0.43  ICHREG= 2
 HA    =      0.48  HD    =      0.40
 UA    =      0.134 F     =      0.491 USTAR =0.3312E-01
 UW    =      2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  998.5029

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  LEFT      DISTB =      0.12
 D0    =      0.214 A0    =      0.036 H0    =      0.40  SUB0  =      0.00
 THETA =      0.00  SIGMA =    270.00
 U0    =      2.068 Q0    =      0.075       =0.7465E-01
 RHO0  =  998.2051  DRHO0 =0.2978E+00  GP0   =0.2925E-02
 C0    =0.1500E-01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.7465E-01  M0    =0.1544E+00  J0    =0.2183E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.19  LM    =     16.67  Lm    =      2.94  Lb    =      0.09
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     82.58  R     =     15.46

FLOW CLASSIFICATION
 11111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =    0.40   1
 1  Limiting Dilution S =QA/Q0=     6.76  1
 11111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1500E-01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  0
 REGMZ =  0
 XINT  =    500.00  XMAX  =    500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.12 m  from the LEFT  bank/shore.
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X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 50 display intervals per module

BEGIN MOD101: DISCHARGE MODULE

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.40	1.0	0.150E-01	0.11	2.068	.00000E+00

END OF MOD101: DISCHARGE MODULE

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

Jet-like motion in weak crossflow.
UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
Following MOD133 will include recirculation into jet region.

Zone of flow establishment: THETAE= -72.93 SIGMAE= 275.23
LE = 0.85 XE = 0.01 YE = -0.25 ZE = -0.41

Profile definitions:
B = Gaussian 1/e (37%) half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.40	1.0	0.150E-01	0.11	2.068	.00000E+00
0.01	-0.25	-0.41	1.0	0.150E-01	0.11	2.068	.00000E+00
0.01	-0.25	-0.41	1.0	0.150E-01	0.11	2.068	.00000E+00

Cumulative travel time = 0.0000 sec (0.00 hrs)

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

Control volume inflow:

X	Y	Z	S	C	B	TT
0.01	-0.25	-0.41	1.0	0.150E-01	0.11	.00000E+00

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
-0.10	-0.25	0.40	1.0	0.150E-01	0.00	0.00	0.40	0.40	.00000E+00
-0.05	-0.25	0.40	1.0	0.150E-01	0.40	0.31	0.40	0.00	

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.00000E+00
      0.01    -0.25    0.40     1.0 0.150E-01   0.40     0.44    0.40    0.00
.00000E+00
      0.06    -0.25    0.40     1.0 0.147E-01   0.40     0.54    0.40    0.00
.33626E+00
      0.11    -0.25    0.40     1.1 0.139E-01   0.40     0.62    0.40    0.00
.71560E+00
      0.16    -0.25    0.40     1.2 0.129E-01   0.40     0.69    0.40    0.00
.10949E+01
      0.21    -0.25    0.40     1.2 0.120E-01   0.40     0.76    0.40    0.00
.14743E+01
      0.26    -0.25    0.40     1.3 0.114E-01   0.40     0.82    0.40    0.00
.18536E+01
      0.31    -0.25    0.40     1.4 0.111E-01   0.40     0.87    0.40    0.00
.22330E+01
      0.36    -0.25    0.40     1.4 0.109E-01   0.40     0.93    0.40    0.00
.26123E+01
      0.41    -0.25    0.40     1.4 0.107E-01   0.40     0.98    0.40    0.00
.29916E+01
 Cumulative travel time =           2.9916 sec  (    0.00 hrs)

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some lateral boundary interaction occurs at end of the near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Discharge is non-buoyant or weakly buoyant.
 Therefore BUOYANT SPREADING REGIME is ABSENT.

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Due to the attachment or proximity of the plume to the bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.265E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.663E-02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
```

BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
0.41	0.12	0.40	1.4	0.107E-01	0.48	1.63	0.40	0.00	.29916E+01
10.40	0.12	0.40	1.7	0.875E-02	0.40	1.99	0.40	0.00	.66667E+02
20.39	0.12	0.40	2.0	0.758E-02	0.40	2.30	0.40	0.00	.13034E+03
30.39	0.12	0.40	2.2	0.678E-02	0.40	2.57	0.40	0.00	.19402E+03
40.38	0.12	0.40	2.4	0.619E-02	0.40	2.82	0.40	0.00	.25769E+03
50.37	0.12	0.40	2.6	0.573E-02	0.40	3.05	0.40	0.00	.32137E+03
60.36	0.12	0.40	2.8	0.536E-02	0.40	3.26	0.40	0.00	.38504E+03
70.35	0.12	0.40	3.0	0.505E-02	0.40	3.45	0.40	0.00	.44872E+03
80.35	0.12	0.40	3.1	0.479E-02	0.40	3.64	0.40	0.00	.51239E+03
90.34	0.12	0.40	3.3	0.457E-02	0.40	3.82	0.40	0.00	.57607E+03
100.33	0.12	0.40	3.4	0.437E-02	0.40	3.99	0.40	0.00	.63974E+03
110.32	0.12	0.40	3.6	0.420E-02	0.40	4.15	0.40	0.00	.70342E+03
120.31	0.12	0.40	3.7	0.405E-02	0.40	4.31	0.40	0.00	.76709E+03
130.30	0.12	0.40	3.8	0.391E-02	0.40	4.46	0.40	0.00	.83077E+03
140.30	0.12	0.40	4.0	0.379E-02	0.40	4.61	0.40	0.00	.89444E+03
150.29	0.12	0.40	4.1	0.368E-02	0.40	4.75	0.40	0.00	.95812E+03
160.28	0.12	0.40	4.2	0.357E-02	0.40	4.88	0.40	0.00	.10218E+04
170.27	0.12	0.40	4.3	0.348E-02	0.40	5.02	0.40	0.00	.10855E+04
180.26	0.12	0.40	4.4	0.339E-02	0.40	5.15	0.40	0.00	.11491E+04
190.26	0.12	0.40	4.5	0.331E-02	0.40	5.28	0.40	0.00	.12128E+04
200.25	0.12	0.40	4.6	0.323E-02	0.40	5.40	0.40	0.00	.12765E+04
210.24	0.12	0.40	4.7	0.316E-02	0.40	5.52	0.40	0.00	.13402E+04
220.23	0.12	0.40	4.8	0.309E-02	0.40	5.64	0.40	0.00	.14038E+04
230.22	0.12	0.40	4.9	0.303E-02	0.40	5.76	0.40	0.00	.14675E+04
240.21	0.12	0.40	5.0	0.297E-02	0.40	5.87	0.40	0.00	.15312E+04
250.21	0.12	0.40	5.1	0.292E-02	0.40	5.98	0.40	0.00	.15949E+04

260.20	0.12	0.40	5.2	0.286E-02	0.40	6.09	0.40	0.00
.16585E+04								
270.19	0.12	0.40	5.3	0.281E-02	0.40	6.20	0.40	0.00
.17222E+04								
280.18	0.12	0.40	5.4	0.277E-02	0.40	6.31	0.40	0.00
.17859E+04								
290.17	0.12	0.40	5.5	0.272E-02	0.40	6.41	0.40	0.00
.18496E+04								
300.16	0.12	0.40	5.6	0.268E-02	0.40	6.51	0.40	0.00
.19132E+04								
310.16	0.12	0.40	5.7	0.264E-02	0.40	6.61	0.40	0.00
.19769E+04								

The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel width during the current prediction interval.

The x-coordinate of bank attachment is 318.78 m.

320.15	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.20406E+04								

Effluent is FULLY MIXED over the entire channel cross-section.

Except for possible far-field decay or reaction processes, there are NO FURTHER CHANGES with downstream direction.

330.14	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.21043E+04								
340.13	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.21679E+04								
350.12	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.22316E+04								
360.12	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.22953E+04								
370.11	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.23590E+04								
380.10	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.24226E+04								
390.09	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.24863E+04								
400.08	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.25500E+04								
410.07	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.26137E+04								
420.07	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.26773E+04								
430.06	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.27410E+04								
440.05	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.28047E+04								
450.04	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.28684E+04								
460.03	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.29320E+04								
470.02	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.29957E+04								
480.02	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.30594E+04								
490.01	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.31231E+04								
500.00	0.12	0.40	5.8	0.260E-02	0.40	6.70	0.40	0.00
.31867E+04								

Cumulative travel time = 3186.7371 sec (0.89 hrs)

Simulation limit based on maximum specified distance = 500.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX1: Single Port Discharges End of Prediction File

1111111111

CORMIX1 PREDICTION FILE:
1111111111

X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 50 display intervals per module

BEGIN MOD101: DISCHARGE MODULE

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.55	1.0	0.150E-01	0.11	2.068	.00000E+00

END OF MOD101: DISCHARGE MODULE

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

Jet-like motion in weak crossflow.
UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
Following MOD133 will include recirculation into jet region.

Zone of flow establishment: THETAE= -72.92 SIGMAE= 275.57
LE = 0.83 XE = 0.01 YE = -0.24 ZE = -0.25

Profile definitions:
B = Gaussian 1/e (37%) half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.55	1.0	0.150E-01	0.11	2.068	.00000E+00
0.01	-0.24	-0.25	1.0	0.150E-01	0.11	2.068	.00000E+00
0.01	-0.24	-0.25	1.0	0.150E-01	0.11	2.068	.00000E+00

Cumulative travel time = 0.0000 sec (0.00 hrs)

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

Control volume inflow:

X	Y	Z	S	C	B	TT
0.01	-0.24	-0.25	1.0	0.150E-01	0.11	.00000E+00

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
-0.10	-0.24	0.55	1.0	0.150E-01	0.00	0.00	0.55	0.55	.00000E+00
-0.03	-0.24	0.55	1.0	0.150E-01	0.55	0.21	0.55	0.00	

```
.00000E+00
      0.04    -0.24    0.55     1.0 0.150E-01   0.55     0.30    0.55    0.00
.17017E+00
      0.10    -0.24    0.55     1.0 0.144E-01   0.55     0.37    0.55    0.00
.63152E+00
      0.17    -0.24    0.55     1.1 0.135E-01   0.55     0.42    0.55    0.00
.10929E+01
      0.23    -0.24    0.55     1.2 0.126E-01   0.55     0.47    0.55    0.00
.15542E+01
      0.30    -0.24    0.55     1.3 0.119E-01   0.55     0.52    0.55    0.00
.20156E+01
      0.36    -0.24    0.55     1.3 0.113E-01   0.55     0.56    0.55    0.00
.24769E+01
      0.43    -0.24    0.55     1.4 0.110E-01   0.55     0.60    0.55    0.00
.29383E+01
      0.50    -0.24    0.55     1.4 0.109E-01   0.55     0.63    0.55    0.00
.33996E+01
      0.56    -0.24    0.55     1.4 0.107E-01   0.55     0.67    0.55    0.00
.38610E+01
 Cumulative travel time =           3.8610 sec  (    0.00 hrs)

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some lateral boundary interaction occurs at end of the near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.56     0.12    0.55     1.4 0.107E-01   0.71     1.03    0.55    0.00
.38610E+01
      0.60     0.12    0.55     1.4 0.107E-01   0.55     1.04    0.55    0.00
.40942E+01
      0.63     0.12    0.55     1.4 0.107E-01   0.55     1.05    0.55    0.00
.43273E+01
      0.67     0.12    0.55     1.4 0.106E-01   0.55     1.06    0.55    0.00
.45605E+01
      0.71     0.12    0.55     1.4 0.106E-01   0.55     1.06    0.55    0.00
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.47936E+01
      0.74     0.12     0.55     1.4 0.106E-01   0.55     1.07     0.55     0.00
.50268E+01
      0.78     0.12     0.55     1.4 0.105E-01   0.55     1.08     0.55     0.00
.52599E+01
      0.81     0.12     0.55     1.4 0.105E-01   0.55     1.09     0.55     0.00
.54931E+01
      0.85     0.12     0.55     1.4 0.105E-01   0.55     1.10     0.55     0.00
.57262E+01
      0.89     0.12     0.55     1.4 0.104E-01   0.55     1.10     0.55     0.00
.59594E+01
      0.92     0.12     0.55     1.4 0.104E-01   0.55     1.11     0.55     0.00
.61925E+01
      0.96     0.12     0.55     1.4 0.104E-01   0.55     1.12     0.55     0.00
.64257E+01
      0.99     0.12     0.55     1.4 0.104E-01   0.55     1.13     0.55     0.00
.66588E+01
      1.03     0.12     0.55     1.5 0.103E-01   0.55     1.13     0.55     0.00
.68920E+01
      1.07     0.12     0.55     1.5 0.103E-01   0.55     1.14     0.55     0.00
.71251E+01
      1.10     0.12     0.55     1.5 0.103E-01   0.55     1.15     0.55     0.00
.73583E+01
      1.14     0.12     0.55     1.5 0.102E-01   0.55     1.16     0.55     0.00
.75914E+01
      1.17     0.12     0.55     1.5 0.102E-01   0.55     1.16     0.55     0.00
.78246E+01
      1.21     0.12     0.55     1.5 0.102E-01   0.55     1.17     0.55     0.00
.80577E+01
      1.25     0.12     0.55     1.5 0.102E-01   0.55     1.18     0.55     0.00
.82909E+01
      1.28     0.12     0.55     1.5 0.101E-01   0.55     1.19     0.55     0.00
.85241E+01
      1.32     0.12     0.55     1.5 0.101E-01   0.55     1.19     0.55     0.00
.87572E+01
      1.35     0.12     0.55     1.5 0.101E-01   0.55     1.20     0.55     0.00
.89904E+01
      1.39     0.12     0.55     1.5 0.101E-01   0.55     1.21     0.55     0.00
.92235E+01
      1.43     0.12     0.55     1.5 0.100E-01   0.55     1.22     0.55     0.00
.94567E+01
      1.46     0.12     0.55     1.5 0.100E-01   0.55     1.22     0.55     0.00
.96898E+01
      1.50     0.12     0.55     1.5 0.998E-02   0.55     1.23     0.55     0.00
.99230E+01
      1.53     0.12     0.55     1.5 0.995E-02   0.55     1.24     0.55     0.00
.10156E+02
      1.57     0.12     0.55     1.5 0.993E-02   0.55     1.25     0.55     0.00
.10389E+02
      1.60     0.12     0.55     1.5 0.990E-02   0.55     1.25     0.55     0.00
.10622E+02
      1.64     0.12     0.55     1.5 0.987E-02   0.55     1.26     0.55     0.00
.10856E+02
      1.68     0.12     0.55     1.5 0.985E-02   0.55     1.27     0.55     0.00
.11089E+02
      1.71     0.12     0.55     1.5 0.982E-02   0.55     1.28     0.55     0.00
.11322E+02
      1.75     0.12     0.55     1.5 0.980E-02   0.55     1.28     0.55     0.00
.11555E+02
      1.78     0.12     0.55     1.5 0.977E-02   0.55     1.29     0.55     0.00
.11788E+02
      1.82     0.12     0.55     1.5 0.975E-02   0.55     1.30     0.55     0.00
.12021E+02
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      1.86     0.12    0.55     1.5 0.972E-02   0.55     1.30    0.55    0.00
.12254E+02
      1.89     0.12    0.55     1.5 0.970E-02   0.55     1.31    0.55    0.00
.12488E+02
      1.93     0.12    0.55     1.6 0.967E-02   0.55     1.32    0.55    0.00
.12721E+02
      1.96     0.12    0.55     1.6 0.964E-02   0.55     1.32    0.55    0.00
.12954E+02
      2.00     0.12    0.55     1.6 0.962E-02   0.55     1.33    0.55    0.00
.13187E+02
      2.04     0.12    0.55     1.6 0.959E-02   0.55     1.34    0.55    0.00
.13420E+02
      2.07     0.12    0.55     1.6 0.957E-02   0.55     1.35    0.55    0.00
.13653E+02
      2.11     0.12    0.55     1.6 0.954E-02   0.55     1.35    0.55    0.00
.13887E+02
      2.14     0.12    0.55     1.6 0.952E-02   0.55     1.36    0.55    0.00
.14120E+02
      2.18     0.12    0.55     1.6 0.949E-02   0.55     1.37    0.55    0.00
.14353E+02
      2.22     0.12    0.55     1.6 0.947E-02   0.55     1.37    0.55    0.00
.14586E+02
      2.25     0.12    0.55     1.6 0.945E-02   0.55     1.38    0.55    0.00
.14819E+02
      2.29     0.12    0.55     1.6 0.942E-02   0.55     1.39    0.55    0.00
.15052E+02
      2.32     0.12    0.55     1.6 0.940E-02   0.55     1.39    0.55    0.00
.15285E+02
      2.36     0.12    0.55     1.6 0.937E-02   0.55     1.40    0.55    0.00
.15519E+02
 Cumulative travel time =          15.5186 sec  (    0.00 hrs)

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Due to the attachment or proximity of the plume to the bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
-------------------------------------------------------------------------------
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.358E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.895E-02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      2.36     0.12    0.55     1.6 0.937E-02   0.55     1.40    0.55    0.00
.15519E+02
```

12.31	0.12	0.55	2.2	0.675E-02	0.55	1.94	0.55	0.00
.80036E+02								
22.27	0.12	0.55	2.7	0.555E-02	0.55	2.36	0.55	0.00
.14455E+03								
32.22	0.12	0.55	3.1	0.482E-02	0.55	2.72	0.55	0.00
.20907E+03								
42.17	0.12	0.55	3.5	0.432E-02	0.55	3.04	0.55	0.00
.27359E+03								
52.12	0.12	0.55	3.8	0.395E-02	0.55	3.32	0.55	0.00
.33811E+03								
62.08	0.12	0.55	4.1	0.366E-02	0.55	3.58	0.55	0.00
.40262E+03								
72.03	0.12	0.55	4.4	0.342E-02	0.55	3.83	0.55	0.00
.46714E+03								
81.98	0.12	0.55	4.6	0.323E-02	0.55	4.06	0.55	0.00
.53166E+03								
91.94	0.12	0.55	4.9	0.307E-02	0.55	4.28	0.55	0.00
.59617E+03								
101.89	0.12	0.55	5.1	0.292E-02	0.55	4.48	0.55	0.00
.66069E+03								
111.84	0.12	0.55	5.4	0.280E-02	0.55	4.68	0.55	0.00
.72521E+03								
121.79	0.12	0.55	5.6	0.269E-02	0.55	4.87	0.55	0.00
.78973E+03								
131.75	0.12	0.55	5.8	0.259E-02	0.55	5.05	0.55	0.00
.85424E+03								
141.70	0.12	0.55	6.0	0.251E-02	0.55	5.23	0.55	0.00
.91876E+03								
151.65	0.12	0.55	6.2	0.243E-02	0.55	5.40	0.55	0.00
.98328E+03								
161.60	0.12	0.55	6.4	0.236E-02	0.55	5.57	0.55	0.00
.10478E+04								
171.56	0.12	0.55	6.6	0.229E-02	0.55	5.73	0.55	0.00
.11123E+04								
181.51	0.12	0.55	6.7	0.223E-02	0.55	5.88	0.55	0.00
.11768E+04								
191.46	0.12	0.55	6.9	0.217E-02	0.55	6.04	0.55	0.00
.12413E+04								
201.42	0.12	0.55	7.1	0.212E-02	0.55	6.19	0.55	0.00
.13059E+04								
211.37	0.12	0.55	7.2	0.207E-02	0.55	6.33	0.55	0.00
.13704E+04								
221.32	0.12	0.55	7.4	0.203E-02	0.55	6.47	0.55	0.00
.14349E+04								
231.27	0.12	0.55	7.6	0.198E-02	0.55	6.61	0.55	0.00
.14994E+04								
241.23	0.12	0.55	7.7	0.194E-02	0.55	6.75	0.55	0.00
.15639E+04								
251.18	0.12	0.55	7.9	0.191E-02	0.55	6.88	0.55	0.00
.16285E+04								
261.13	0.12	0.55	8.0	0.187E-02	0.55	7.01	0.55	0.00
.16930E+04								
271.09	0.12	0.55	8.2	0.184E-02	0.55	7.14	0.55	0.00
.17575E+04								
281.04	0.12	0.55	8.3	0.181E-02	0.55	7.26	0.55	0.00
.18220E+04								
290.99	0.12	0.55	8.5	0.178E-02	0.55	7.39	0.55	0.00
.18865E+04								
300.94	0.12	0.55	8.6	0.175E-02	0.55	7.51	0.55	0.00
.19510E+04								
310.90	0.12	0.55	8.7	0.172E-02	0.55	7.63	0.55	0.00
.20156E+04								
320.85	0.12	0.55	8.9	0.169E-02	0.55	7.75	0.55	0.00

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.20801E+04
    330.80     0.12    0.55     9.0 0.167E-02   0.55     7.86    0.55    0.00
.21446E+04
    340.76     0.12    0.55     9.1 0.164E-02   0.55     7.98    0.55    0.00
.22091E+04
    350.71     0.12    0.55     9.3 0.162E-02   0.55     8.09    0.55    0.00
.22736E+04
 The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel
     width during the current prediction interval.
 The x-coordinate of bank attachment is     351.43 m.
    360.66     0.12    0.55     9.4 0.160E-02   0.55     8.10    0.55    0.00
.23381E+04
 Effluent is FULLY MIXED over the entire channel cross-section.
 Except for possible far-field decay or reaction processes, there are
     NO FURTHER CHANGES with downstream direction.
    370.61     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.24027E+04
    380.57     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.24672E+04
    390.52     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.25317E+04
    400.47     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.25962E+04
    410.42     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.26607E+04
    420.38     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.27252E+04
    430.33     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.27898E+04
    440.28     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.28543E+04
    450.24     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.29188E+04
    460.19     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.29833E+04
    470.14     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.30478E+04
    480.09     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.31123E+04
    490.05     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.31769E+04
    500.00     0.12    0.55     9.3 0.162E-02   0.55     8.10    0.55    0.00
.32414E+04
 Cumulative travel time =        3241.3823 sec  (    0.90 hrs)

 Simulation limit based on maximum specified distance =    500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
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CORMIX1 PREDICTION FILE:
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X-axis points downstream, Y-axis points to left, Z-axis points upward.

NSTEP = 50 display intervals per module

BEGIN MOD101: DISCHARGE MODULE

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.40	1.0	0.976E+00	0.14	2.282	.00000E+00

END OF MOD101: DISCHARGE MODULE

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

Jet-like motion in weak crossflow.
UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
Following MOD133 will include recirculation into jet region.

Zone of flow establishment: THETAE= -59.97 SIGMAE= 272.78
LE = 1.14 XE = 0.01 YE = -0.57 ZE = -0.59

Profile definitions:
B = Gaussian 1/e (37%) half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.40	1.0	0.976E+00	0.14	2.282	.00000E+00
0.01	-0.57	-0.59	1.0	0.976E+00	0.14	2.282	.00000E+00
0.01	-0.57	-0.59	1.0	0.976E+00	0.14	2.282	.00000E+00

Cumulative travel time = 0.0000 sec (0.00 hrs)

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

Control volume inflow:

X	Y	Z	S	C	B	TT
0.01	-0.57	-0.59	1.0	0.976E+00	0.14	.00000E+00

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
-0.13	-0.57	0.40	1.0	0.976E+00	0.00	0.00	0.40	0.40	.00000E+00
-0.07	-0.57	0.40	1.0	0.976E+00	0.40	0.59	0.40	0.00	

```
.00000E+00
     -0.02    -0.57    0.40     1.0 0.976E+00   0.40     0.83    0.40    0.00
.00000E+00
      0.04    -0.57    0.40     1.0 0.972E+00   0.40     1.02    0.40    0.00
.15942E+00
      0.09    -0.57    0.40     1.1 0.927E+00   0.40     1.18    0.40    0.00
.56402E+00
      0.14    -0.57    0.40     1.1 0.858E+00   0.40     1.32    0.40    0.00
.96862E+00
      0.20    -0.57    0.40     1.2 0.795E+00   0.40     1.44    0.40    0.00
.13732E+01
      0.25    -0.57    0.40     1.3 0.749E+00   0.40     1.56    0.40    0.00
.17778E+01
      0.31    -0.57    0.40     1.4 0.722E+00   0.40     1.67    0.40    0.00
.21824E+01
      0.36    -0.57    0.40     1.4 0.707E+00   0.40     1.77    0.40    0.00
.25870E+01
      0.41    -0.57    0.40     1.4 0.697E+00   0.40     1.87    0.40    0.00
.29916E+01
 Cumulative travel time =           2.9916 sec  (    0.00 hrs)

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some lateral boundary interaction occurs at end of the near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Discharge is non-buoyant or weakly buoyant.
 Therefore BUOYANT SPREADING REGIME is ABSENT.

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Due to the attachment or proximity of the plume to the bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.265E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.663E-02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
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BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
0.41	0.23	0.40	1.4	0.697E+00	0.48	3.11	0.40	0.00	.29916E+01
10.41	0.23	0.40	1.5	0.656E+00	0.40	3.29	0.40	0.00	.59120E+02
20.40	0.23	0.40	1.6	0.621E+00	0.40	3.46	0.40	0.00	.11525E+03
30.39	0.23	0.40	1.6	0.591E+00	0.40	3.63	0.40	0.00	.17138E+03
40.38	0.23	0.40	1.7	0.565E+00	0.40	3.79	0.40	0.00	.22750E+03
50.37	0.23	0.40	1.8	0.541E+00	0.40	3.94	0.40	0.00	.28363E+03
60.36	0.23	0.40	1.8	0.520E+00	0.40	4.08	0.40	0.00	.33976E+03
70.36	0.23	0.40	1.9	0.501E+00	0.40	4.22	0.40	0.00	.39589E+03
80.35	0.23	0.40	2.0	0.484E+00	0.40	4.36	0.40	0.00	.45202E+03
90.34	0.23	0.40	2.0	0.468E+00	0.40	4.49	0.40	0.00	.50815E+03
100.33	0.23	0.40	2.1	0.454E+00	0.40	4.62	0.40	0.00	.56427E+03
110.32	0.23	0.40	2.1	0.441E+00	0.40	4.75	0.40	0.00	.62040E+03
120.31	0.23	0.40	2.2	0.428E+00	0.40	4.87	0.40	0.00	.67653E+03
130.31	0.23	0.40	2.2	0.417E+00	0.40	4.99	0.40	0.00	.73266E+03
140.30	0.23	0.40	2.3	0.406E+00	0.40	5.10	0.40	0.00	.78879E+03
150.29	0.23	0.40	2.3	0.396E+00	0.40	5.21	0.40	0.00	.84491E+03
160.28	0.23	0.40	2.4	0.386E+00	0.40	5.33	0.40	0.00	.90104E+03
170.27	0.23	0.40	2.4	0.377E+00	0.40	5.43	0.40	0.00	.95717E+03
180.26	0.23	0.40	2.5	0.369E+00	0.40	5.54	0.40	0.00	.10133E+04
190.26	0.23	0.40	2.5	0.361E+00	0.40	5.64	0.40	0.00	.10694E+04
200.25	0.23	0.40	2.6	0.353E+00	0.40	5.75	0.40	0.00	.11256E+04
210.24	0.23	0.40	2.6	0.346E+00	0.40	5.85	0.40	0.00	.11817E+04
220.23	0.23	0.40	2.7	0.339E+00	0.40	5.95	0.40	0.00	.12378E+04

WATER QUALITY STANDARD OR CCC HAS BEEN FOUND
The pollutant concentration in the plume falls below water quality standard or CCC value of 0.336E+00 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality standard or CCC value.

230.22	0.23	0.40	2.7	0.333E+00	0.40	6.04	0.40	0.00

.12939E+04
240.22 0.23 0.40 2.8 0.326E+00 0.40 6.14 0.40 0.00
.13501E+04
250.21 0.23 0.40 2.8 0.320E+00 0.40 6.24 0.40 0.00
.14062E+04
260.20 0.23 0.40 2.9 0.315E+00 0.40 6.33 0.40 0.00
.14623E+04
270.19 0.23 0.40 2.9 0.309E+00 0.40 6.42 0.40 0.00
.15185E+04
280.18 0.23 0.40 2.9 0.304E+00 0.40 6.51 0.40 0.00
.15746E+04
290.17 0.23 0.40 3.0 0.299E+00 0.40 6.60 0.40 0.00
.16307E+04
300.17 0.23 0.40 3.0 0.294E+00 0.40 6.69 0.40 0.00
.16868E+04
The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel width during the current prediction interval.
The x-coordinate of bank attachment is 301.63 m.
310.16 0.23 0.40 3.1 0.289E+00 0.40 6.70 0.40 0.00
.17430E+04
Effluent is FULLY MIXED over the entire channel cross-section.
Except for possible far-field decay or reaction processes, there are NO FURTHER CHANGES with downstream direction.
320.15 0.23 0.40 3.0 0.291E+00 0.40 6.70 0.40 0.00
.17991E+04
330.14 0.23 0.40 3.0 0.291E+00 0.40 6.70 0.40 0.00
.18552E+04
340.13 0.23 0.40 3.0 0.290E+00 0.40 6.70 0.40 0.00
.19114E+04
350.12 0.23 0.40 3.0 0.289E+00 0.40 6.70 0.40 0.00
.19675E+04
360.12 0.23 0.40 3.0 0.288E+00 0.40 6.70 0.40 0.00
.20236E+04
370.11 0.23 0.40 3.0 0.287E+00 0.40 6.70 0.40 0.00
.20797E+04
380.10 0.23 0.40 3.0 0.286E+00 0.40 6.70 0.40 0.00
.21359E+04
390.09 0.23 0.40 3.0 0.285E+00 0.40 6.70 0.40 0.00
.21920E+04
400.08 0.23 0.40 3.0 0.284E+00 0.40 6.70 0.40 0.00
.22481E+04
410.07 0.23 0.40 3.0 0.283E+00 0.40 6.70 0.40 0.00
.23042E+04
420.07 0.23 0.40 3.0 0.282E+00 0.40 6.70 0.40 0.00
.23604E+04
430.06 0.23 0.40 3.0 0.281E+00 0.40 6.70 0.40 0.00
.24165E+04
440.05 0.23 0.40 3.0 0.280E+00 0.40 6.70 0.40 0.00
.24726E+04
450.04 0.23 0.40 3.0 0.279E+00 0.40 6.70 0.40 0.00
.25288E+04
460.03 0.23 0.40 3.0 0.279E+00 0.40 6.70 0.40 0.00
.25849E+04
470.03 0.23 0.40 3.0 0.278E+00 0.40 6.70 0.40 0.00
.26410E+04
480.02 0.23 0.40 3.0 0.277E+00 0.40 6.70 0.40 0.00
.26971E+04
490.01 0.23 0.40 3.0 0.276E+00 0.40 6.70 0.40 0.00
.27533E+04
500.00 0.23 0.40 3.0 0.275E+00 0.40 6.70 0.40 0.00
.28094E+04
Cumulative travel time = 2809.4004 sec (0.78 hrs)

 Simulation limit based on maximum specified distance = 500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX1: Single Port Discharges End of Prediction File
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CORMIX1 PREDICTION FILE:
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                      CORMIX MIXING ZONE EXPERT SYSTEM
                  Subsystem CORMIX1: Single Port Discharges
                             CORMIX Version 9.0GT
                    HYDRO1 Version 9.0.0.0 September 2014
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CASE DESCRIPTION
 Site name/label:   Willow-Creek
 Design case:       Full Build Out-Winter-Ammonia
 FILE NAME:         E:\Midhurst\FBO-winter ammonia.prd
 Time stamp:        Tue Mar  8 12:42:26 2016

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =      8.10  AS    =      6.32  QA    =      0.90  ICHREG= 2
 HA    =      0.78  HD    =      0.55
 UA    =     0.142  F     =     0.418 USTAR =0.3255E-01
 UW    =     2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  999.9750

DISCHARGE PARAMETERS (metric units)
 Above Surface Discharge:
 Re-computed discharge conditions at entry point at water surface.
 BANK  =  LEFT      DISTB =      0.23
 D0    =     0.282 A0    =     0.062 H0    =      0.55  SUB0  =      0.00
 THETA =      0.00  SIGMA =    270.00
 U0    =     2.282 Q0    =     0.142       =0.1425E+00
 RHO0  =  999.3789  DRHO0 =0.5961E+00  GP0   =0.5846E-02
 C0    =0.1976E+01  CUNITS=  mg/l
 IPOLL =  1         KS    =0.0000E+00  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.1425E+00  M0    =0.3252E+00  J0    =0.8330E-03  SIGNJ0=      1.0
 Associated length scales (meters)
 LQ    =      0.25  LM    =     14.92  Lm    =      4.00  Lb    =      0.29
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     56.22  R     =     16.02

FLOW CLASSIFICATION
 11111111111111111111111111111111111111111
 1  Flow class (CORMIX1)      =    IPV4   1
 1  Applicable layer depth HS =    0.55   1
 1  Limiting Dilution S =QA/Q0=     7.32  1
 11111111111111111111111111111111111111111

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1976E+01  CUNITS=  mg/l
 NTOX  =  0
 NSTD  =  1         CSTD  =0.9360E+00
 REGMZ =  0
 XINT  =    500.00  XMAX  =    500.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and below the center of the port:
         0.23 m  from the LEFT  bank/shore.
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X-axis points downstream, Y-axis points to left, Z-axis points upward.

NSTEP = 50 display intervals per module

BEGIN MOD101: DISCHARGE MODULE

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.55	1.0	0.198E+01	0.14	2.282	.00000E+00

END OF MOD101: DISCHARGE MODULE

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

Jet-like motion in weak crossflow.
UNSTABLE NEAR-FIELD: Jet/plume will mix over full layer depth.
Following MOD133 will include recirculation into jet region.

Zone of flow establishment: THETAE= -59.97 SIGMAE= 272.96
LE = 1.13 XE = 0.01 YE = -0.56 ZE = -0.43

Profile definitions:
B = Gaussian 1/e (37%) half-width, normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time

X	Y	Z	S	C	B	Uc	TT
0.00	0.00	0.55	1.0	0.198E+01	0.14	2.282	.00000E+00
0.01	-0.56	-0.43	1.0	0.198E+01	0.14	2.282	.00000E+00
0.01	-0.56	-0.43	1.0	0.198E+01	0.14	2.282	.00000E+00

Cumulative travel time = 0.0000 sec (0.00 hrs)

END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING

Control volume inflow:

X	Y	Z	S	C	B	TT
0.01	-0.56	-0.43	1.0	0.198E+01	0.14	.00000E+00

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time

X	Y	Z	S	C	BV	BH	ZU	ZL	TT
-0.13	-0.56	0.55	1.0	0.198E+01	0.00	0.00	0.55	0.55	.00000E+00
-0.06	-0.56	0.55	1.0	0.198E+01	0.55	0.40	0.55	0.00	

```
.00000E+00
      0.01    -0.56    0.55     1.0 0.198E+01   0.55     0.57    0.55    0.00
.00000E+00
      0.08    -0.56    0.55     1.0 0.193E+01   0.55     0.70    0.55    0.00
.46553E+00
      0.15    -0.56    0.55     1.1 0.182E+01   0.55     0.81    0.55    0.00
.95060E+00
      0.22    -0.56    0.55     1.2 0.169E+01   0.55     0.90    0.55    0.00
.14357E+01
      0.29    -0.56    0.55     1.3 0.158E+01   0.55     0.99    0.55    0.00
.19207E+01
      0.36    -0.56    0.55     1.3 0.150E+01   0.55     1.07    0.55    0.00
.24058E+01
      0.43    -0.56    0.55     1.4 0.146E+01   0.55     1.14    0.55    0.00
.28909E+01
      0.50    -0.56    0.55     1.4 0.143E+01   0.55     1.21    0.55    0.00
.33759E+01
      0.56    -0.56    0.55     1.4 0.141E+01   0.55     1.27    0.55    0.00
.38610E+01
 Cumulative travel time =           3.8610 sec  (    0.00 hrs)

END OF MOD133: LAYER BOUNDARY IMPINGEMENT/FULL VERTICAL MIXING
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** End of NEAR-FIELD REGION (NFR) **

 In this design case, the discharge is located CLOSE TO BANK/SHORE.
 Some lateral boundary interaction occurs at end of the near-field.
   This may be related to a design case with a very LOW AMBIENT VELOCITY.
   The dilution values in one or more of the preceding zones may be too high.
 Carefully evaluate results in near-field and check degree of interaction.

 Consider locating outfall further away from bank or shore.
 In the next prediction module, the plume centerline will be set
   to follow the bank/shore.
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BEGIN MOD141: BUOYANT AMBIENT SPREADING

 Plume is ATTACHED to LEFT  bank/shore.
   Plume width is now determined from LEFT  bank/shore.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      0.56     0.23    0.55     1.4 0.141E+01   0.68     2.07    0.55    0.00
.38610E+01
      0.66     0.23    0.55     1.4 0.140E+01   0.55     2.08    0.55    0.00
.44403E+01
      0.76     0.23    0.55     1.4 0.140E+01   0.55     2.10    0.55    0.00
.50196E+01
      0.85     0.23    0.55     1.4 0.139E+01   0.55     2.12    0.55    0.00
.55989E+01
      0.95     0.23    0.55     1.4 0.139E+01   0.55     2.14    0.55    0.00
```

.61782E+01								
1.04	0.23	0.55	1.4	0.138E+01	0.55	2.16	0.55	0.00
.67575E+01								
1.14	0.23	0.55	1.4	0.137E+01	0.55	2.17	0.55	0.00
.73368E+01								
1.23	0.23	0.55	1.4	0.137E+01	0.55	2.19	0.55	0.00
.79161E+01								
1.33	0.23	0.55	1.5	0.136E+01	0.55	2.21	0.55	0.00
.84954E+01								
1.42	0.23	0.55	1.5	0.135E+01	0.55	2.23	0.55	0.00
.90747E+01								
1.52	0.23	0.55	1.5	0.135E+01	0.55	2.24	0.55	0.00
.96540E+01								
1.62	0.23	0.55	1.5	0.134E+01	0.55	2.26	0.55	0.00
.10233E+02								
1.71	0.23	0.55	1.5	0.134E+01	0.55	2.28	0.55	0.00
.10813E+02								
1.81	0.23	0.55	1.5	0.133E+01	0.55	2.29	0.55	0.00
.11392E+02								
1.90	0.23	0.55	1.5	0.132E+01	0.55	2.31	0.55	0.00
.11971E+02								
2.00	0.23	0.55	1.5	0.132E+01	0.55	2.33	0.55	0.00
.12551E+02								
2.09	0.23	0.55	1.5	0.131E+01	0.55	2.34	0.55	0.00
.13130E+02								
2.19	0.23	0.55	1.5	0.130E+01	0.55	2.36	0.55	0.00
.13709E+02								
2.29	0.23	0.55	1.5	0.130E+01	0.55	2.38	0.55	0.00
.14288E+02								
2.38	0.23	0.55	1.5	0.129E+01	0.55	2.39	0.55	0.00
.14868E+02								
2.48	0.23	0.55	1.5	0.129E+01	0.55	2.41	0.55	0.00
.15447E+02								
2.57	0.23	0.55	1.5	0.128E+01	0.55	2.43	0.55	0.00
.16026E+02								
2.67	0.23	0.55	1.6	0.127E+01	0.55	2.44	0.55	0.00
.16606E+02								
2.76	0.23	0.55	1.6	0.127E+01	0.55	2.46	0.55	0.00
.17185E+02								
2.86	0.23	0.55	1.6	0.126E+01	0.55	2.47	0.55	0.00
.17764E+02								
2.95	0.23	0.55	1.6	0.126E+01	0.55	2.49	0.55	0.00
.18344E+02								
3.05	0.23	0.55	1.6	0.125E+01	0.55	2.51	0.55	0.00
.18923E+02								
3.15	0.23	0.55	1.6	0.125E+01	0.55	2.52	0.55	0.00
.19502E+02								
3.24	0.23	0.55	1.6	0.124E+01	0.55	2.54	0.55	0.00
.20082E+02								
3.34	0.23	0.55	1.6	0.123E+01	0.55	2.55	0.55	0.00
.20661E+02								
3.43	0.23	0.55	1.6	0.123E+01	0.55	2.57	0.55	0.00
.21240E+02								
3.53	0.23	0.55	1.6	0.122E+01	0.55	2.58	0.55	0.00
.21819E+02								
3.62	0.23	0.55	1.6	0.122E+01	0.55	2.60	0.55	0.00
.22399E+02								
3.72	0.23	0.55	1.6	0.121E+01	0.55	2.62	0.55	0.00
.22978E+02								
3.81	0.23	0.55	1.6	0.120E+01	0.55	2.63	0.55	0.00
.23557E+02								
3.91	0.23	0.55	1.6	0.120E+01	0.55	2.65	0.55	0.00
.24137E+02								

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      4.01     0.23    0.55     1.7 0.119E+01   0.55     2.66    0.55    0.00
.24716E+02
      4.10     0.23    0.55     1.7 0.119E+01   0.55     2.68    0.55    0.00
.25295E+02
      4.20     0.23    0.55     1.7 0.118E+01   0.55     2.69    0.55    0.00
.25875E+02
      4.29     0.23    0.55     1.7 0.118E+01   0.55     2.71    0.55    0.00
.26454E+02
      4.39     0.23    0.55     1.7 0.117E+01   0.55     2.72    0.55    0.00
.27033E+02
      4.48     0.23    0.55     1.7 0.116E+01   0.55     2.74    0.55    0.00
.27612E+02
      4.58     0.23    0.55     1.7 0.116E+01   0.55     2.75    0.55    0.00
.28192E+02
      4.67     0.23    0.55     1.7 0.115E+01   0.55     2.77    0.55    0.00
.28771E+02
      4.77     0.23    0.55     1.7 0.115E+01   0.55     2.78    0.55    0.00
.29350E+02
      4.87     0.23    0.55     1.7 0.114E+01   0.55     2.80    0.55    0.00
.29930E+02
      4.96     0.23    0.55     1.7 0.114E+01   0.55     2.81    0.55    0.00
.30509E+02
      5.06     0.23    0.55     1.7 0.113E+01   0.55     2.83    0.55    0.00
.31088E+02
      5.15     0.23    0.55     1.8 0.113E+01   0.55     2.84    0.55    0.00
.31668E+02
      5.25     0.23    0.55     1.8 0.112E+01   0.55     2.85    0.55    0.00
.32247E+02
      5.34     0.23    0.55     1.8 0.111E+01   0.55     2.87    0.55    0.00
.32826E+02
 Cumulative travel time =          32.8262 sec  (    0.01 hrs)

END OF MOD141: BUOYANT AMBIENT SPREADING
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 Due to the attachment or proximity of the plume to the bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
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BEGIN MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.358E-02 m^2/s
  Horizontal diffusivity (initial value) = 0.895E-02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
TT
      5.34     0.23    0.55     1.8 0.111E+01   0.55     2.87    0.55    0.00
.32826E+02
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     15.24     0.23    0.55     1.9 0.102E+01   0.55     3.15    0.55    0.00
.92783E+02
     25.13     0.23    0.55     2.1 0.939E+00   0.55     3.41    0.55    0.00
.15274E+03
**WATER QUALITY STANDARD OR CCC HAS BEEN FOUND**
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.936E+00 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     35.02     0.23    0.55     2.3 0.877E+00   0.55     3.65    0.55    0.00
.21270E+03
     44.92     0.23    0.55     2.4 0.826E+00   0.55     3.87    0.55    0.00
.27265E+03
     54.81     0.23    0.55     2.5 0.783E+00   0.55     4.08    0.55    0.00
.33261E+03
     64.70     0.23    0.55     2.6 0.747E+00   0.55     4.28    0.55    0.00
.39257E+03
     74.60     0.23    0.55     2.8 0.714E+00   0.55     4.48    0.55    0.00
.45252E+03
     84.49     0.23    0.55     2.9 0.686E+00   0.55     4.66    0.55    0.00
.51248E+03
     94.38     0.23    0.55     3.0 0.661E+00   0.55     4.84    0.55    0.00
.57244E+03
    104.28     0.23    0.55     3.1 0.638E+00   0.55     5.01    0.55    0.00
.63239E+03
    114.17     0.23    0.55     3.2 0.618E+00   0.55     5.18    0.55    0.00
.69235E+03
    124.06     0.23    0.55     3.3 0.599E+00   0.55     5.34    0.55    0.00
.75231E+03
    133.95     0.23    0.55     3.4 0.582E+00   0.55     5.49    0.55    0.00
.81226E+03
    143.85     0.23    0.55     3.5 0.567E+00   0.55     5.64    0.55    0.00
.87222E+03
    153.74     0.23    0.55     3.6 0.552E+00   0.55     5.79    0.55    0.00
.93217E+03
    163.63     0.23    0.55     3.7 0.539E+00   0.55     5.93    0.55    0.00
.99213E+03
    173.53     0.23    0.55     3.8 0.526E+00   0.55     6.07    0.55    0.00
.10521E+04
    183.42     0.23    0.55     3.8 0.515E+00   0.55     6.21    0.55    0.00
.11120E+04
    193.31     0.23    0.55     3.9 0.504E+00   0.55     6.35    0.55    0.00
.11720E+04
    203.21     0.23    0.55     4.0 0.494E+00   0.55     6.48    0.55    0.00
.12320E+04
    213.10     0.23    0.55     4.1 0.484E+00   0.55     6.61    0.55    0.00
.12919E+04
    222.99     0.23    0.55     4.2 0.475E+00   0.55     6.73    0.55    0.00
.13519E+04
    232.89     0.23    0.55     4.2 0.466E+00   0.55     6.86    0.55    0.00
.14118E+04
    242.78     0.23    0.55     4.3 0.458E+00   0.55     6.98    0.55    0.00
.14718E+04
    252.67     0.23    0.55     4.4 0.450E+00   0.55     7.10    0.55    0.00
.15317E+04
    262.57     0.23    0.55     4.5 0.443E+00   0.55     7.22    0.55    0.00
.15917E+04
    272.46     0.23    0.55     4.5 0.436E+00   0.55     7.33    0.55    0.00
.16517E+04
    282.35     0.23    0.55     4.6 0.429E+00   0.55     7.45    0.55    0.00
.17116E+04
    292.24     0.23    0.55     4.7 0.423E+00   0.55     7.56    0.55    0.00
.17716E+04
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    302.14     0.23    0.55     4.7 0.417E+00   0.55     7.67    0.55    0.00
.18315E+04
    312.03     0.23    0.55     4.8 0.411E+00   0.55     7.78    0.55    0.00
.18915E+04
    321.92     0.23    0.55     4.9 0.405E+00   0.55     7.89    0.55    0.00
.19514E+04
    331.82     0.23    0.55     4.9 0.400E+00   0.55     7.99    0.55    0.00
.20114E+04
    341.71     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.20714E+04
 The passive diffusion plume becomes LATERALLY FULLY MIXED over the channel
     width during the current prediction interval.
 The x-coordinate of bank attachment is     341.93 m.
    351.60     0.23    0.55     5.1 0.390E+00   0.55     8.10    0.55    0.00
.21313E+04
 Effluent is FULLY MIXED over the entire channel cross-section.
 Except for possible far-field decay or reaction processes, there are
     NO FURTHER CHANGES with downstream direction.
    361.50     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.21913E+04
    371.39     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.22512E+04
    381.28     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.23112E+04
    391.18     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.23711E+04
    401.07     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.24311E+04
    410.96     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.24910E+04
    420.86     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.25510E+04
    430.75     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.26110E+04
    440.64     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.26709E+04
    450.53     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.27309E+04
    460.43     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.27908E+04
    470.32     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.28508E+04
    480.21     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.29107E+04
    490.11     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.29707E+04
    500.00     0.23    0.55     5.0 0.395E+00   0.55     8.10    0.55    0.00
.30307E+04
 Cumulative travel time =        3030.6555 sec  (    0.84 hrs)

 Simulation limit based on maximum specified distance =    500.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD161: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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CORMIX1: Single Port Discharges              End of Prediction File
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Appendix I. Results of QUAL2K Far Field Modelling

Phase 1 QUAL2K Results

Reach Label	x(km)	cond (umhos)	DO(mgO2/L)	BODf (mgO2/L	No(ugN/L)	NH4(ugN/L)	NO3(ugN/L)	Po (ugP/L)
Mainstem headwa	5.81	514.00	10.16	1.00	480.00	25.00	846.00	27.00
WC0	5.64	514.00	9.70	0.90	460.19	34.72	848.50	25.94
WC1	5.25	571.10	8.68	2.64	460.55	230.56	3038.39	22.64
WC1	4.82	571.10	8.45	2.33	441.08	211.14	3058.38	21.74
WC1	4.40	571.10	8.31	2.05	422.43	193.09	3075.93	20.88
WC1	3.97	571.10	8.23	1.81	404.57	176.29	3091.18	20.05
WC2	3.59	571.10	8.20	1.67	394.13	165.79	3100.23	19.57
WC2	3.25	571.10	8.18	1.54	383.95	155.58	3108.54	19.10
WC2	2.91	571.10	8.16	1.41	374.03	145.70	3116.08	18.65
WC3	2.39	571.10	8.16	1.15	342.82	124.14	3125.83	17.16
WC3	1.71	571.10	8.14	0.92	314.13	103.84	3131.18	15.80
WC3	1.03	571.10	8.10	0.74	287.76	85.60	3132.23	14.54
WC3	0.34	571.10	8.07	0.59	263.55	69.74	3129.39	13.38
Terminus	0.00	571.10	8.07	0.59	263.55	69.74	3129.39	13.38

Full Build Out QUAL2K Results

Reach Label	x(km)	cond (umhos)	DO(mgO2/L)	BODf (mgO2/L	No(ugN/L)	NH4(ugN/L)	NO3(ugN/L)	Po (ugP/L)
Mainstem headwa	5.81	514.00	10.16	1.00	480.00	25.00	846.00	27.00
WC0	5.64	514.00	9.69	0.90	459.78	34.94	848.52	25.92
WC1	5.25	610.08	8.26	3.91	475.67	250.88	4639.12	20.20
WC1	4.82	610.08	8.03	3.47	457.40	228.45	4655.59	19.48
WC1	4.40	610.08	7.91	3.08	439.82	207.73	4669.48	18.78
WC1	3.97	610.08	7.85	2.73	422.91	188.62	4680.95	18.11
WC2	3.59	610.08	7.84	2.53	413.02	176.89	4687.69	17.72
WC2	3.25	610.08	7.83	2.34	403.36	165.61	4693.61	17.34
WC2	2.91	610.08	7.83	2.16	393.92	154.82	4698.72	16.96
WC3	2.39	610.08	7.91	1.77	363.91	131.56	4699.42	15.74
WC3	1.71	610.08	7.95	1.44	336.12	110.28	4695.58	14.60
WC3	1.03	610.08	7.96	1.17	310.37	91.37	4687.47	13.54
WC3	0.34	610.08	7.96	0.94	286.54	74.98	4675.62	12.56
Terminus	0.00	610.08	7.96	0.94	286.54	74.98	4675.62	12.56

Phase 1 QUAL2K Results

							Bot Algae	
Reach Label	Inorg P (ugP/L)	Phyto (ugA/L)	Detritus (mgD/L)	Pathogen	Alk	pH	(mgA/m2)	TOC
Mainstem headwa	4.00	0.50	5.00	432.00	197.00	8.40	0.00	2.39
WC0	3.99	0.48	4.91	326.42	196.98	8.40	51.65	2.32
WC1	9.17	0.40	4.39	259.88	194.23	8.31	37.05	2.75
WC1	9.04	0.38	4.31	221.17	194.01	8.28	37.58	2.60
WC1	8.93	0.37	4.23	189.34	193.81	8.27	38.00	2.47
WC1	8.83	0.36	4.15	162.79	193.62	8.26	38.33	2.35
WC2	8.77	0.35	4.10	139.35	193.51	8.26	60.00	2.27
WC2	8.71	0.34	4.05	121.79	193.41	8.26	60.84	2.21
WC2	8.66	0.33	4.01	107.99	193.30	8.27	61.57	2.14
WC3	8.59	0.31	3.85	80.93	193.07	8.30	64.05	1.98
WC3	8.54	0.29	3.70	61.29	192.86	8.33	64.82	1.83
WC3	8.52	0.27	3.55	46.43	192.69	8.36	64.90	1.71
WC3	8.52	0.25	3.41	34.99	192.54	8.39	64.46	1.59
Terminus	8.52	0.25	3.41	34.99	192.54	8.39	64.46	1.59

Full Build Out QUAL2K Results

							Bot Algae	
Reach Label	Inorg P (ugP/L)	Phyto (ugA/L)	Detritus (mgD/L)	Pathogen	Alk	pH	(mgA/m2)	TOC
Mainstem headwa	4.00	0.50	5.00	432.00	197.00	8.40	0.00	2.39
WC0	3.99	0.48	4.90	325.45	196.98	8.40	51.76	2.31
WC1	8.85	0.35	4.11	250.61	192.50	8.25	37.03	3.11
WC1	8.75	0.34	4.04	215.08	192.28	8.21	37.53	2.92
WC1	8.65	0.33	3.97	185.69	192.07	8.19	37.93	2.75
WC1	8.57	0.32	3.90	161.04	191.88	8.18	38.25	2.59
WC2	8.52	0.31	3.86	138.70	191.76	8.18	59.85	2.50
WC2	8.48	0.30	3.82	121.93	191.65	8.18	60.63	2.41
WC2	8.43	0.30	3.79	108.80	191.55	8.18	61.32	2.33
WC3	8.36	0.28	3.65	82.86	191.31	8.21	63.84	2.13
WC3	8.32	0.26	3.52	63.83	191.10	8.25	64.68	1.95
WC3	8.29	0.24	3.39	49.25	190.93	8.28	64.87	1.80
WC3	8.28	0.23	3.27	37.85	190.77	8.32	64.57	1.67
Terminus	8.28	0.23	3.27	37.85	190.77	8.32	64.57	1.67

Phase 1 QUAL2K Results

				TSS				
Reach Label	TN	TP	TKN	(mgD/L)	CBODu	NH3	DO sat	pHsat
Mainstem headwa	1354.60	31.50	508.60	13.85	6.43	1.99	9.24	8.71
WC0	1346.89	30.41	498.39	12.90	6.23	2.86	9.16	8.72
WC1	3732.36	32.21	693.97	10.80	7.40	15.97	9.08	8.71
WC1	3713.36	31.16	654.98	10.08	7.00	14.08	9.04	8.71
WC1	3694.11	30.18	618.18	9.43	6.64	12.67	9.01	8.71
WC1	3674.61	29.24	583.42	8.84	6.31	11.57	8.97	8.71
WC2	3662.66	28.69	562.42	8.50	6.12	11.09	8.92	8.71
WC2	3650.52	28.16	541.98	8.19	5.93	10.65	8.87	8.71
WC2	3638.20	27.64	522.12	7.89	5.76	10.23	8.82	8.71
WC3	3595.01	26.06	469.18	7.02	5.32	9.83	8.68	8.72
WC3	3551.22	24.63	420.04	6.29	4.93	9.19	8.56	8.72
WC3	3507.52	23.33	375.28	5.67	4.59	8.38	8.45	8.72
WC3	3464.46	22.15	335.07	5.14	4.29	7.48	8.35	8.73
Terminus	3464.46	22.15	335.07	5.14	4.29	7.48	8.35	8.73

Full Build Out QUAL2K Results

				TSS				
Reach Label	TN	TP	TKN	(mgD/L)	CBODu	NH3	DO sat	pHsat
Mainstem headwa	1354.60	31.50	508.60	13.85	6.43	1.99	9.24	8.71
WC0	1346.72	30.39	498.20	12.88	6.23	2.88	9.16	8.72
WC1	5368.20	29.41	729.08	10.01	8.37	15.50	9.06	8.70
WC1	5343.88	28.56	688.29	9.41	7.86	13.22	9.02	8.70
WC1	5319.38	27.76	649.91	8.86	7.39	11.60	8.99	8.70
WC1	5294.76	27.00	613.81	8.36	6.97	10.40	8.96	8.70
WC2	5279.83	26.55	592.14	8.07	6.72	9.86	8.91	8.70
WC2	5264.76	26.11	571.15	7.79	6.49	9.40	8.87	8.70
WC2	5249.58	25.69	550.86	7.53	6.26	8.98	8.82	8.71
WC3	5196.89	24.37	497.47	6.77	5.72	8.66	8.70	8.71
WC3	5143.84	23.17	448.26	6.11	5.25	8.17	8.58	8.71
WC3	5090.95	22.07	403.48	5.55	4.84	7.56	8.48	8.71
WC3	5038.76	21.07	363.14	5.07	4.49	6.87	8.39	8.72
Terminus	5038.76	21.07	363.14	5.07	4.49	6.87	8.39	8.72

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Technical Memorandum

Date: **February 7, 2017**

To: **Joe Mullan (Ainley and Associates)**

From: **Neil Hutchinson, Brent Parsons**

Re: **Hine's Emerald Dragonfly Habitat in the Minesing Wetlands and the Midhurst Development**

The Hine's Emerald Dragonfly (HED; *Somatochlora hineana*) is listed as endangered federally and provincially and its habitat is protected and regulated under Ontario's *Endangered Species Act* (2007). It is found in Wisconsin, Michigan, Illinois, Missouri and in one section of the Minesing wetland in Ontario and is considered rare throughout its range (COSEWIC 2011). This memo reviews the characteristics of the HED habitat and the proposed Midhurst Development to determine the potential for interaction of the development with regulated HED habitat.

The development of the Midhurst Secondary Plan (the "Midhurst Development") is >5 km from the regulated HED habitat in the Minesing wetland (Figure 1) and so there is no potential for direct effects on habitat. HED habitat is associated with areas of groundwater upwelling however, and so this memo examines how groundwater pumping for water supply to the development may interact with HED habitat and reviews the management activities that will assure there is no impact to HED or its habitat.

Areas of potential interference to HED habitat were determined by delineation of regulated HED habitat based on a literature review of publicly available HED habitat documentation. This information was combined with post-development surface water levels for the Minesing Wetlands, as modelled by Golder Associates Ltd. (Golder's) hydrological/hydrogeological model for the Midhurst development (Golder 2017).

Species and Habitat Description

Females lay eggs in moist sediment or shallow water and eggs hatch into larvae that live in the wetland for 3-5 years before crawling up emergent vegetation, shedding their exoskeleton and emerging as adults. This likely occurs between early and mid-June in Ontario (COSEWIC 2011). The larvae are associated with Digger Crayfish (*Fallicambarus fodiens*) because crayfish burrows provide refuge against drought conditions in summer and freezing conditions in winter. Adults live up to 4 to 5 weeks, with males generally occurring in seepage areas and fens and females in dry meadow habitat (Pulfer et al. 2013; USFWS 2013).

Habitat in the Minesing Wetlands in the vicinity of the HED observations is characterized as calcareous wetlands with groundwater high in bicarbonate, carbonate and alkalinity, and vegetation in a wet/saturated state dominated by grasses and fed primarily from intermittent seeps of groundwater (COSEWIC 2011; Post et al. 2015).

Species Occurrences

The first HED discovery in Canada occurred on June 20, 2007 in the Minesing Wetlands when Chris Evans captured an adult male HED (COSEWIC 2011). Additional HED were observed during focused surveys (238 person hours) of 28 sites during 2007, 2008 and 2009, including the observation of larvae on July 7, 2008 while pumping water into crayfish burrows.

We searched the Natural Heritage Information Centre (NHIC) for records of species occurrences of HED in the area noted in COSEWIC (2011). A number of 1 km x 1 km grids contained an occurrence of HED, with the latest observation dated June 22, 2009. A study by Post et al. (2015) focuss only on a description of monitoring efforts and groundwater well locations within "areas of known co-occurrence of HED and digger crayfish" and did not include document any additional observations of HED. These wells were the most precise locations of known Ontario HED habitat identified in our literature review and were used in our delineation of regulated habitat (Figure 1).

Habitat Regulation

HED habitat is protected under Ontario's *Endangered Species Act*. Ontario Regulation 242/08 describes HED habitat as the following:

- Category 1

  Any part of a fen, marsh, seepage area, pond or other body of water, including a vernal or other temporary pool, that is being used, or has been used at any time in the past, by HED for egg laying or larval development.

  Areas classified as Category 1 have the lowest tolerance to alteration.

- Category 2

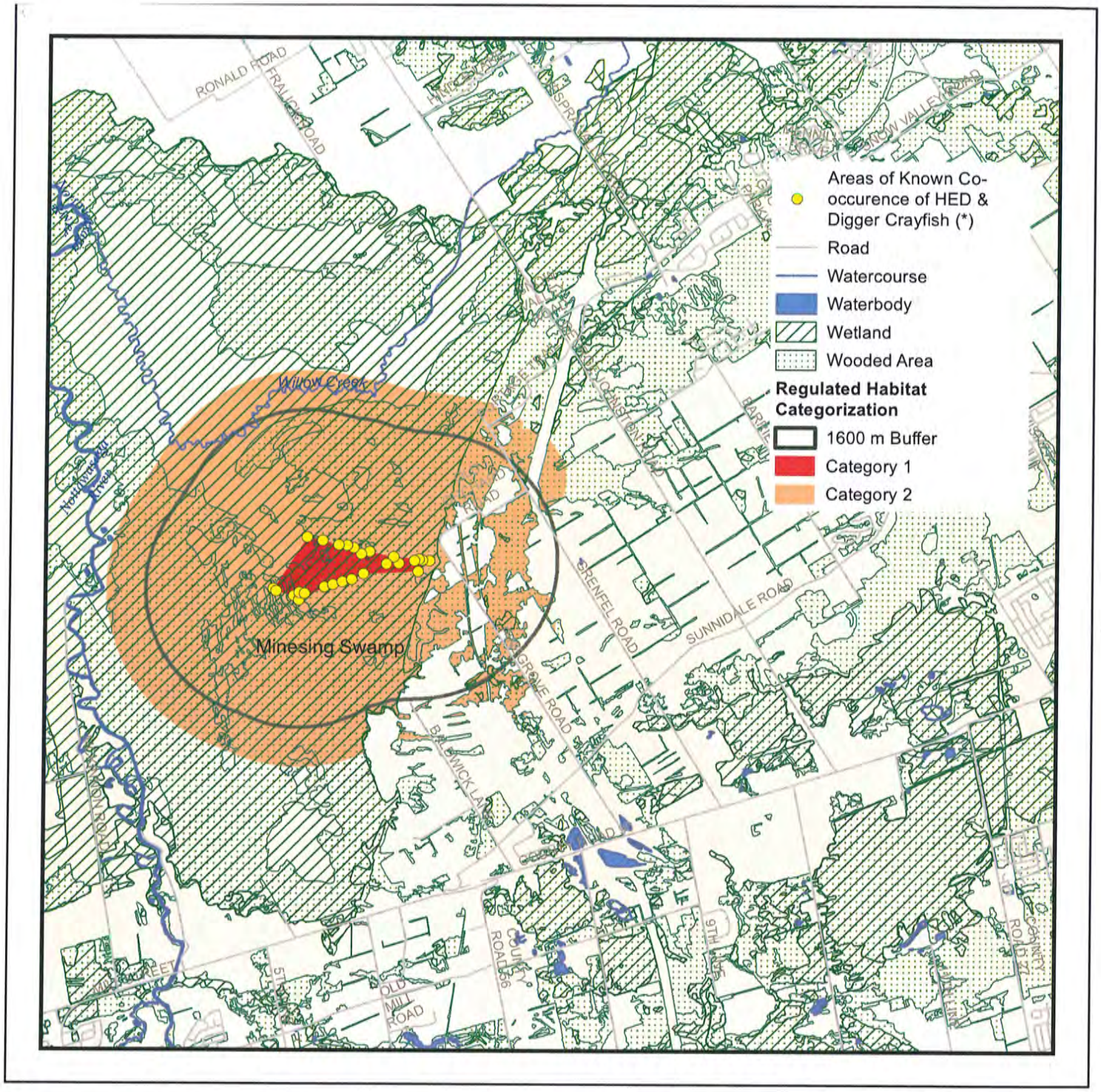
  Any part of a wetland, watercourse, pond or other body of water, including a vernal or other temporary pool, up to the high water mark, that is within 1600 metres of an area used for egg laying or larval development.

  AND

  Any area that does not have an impervious surface and that is within 500 metres of the wetland or aquatic features described in #2. Areas that do not allow water infiltration into the soil (e.g., roads and buildings) are not included in the 500 m area.

  Areas classified as Category 2 have a moderate tolerance to alteration.

Category 1 and 2 regulated HED habitat is presented in Figure 1 based on areas of known co-occurrence of HED and digger crayfish (Post et al. 2015). All regulated Category 1 and 2 habitat areas are >4 km from the boundaries of the Midhurst Secondary Plan Area (MSPA, Figure 2).





(*)Post, R., McPhie, St., and J. Spoelstra. 2015. Hydrogeological and Geochemical Evaluation of the Eastern Minesing Wetland in Support of the Hine's Emerald Dragonfly (Sometochlora hineana). Nottawasaga Valley Conservation Authority.

Figure 1:
Regulated Hine's Emerald Dragonfly Habitat in the Minesing Wetlands

Project: Midhurst Secondary Plan
Project #: 130030

Project Lead: Brent Parsons
Prepared by: Eric Dilligeard
Data Source: HESL,Ontario Land
Coordinate System: NAD 1983 UTM Zone 17N

May 2, 2016

Hutchinson Environmental Sciences Ltd.

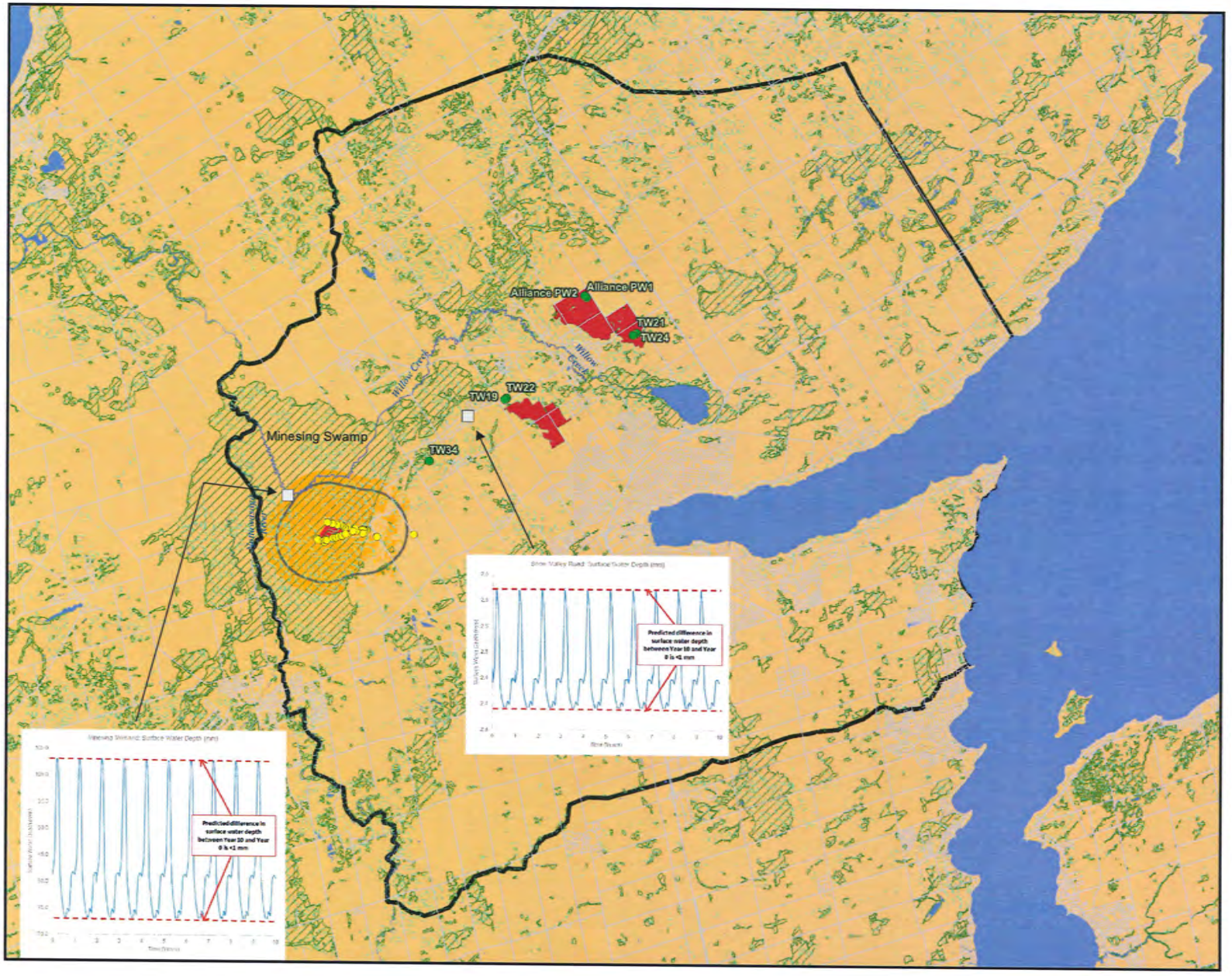


Figure 2:
Regulated Hine's Emerald Dragonfly Habitat and Golder Hydrological/Hydrogeological Model Results

- Surface Water Model Sites
- Pumping Well
- Areas of Known Co-occurence of HED & Digger Crayfish
- Road
- Watercourse
- Wooded Area
- Waterbody
- Golder Model Domain
- Wetland
- Proposed Carson, Doran and Midhurst Heights Neighbourhood Boundaries

Regulated Habitat Categorization

- 1600 m Buffer
- Category 1
- Category 2





Prepared by: Eric Dilligeard
Data Source: HESL, Golder Associates, Ontario Land
Coordinate System: NAD 1983 UTM Zone 17N

Project Lead: Brent Parsons
Project: Midhurst Secondary Plan
Project#: 130030

May 2, 2016

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Activities generally deemed incompatible with regulated habitat include alteration of aquatic or wetland habitat including changes to water quality, flows, levels, or vegetation characteristics (COSEWIC 2011). Specific threats and how these threats relate to the Minesing Wetlands include:

- Groundwater and Surface Water Levels - The impacts of the MSPA supply wells on surface water levels in and around the Minesing wetlands were predicted to be minimal by Golder's hydrological/hydrogeological model. These predictions are detailed below.
- Groundwater/Surface Water Quality - There will be no interaction of the MSPA activities with water quality in the HED habitat area as the development areas are >5km distant. Treated municipal wastewater effluent will be discharged to Willow Creek, which does not interact with the HED habitat area. The proposed effluent limits will maintain total phosphorus, dissolved oxygen and un-ionized ammonia concentrations within their respective PWQOs in Minesing Creek (HESL 2016) and will not, therefore, impact aquatic life.
- Invasion of Non-native Species - The spread of invasive non-native plant species, particularly European Common Reed (*Phragmites australis ssp. australis*) and Glossy Buckthorn (*Frangula alnus*) into the Minesing Wetlands, could threaten HED habitat but the spread will not be influenced by or altered by interactions with the Midhurst Development.
- Climate Change - Climate change and its effects on weather patterns will not be influenced by or altered by interactions with the Midhurst Development. The stormwater management plan for the development will infiltrate the first 20mm of runoff from storm events to promote groundwater recharge.

Predicted Changes in Streamflow and Surface Water Levels in and around the Minesing Wetlands due to Future Groundwater Pumping Activities

A hydrologic/hydrogeologic model was built by Golder Associates Ltd. (Golder 2017) to assess changes, if any, in surface water levels and flows at the Minesing Wetland as a result of proposed water supply pumping from development of the Midhurst Secondary Plan. The model encompassed a total area of 746 km^2 including approximately 90% of the Willow Creek Watershed, the proposed development area and all proposed water supply wells for these neighbourhoods, existing municipal supply wells in Midhurst and the City of Barrie, and other regional takings within the model area. Particular focus was given to Willow Creek and the Minesing Wetlands. The calibrated model was run for 10-year simulations and steady-state (annual average) simulations at Post-Development conditions. The model report, which includes details of the model development and results, is provided as a companion document to this memorandum (Appendix A *Report on Carson and Doran Neighbourhoods Proposed Water Supply: Supplementary Hydrologic Modelling* (Golder, January 2017).

An annual average streamflow reduction of 3% was simulated with a maximum decline of 5% occurring during summer at the Minesing Wetland. However, when inflow from the Nottawasaga River upstream of the model domain and discharge from the proposed upstream wastewater treatment plant at Willow Creek and Highway 26 were considered, these losses comprised less than 1% of the wetland's total flow and are thus considered negligible. Modelled surface water level changes in the Minesing Wetland and Snow Valley area showed a reduction of approximately 1 millimetre (mm) or less and are considered inconsequential (Golder, 2017).

Recommendations

Table 1 describes Best Management Practices that have been used to protect the largest known HED population in Wisconsin (i.e., The Ridges Sanctuary 2013). These have been or will be implemented in the design for the Midhurst Secondary Plan Area (SPA), as additional protective measures.

Table 1. Best Management Practices to Protect HED Population in Wisconsin and Recommended Action Items for the Midhurst Secondary Plan Area

Item	Best Management Practice	Comments/Recommended Action Items for Midhurst SPA
1	Eliminate pesticide and synthetic fertilizer usage on residential lawns, recreational fields and public spaces immediately adjacent to known habitat.	Not Applicable - The Midhurst Secondary Plan (MSP) areas are over 5 km from any regulated HED habitat and there is no pathway for transport.
2	Maintain private onsite wastewater treatment systems in rural lands through inspections, maintenance and awareness	Not Applicable - Collection of municipal effluent and treatment at the proposed WWTP will achieve a superior degree of treatment and greater assurance and regulation than what is achieved through private on-site systems
3	Properly dispose of pharmaceuticals and hazardous waste	Already implemented through municipal sewer use bylaws, provincial regulations and educational programs
4	Follow manure application standards	Not Applicable on developed lands
5	Develop and implement a Storm Water Management Plan to control erosion on construction sites	No construction is proposed within 5 km of the regulated area. Stormwater and Sediment and Erosion Control Plans have been or will be developed for the MSP areas.
6	Install storm water infiltration systems to mitigate impervious surface runoff	Already Implemented - The Low Impact Development techniques proposed for the Midhurst Development will infiltrate the first 20 mm of precipitation from all storms, or ~90% of the annual precipitation to maintain groundwater recharge;
7	Protect groundwater from the impacts of development with conservation easements	Not Necessary - The development areas are >5 km from the regulated habitat areas. Low Impact Development techniques will maintain groundwater recharge.
8	Groundwater protection through accurate delineation of locations supplying groundwater to HED larval wetlands	Already Implemented - See Figure 2 and Golder (2017).

Conclusions and Recommendations

HED habitat is protected under the *Endangered Species Act* which includes the provision that no person shall damage or destroy the habitat of an endangered or threatened species. Our review concludes that development of the MSPA does not threaten the HED or its habitat:

- No physical disturbances associated with development of the MSPA will occur within 5 km of the regulated HED habitat and so there are no direct impacts,
- A hydrologic/hydrogeologic model (Golder 2017) indicated maximum surface water level decreases of less than 1 mm in the Minesing Wetland over a ten-year period at full development build out. Therefore, with respect to regulated HED habitat, the HED's use of the wetlands for egg-laying and larval development would not be affected as a result of water level changes.
- A series of Best Management Practices have been or will be implemented in the design for the Midhurst Secondary Plan Area (SPA), as appropriate, as additional protective measures.

We will continue to monitor the ecological literature and local information on the HED to maintain our knowledge of current conditions.

References

COSEWIC. 2011. COSEWIC assessment and status report on the Hine's Emerald Dragonfly *Somatochlora hineana* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 41 pp

Golder Associates. 2017. Midhurst Ontario: Report on Carson and Doran Neighbourhoods Proposed Water Supply Groundwater Modelling. January 2017.

Hutchinson Environmental Sciences Ltd. 2016. Willow Creek Assimilative Capacity Study, Final Report. April 2016.

Post, R., McPhie, St., and J. Spoelstra. 2015. Hydrogeological and Geochemical Evaluation of the Eastern Minesing Wetland in Support of the Hine's Emerald Dragonfly (*Sometochlora hineana*). Nottawasaga Valley Conservation Authority.

Pulfer, T.L., C.G. Evans, D. Featherstone, R. Post, J.I. McCarter, and J.F. Laverty. 2013. Recovery Strategy for the Hine's Emerald (*Somatochlora hineana*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 27 pp.

The Ridges Sanctuary, 2013. Best Management Practives to Protect Groundwater at Hine's Emerald Dragonfly Larval Sites in Door County, Wisconsin. Cooperative Agreement between the USFWS and the Ridges Sanctuary.

USFWS. 2013. Hine's Emerald Dragonfly, Somatochlora hineana (Odonata: Corduliidae) 5-Year Review: Summary and Evaluation. Chicago Ecological Services Field Office. Barrington, Illinois – May 2013

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Technical Memorandum

Date: **August 9, 2016**

To: **Joe Mullan**

From: **Kris Hadley, Deborah Sinclair and Neil Hutchinson**

Re: **Estimating Phosphorus Loads to the Minesing Wetland**

Hutchinson Environmental Sciences (HESL) was requested to assess the total phosphorus (TP) loads that will be generated as a result of the full build out of the Midhurst Secondary Plan Area (MSPA), relative to existing TP loads to a) Willow Creek from its watershed and b) the Minesing Wetland from its upstream watershed. While it is possible to provide a quick estimate on the basis of a "back of the envelope" calculation we have completed a formal analysis in recognition that the estimate is important and must be able to be substantiated through means that are verifiable by a third party in order to maintain public trust in the Class EA process. The estimates provided are therefore based on the available monitoring data in the region and, although they do not represent all possible inputs to the wetland (e.g., groundwater within the wetland) are illustrative of the relative contribution to P loading of the MSPA.

1. Methods

Phosphorus loadings from the MSPA to Willow Creek and the Minesing Wetland were estimated using the Ministry of Environment and Climate Change's (MOECC) Provincial Water Quality Monitoring Network (PWQMN) water quality data and Water Survey of Canada (WSC) flow data. The Ontario Flow Assessment Tool (OFAT III) was used to delineate and characterize the watersheds upstream of the Minesing Wetland (Figure 1).

1.1 Flow

Four major (Willow, Nottawasaga, Mad, and Pine) and twenty minor watersheds flow into the Minesing Wetland (Figure 1). Water levels and flows are monitored by the WSC in the four major watersheds. Historical flow data from the WSC stations (Nottawasaga River, Mad River, Willow Creek, and Pine River) for the past 10 years (2005-2015) were used to estimate the mean annual flow from the gauged watersheds (Figure 1), except in Pine River (where 2015 data was not available) and Willow Creek (where data collection began in 2006). A summary of the periods of record and station IDs for all WSC data has been provided (Table 1). Black Creek flow was determined based on monitoring data collected by HESL as a part of an ongoing monitoring program (unpublished data).

1.2 Water quality – Total Phosphorus

Mean annual total phosphorus concentrations were estimated from all PWQMN data for the Nottawasaga River, Mad River, Willow Creek and Pine River stations. We used all available PWQMN data rather than restricting the period of record as data was limited, particularly in the winter. A summary of the periods of

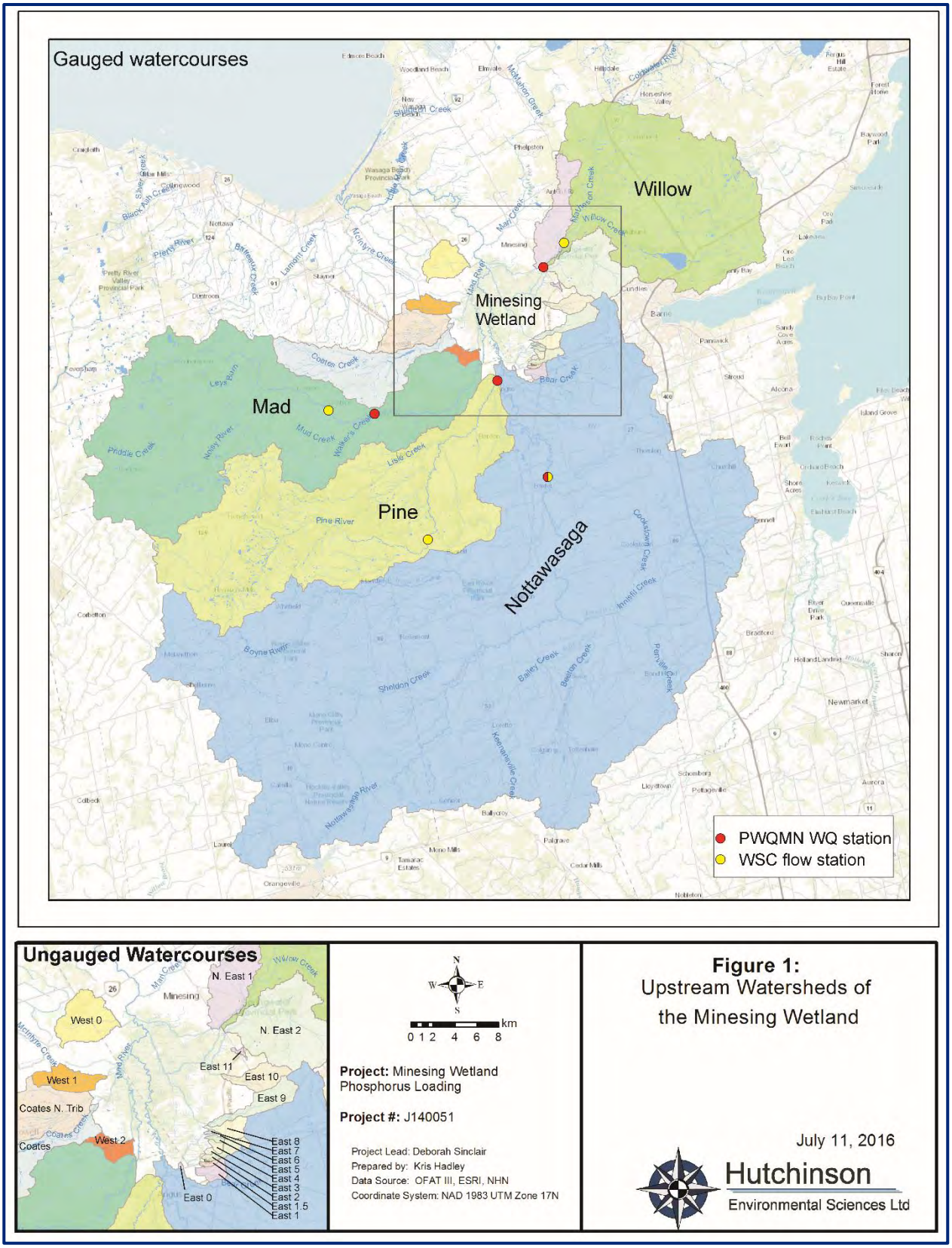
record and station IDs for all PWQMN data is provided (Table 1). Black Creek mean TP concentration was determined based on monitoring data collected by HESL as a part of an ongoing monitoring program (unpublished data).

Table 1. Summary of Data Sources for Phosphorus Loading Estimates

Subwatershed	PWQMN Station ID	WSC Station ID	PWQMN TP data Period of Record	Mean Annual PWQMN TP Concentration (mg/L)	WSC flow data Period of Record	WSC Mean Annual Flow (m^3/s)
Nottawasaga River	03005702902	02ED003	2002-2014	0.056	2006-2015	11.25
Pine River	03005701002	02ED014	2000-2014	0.043	2004-2014	2.28
Mad River	03005702102	02ED015	2000-2014	0.030	2005-2013, 2015	4.01
Willow Creek	03005703002	02ED032	2002-2014	0.031	2007-2015	2.57
Black Creek (Willow Creek Tributary)	NA	NA	2008, 2014 – 2016*	0.016	2008, 2014 – 2016*	0.018
Midhurst Secondary Plan Area (Full Build out)	NA	NA	*HESL 2016		*HESL 2016	

**Note: Data from HESL field sampling*

Figure 1. Watersheds Contributing to the Minesing Wetland.



1.3 Watershed characterization

Rivers, creeks and streams which flow into or through the Minesing Wetland were characterized using the OFAT III tool, an internet-based hydrology tool. OFAT allows users to define a watershed based on a drainage point of a selected stream, river or lake (OFAT 2015). For watersheds with WSC flow stations, watershed areas were calculated upstream of the WSC stations, and immediately upstream of the wetland. Loads were calculated from measured data from the gauged portion of the watershed and prorated to the ungauged portions to calculate the loads for the entire watershed upstream of the wetland (Figure 2).

In the unmonitored subwatersheds the watershed area at the confluence with the Minesing Wetland was calculated using the OFAT tool (Figure 1, inset). The OFAT tool was also used to characterize land use in all watersheds draining into and through the Minesing Wetland (Table 2).

1.4 Load estimation

Total phosphorus (TP) loads in the gauged watercourses were estimated from PWQMN TP data and WSC flows and then prorated to determine the TP loads entering the Minesing Wetland from all areas (Table 4). First, mean annual loads were calculated following Equation (1):

$$(1)\quad TP_{load}\left(\frac{kg}{yr}\right) = \frac{Mean\ Annual\ Flow\left(\frac{L}{s}\right) * \ Mean\ annual\ [TP]\left(\frac{mg}{L}\right) * 86400\left(\frac{s}{day}\right) * 365\left(\frac{day}{yr}\right)}{1{,}000{,}000\left(\frac{mg}{kg}\right)}$$

These total phosphorus loads were then used to calculate an export coefficient for each watershed by dividing the calculated load by the watershed area at the flow gauging station estimated from the OFAT III tool (Equation 2):

$$(2)\quad TP_{export}\left(\frac{kg \cdot yr^{-1}}{ha}\right) = \frac{TP_{load}\left(\frac{kg}{yr}\right)}{Watershed\ area\ (ha)}$$

In addition to the five gauged watercourses (Black Creek, Pine River, Mad River, Nottawasaga River and Willow Creek), P loads were estimated for streams and tributaries where flow measurements and water quality data were not available. Each of the 20 subwatersheds where monitoring data were not available was assigned the phosphorus export coefficient of one of the five gauged watercourses that had the most similar land use as determined by pairwise Bray Curtis analysis (Table 3).

Table 2. Summary of Land Use (% of watershed) in the Minesing Wetland Watershed Area

	Clear Open Water	Marsh	Swamp	Fen	Treed Upland	Deciduous Treed	Mixed Treed	Coniferous Treed	Plantations - Treed Cultivated	Hedge Rows	Sand/Gravel/Mine Tailings/Extraction	Community/Infrastructure	Agriculture and Undifferentiated Rural Land Use
Gauged													
Nottawasaga at Baxter	0.4	0.5	9.5	0.0	0.4	5.3	7.2	2.6	4.0	0.6	0.3	6.0	63.2
Mad River	0.4	0.7	17.7	0.0	0.3	7.0	6.7	2.3	4.4	0.2	0.3	3.0	56.9
Willow Creek	1.1	0.6	15.2	0.0	0.4	6.0	8.7	2.2	8.1	1.5	0.3	9.0	47.0
Pine River	0.3	0.5	10.8	0.0	0.3	9.7	11.0	4.1	6.4	0.5	0.1	6.2	50.0
Black Creek (HESL site SWC)	0.0	0.0	0.8	0.0	0.1	4.5	1.7	0.1	0.0	2.9	0.0	8.1	81.8
Ungauged													
Coates Creek	0.5	0.3	16.0	0.0	0.3	3.1	7.8	1.2	3.4	0.3	0.8	3.4	62.9
Coates Creek N Tributary	0.1	0.2	7.2	0.0	0.2	0.6	9.0	10.0	0.7	0.1	0.1	6.5	65.4
West Tributary 0	0.0	0.0	11.3	0.0	0.2	6.3	1.8	0.3	1.9	0.0	3.1	2.3	72.7
West Tributary 1	0.0	0.0	0.2	0.0	0.1	1.1	1.5	0.1	0.2	0.1	0.0	2.8	93.9
West Tributary 2	0.0	0.0	12.8	0.0	0.0	0.2	4.8	0.0	0.0	0.0	0.0	2.1	80.1
NE Tributary 1	0.0	0.2	8.1	0.0	0.2	5.2	6.4	1.8	11.0	0.4	0.0	6.2	60.4
NE Tributary 2	0.0	0.2	19.1	0.1	0.1	8.4	10.0	1.0	8.1	1.2	0.4	12.5	38.9
East Tributary 0	0.0	0.0	2.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	2.9	93.9
East Tributary 1	0.0	0.1	1.5	0.0	0.0	4.7	4.6	1.4	0.0	1.8	0.1	7.8	77.9
East Tributary 1.5	0.0	0.0	1.9	0.0	0.6	1.4	0.0	0.0	0.0	1.9	0.0	5.5	88.7
East Tributary 2	1.6	0.1	3.4	0.0	0.6	4.5	9.3	0.8	4.9	0.1	16.1	34.5	24.1
East Tributary 3	0.0	0.0	0.0	0.0	0.0	4.0	4.5	0.0	0.0	0.5	26.6	1.4	63.0
East Tributary 4	0.3	0.0	0.2	0.0	0.3	0.9	5.5	7.3	4.1	0.0	29.8	2.9	48.9
East Tributary 5	0.0	0.0	0.0	0.0	0.0	8.4	7.8	0.2	6.6	0.4	0.0	3.0	73.6
East Tributary 6	0.0	0.0	0.0	0.0	0.0	0.1	3.4	0.0	0.0	0.0	0.0	3.6	92.9
East Tributary 7	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.2	0.0	0.0	0.0	1.5	89.4
East Tributary 8	0.0	0.0	0.6	0.0	0.8	5.1	4.2	1.6	2.0	1.3	0.6	7.8	76.1
East Tributary 9	0.0	0.8	0.7	0.0	0.3	3.5	4.0	1.0	2.3	2.8	0.0	6.5	78.2
East Tributary 10	0.1	0.0	1.8	0.0	0.2	16.4	9.2	0.8	4.0	3.2	0.7	1.7	61.8
East Tributary 11	0.0	0.0	21.5	0.0	0.0	12.1	26.4	3.9	0.0	0.0	1.4	6.3	28.5

Phosphorus coefficients were then multiplied by the watershed area of each subwatershed to determine its load to the wetland (Table 3). Phosphorus exports from the gauged + ungauged areas were then summed to determine the total phosphorus load to the Minesing Wetland.

Table 3. Summary of the Watershed Characterization, Bray Curtis Land Use Similarity, Assigned Export Coefficient and TP Loads of the Unmonitored Watershed Areas of the Minesing Wetland

Subwatershed ID	Watershed Area (ha)	Bray Curtis Similarity	Export coefficient (kg/yr/ha)	Estimated TP Load (kg/yr)
Coates Creek	4982.5	Nottawasaga (0.923)	0.16	805
Coates Creek N. Trib	1771.3	Nottawasaga (0.882)	0.16	286
West Trib. 0	1000.3	Nottawasaga (0.848)	0.16	162
West Trib. 1	540.1	Black Creek (0.877)	0.01	6
West Trib. 2	311.8	Black Creek (0.849)	0.01	3
N. East Trib. 1	2023.6	Nottawasaga (0.927)	0.16	327
N. East Trib. 2	2943.9	Willow (0.887)	0.11	323
East Trib. 0	12.6	Black Creek (0.860)	0.01	0.1
East Trib. 1	187.5	Black Creek (0.946)	0.01	2
East Trib. 1.5	36.5	Black Creek (0.915)	0.01	0.4
East Trib. 2	206.6	Willow (0.574)	0.11	23
East Trib. 3	26.5	Nottawasaga (0.737)	0.16	4
East Trib. 4	54.9	Pine (0.673)	0.16	9
East Trib. 5	40.6	Nottawasaga (0.833)	0.16	7
East Trib. 6	19.6	Black Creek (0.872)	0.01	0.2
East Trib. 7	14.6	Black Creek (0.870)	0.01	0.15
East Trib. 8	233.9	Black Creek (0.922)	0.01	2
East Trib. 9	571.8	Black Creek (0.936)	0.01	6
East Trib. 10	461.6	Nottawasaga (0.838)	0.16	75
East Trib. 11	29.8	Pine (0.702)	0.16	5
Total	**15470**			**2046**

Phosphorus is also added to the surface area of the Minesing wetland by direct atmospheric deposition. HESL (2014) used an export coefficient of 0.26 kg/ha/yr for atmospheric deposition in the Nottawasaga Valley, based on data from MOECC and the Lake Simcoe Region Conservation Authority (Scott et al. 2001). The Minesing wetland is~6000 ha in size and so receives a total of ~1560 kg/yr of TP from atmospheric deposition.

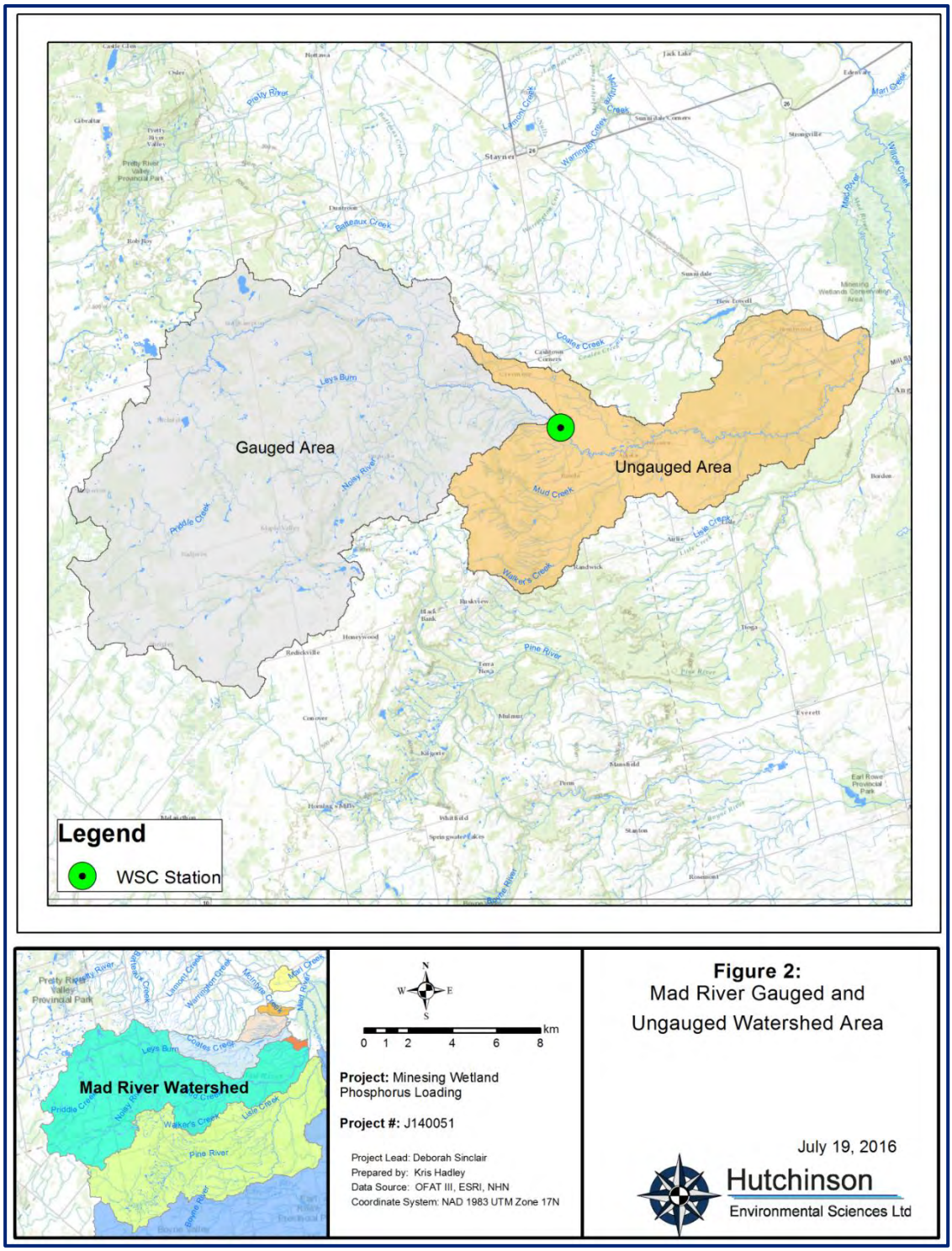
The net phosphorus loading from the Midhurst Secondary Plan Area was calculated as the sum of a) discharge from the proposed WWTP at full build out (Table 1 in Willow Creek Assimilative Capacity Study, HESL 2016a) and b) and stormwater runoff (Midhurst Secondary Plan Phosphorus Budget (HESL 2016b). The net loading of 66 kg/yr will be generated from ~2813 ha of the MSPA and corresponds to an export coefficient of 0.023 kg/ha/yr.

1.5 Limitations

- WSC and PWQMN stations were not at the same location for three of the four gauged watercourses (Pine River, Mad River and Willow Creek); however they provide the best available estimate of flow and TP concentrations in the region.
- Without detailed hydrological data on the flood frequency of the channelized streams into the wetland it is difficult to quantify how much of the TP load in the stream interacts directly with the wetland - much of the upstream loading likely moves through the wetland in the channels of the Nottawasaga River and Willow Creek.

- PWQMN data were biased towards the open water season (May -October), when flows and TP concentrations are relatively low, likely underestimating actual TP loads in the gauged watercourses.

Figure 2. Mad River Gauged and Ungauged Watershed Area



2. Results

Our calculations (Figure 3; Table 4; Table 5) show that:

- the phosphorus loads entering the Minesing Wetland are dominated by the Nottawasaga River, which accounts for 56% of the calculated load;
- Willow Creek, which drains a relatively small watershed and has relatively low flow, accounts for less than 7% of the load to the wetland;
- the 20 unmonitored subwatersheds combined add less phosphorus (2046 kg/yr, 5%) to the wetland than Willow Creek,
    - over 90% of this is contributed by the five largest subwatersheds (Coates Cr., West Trib. 0, NE Tribs. 1,2; Table 3).
- atmospheric loading of 1560 kg/yr accounts for 4% of the total;

The estimated increase in TP loads associated with the MSPA (66 kg/yr) represents

- an increase of only 2.6% from the existing Willow Creek load of 2527 kg/yr
- or 0.2% to the total estimated load to the Minesing wetland from all watercourses (Table 5)

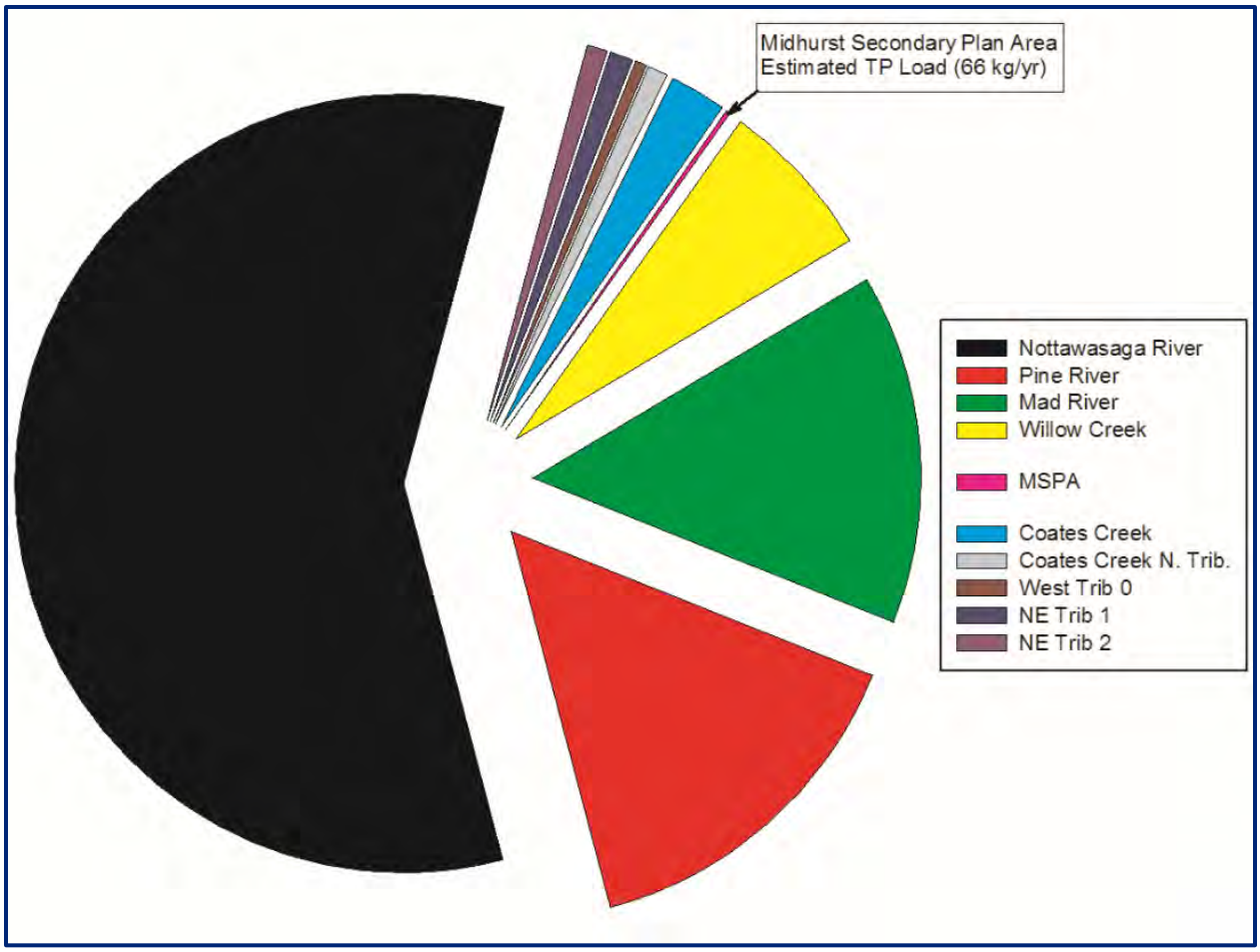
Table 4. Summary of the Source Loadings of TP to the Minesing Wetland

Subwatershed ID	Watershed Area (ha)	TP load (kg/yr)	Export Coefficient (kg/yr/ha)	Prorated TP Load (kg/yr)	Percent of Total
Nottawasaga River	123,039.4	19,868	0.161	22,097	56
Pine River	19,009.6	3092	0.163	5629	14.3
Mad River	24,583.9	3794	0.154	5515	14
Willow Creek	22,922.1	2512	0.110	2527	6.4
Black Creek	854.9	9	0.010	NA	
Ungauged Total	15470	2046	0.132	2046	5.2
Atmosphere	6000	1560	0.26	1560	4
MSPA	Incl. in Willow Creek total	66	0.023	66	0.17
Total	205,880			39,440	

Table 5. Summary of the Contribution of the MSPA Relative to Current Estimated Loads from Willow Creek and All Source Watersheds

	Total Phosphorus Load
Redevelopment of MSPA (Full Build out)	66 kg/yr
Willow Creek (at George Johnson Road)	2527 kg/yr
% MSPA of Willow Creek	2.6%
All Sources to Minesing Wetland	39,440 kg/yr
% MSPA of Minesing Wetland	0.2%

Figure 3. Estimated Phosphorus Loads of the Key Contributing (>100 kg/yr) Watersheds and the Midhurst Secondary Plan Area



3. Conclusions

The MSPA will be built and serviced to high standards for storm water infiltration and treatment of WWTP effluent. These measures will minimize the increase in nutrient loading to Willow Creek (and hence Minesing Wetland) to 66 kg/yr at full build out from the 2813 ha of the MSPA. The resultant export coefficient for the MSPA is therefore 0.023 kg/ha/yr. This value is <40% of the export coefficient from forested lands in the Nottawasaga Valley (= 0.06 kg/ha/yr. Table 1, HESL 2014) and lower than any of the watersheds contributing to the Minesing Wetland or the atmospheric loading. The increase of 66 kg/yr represents an increase of <3% to Willow Creek and <0.2% of the annual loading to the wetland from all sources. These changes are below the limits of measurement and the range of natural variability. There will be no detectable change in nutrient status of the wetland as a result of development of the MSPA.

4. References

Hutchinson Environmental Sciences Ltd. 2013. Managing New Urban Development in Phosphorus-Sensitive Watersheds – Final Report. Prepared for Nottawasaga Valley Conservation Authority. October 2014. 82pp.

Hutchinson Environmental Sciences Ltd. 2016a. Willow Creek Assimilative Capacity Study – Final Report. April 2016.

Hutchinson Environmental Sciences Ltd. 2016b. Midhurst Secondary Plan Area Phosphorus Budget – Update. May 2016.

Ontario Flow Assessment Tool. 2015. User Guide for Ontario Flow Assessment Tool (OFAT). September 2015.

Scott, L.D., Winter, J.G., Futter, M.N., and Girard, R.E. 2001. Annual Water Balances and Phosphorus Loading for Lake Simcoe, 1990-1998. LSEMS Implementation Report No. IMP.A3. Lake Simcoe Region Conservation Authority, Newmarket, Ontario. 61 pp.

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5. Appendix A. Bray Curtis Dissimilarity Matrix

Table A1. Summary of Bray Curtis Dissimilarity

	NOTTA	MAD	WILLOW	PINE	SWC
NOTTA	0				
MAD	0.106	0			
WILLOW	0.166	0.137	0		
PINE	0.137	0.143	0.11	0	
SWC	0.23	0.327	0.362	0.361	0
COATES	*0.077*	0.082	0.172	0.19	0.276
COATESTRIB	*0.118*	0.219	0.265	0.215	0.247
WEST0	*0.152*	0.186	0.289	0.262	0.178
WEST1	0.307	0.37	0.469	0.439	*0.123*
WEST2	0.202	0.232	0.331	0.321	*0.151*
NE1	*0.073*	0.135	0.164	0.15	0.258
NE2	0.269	0.205	*0.113*	0.174	0.446
EAST0	0.307	0.37	0.469	0.439	*0.14*
EAST1	0.178	0.274	0.313	0.308	*0.054*
EAST1.5	0.27	0.363	0.423	0.404	*0.085*
EAST2	0.487	0.519	*0.426*	0.459	0.605
EAST3	*0.263*	0.327	0.423	0.395	0.294
EAST4	0.342	0.343	0.364	*0.327*	0.453
EAST5	*0.167*	0.216	0.29	0.238	*0.167*
EAST6	0.297	0.366	0.459	0.429	*0.128*
EAST7	0.26	0.323	0.409	0.362	*0.13*
EAST8	0.16	0.258	0.298	0.294	*0.078*
EAST9	0.179	0.274	0.327	0.31	*0.064*
EAST10	*0.162*	0.202	0.279	0.218	0.264
EAST11	0.406	0.345	0.329	*0.298*	0.581

Note: Italics indicate the lowest dissimilarity (i.e., the highest similarity)

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Technical Memorandum

Date: October 13, 2016

To: Vimal Patel (Geranium), Joe Mullan (Ainley)

From: Neil Hutchinson and Tara Roumeliotis

Re: Monthly Total Phosphorus Concentrations in Willow Creek Predicted at Phase 1 and Full Build Out of the Midhurst Secondary Plan Area

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Introduction and Purpose of Technical Memorandum

The Willow Creek Assimilative Capacity Study (ACS) draft report (HESL, May 2016) used a mass balance model to predict total phosphorus (TP) concentrations in Willow Creek beyond the point of complete mixing between the Creek and treated effluent from the proposed Midhurst Waste Water Treatment Plant (WWTP). The Ontario Ministry of the Environment and Climate Change (MOECC) typically require the use of the 7Q20 low flow statistic (i.e., the 7-day low flow with a recurrence period of 20 years) and 75th percentile water quality concentrations in assessing the assimilative capacity of a receiving water in order to conservatively ensure protection of the receiving water over its full range of flows. From the ACS, a downstream Willow Creek TP concentration of 0.034 mg/L (Phase 1) and 0.031 mg/L (Full Build Out) was calculated using the 7Q20 low flow statistic (430 L/s), the 75th percentile TP concentration in Willow Creek (0.031 mg/L), and effluent flows and TP concentrations for the proposed WWTP (Phase 1 – 74.7 L/s and 0.05 mg/L TP; Full Build Out – 142.5 L/s and 0.03 mg/L TP).

In reality, water quality often varies with flow and periods of low flows do not necessarily coincide with periods of the poorest water quality. This is the case in Willow Creek where a highly significant relationship ($p<0.00001$) between TP and total suspended solids (TSS) was found at the George Johnson Road Water Quality Monitoring Network (PWQMN) station (HESL, May 2016). The relationship showed that Willow Creek is a Policy 1 receiver for total phosphorus (i.e., TP concentrations are below the Provincial Water Quality Objective [PWQO] of 0.03 mg/L) during clear flow periods. For Willow Creek, this equated to periods when TSS concentrations are below 8 mg/L.

The purpose of this technical memorandum is to provide an understanding of TP concentrations in Willow Creek during all times of the year, and the associated effect the proposed Midhurst WWTP will have on TP concentrations in the creek.

Monthly TP Mass Balance

To examine TP in Willow Creek throughout the year, the existing water quality data set from the PWQMN station at George Johnson Road (2002 through 2014 data) was supplemented with water quality data collected by HESL in 2013, 2014 and 2016. The average TP concentration on a monthly basis was then calculated (Table 1).

Table 1. Monthly Average Total Phosphorus Concentrations in Willow Creek

Month	Average Total Phosphorus (mg/L)	Number of Samples
January	0.021	See note
February	0.008	1
March	**0.148**	2
April	**0.059**	6
May	0.029	12
June	**0.031**	15
July	**0.038**	12
August	0.018	19
September	0.026	11
October	0.022	18
November	0.027	10
December	**0.033**	2

- Note: There were no water quality data collected during the month of January. The average TP concentration for January was therefore calculated as the average between the months of December and February.
- **Bold** concentrations represent TP concentrations above the PWQO of 0.03 mg/L.

As would be expected, TP concentrations in Willow Creek are not consistent year-round. Agricultural activities in the lower Willow Creek watershed are the primary source of nutrient loading to the creek. Concentrations are above the PWQO for five of twelve months of the year, with the highest concentrations measured in March and April (at 0.148 mg/L and 0.059 mg/L, respectively), coinciding with spring freshet. Correspondingly, TP concentrations were below the PWQO in seven of twelve months of the year. Notably, this includes August and September, in which some of the lowest flows of the year are typically measured.

Daily minimum and median Willow Creek flows were calculated using the 10-year period of flow measurements available from the Water Survey of Canada (WSC) Station 02ED032 located on Willow Creek at Highway 26. The daily minimum flow was the single lowest flow measured for each date of the year, and the median flow was calculated as the median of all flows measured for each date of the year. Figure 1 shows the resulting minimum and median Willow Creek flows. Flows are highest in spring and lowest in the summer and early fall months.



Figure 1. Willow Creek Minimum and Median Daily Flows

The resulting TP concentrations in Willow Creek, downstream of the proposed WWTP discharge were calculated by a mass balance using the existing monthly TP concentrations in Willow Creek (as presented in Table 1), daily flow (at both the minimum and median rates, as presented in Figure 1) and the WWTP effluent flows and concentrations for Phase 1 and Full Build Out (Phase 1 – 74.7 L/s and 0.05 mg/L TP; Full Build Out – 142.5 L/s and 0.03 mg/L TP). The daily change in TP concentration as a result of the addition of the proposed Midhurst WWTP discharge to Willow Creek was compared to the existing TP concentration in Figures 2 and 3 for Phase 1 and Full Build Out, respectively.

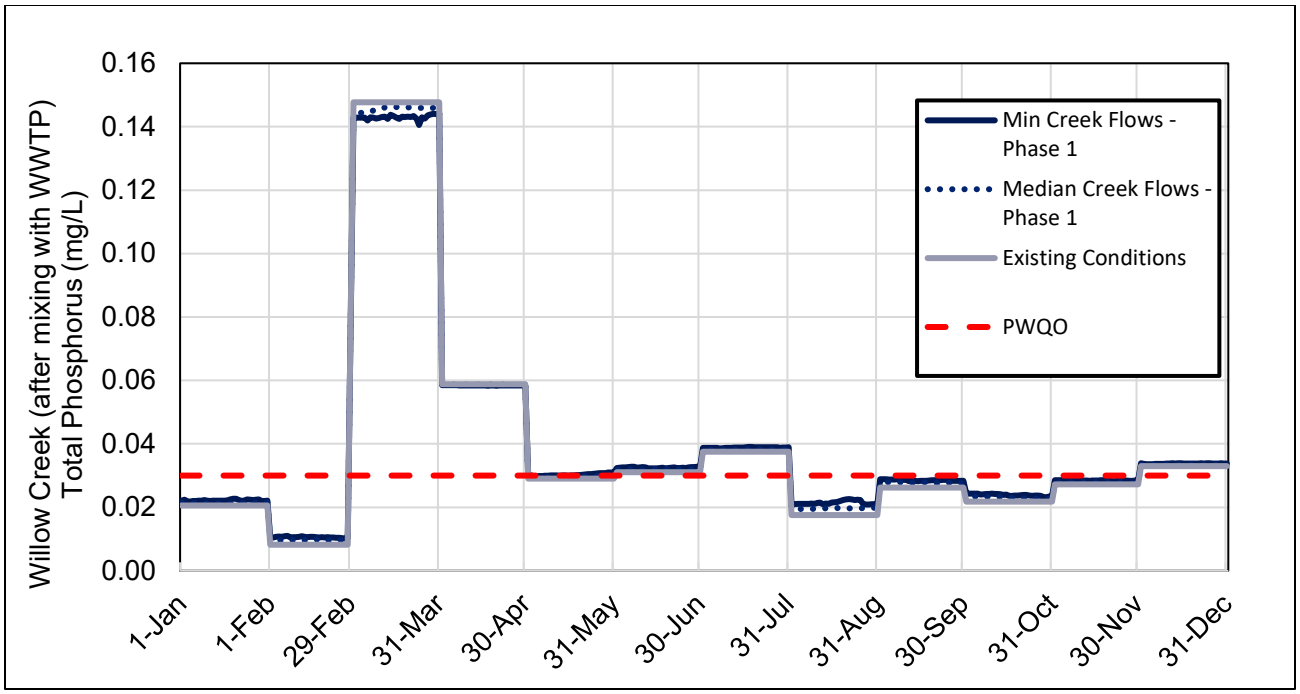


Figure 2. Resulting Willow Creek Total Phosphorus Concentrations After Mixing with Midhurst WWTP (Phase 1)

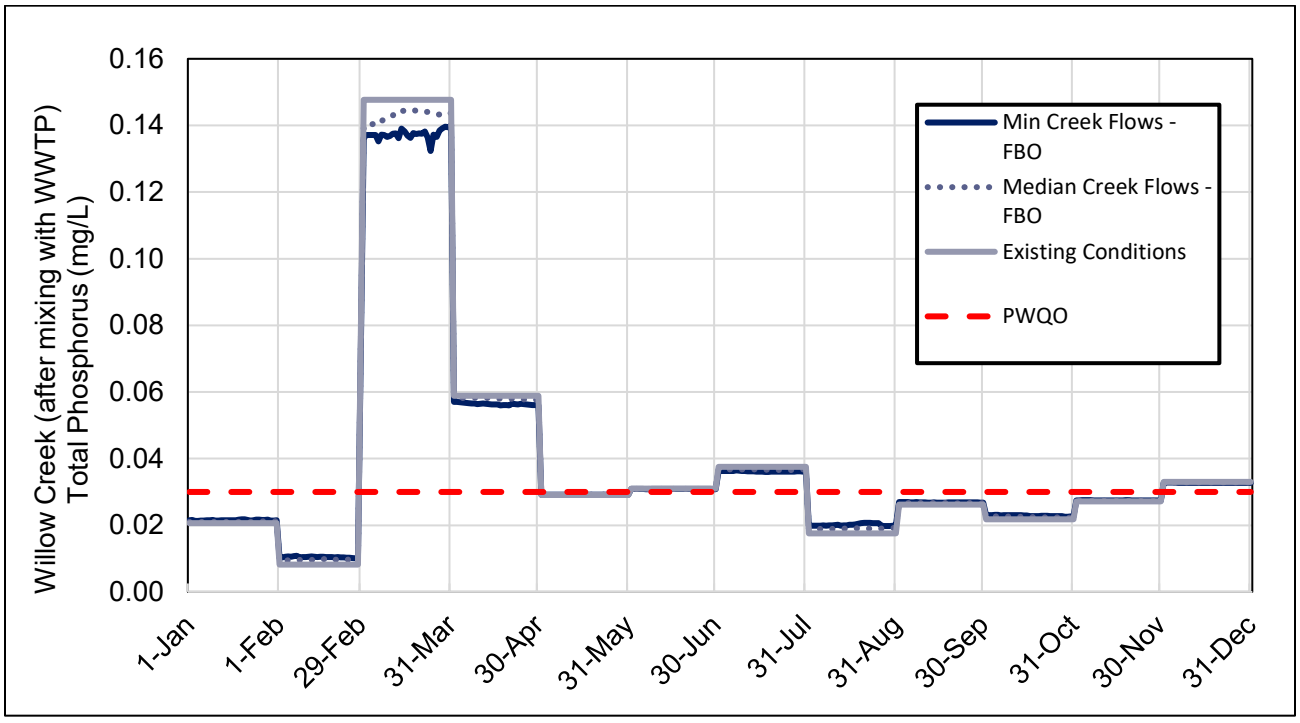


Figure 3. Resulting Willow Creek Total Phosphorus Concentrations After Mixing with Midhurst WWTP (Full Build Out)

When existing TP concentrations are examined throughout the year and in comparison to predicted fully mixed (downstream) concentrations at Phase 1 and Full Build Out of the WWTP (Figures 2 and 3, respectively), the impact of the additional loading from the WWTP is minimal in months with existing TP concentrations near the PWQO. In the month of March, the WWTP discharge notably improves downstream water quality in Willow Creek since the TP concentrations in the effluent are lower than the average TP concentrations measured in March in Willow Creek. The existing March Willow Creek TP concentration of 0.148 mg/L is reduced to a monthly average concentration of 0.143 mg/L and 0.146 mg/L at minimum and median creek flows, respectively, at Phase 1 effluent concentrations and flows. At Full Build Out, the Willow Creek TP concentration is reduced to 0.137 mg/L and 0.143 mg/L at minimum and median flows, respectively.

In the months of January, February, May, August, September, October, and November, existing Willow Creek average TP concentrations were below the PWQO. In all cases, except May minimum flows for Phase 1, the input from the WWTP discharge (at both Phase 1 and Full Build Out levels) did not result in the downstream TP concentration increasing to beyond the PWQO of 0.03 mg/L.

This detailed TP analysis further supports the case that phosphorus offsets in the watershed are not needed to balance the impact of the WWTP discharge.

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Memorandum

Date: **March 7, 2017**

To: **Joe Mullan - Ainley Group**

From: **Neil Hutchinson and Deborah Sinclair**

Re: **HESL J140051 : Response to XCG Review of Midhurst Phosphorus Budget**

On June 22, 2016, XCG Consulting Limited submitted a brief memo containing their "initial" review of the HESL report "Midhurst Secondary Plan Phosphorus Budget - Update, Draft for Discussion" to Mr. Joe Mullan of the Ainley Group. These comments were provided to HESL on or about October 10, 2016 and we provided a preliminary response to Midhurst Development Group on November 11, 2016.

The XCG review was brief, to the point and favourable, as XCG generally agreed with our analysis and methods. Although XCG described their report as an "initial review" they did not indicate that there was any subsequent review to follow.

The key concern of XCG was the infiltration calculations that were used and that these might have overestimated the amount of infiltration to be provided by the LID facilities and thus the post development phosphorus reduction. In brief, their concern is that the analysis does not provide for "recovery time" of the infiltration galleries between events. That is, although they accept that the technologies will infiltrate 20 mm, they point out that the galleries would need to drain between events. For example - a 20mm event would not drain instantaneously, but would need time to make the 20mm capacity available for the next event. Thus, if the 20mm event was followed by a 15 mm event on the next day, not all of that 15 mm would be infiltrated. I consider that this concern is valid and have prepared a spreadsheet model to estimate its implications.

Conceptual Model

The implications can only be assessed if we provide an estimate of "event recovery time' for the infiltration galleries. The infiltration design was provided by SCS Consulting Group (Jun 8 2014, memo: Steve Schaefer to Glenn Switzer NVCA) and contained the following requirement (p.2) *"Proposed infiltration measures are required to draw down over the CVC/TRCA maximum drawdown time for below grade infiltration measures of 72 hours."* Under our proposed scenario of infiltration of a 20 mm storm event this drawdown equates to 6.6 mm/day if we make the conservative assumption that the drawdown is linear and constant. I therefore modelled 20mm infiltration with a recovery of 6.7 mm/day for full recovery of 20 mm in 3 days. Thus if 20mm was infiltrated in one storm there would be 6.7 mm available on the day after and 13.4 mm available two days after, provided there was no additional precipitation.

Results of the conceptual model are provided in Figure 1 below. It shows the response to events of 25, 15 and 5 mm on each of days 2, 3 and 4, with no precipitation on Days 5, 6 and 7, and events of 0.5, 17, 12, 4, 2 and 1mm and 1 on Days 8-13. Storage never exceeds 20 mm, 6.7 mm of storage are recovered each day and the runoff (that precipitation which cannot be stored and infiltrated) is shown as negative values on the graph.

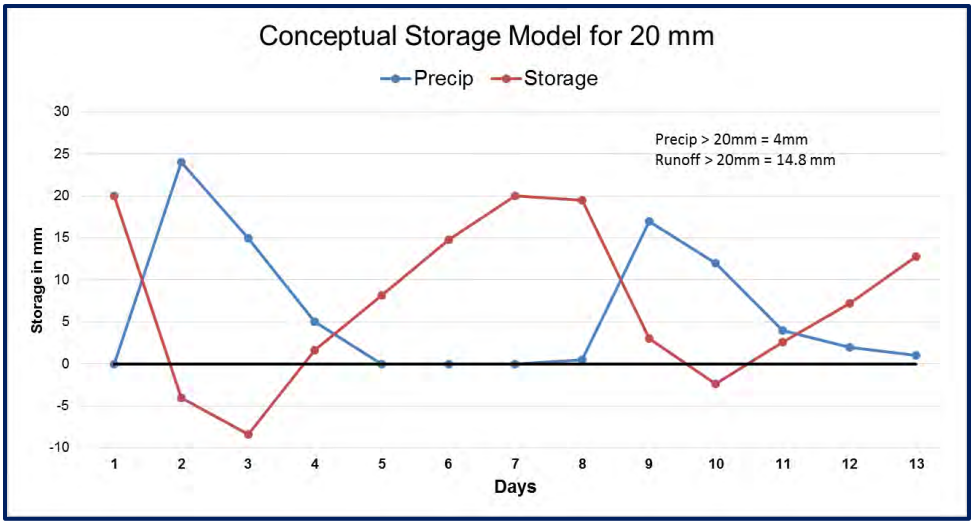
In our analysis as reviewed by XCG, we did not infiltrate any precipitation which exceeded 20 mm in a day.

- Our total runoff in the conceptual model would be 4 mm in this scenario (the 24 mm event on Day 2) or 5% of the 80.4 mm of total precipitation (95% capture).

If we account for recovery time then we did not infiltrate any precipitation that exceeded the 20mm storage volume, as modified by recovery time.

- Our total runoff in the conceptual model would be increased to 14.8 mm in this scenario (the 3 events with negative storage) or 18% of the 80.4 mm of total precipitation (82% capture).

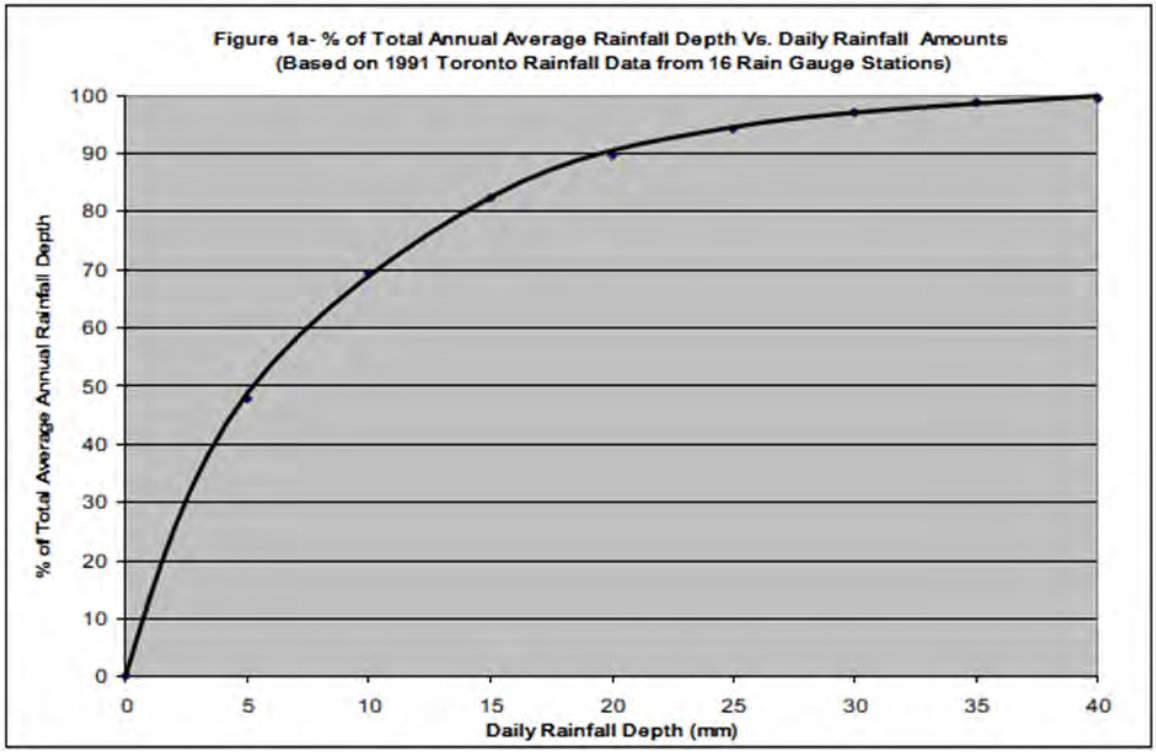
Figure 1. Conceptual precipitation storage and recovery model.



Midhurst Model

The City of Toronto's Wet Weather Flow Management Guidelines (Toronto 2006) were used to design the infiltration galleries. These guidelines estimate that approximately 90% and 95% of total annual precipitation falls within a daily depth of 20 mm and 25 mm (Fig. 4).

Figure 2. Proportion of Annual Precipitation Falling for Daily Rainfall Depths. (City of Toronto, 2006)



The response at Midhurst was modelled using the Environment Canada Shanty Bay precipitation records for 2009-2015 as a local record and the infiltration target of all events up to the 20mm event. Table 1 shows, that, as for the City of Toronto, 90% of all storms were 20mm or less. The 25mm storms accounted for 94% of all annual precipitation, as opposed to 95% for the City of Toronto data.

The results for two typical years are shown in Figures 2 and 3. Negative values for “Available Storage” indicate the depth of precipitation from an event that ran off instead of being infiltrated. The summary of changes for each year is provided in Table 1.

Figure 3. Shanty Bay Model 2010

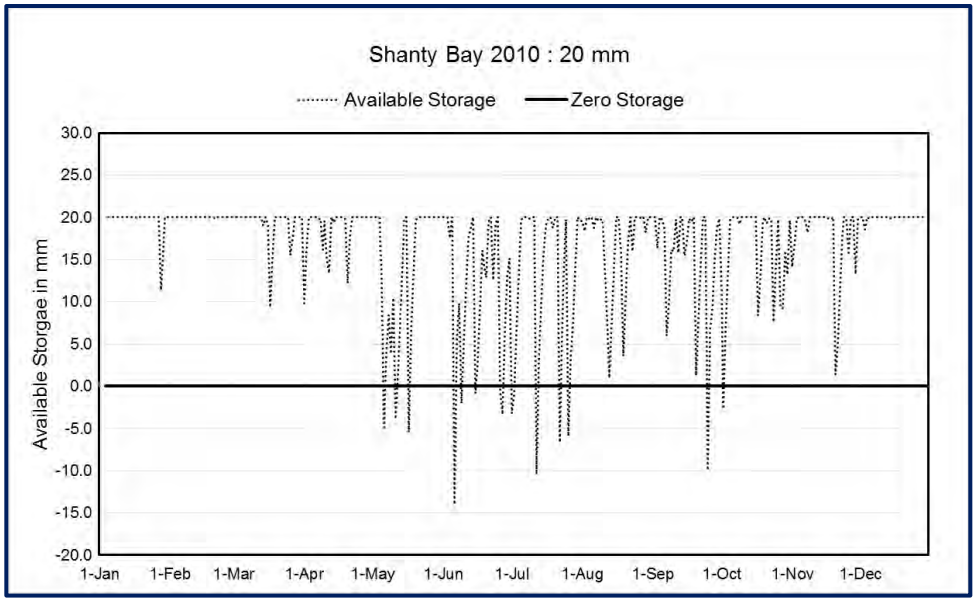
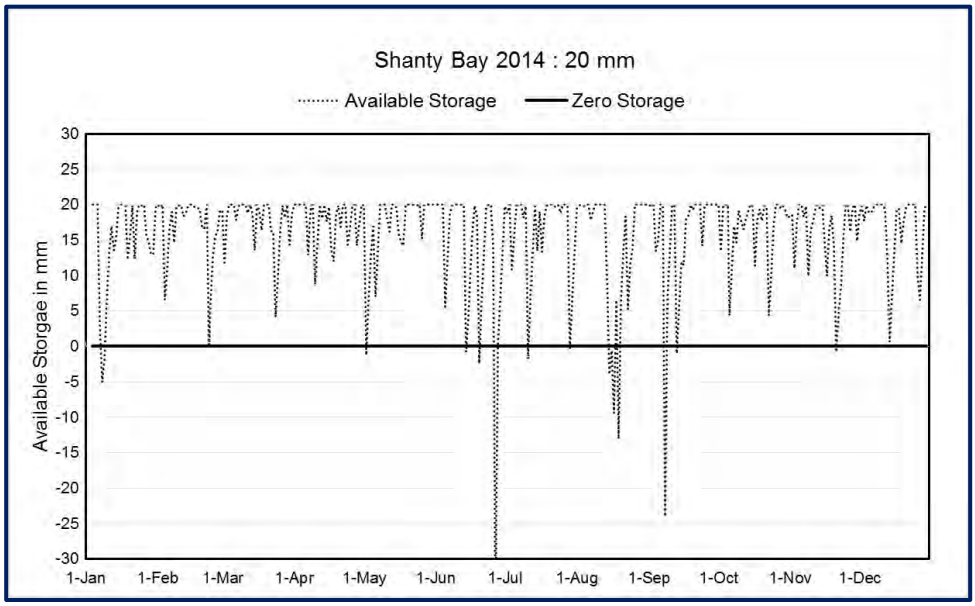


Figure 4. Shanty Bay Model 2014



In the original analysis as reviewed by XCG, we did not infiltrate any precipitation which exceeded 20 mm in a day.

- Total runoff in the Shanty Bay model for 2009-2015 in this scenario ranged from 56 to 94 mm/yr or 8-13% of the total annual precipitation (87-92% capture, Table 1).

Recovery time was modelled by not infiltrating any precipitation that exceeded the 20mm storage volume, as modified by the recovery of 6.7 mm/day.

- The total runoff in the Shanty Bay model for 2009-2015 increased to 75 to 128 mm/yr or 10-17% of the total annual precipitation (83-90% capture, Table 1).

Table 1. Effect of infiltration gallery recovery time on annual infiltration - 20 mm events.

	Total Precipitation	Original Calculations : No Recovery Consideration			Revised Calculations : Recovery Time Considered		
		Total>20	Percent of Total	No. of Events	Total Excess	Percent of Total	No. of Events
2009	723	56	8%	7	84	12%	11
2010	749	63	8%	12	75	10%	15
2011	693	89	13%	6	97	14%	6
2012	737	76	10%	7	114	16%	13
2013	737	94	13%	6	128	17%	14
2014	982	76	8%	10	103	10%	16
2015	786	73	9%	5	88	11%	10
Average	770	76	10%	8	100	13%	13

The XCG concern is therefore valid.

- Table 1 shows that, for the seven years (2009-2015) modelled, on average, 10% of the annual depth of rainfall fell in events of >20mm and there was, on average, 8 days in which a total of 76mm of the annual total would not be captured in SWM features designed to infiltrate 20 mm, if we assume that there was complete recovery between events as we did in the original analysis.

- If recovery time is considered, then, on average, 13% (100mm) of the annual rainfall cannot be captured in SWM features designed to infiltrate 20mm of precipitation and recover 6.7mm of infiltration capacity each day. There was, on average, 13 days each year when the rainfall could not be infiltrated after recovery time was considered.

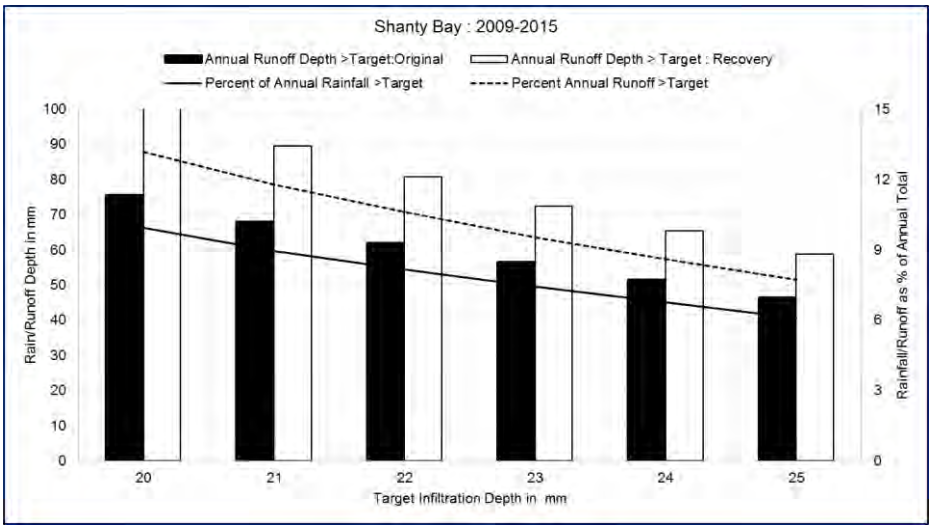
Infiltration Design Requirements.

Table 2 and Figure 5 show that the target of infiltrating 90% of the rainfall volume from 20mm events can be met if infiltration galleries are designed for the 23mm event to account for recovery time between storms. Intermediate infiltration targets are also presented.

Table 2. Effect of infiltration gallery recovery time on annual infiltration: 20 - 25 mm events.

		Runoff Exceeding Target Original			Runoff Exceeding Target Corrected for Recovery		
	Target Event	Depth	% of Volume	No. of Events	Depth	% of Volume	No. of Events
Average Annual Rainfall = 770mm	20 mm	76	10%	8	100	13%	13
	21 mm	68	9%	6	90	12%	11
	22 mm	62	8%	6	81	11%	10
	23 mm	56	7%	5	72	10%	8
	24 mm	51	7%	5	65	9%	8
	25 mm	46	6%	5	59	8%	7

Figure 5. Infiltration and runoff with and without recovery time.



Implications to Phosphorus Budget

The Draft Phosphorus Budget for the Midhurst Secondary Plan was derived with the target of 20mm infiltration. This would infiltrate 90% of the annual rainfall volume for 100% phosphorus attenuation. The runoff volume would represent 10% of the annual rainfall and 63% of the phosphorus in this runoff would be removed by the "Enhanced Level" SWM ponds. The calculations for infiltrating 95% of the precipitation also assumed that 100% of the phosphorus was removed from the 95% that was infiltrated and 63% was removed from the portion running off.

These values were applied to the post-development no infiltration phosphorus export estimates to estimate the amount of phosphorus reduction with 20 and 25 mm of infiltration. The phosphorus loadings for Phase 1 and Full Build Out are presented in Table 3. Under the post-development scenarios the net phosphorus loadings from stormwater without implementation of LID techniques and BMPs were 213 and 663 kg/yr for Phase 1 and Full Build Out respectively. Infiltration of all storms up to 20mm and 63% removal in the runoff portion reduced the phosphorus loadings from SW runoff to 21 kg and 66 kg for Phase 1 and Full Build Out respectively.

Table 3 Summary of Phosphorus Loadings (kg/yr) in original calculations with no consideration of recovery time.

	Phase 1			Full Build Out		
Infiltration	**None**	**20 mm**	**25 mm**	**None**	**20 mm**	**25 mm**
Pre-development	**46**	**46**	**46**	**134**	**134**	**134**
Runoff	213	21	11	663	66	33
WWTP Load	118	118	118	134	134	134
Total Post Development	**331**	**139**	**129**	**797**	**200**	**167**
Change in P export	**285**	**93**	**83**	**663**	**66**	**33**

Notes: Post-development loads also incorporate 63% reduction from SWMP.

Accounting for Recovery Time

The phosphorus budget for the 20mm infiltration scenario was updated to account for Shanty Bay precipitation patterns and the need for a recovery time of the infiltration galleries between events. The calculations above (Table 1) showed that 87% (vs 90%) of the total annual precipitation would be infiltrated, and 13% (vs 10%) would be run off under that 20 mm infiltration scenario after accounting for recovery time. These values were applied to the post-development scenario to estimate the amount of phosphorus reduction with 20 mm of infiltration and recovery. Phosphorus export was reduced by an additional 63% to account for the SWM pond-treatment for the volumes that could not be infiltrated. Results are presented in Table 4.

Table 4 Updated Phosphorus Loadings (kg/yr) for 20 mm infiltration scenario using Shanty Bay Precipitation Patterns and considering recovery time.

	Phase 1	Full Build Out
Pre Development Load	46	134
Runoff	28	86
WWTP	118	134
Total Post Development Load	146	220
Change in P export	100	86

Accounting for recovery time increased the phosphorus export from 21 to 28 kg/yr, and from 66 to 86 kg/yr for the Phase 1 and Full Build Out Scenarios, respectively. The net change from Pre-Development, after adding the WWTP loads, is therefore 100 and 86 kg/yr, for Phase 1 and Full Build Out respectively. This represents a 7 kg increase in Phase 1 and 20 kg increase in Full Build Out phosphorus loadings (Table 3) after accounting for recovery time of the infiltration galleries.

The amended values were also applied to the post-development scenario for 25 mm of infiltration and recovery. Phosphorus export was reduced by an additional 63% to account for the SWM pond-treatment for the volumes that could not be infiltrated. Results are presented in Table 5.

Table 5. Updated Phosphorus Loadings (kg/yr) for 25 mm infiltration scenario using Shanty Bay Precipitation Patterns and considering recovery time.

	Phase 1	Full Build Out
Pre Development Load	46	134
Runoff	17	53
WWTP	118	134
Total Post Development Load	135	187
Change in P export	89	53

Accounting for recovery time increased the phosphorus export from 11 to 17 kg/yr, and from 33 to 53 kg/yr for the Phase 1 and Full Build Out Scenarios, respectively. The net change from Pre-Development, after adding the WWTP loads, is therefore 89 and 53 kg/yr, for Phase 1 and Full Build Out respectively. This represents a 6 kg increase in Phase 1 and 19 kg increase in Full Build Out phosphorus loadings (Table 3) after accounting for recovery time of the infiltration galleries.

Phosphorus in post-development runoff was reduced to the original estimates of 21 and 66 kg/yr for Phase 1 and Full Build Out, respectively, by increasing infiltration from 20 mm (with no recovery allowance) to 23 mm (allowing for recovery time) in the post development condition.

Conclusions and Recommendations

The XCG review raised a valid consideration of the need to consider recovery time of the infiltration galleries between storms. Failure to do so overestimated the amount of annual rainfall that can be infiltrated with corresponding overestimates of phosphorus reduction from the proposed LID techniques.

Table 2 and Figure 4 provide a range of corrected infiltration volumes for the Midhurst Secondary Plan area that were derived by allowing recovery from design events over three days. The infiltration characteristics were provided by SCS Consulting Group (Jun 8 2014, memo: Steve Schaefer to Glenn Switzer NVCA, p.2) *"Proposed infiltration measures are required to draw down over the CVC/TRCA maximum drawdown time for below grade infiltration measures of 72 hours."* .

Infiltration galleries must be designed for a 23 mm storm (after accounting for infiltration) instead of a 20 mm storm in order to reduce phosphorus in runoff to 21 and 66 kg for Phase 1 and Full Build out respectively. Tables 4 and 5 show the implications for phosphorus removal over design storm ranges of 20 and 25mm.

In all cases, however, the infiltration - based LID techniques, with or without accounting for recovery, reduce post development phosphorus loads from storm water runoff by at least 35% over the pre-development (existing conditions) estimates.

APPENDIX 'M'

XCG Consulting Limited Letter, January 29, 2016 Re: Phosphorus Budget Work Plan

XCG Consulting Limited Letter, June 22, 2016 Re: Review of Phosphorus Budget Report

Midhurst Secondary Plan Area, Phosphorus Budget Update – Hutchinson Environmental Sciences Ltd., May 2018

XCG CONSULTING LIMITED
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January 29, 2016

XCG File No.: 3-2984-02-01

J. A. Mullan, P.Eng.
President & CEO,
Ainley Group
280 Pretty River Parkway,
Collingwood, Ontario L9Y 4J5

Re: Midhurst Secondary Plan: Phosphorus Budget

Dear J.A. Mullan:

The purpose of this letter is to provide initial comments on the workplan of Hutchinson Environmental Sciences Limited (HESL) for refinement of the Midhurst Secondary Plan Area Phosphorus Budget. The HESL workplan is described in the letter of March 9, 2015 addressed to Mr. Glenn Switzer of Nottawasaga Valley Conservation Authority (NVCA).

Information Reviewed

To prepare the following comments, XCG Consulting Limited (XCG) has reviewed the workplan, as well as the following documents that were provided to us at the initial meeting we had on December 22, 2015 and subsequent emails we received on December 23, 2015.

- HESL, 2014a. Memorandum dated June 5, 2014, regarding "Phosphorus Budget for Midhurst Secondary Plan Area", prepared for SCS Consulting Group.
- HESL, 2014b. "Managing New Urban Development in Phosphorus Sensitive Watersheds – Final Report", prepared for NVCA, dated October 31, 2014.
- Ontario Municipal Board (OMB), Minutes of Settlement for OMB Case Nos. PL131125 et al., dated July 3, 2014.
- Greenland International Consulting Ltd (GICL), 2014. Correspondence addressed to Hutchinson Environmental Sciences Ltd., dated June 12, 2014 "RE: Technical Peer Review of 'Phosphorus Budget for Midhurst Secondary Plan Area'" (5 pages); and correspondence to Hutchinson Environmental Sciences Ltd., dated June 19, 2014, regarding "Technical Peer Review of 'Phosphorus Budget for Midhurst Secondary Plan Area', Reply to Comment response Based on 12 June 2014 Greenland Phase 1 Comments" (12 pages), File No. G14-3221.

As well we have considered the information we received at the December 22nd meeting regarding the current status of infrastructure planning for the Secondary Plan Area.

Context

The Midhurst Secondary Plan Area (MSPA) includes a total potential urban development area of 756 hectares within the Midhurst Settlement Area (approximately 2,813 hectares). At present, 300 of the 756 hectares can proceed to development, based on partial withdrawal of an OMB appeal in November 2012. Draft Plans of Subdivision for the 300

hectares have proceeded to OMB approval, with conditions and requirements set out in the OMB Minutes of Settlement of July 2014.

Requirements for drainage management in the proposed development area are set out in the OMB Minutes. Our understanding is that these requirements have been set out by the OMB to address concerns and requirements of the NVCA. With respect to nutrient loadings and stormwater volume control, key requirements in the OMB Minutes are as follows:

- No additional nutrient loading downstream from both the land development and the wastewater treatment plant (WWTP).
- As much water as possible to be infiltrated back into the ground, aiming for the first 25 mm of rainfall; and demonstrate the ability of the stormwater management system to hold back the 25 mm storm runoff for 48 hours.
- At each drainage outlet there will be no increase in the volume of post-development runoff volume from the pre-development condition. However, some increase in post-development runoff may be permitted for infrequent storms, if it is demonstrated that there will be no cumulative downstream impacts, taking into consideration all of the subdivisions in the Midhurst Secondary Plan Area.

The MSPA drains to Willow Creek, which in turn flows to the Nottawasaga River via the Minesing Swamp. The foregoing targets are directed at controlling nutrient loadings to Willow Creek and Minesing Swamp, and ensuring maintenance of local hydrologic water budget.

Within the MSPA, current land use includes existing residential development in the Village of Midhurst, along with cultivated farm fields, wooded areas, institutional properties (County of Simcoe Administrative Centre, Archives and Museum, and Simcoe County District School Board), the Barrie Community Sports Complex, some commercial properties and a rail corridor. The Village of Midhurst is served by municipal water supply system, but all homes have private on-site sewage systems (i.e. septic tank systems).

The proposed development will be served by a new WWTP that will discharge its effluent to Willow Creek.

Preliminary Phosphorus Budget

HESL (2014a) presents a preliminary phosphorus budget for the MSPA. This analysis included pre-development and post-development total phosphorus (TP) loading estimates for 881.7 hectares of potential urban development area within the Midhurst Settlement Area. In summary this analysis indicated the following:

- Conversion of what currently is predominantly crop land, to urban development (i.e. without any urban stormwater treatment or other measures to reduce urban stormwater load) has the potential to increase annual non-point sources (NPS) TP loading from the 881.7 ha by an estimated 979 kg (increase from 144 kg to 1,123 kg).
- Based on analysis of historical daily precipitation at Shanty Bay, it was estimated by HESL that "infiltration of the first 20 mm of all rain events (all precipitation for events up to 20 mm and the first 20 mm of grater magnitude events) results in

infiltration of 83% of the total annual precipitation, leaving only 17% for run off and treatment by SWM Ponds".

- On this basis, it was estimated that if infiltration practices within the new urban development were able to infiltrate the first 20 mm of rain, that would result in 83% reduction in urban NPS phosphorus loading.
- In combination with stormwater treatment (63% P load reduction) for runoff from the residual 17% of precipitation, the result was post-development NPS loading from the development area that is less than the pre-development condition (reduced from 144 kg to 69 kg).
- However, with the addition of the future effluent load from the proposed Midhurst WWTP of 135 kg, the net result was an estimated increase in total load (i.e. non-point sources plus point sources) of 60 kg per year (69+135-144=60).

The preliminary analysis clearly indicated that the primary means of reducing the NPS TP load from the development area would be through infiltration practices, and that infiltrating more than 80% of precipitation will likely be required to meet the objective of no net increase in total phosphorus (TP) loading to Willow Creek.

Refined Phosphorus Budget Required

XCG's understanding is that a refined phosphorus budget ("P Budget") will be prepared by HESL to address the OMB Minutes requirements. XCG's understanding is as follows.

- To address the OMB Minutes, the P Budget will address the annual phosphorus budget; that is, the phosphorus budget for an "average" year in terms of precipitation.
- The P Budget will need to address all non-point sources (NPS) and point sources within the MSPA including the proposed WWTP. The MSPA is understood to be the entirety of the Midhurst Settlement Area (approximately 2,813 ha). The area that the P budget needs to encompass should be clarified (see below).
- The P Budget will be carried out for the "Phase 1" development scenario (300 hectares of urban development) and the "full build-out" development scenario (756 ha).
- Under current land-use conditions, NPS will include all surface drainage and stormwater runoff, as well as any loadings that may be attributable to private sewage systems (septic systems) in the MSPA.
- Under interim and ultimate future scenarios, NPS will include stormwater runoff from the proposed urban development, along with any of the remaining current sources. Point sources will include the effluent discharge from the proposed Midhurst WWTP.

Clarification Required:

The foregoing is our current understanding of the P Budget requirements. However, clarification is needed as follows.

- **Geographic Scope:** The geographic area to be encompassed by the P Budget should be confirmed. Will it be the entirety of the Midhurst Settlement Area (approx. 2,813 ha)?; or only that portion of the Settlement Area which drains to Willow Creek?; or only the development lands themselves (i.e. 300 ha in Phase 1, 756 at full build-out)?

- **Phosphorus Only:** The OMB Minutes refer to "no additional nutrient loading". In the HESL workplan, the first paragraph under "Constituents Modelled" appears to state that phosphorus is the only nutrient of concern. As well, the correspondence of June 19, 2014 from Greenland indicates that NVCA has stated that phosphorus is the nutrient of primary concern. If not already done, we believe that it should be clarified with NVCA that other nutrients (i.e. nitrogen compounds) are not at issue.
- **Seasonal Considerations:**
  - The "no additional nutrient loading" requirement is presumed to relate to average annual loading (as opposed to the loading generated in the ice-free period only). This should be confirmed with NVCA, so that it is clear as to whether the P Budget needs to consider winter and spring melt conditions.
  - Clarification from NVCA may be needed with respect to the requirement to infiltrate as much water as possible, with the target being the first 25 mm of rainfall. It is presumed that this requirement applies only within the ice-free period. This should be confirmed, again so that it is clear as to whether hydrologic analysis to support the P Budget needs to consider winter and spring melt conditions.
- **Each Outlet:**
  - Confirmation that P Budget should be completed for each separate drainage outlet from the MSPA, as opposed to only the MSPA as a whole.

HESL Proposed Methodology and Tools

The March 9, 2015 workplan document states that the "NVCA Tool" (HESL, 2014b) will be applied in the P Budget.

In general, we believe there needs to be elaboration on how proposed infiltration practices within the urban development blocks will be represented in application of the NVCA Tool. Because of the primary role that infiltration practices will play in the load-control strategy, we believe the analysis needs to clearly document how they have been represented.

Our understanding is that TP export from existing and proposed urban area will be estimated using Equation 3.

- Will engineered infiltration practices within the development area be accounted for by way of Equation 3?
- Or will Equation 3 be used only to compute the "unmitigated" load (Module 2), with volume reductions by infiltration practices then accounted for in Module 3 (per Table 11)?

Some specific questions we have regarding application of Equation 3:

- **Precip:** will this be total annual precipitation (i.e. all 12 months of the year, for Shanty Bay average 969 mm over 2009-2014, 30-year normal 968 mm)?
- **Fraction of annual precipitation that produces runoff (Pj):** How will this be estimated? Will this parameter be used in the analysis to account for on-site infiltration practices and if so, how?

- **Runoff coefficient (Rv):** Will this be computed using the Equation 5 and if so, how will fraction of impervious area be estimated? Will the runoff coefficient be used to account for on-site infiltration practices and if so, what methods will be used to adjust it?

Our understanding is that engineering consultants working for the land developers are working on the design of engineered infiltration practices to be installed at various locations within the development area to meet the infiltration targets. XCG understands that HESL staff will be consulting with the developers' engineers to obtain relevant information about the proposed locations and expected effectiveness of the infiltration practices, and then using that information to complete the P Budget using the NVCA Tool. In our opinion, this linkage needs to be documented as part of the P Budget analysis, in order to substantiate whatever parameter values or methods are used in the NVCA Tool to represent the proposed infiltration practices.

Precipitation Analysis:

The NVCA Tool manual (HESL, 2014b), Section 5.1.1, presents a discussion regarding how infiltration practices can be represented or accounted for in applying the Tool. This includes results of analysis of daily precipitation data from 2009 to 2014, for the meteorological station at Shanty Bay.

As noted above, HESL's analysis of these precipitation data led to the conclusion that "infiltration of the first 20 mm of all rain events (all precipitation for events up to 20 mm and the first 20 mm of greater magnitude events) results in cumulative infiltration of 83% of the total annual precipitation, leaving only 17% for run off and treatment by other methods".

This is a significant outcome that was built into the preliminary P budget (HESL, 2014a). We wish to note some points regarding this precipitation analysis.

- The wording in Section 5.1.1 is inconsistent with respect to whether the statements made apply to only the portion of annual precipitation that occurs as rainfall, or total annual precipitation (rainfall and snow). The HESL analysis quotes an average annual rainfall amount of 717.3 mm of rainfall at Shanty Bay, which we have confirmed is rainfall only (i.e. does not include any snowfall).
- The analysis of "events" presented by HESL appears to be based on considering rainfall only. While the statement that "68% of annual ***rainfall*** events fell in events of up to 20 mm precipitation" may be valid, the following statement that infiltration of the first 20 mm "results in cumulative infiltration of 83% of ***total annual precipitation***" (emphasis ours) may not be supported.
- Another important consideration regarding this analysis is how "events" are defined. The HESL analysis appears to have been based on considering each rain day a separate "event". In other words, there was no requirement for an intervening number of days without rain to separate individual events. For example, it appears that two consecutive days with rainfall were considered to be two "events". When considering what may achievable by engineered infiltration practices, this specific analysis may not be appropriate. It does not appear to consider the fact that infiltration practices may require recovery time (i.e. time for infiltration of one event to occur before the facility has capacity available for the next event). For example, if infiltration practices

are designed to completely infiltrate a "design event" of 20 mm rainfall, but require a recovery time of one day to recover capacity, then it may be more appropriate to define individual rain events based on a minimum separation of one day with zero rain. The HESL analysis appears to effectively assume zero recovery time (i.e. precipitation is infiltrated as quickly as it occurs). The result may be a significant over-estimate of what infiltration practices can achieve.

We believe that the precipitation analysis and the conclusions derived from it regarding the potential runoff-volume reduction by infiltration, should be reviewed. Presumably such review could take into account whatever analysis and information will become available from the engineering consultants working on design of the proposed infiltration practices.

Pre-Development Validation using Monitoring Data

Defensible estimation of NPS load under existing conditions will be important. Can any recent or ongoing monitoring data from the Willow Creek watershed be used to validate the pre-development analysis?

Additional Considerations

As a final comment, while not directly within the scope of what we have been asked to comment upon, we wish to note that analysis and documentation of feasibility and acceptability of on-site stormwater infiltration practices should make reference to any existing Source Protection Plans (i.e. the South Georgian Bay Lake Simcoe Source Protection Plan) that may apply to the area.

If there are questions on the above, please do not hesitate to contact the undersigned.

Yours very truly,
XCG CONSULTING LIMITED



Harold Chard, P.Eng.
Senior Project Manager

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June 22, 2016 **XCG File No. 3-2894-02-01**

Mr. J. A. Mullan, P.Eng. **Sent via Email: mullan@ainleygroup.com**
President & CEO
Ainley Group
280 Pretty River Parkway,
Collingwood, Ontario L9Y 4J5

Re: Midhurst Secondary Plan: Phosphorus Budget

Dear Mr. Mullan:

XCG Consulting Limited (XCG) has completed initial review of the report "Midhurst Secondary Plan Area Phosphorus Budget – Update, Draft for Discussion" prepared by Hutchinson Environmental Sciences Limited (HESL), dated May 2016. We have reviewed the report with respect to the phosphorus budget analysis and assessment of the potential impact of changes in phosphorus loadings. We offer the following comments for your consideration.

1. As discussed at our last meeting (February 19, 2016), the ability to limit post-development phosphorus loadings to Willow Creek or the Minesing wetland will depend largely on the feasibility of implementing effective stormwater infiltration practices within the proposed development area. The report, particularly its Appendix A, provides considerable conceptual design information on how and where infiltration will be accomplished within Phase 1. It is our understanding that the pending Master Drainage Plan and detailed designs for approved draft plans of subdivision will provide further technical detail.

2. The approach that has been taken to develop estimates of pre-development phosphorus export from the proposed development lands appears to be well documented, as the report provides the source of information used to estimate export coefficients and other relevant parameters applied in the NVCA Phosphorus Budget Tool.

3. With respect to the post-development phosphorus budgets as summarized in Tables 8 to 12, the methodology that has been applied is well documented. One potential concern may be the interpretation and application of the rainfall statistics as characterized by Figure 6. As noted in our letter of January 29, 2016, this particular form of rainfall data analysis is based on considering daily rainfall amounts at the selected rain gauge station(s). It is not an analysis that defines the number of "events" if we define events as being separated by a defined inter-event dry interval that would be selected based on the estimated capacity recovery time of infiltration facilities. In other words, the concern may be that this analysis does not properly account for infiltration facility recovery time; and that therefore the estimates that 90% and 95% runoff reduction will be provided by 20 mm and 25 mm infiltration, respectively, may be over-estimates, and possibly significantly so. The information in Appendix A appears to indicate that as much as 72 hours

may be needed for full capacity recovery at below-grade infiltration facilities. We believe this matter should be reviewed further to help ensure that the estimates of post-development runoff reduction and resulting phosphorus load reduction are reasonable and defensible.

4. Section 7 of the report directly addresses a number of questions that NVCA has raised with respect to the potential impact of any change in nutrient loading on the Minesing swamp. The information and discussion provided in Section 7 is, in our view, very helpful in addressing these specific questions, and demonstrates that they have been well considered.

We look forward to further discussing the above comments with you at your convenience. If there are questions on the above, please do not hesitate to contact the undersigned.

Yours very truly,

XCG CONSULTING LIMITED



Harold Chard, P.Eng.
Senior Project Manager

Hutchinson

Environmental Sciences Ltd.

Midhurst Secondary Plan Area Phosphorus Budget

Prepared for: The Township of Springwater c/o Ainley Group
Job #: J140051

May 2018

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May 28, 2018 HESL Job #: J140051

Mr. Joe Mullan, P.Eng.
The Township of Springwater c/o Ainley Group
550 Welham Road,
Barrie, Ontario L4N 8Z7

Dear Mr. Mullan:

Re: **Midhurst Secondary Plan Area Phosphorus Budget - Update**

We are pleased to submit the final phosphorus budget for the Midhurst Secondary Plan Area (MSPA) in connection with the Environmental Study Report for Phases 3 and 4 of the Midhurst Class Environmental Assessment. We have completed the budget to provide an assessment of the cumulative loadings of phosphorus from storm and waste water discharges associated with development of the Midhurst Secondary Plan Area (MSPA).

The initial phosphorus budget was completed in 2014. It was updated in May 2016 with modelling and assessment at finer resolution based on refinement of the approved draft plans and more detailed information on land use, stormwater management and LID techniques.

A peer review of the updated budget from May 2016 was provided by XCG Consultants Ltd. on June 22, 2016. The review agreed the methods used and conclusions drawn but recommended that the budget be revised to account for the recovery time of the LID infiltration galleries between storm events and the implications of this to the budget estimates. These revisions were and have been incorporated into this May 2018 Midhurst Phosphorus Budget.

We thank you for the opportunity to contribute to this project and look forward to the next steps. If you have any questions please do not hesitate to contact the undersigned.

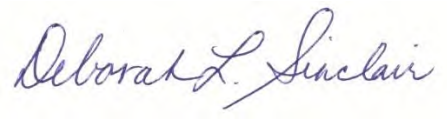
Sincerely,
Per. Hutchinson Environmental Sciences Ltd.



Deborah Sinclair, M.A.Sc.
deborah.sinclair@environmentalsciences.ca

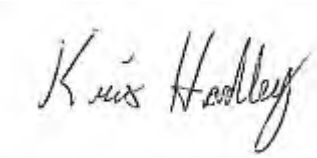
Signatures

Report Prepared by:



Deborah Sinclair
Senior Aquatic Scientist

Tammy Karst-Riddoch, Ph.D.
Senior Aquatic Scientist – (Departed June 2017



Kris Hadley, Ph.D.
Aquatic Scientist

Report Reviewed by:



Neil Hutchinson, Ph.D.
Principal Scientist

Executive Summary

The Nottawasaga Valley Conservation Authority (NVCA) requested the submission of a Master Drainage Plan (MDP) that addressed cumulative impacts of stormwater management and municipal effluent discharge on water quality in Willow Creek and the Minesing wetland in connection with the Midhurst Secondary Plan Area (MSPA) and subdivision approvals process. The submission is to include assessment of[1]:

- the cumulative impact of phosphorus from stormwater management ponds,
- consideration of the cumulative impacts of the sewage treatment plant and stormwater on flooding, erosion and phosphorus loading, and
- how the development will proceed with no net increase in phosphorus loading to the Minesing Wetland.

The assessments of flooding and erosion are covered in other reports that were submitted to the NVCA. In June 2014 the Midhurst Landowners Group (MLG) submitted a phosphorus budget for the MSPA to the NVCA. The budget, which was approved by the NVCA, was completed by Hutchinson Environmental Sciences (HESL 2014a) on a Secondary Plan level to provide an assessment of the cumulative loadings of phosphorus. More detailed land use, storm water management, and LID design descriptions were then developed related to the design of approved draft plans which allowed modelling and assessment at finer resolution. These descriptions were used to refine the initial phosphorus budget completed in 2014. The approved work plan for the Phosphorus Budget was developed in consultation with the Ainley Group, NVCA and XCG Consulting Ltd.[2] and submitted to the Ainley Group in April of 2016. The work plan considered:

- More refined descriptions of land uses, development and SWM approaches and developed areas;
- A breakdown by specific development blocks and SWM catchments to estimate the loading from specific development areas and
- The use of the more refined model for estimation of phosphorus runoff and control that was developed by HESL for the NVCA in 2014 (HESL 2014b).

Phosphorus budgets were completed for the two development stages: Phase 1 and Full Build Out. The budgets address changes in phosphorus export only for those areas in which land use will change as a result of the Midhurst Secondary Plan (MSP), and does not address export from, or changes to, export from land use activities in the rest of the Willow Creek subwatershed.

The phosphorus budget was developed using the approach described in the *Phosphorus Budget Tool and Guidance for Managing New Urban Development in Phosphorus-Sensitive Watersheds* (HESL, 2014b). This 'Tool' was adapted from the *Lake Simcoe Phosphorus Budget Tool* (HESL, 2012) for estimating phosphorus loads and phosphorus reduction with implementation of BMPs and LID's in Ontario outside of the Lake Simcoe watershed. The Tool is the accepted and approved model to estimate phosphorus export from development in NVCA's jurisdiction.

[1] *(Letter: HESL to Ainley, April 6 2016. "Refinement of the Midhurst Secondary Plan Phosphorus Budget")*
[2] *Meeting held on February 19, 2016 at Ainley Group in Barrie, ON.*

The Tool uses established phosphorus export coefficients for natural heritage land uses in Ontario (forest, transition, wetland, open water, turf/sod, low intensity residential, and unpaved roads) and derivation techniques for estimating phosphorus loads from urban and agricultural lands based on site-specific soil and runoff characteristics.

Stormwater runoff from the developments will be collected and treated to provide, MOECC "Enhanced Level" quality control (80% removal of Total Suspended Solids). On site controls, such as LID's and BMP's will also be implemented to reduce stormwater runoff volumes and associated phosphorus loads by infiltrating stormwater runoff to the extent possible, targeting infiltration of the first 25 mm of all rain events. LID's proposed for the development include soakaway pits, infiltration trenches, bio-swales, and increased topsoil depth. Any site runoff that is not infiltrated will be directed to one of the stormwater management ponds (SWMPs). The SWM and LID techniques proposed in the MDP are designed to accommodate a 15% increase in total precipitation as a result of climate change. The phosphorus budget was completed with the assumptions of infiltration of the first 20 mm of all rainfall events and comparison with the NVCA target of 25mm of infiltration. The infiltration target of 20 mm was subsequently increased to 23 mm in response to XCG's peer review which recommended that the infiltration galleries would need time to recover their full infiltration capacity between rain events.

For the Phase 1 Development the following phosphorus loadings were estimated:

- 46 kg/yr from current land uses (agriculture and forest)
- 213 kg/yr of post development phosphorus loadings without implementation of LID techniques and BMPs
- Infiltration of 23 mm of precipitation to account for recovery between events. Post development phosphorus loadings of 21 kg/yr would be achieved with 23 mm infiltration of stormwater by LID techniques. BMPs and SWM techniques implemented for volumes > 23mm would result in a 25 kg/yr reduction from pre-development conditions
- Treatment of municipal effluent to a total phosphorus limit of 0.05 mg/L for Phase 1 would add 118 kg/yr of total phosphorus to Willow Creek
- 139 kg/yr phosphorus loadings to the Willow Creek subwatershed with 23 mm of infiltration, BMPs, and SWM techniques implemented for volumes > 23mm and the WWTP load. This is an increase of 93 kg/yr from pre-development conditions.

For Full Build Out the following phosphorus loadings were estimated:

- 134 kg/yr from current mixed land uses
- 663 kg/yr of post development phosphorus loadings from stormwater without implementation of LID techniques and BMPs
- Infiltration of 23 mm of precipitation to account for recovery between events. Post development phosphorus loadings of 66 kg/yr with 23 mm infiltration of stormwater by LID techniques, BMPs and SWM techniques implemented for volumes > 23mm would result in a 68 kg/yr reduction from pre-development conditions
- Treatment of municipal effluent to a total phosphorus limit of 0.03 mg/L would add 134 kg/yr of total phosphorus to Willow Creek.

- 200 kg/yr of phosphorus loadings to the Willow Creek subwatershed with 23 mm of infiltration, BMPs, and SWM techniques implemented for volumes > 23mm, and WWTP load. This is an increase of 66 kg/yr from pre-development conditions.

Summary of Phosphorus Loadings (kg/yr) from the redevelopment of MSPA

	Phase 1		Full Build Out	
Infiltration	**None**	**23 mm**	**None**	**23 mm**
Pre-development	**46**	**46**	**134**	**134**
Runoff	213	21	663	66
WWTP Load	118	118	134	134
Total Post Development	**331**	**139**	**797**	**200**
Change in P export	**285**	**93**	**663**	**66**

Notes: Post-development loads incorporate 63% reduction from SWMP.

Additional analyses concluded that the minor increase in phosphorus loadings from both the 23 mm and 25 mm scenario would have no effect on the Minesing Wetland and that the TP limit of 0.03 mg/L for discharge of treated municipal effluent at Full Build Out would reduce the 75th percentile phosphorus concentrations in Willow Creek. The overall conclusions reached in the original analysis have not changed and we continue to recommend against implementing a phosphorus offsetting program for the Willow Creek watershed.

This report is based on land use, stormwater management and LID techniques proposed for the development in 2016. The phosphorus budget should be revisited to confirm our conclusions in the event that any aspects of stormwater management for the development are altered.

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1. Introduction

The Nottawasaga Valley Conservation Authority (NVCA) requested the submission of a Master Drainage Plan (MDP) that addressed cumulative impacts of stormwater management and treated municipal effluent discharge on water quality in Willow Creek and the Minesing wetland in connection with the Midhurst Secondary Plan Area (MSPA) approvals process. The submission is to include assessment of:

- the cumulative impact of phosphorus from stormwater management ponds (SWMPs),
- consideration of the cumulative impacts of the sewage treatment plant and stormwater on flooding, erosion and phosphorus loading, and
- how the development will proceed with no net increase in phosphorus loading to the Minesing Wetland.

The assessments of flooding and erosion are covered in other reports that were submitted to the NVCA. In June 2014 the MLG submitted a preliminary phosphorus budget for the MSPA to the NVCA. The budget was completed by Hutchinson Environmental Sciences (HESL 2014a) on a Secondary Plan level to provide an assessment of the cumulative loadings of phosphorus. That phosphorus budget concluded that there would be no increase as a result of application of LID techniques to the proposed land use changes but, with consideration of the WWTP discharge, the annual load of phosphorus to Willow Creek would increase by 60 kg/yr, or 2.2%.

More detailed land use, storm water management, and LID design descriptions were developed in connection with the design of the approved draft plans which allowed modelling and assessment at finer resolution. These descriptions were used to refine the initial phosphorus budget completed in 2014. The approved work plan for the Phosphorus Budget was developed in consultation with the Ainley Group, NVCA and XCG Consultants Ltd.[3] and submitted to the Ainley Group in May 2016.

The updated Phosphorus Budget considered:

- More refined descriptions of land uses, development and SWM approaches and developed areas;
- A breakdown by specific development blocks and SWM catchments to estimate the loading from specific development areas as refinement of the grouping of development by land use that was used in Phase 1; and
- The use of the more refined model for estimation of phosphorus runoff and control that was developed by HESL for the NVCA in 2014.

A peer review of the updated budget from May 2016 was provided by XCG Consultants Ltd. on June 22, 2016. The review agreed with the methods used and conclusions drawn but recommended that the budget be revised to account for the recovery time of the LID infiltration galleries between storm events and the implications of this to the budget estimates. These revisions were provided to the Ainley Group on March 7, 2017 and have been incorporated into this May 2018 Final Midhurst Phosphorus Budget.

[3] *Meeting held on February 19, 2016 at Ainley Group in Barrie, ON.*

1.1 Study Area

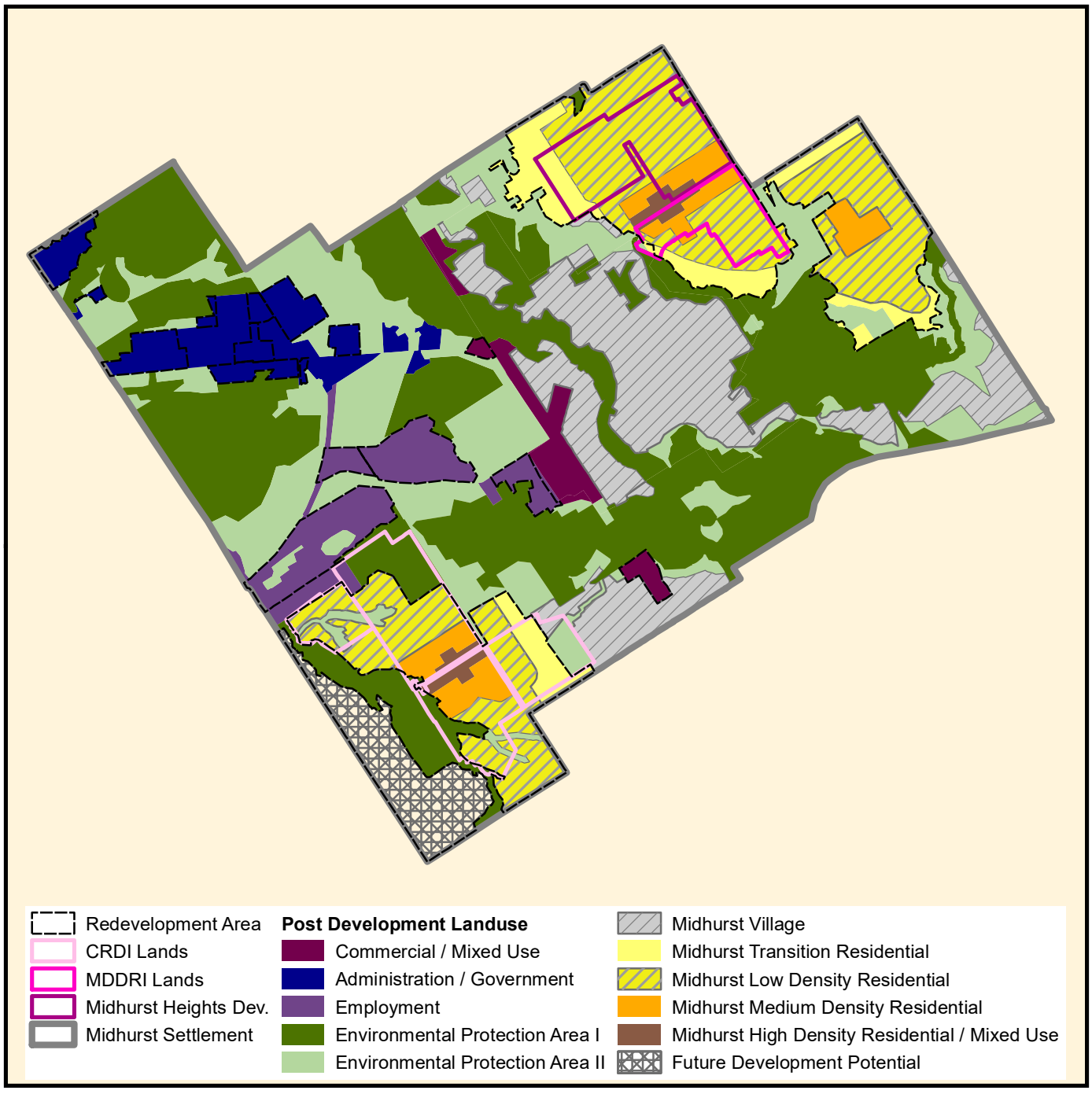
The MSPA is located in the Township of Springwater, Ontario. Existing development in the Secondary Plan Area includes residential use and commercial/industrial and mixed use along Bayfield Rd., Snow Valley Rd, and Highway 26. Proposed development in the Secondary Plan Area includes residential communities, commercial, industrial, mixed use and employment lands (Figure 1). The details of the planned development for the Midhurst Secondary Plan Area are contained within Official Plan Amendment (OPA) No. 38 Midhurst Secondary Plan (MSP) and in approved draft plans.

Domestic water supply for the Secondary Plan Area will be provided by groundwater from future municipal wells. Municipal wastewater will be collected, treated and discharged to Willow Creek downstream of Midhurst. The annual phosphorus loading to Willow Creek from the WWTP is estimated as 118 kg for Phase 1 and 134 kg at Full Build Out (HESL 2018).

The total area of the MSPA is approximately 2,813 Ha (Figure 1). Phosphorus budgets were completed for two development scenarios: Phase 1 and Full Build Out. These address land use changes proposed for the MSPA, and do not address any changes or phosphorus export from existing land uses in the rest of the Willow Creek subwatershed as agreed to in the terms of reference.

For Phase 1, only the 300 ha of development which has been approved for development (Carson Road Development Inc. (CRDI), Midhurst Development Doran Road Inc. (MDDRI), and Midhurst Heights; Figure 1) was modelled. For Full Build Out, the phosphorus budget was completed for all MSPA lands. This included the Phase 1 lands and areas outside of Phase 1 called “Redevelopable Areas” (Figure 1) in the MSPA. Existing land uses (e.g. residential, commercial, employment, administration, and environmental protection areas) that are outside of the redevelopable area were not included in the analysis as agreed to in the terms of reference.

For Phase 1, post-development phosphorus budgets were completed for each point of stormwater discharge and summed to provide a cumulative phosphorus load. For Full Build Out, the specific locations of SWMP discharges have not yet been determined; therefore, one load for Full Build Out was calculated and added to the Phase 1 loads.





N

0 0.5 1 2 km

Project Lead: Deborah Sinclair
Prepared by: Eric Dilligeard
Data Source: Malone Given Parson Ltd., LIO
Coordinate System: NAD 1983 UTM Zone 17N

Figure 1:
Midhurst Secondary Plan Area

Project: Midhurst Secondary Plan – Phosphorus Budget
Project #: J140051

May 5, 2016

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1.2 Constituents Modelled

NVCA has identified phosphorus loadings as the most significant water quality issue within their watershed (NVCA 2013). Phosphorus is the limiting nutrient for aquatic plant growth in fresh water. Stormwater and WWTP effluent from the MSPA will discharge to Willow Creek, which is a Policy 2 receiver for total phosphorus as the 75th percentile concentration of 0.035 mg/L (HESL 2018) exceeds the Provincial Water Quality Objective (PWQO) of 0.03 mg/L. In addition, the NVCA has specifically identified phosphorus as the nutrient of concern in the MSPA, advising that the cumulative impact of the WWTP and stormwater management on phosphorus be addressed. Phosphorus budgets were therefore undertaken to estimate the cumulative non-point source phosphorus loadings for pre and post-development land uses from the Midhurst Secondary Plan Area. The cumulative loadings of phosphorus were estimated for the total loading to Willow Creek downstream of the development and hence to the Minesing Wetland.

Although orthophosphorus is the most bioavailable form of phosphorus for plant uptake and growth, it is difficult to accurately model because complex interactions with suspended particulates, bottom sediments, organic matter, and plants (e.g. algae and macrophytes) (Correll, 1998) mean that a) the proportion of the total concentration that is bioavailable is variable such that the transformations between total and bioavailable forms cannot be accurately modelled and b) there is very little measured data to inform any modelling exercise[4], In addition, there are no regulatory standards for bioavailable phosphorus for assessment of the significance of modelled output. Total phosphorus was therefore modelled as it includes both the dissolved bioavailable fraction as well as the particulate form, some of which has the potential to dissolve and become bioavailable through site-specific nutrient dynamics. Modelling of total phosphorus therefore represents a conservative approach to the assessment. In addition, the PWQO for phosphorus is based on the total concentration and it is a standard water quality objective used by the NVCA and the MOECC as a guideline for protection of water quality in their watersheds. By modelling total phosphorus concentrations, the influence of the MSPA can be assessed in comparison to both provincial and local water quality standards.

2. Approach

The phosphorus budget was developed using the approach described in the *Phosphorus Budget Tool and Guidance for Managing New Urban Development in Phosphorus-Sensitive Watersheds* (HESL, 2014b). The reader is referred to that document for details on derivation of the methods summarized below. This 'Tool' was adapted from the *Lake Simcoe Phosphorus Budget Tool* (HESL, 2012) for the NVCA to estimate phosphorus loads and phosphorus reduction with implementation of BMPs and LID techniques in Ontario outside of the Lake Simcoe watershed. The Tool is the accepted and approved model to estimate phosphorus export from development in NVCA's jurisdiction.

The Tool uses established phosphorus export coefficients for natural heritage land uses in Ontario (forest, transition, wetland, open water, turf/sod, low intensity residential, unpaved roads) and derivation

[4] *In 2016 HESL, on behalf of the MLG, added orthophosphorus measurements to the baseline monitoring program for the Willow Creek subwatershed to allow future comparisons as part of the Monitoring and Adaptive Management Plan for the MSPA.*

techniques for estimating phosphorus loads from urban and agricultural lands based on site-specific soil and runoff characteristics (Table 1).

Phosphorus export coefficients for cropland were derived from the relationship between CANWET-derived phosphorus export for Lake Simcoe subwatersheds and soil loss (A) as estimated using the Universal Soil Loss Equation (USLE):

$$\text{Phosphorus Export (kg/ha/yr)} = (0.16 \times A) + 0.16$$

The factors used in the USLE were developed for use in Ontario by the Ministry of Agriculture, Food and Rural Affairs (Stone and Hilborn, 2012).

Table 1. Phosphorus Export Coefficients Used in the NVCA Tool (HESL 2014b)

Land Use	Export Coefficient (kg/ha/yr)	Notes
Forest	0.06	Mean phosphorus export for all 'monitored' Lake Simcoe subwatersheds (n = 7) derived using phosphorus loads from CANWET modeling. Monitored subwatersheds were those with sufficient measured data to validate and calibrate the model.
Transition	0.07	
Wetland	0.05	
Turf/Sod	0.11	
Hay/Pasture	0.08	
Low Intensity Residential	0.13	
Unpaved Roads	0.83	
Open Water	0.26	Calculated from the mean measured atmospheric load of 19 tonnes/yr averaged over 5 years from 2002 to 2007 to the surface of Lake Simcoe (surface area = 722 km^2) (Scott et al., 2006; LSRCA, 2009).
Cropland	0.16 x A +0.16	Developed from the relationship between CANWET derived phosphorus export for Lake Simcoe subwatersheds and soil loss. Where: A = soil loss determined using the Universal Soil Loss Equation (USLE)
Residential	$TP_i \times Precip \times P_j \times R_V \times 10^{-2}$	Where: • TP_i is total phosphorus concentration (mg/L) in runoff measured from urban land uses: 0.41 mg/L for residential, 0.20 mg/L for commercial, 0.41 mg/L for industrial and 0.50 mg/L for transportation, • Precip is the annual precipitation (mm/yr), • P_j is the fraction of Precip that produces runoff, and • R_V is the runoff coefficient.
Commercial		
Industrial		
Transportation		

Phosphorus export coefficients for urban land use classes (high intensity residential, commercial, industrial, and transportation) were derived using an approach to account for site-specific variation in runoff conditions in urban settings. The equation used a standard value for phosphorus concentrations in urban runoff (TP_i), annual depth of precipitation (Precip), that fraction of precipitation producing runoff (Pi) and a runoff coefficient derived for impervious surfaces (Rv):

$$\text{Phosphorus Export (kg/ha/yr)} = TP_i \times Precip \times P_j \times R_V \times 10^{-2}$$

The NVCA Tool calculates P loads from urban lands as a function of the volume of runoff produced and the concentration of P in that runoff. The Tool is based on a comprehensive literature review of the documented effectiveness of SWM and LID techniques (Table 2), which was incorporated into the phosphorus modelling. The Tool provides for a 100% reduction in P load for all runoff that is infiltrated. Not all techniques shown in Table 2 are proposed for use in the MSPA - Section 3 of the report documents the proposed SWM and LIDs for the project.

Table 2. Recommended Phosphorus Removal Efficiencies of BMP/LID Classes (from HESL, 2014b)

BMP/LID Class	% Phosphorus Removal Efficiency
Bioretention Systems	**100***
Constructed Wetlands	77
Dry Detention Ponds	10
Dry Swales	none
Enhanced Grass/Water Quality Swales	**100***
Flow Balancing Systems	77
Green Roofs	**100***
Hydrodynamic Devices	none
Perforated Pipe Infiltration/Exfiltration Systems	87
Permeable Pavement	**100***
Sand or Media Filters	45
Soakaways - Infiltration Trenches	60 (**100***)
Sorbtive Media Interceptors	79
Underground Storage	25
Vegetated Filter Strips/Stream Buffers	65
Wet Detention Ponds	63

* infiltration techniques are credited with 100% removal efficiency if their effectiveness is verified in the SWM plan.

The phosphorus budget calculated average annual phosphorus loadings, including winter and spring loadings from precipitation and runoff. The proposed infiltration practices (aside from at-grade bioswales adjacent to parkland in the Midhurst Development Doran Road Inc. (MDDRI) development) are to be constructed below the frost line and will therefore be functional when snow melt is conveyed to the infiltration areas during the winter months.

The annual phosphorus loading to Willow Creek from the proposed Midhurst WWTP was added to the post-development storm water phosphorus budgets for Phase 1 and Full Build Out to determine the cumulative phosphorus loads from both stormwater and sanitary sources.

3. Stormwater Management

The stormwater management plans for the MSPA (SCS 2014 and Crozier and Associates 2014) were used to develop the phosphorus budget. Stormwater from the developments will be collected and treated to MOECC "Enhanced Level" standards (80% removal of Total Suspended Solids). On site controls, LID techniques and BMPs will also be developed and implemented to reduce stormwater volumes, improve quality and reduce temperature. Any treated stormwater that is not infiltrated will be discharged after treatment to tributaries of Willow and Black Creeks adjacent to the SWMP ponds in each of the development areas. The NVCA requested as much as possible infiltration with the target for infiltration of runoff in the post-development of 25 mm of rainfall. This will assist in the volume control and water quality control. The budget was developed considering two infiltration scenarios of 20 and 25mm rainfalls. The SWM and LID techniques proposed in the Phase 1 MDP are designed to accommodate a 15% increase in total precipitation as a result of climate change.

Detailed drainage plans are not available for the Full Build Out scenario (outside of the Phase 1 area). Infiltration characteristics and treatment by SWMPs were therefore assumed to be similar to that of Phase 1, for the purposes of estimating phosphorus export. The following provides a summary of stormwater management practices proposed for the Phase 1 development.

3.1.1 Carson Road Development Inc. (CRDI) and MDDRI Developments

For the CRDI and MDDRI developments, the proposed stormwater management in the post development includes private and public LID techniques to promote infiltration and stormwater management ponds to manage site runoff.

The proposed LID techniques on private lands include:

- increased topsoil depth,
- direction of roof leaders to soakaway pits, and
- exfiltration trenches.

The increased soil depth (lawns will have a minimum soil depth of 300 mm) will promote infiltration and reduce runoff. The soakaway pits (located in the front and rear yards) and exfiltration trenches to infiltrate roof and rear lot drainage will be designed to infiltrate drainage from the 25 mm storm event.

Proposed LID techniques in public lands include:

- increased topsoil depth in public landscaped areas,
- infiltration galleries in each park area,
- municipal rain gardens/bioswales, and
- permanent pool drawdown.

Soil depth in boulevards and park areas will have a minimum depth of 300 mm, which will promote infiltration and reduce runoff. Infiltration galleries in park areas will be directly connected to the municipal storm sewer. Municipal rain gardens or bio-swales may be feasible on the green space adjacent to the right of ways in the MDDRI development areas. The bio-swales will provide infiltration for 25 mm runoff.

Any site runoff that is not infiltrated will be directed to one of the SWM ponds. Four SWM ponds are proposed for the CRDI development area (North Pond, Carson Road North Pond, Carson Road South Pond, and South Pond). For Phase 1, one SWM pond is proposed for the MDDRI Development area (Russell Road Pond). A linear trench is proposed around the perimeter of each SWM pond. The first 0.5 – 1.0 m of permanent pool will be directed to the drawdown trench and infiltrated.

Further information on the LIDs, locations of the SWM ponds and the drainage catchments for each SWM pond is provided in Appendix A.

3.1.1 Midhurst Heights Development

The proposed stormwater management for Midhurst Heights also includes private and public LID techniques to promote infiltration and a stormwater management pond to manage site runoff.

The proposed LID technique on private lands include the direction of roof leaders to soakaway pits. The soakaway pits (located in the front and rear yards) will be designed to infiltrate drainage as required to prevent geomorphological, water balance and phosphorus export impacts (infiltration quantities to be determined through Master Drainage Plan).

Proposed LID techniques in public lands include:

- increased topsoil depth in public landscaped areas, and
- bio-retention and/or infiltration galleries in park blocks and SWM Pond Block

Soil depth in boulevards and park areas will have a minimum depth of 300 mm, which will promote infiltration and reduce runoff. Bio-retention/infiltration galleries in park areas will be directly connected to the municipal storm sewer. In the SWMP, a linear trench is proposed around the perimeter.

One SWMP is proposed for management of runoff from the Midhurst Heights development area. A small portion (3.045 ha) of the site will not be directed to the SWMP. Runoff from this area will be directed to the ditch along Gill Road following treatment in local LID installations such as lot level soakaway pits and bio-swales. All other site runoff that is not infiltrated will be directed to the SWMP.

Further information, schematics and technical details with respect to the proposed SWM strategy and LID practices for the Midhurst Heights subdivision can be found in the Summary Document for OMB Proceedings (Crozier, August 2014).

3.1.2 Full Build Out

Detailed stormwater management plans have not been developed for Full Build Out and so the phosphorus budget assumes the same techniques and effectiveness for the full Build Out as are proposed for Phase 1. All stormwater from the developments will be collected and treated by stormwater management ponds to enhanced level standards. On site controls, such as LID techniques and BMPs will also be implemented to reduce stormwater runoff volumes.

4. Model Inputs

The Tool requires input parameters specific to the project and site. This includes pre and post development land use areas, total annual precipitation, the fraction of precipitation that produces runoff (Pj), runoff coefficients, and cropland characteristics.

4.1 Land Use Areas

The entire MSPA is 2, 813 ha, of which ~300 ha will be developed as part of the Phase 1 development, and the balance totalling ~900 ha at Full Build Out (Figure 1, Table 3). Land uses in the balance of the MSPA will not be altered and have not been included in the phosphorus budget calculations.

4.1.1 Pre-development

The areas of each land use were calculated for both scenarios (Table 3). For Phase 1, only the land uses for the approved developments (CRDI, MDDRI, and Midhurst Heights in Figure 2) were calculated. For Full Build Out, land uses for all of the redevelopable areas (Figure 3) in the MSPA were calculated.

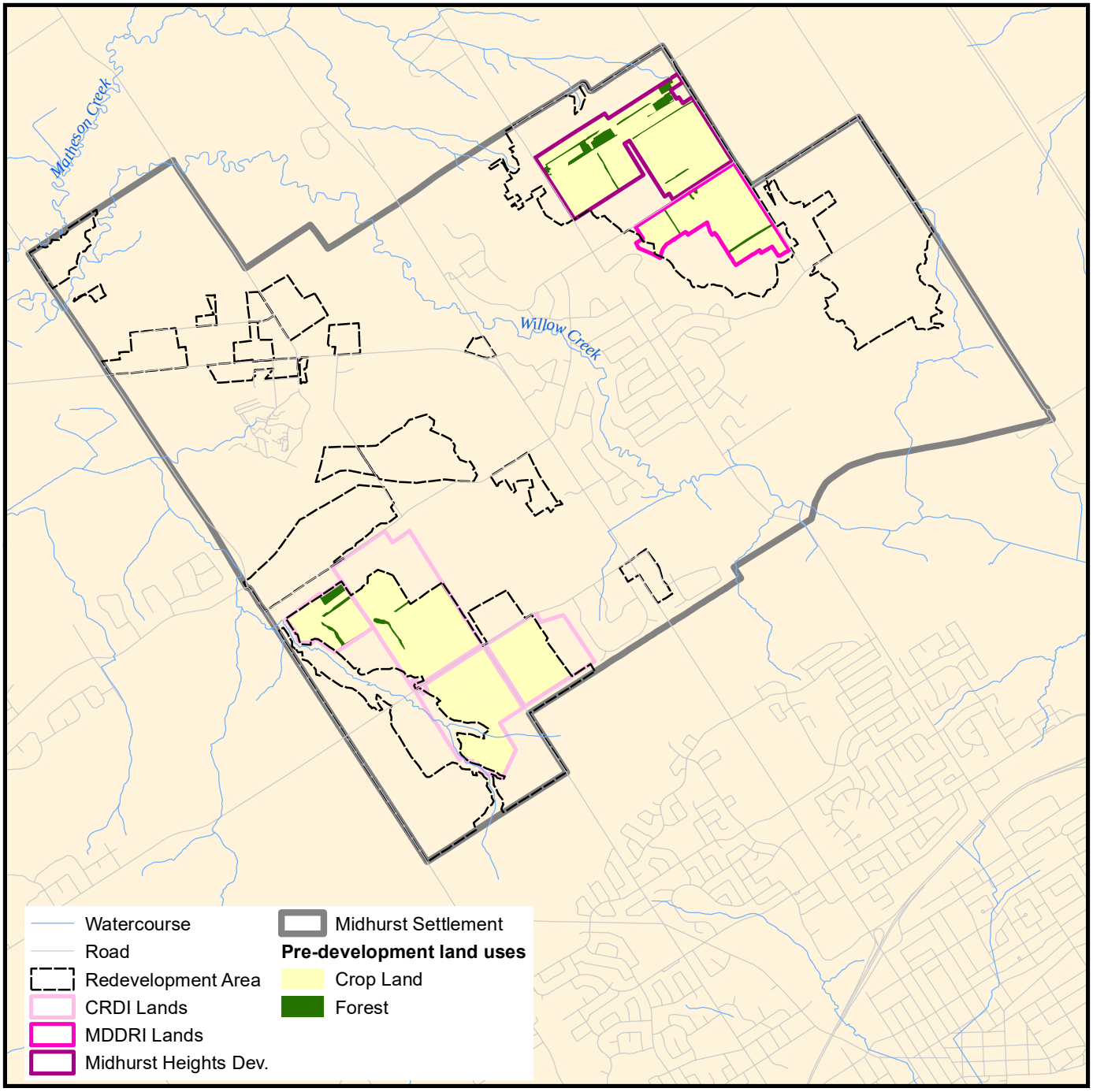
For each scenario, pre-development land uses were delineated by Malone Given Parsons using satellite imagery (HESL 2014) and ground-truthed with site visits by HESL staff in May 2014 and October 2015 to ascertain crop types and tillage practices The Phase 1 land uses were also cross-checked with available Ecological Land Classification from Beacon Environmental.

Table 3 Pre-development Land Uses

	Phase 1	Full Build Out
Cropland	278	642
Forest	20	81
Hay/Pasture		2.1
Commercial/Industrial		5
Residential		0.4
Low Intensity Development		95
Open Water		1
Quarry		30
Transitional		42
Wetland		2
Total	**298**	**899**

Notes: Land uses are approximate and subject to change

For both the Phase 1 and Full Build Out scenario, the predominant pre-development land use is cropland. In Phase 1, the only other land use is forest. In Full Build Out scenario; commercial/industrial, low intensity development, quarry, wetland, open water and transitional land uses are also present.





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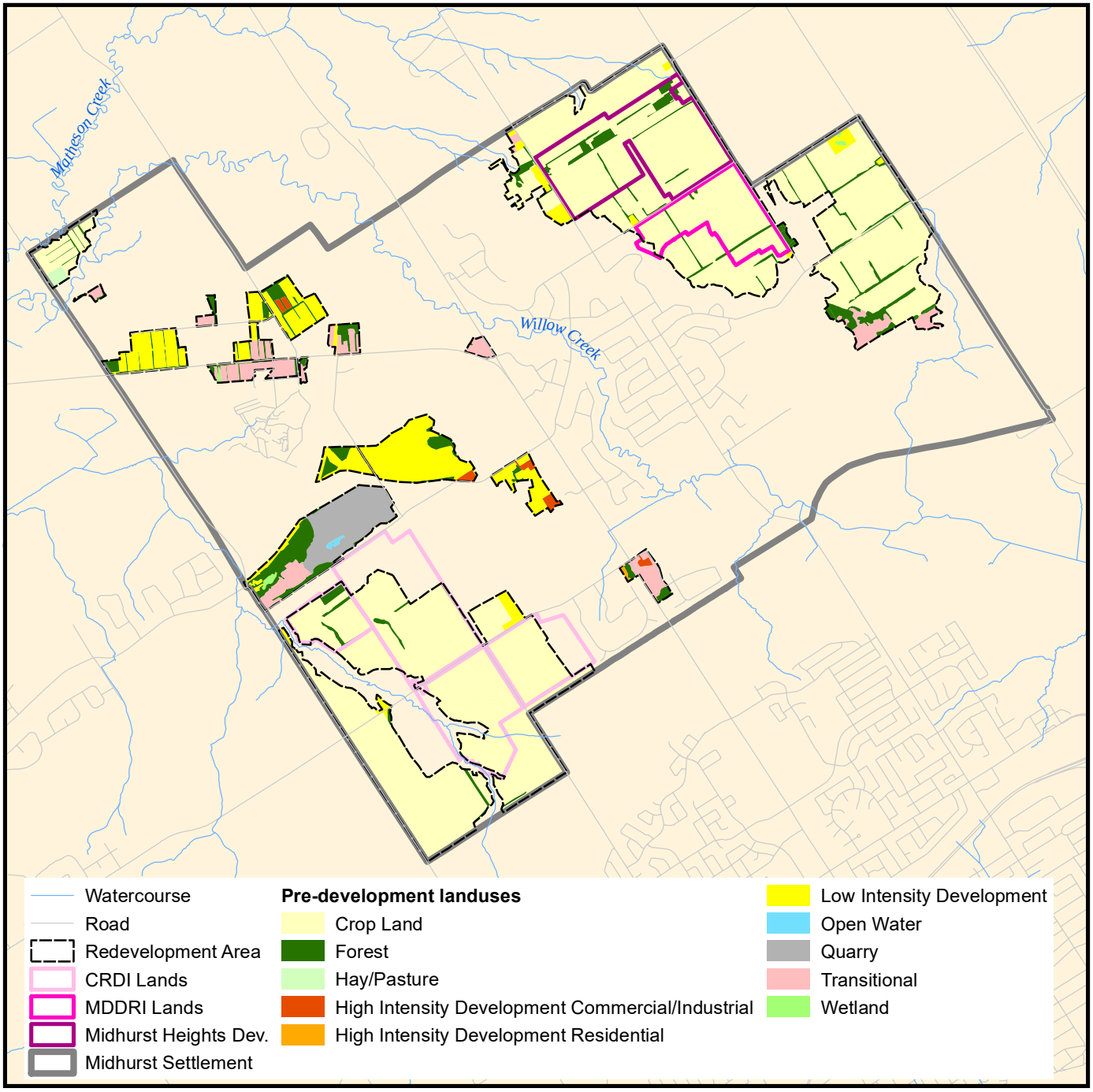
Project Lead: Deborah Sinclair
Prepared by: Eric Dilligeard
Data Source: Malone Given Parson Ltd., LIO
Coordinate System: NAD 1983 UTM Zone 17N

Figure 2:
Phase 1 Pre-development Land Uses

Project: Midhurst Secondary Plan – Phosphorus Budget
Project #: J140051

May 5, 2016

Hutchinson Environmental Sciences Ltd.





N

0 0.5 1 2 km

Project Lead: Deborah Sinclair
Prepared by: Eric Dilligeard
Data Source: Malone Given Parson Ltd., LIO
Coordinate System: NAD 1983 UTM Zone 17N

Figure 3:
Full Build-out Pre-development Land Uses

Project: Midhurst Secondary Plan – Phosphorus Budget
Project #: J140051

May 6, 2016

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4.1.1 Post-development

Post- development land use areas were calculated for both modeling scenarios (Phase 1 and Full Build-out) and provided to HESL by the planning and engineering teams at Malone Givens Parsons, SCS and Crozier. For Phase 1, the detailed draft plans of subdivisions provided the land uses and areas for the subdivisions (Appendix A). Post-development drainage plans were prepared by the project's civil engineers for the draft plan subdivisions, and reclassified according to the NVCA Tool's land use descriptions (Appendix B). The drainage plans provided land use areas draining to each stormwater management pond in the subdivisions.

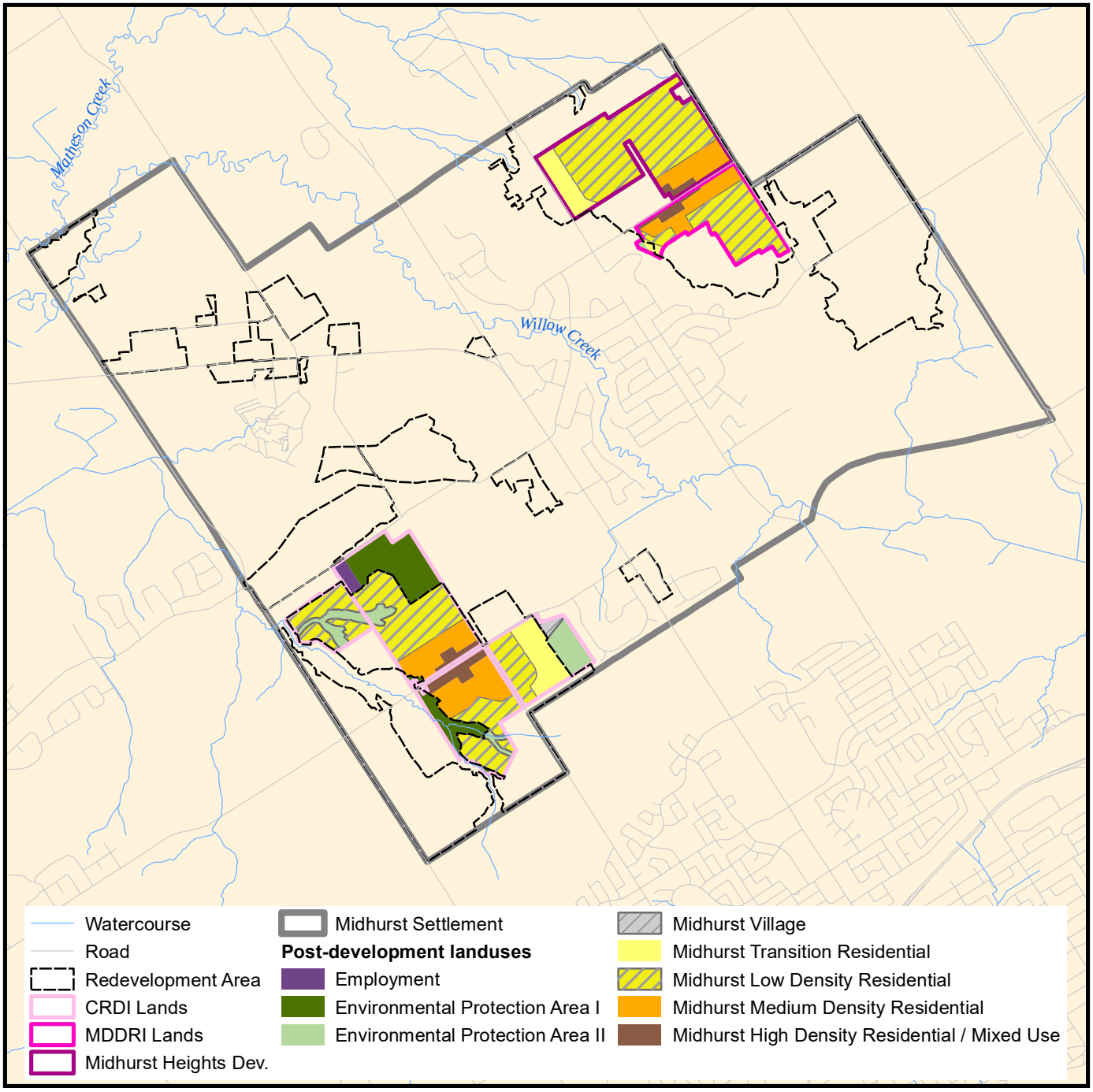
For Phase 1, the land uses in each drainage catchment were used to estimate post-development land use areas to calculate the phosphorus loading from each stormwater management pond (Table 4). For the MDDRI development, the stormwater management pond was not included in the draft plan of subdivision, and so the post-development land use is approximately 4.39 ha greater than the MDDRI Phase 1 development area. In addition, a small portion of the Midhurst Heights development does not drain to the SWMP; these lands are, however included in the calculation of the P budget, to account for all phosphorus leaving the site.

Table 4. Phase 1 Drainage Catchment Land Use Areas (ha)

Development	**CRDI Development**				**MDDRI Development**	**Midhurst Heights**	**Total Phase 1 Area**
P Budget Land Use	South Pond	Carson Road South Pond	Carson Road North Pond	North Pond	Russell Road Pond	Midhurst Heights Pond	
Residential	11.69	46.94	15.87	46.87	42.56	81.75	245.68
Commercial	0	3.17	4.48	0	3.41	4.17	15.23
Low Intensity Residential	0.75	8.38	1.5	5.43	4.26	5.88	26.20
Open Water[3]	0.555	1.055	0.585	1.825	2.195	2.72	8.94
Transitional[4]	0.555	1.055	0.585	1.825	2.195	2.72	8.94
Total	**13.55**	**60.6**	**23.02**	**55.95**	**54.62[1]**	**97.24[2]**	**304.98[1]**

Notes: 1 – The Russell Road catchment includes 4.39 ha for the SWMP (which is outside of the draft plan area), therefore the total area incorporates development lands within the 300 ha plus the area for the SWMP. 2 – a small portion of the Midhurst Heights Lands do not drain to the SWMP; these lands are included in the calculation of the P budget, 3 –water portion of SWMP, 4 – perimeter of stormwater management property that is not water, assumed to be 50% of stormwater management block.

The same level of detail available for Phase 1, including detailed drainage plans, is not yet available for the Full Build-Out scenario. Land uses for the developable areas outside of the Phase 1 (Figure 5) were therefore estimated from the Secondary Plan land use designations and reclassified according to the NVCA Tool's land use descriptions (Appendix B). These areas were then added to the detailed Phase 1 land uses for the total developable area for Full Build Out (Table 5).





N

0 0.5 1 2 km

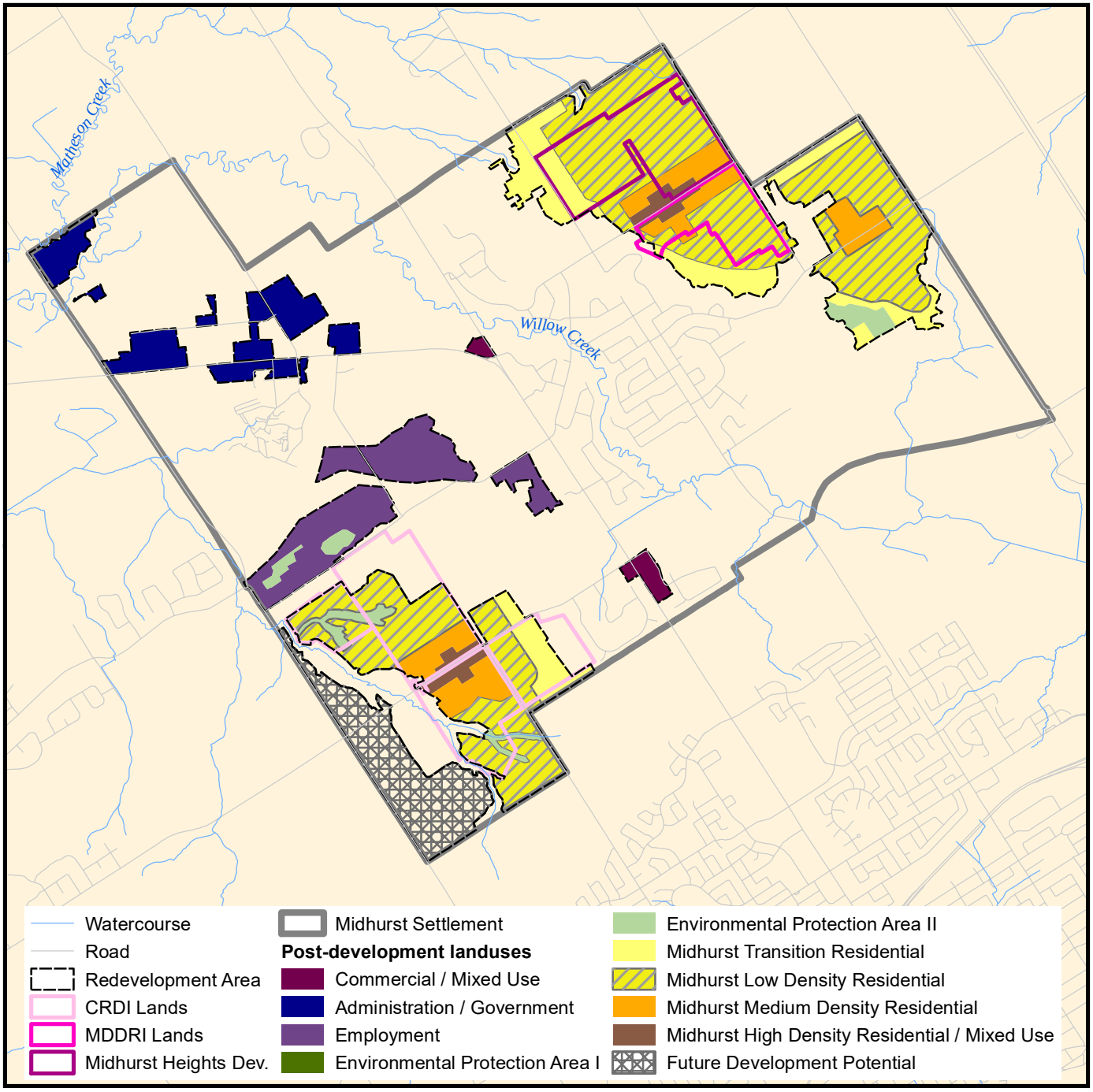
Project Lead: Deborah Sinclair
Prepared by: Eric Dilligeard
Data Source: Malone Given Parson Ltd., LIO
Coordinate System: NAD 1983 UTM Zone 17N

Figure 4:
Phase 1 Post-development Land Uses

Project: Midhurst Secondary Plan – Phosphorus Budget
Project #: J140051

May 6, 2016

Hutchinson Environmental Sciences Ltd.





N

0 0.5 1 2 km

Project Lead: Deborah Sinclair
Prepared by: Eric Dilligeard
Data Source: Malone Given Parson Ltd., LIO
Coordinate System: NAD 1983 UTM Zone 17N

Figure 5:
Full Build-out Post-development Land Uses

Project: Midhurst Secondary Plan – Phosphorus Budget
Project #: J140051

May 5, 2016

Hutchinson Environmental Sciences Ltd.

Table 5. Full Build Out Land Use Areas

P Budget Land Use	Phase 1	Redevelopable Area Outside of Phase 1	Full Build Out
Residential	245.68	338.42	584.10
Commercial	15.23	93.59	108.82
Industrial		89.85	89.85
Low Intensity Residential	26.2	21.16	47.36
Forest		18.67	18.67
Open Water	8.94	17.47	26.41
Transitional	8.94	17.47	26.41
Total	**304.98**	**596.63**	**901.62**

Notes: Full Build Out land uses are approximate and subject to minor change

4.2 Precipitation

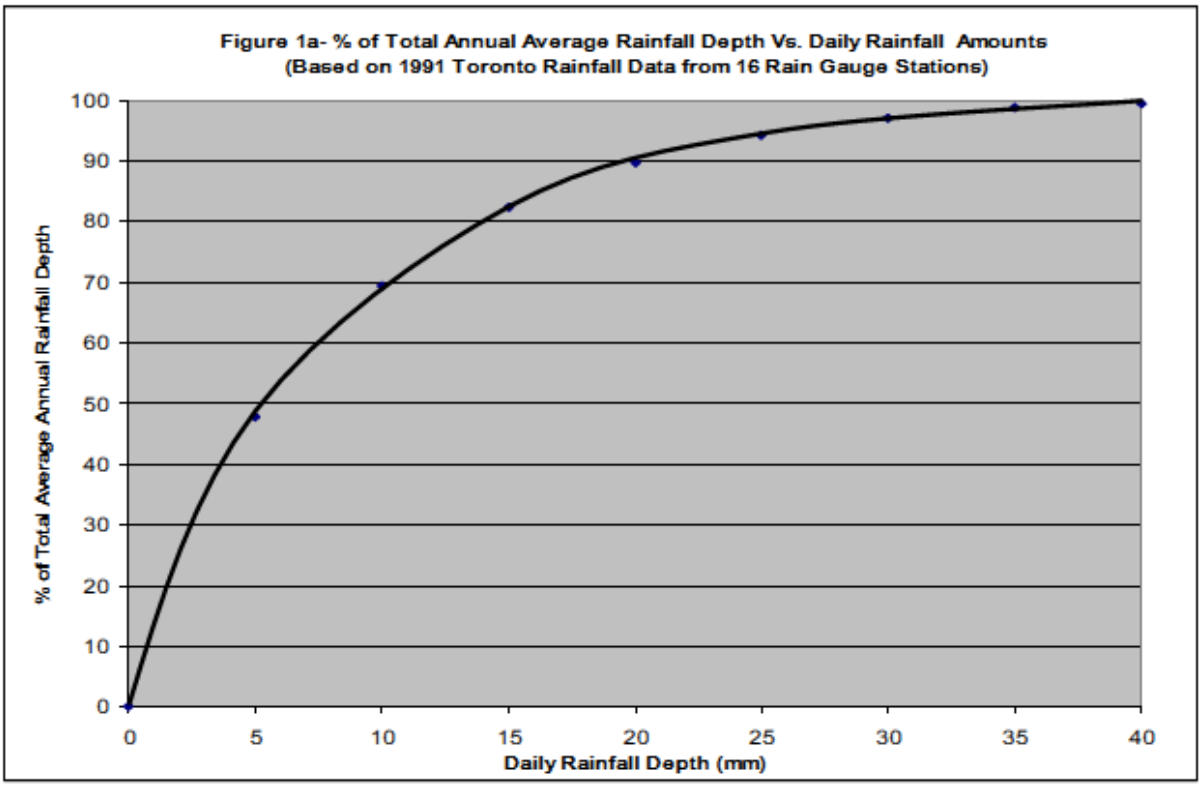
The closest Environment Canada climate station to the subject property is Shanty Bay (Climate ID 6117684). The total precipitation for Shanty Bay is 967.9 mm/yr (1981 – 2010 normal). The fraction of precipitation that produces runoff (P_j) was estimated as 0.9, which is the standard default value recommended in the NVCA P Budget Tool. This value was used to account for the fact that many of the rain events that occur during a year are minor and much of the rain from these events is stored (e.g., in surface depressions) and evaporates without producing runoff. The Pj value did not change in the pre- and post-development scenarios.

The NVCA wants to see as much infiltration as possible, with the target for infiltration of runoff post-development being 25mm. Phosphorus loadings were calculated for three post-development scenarios: no infiltration, 20 mm and 25 mm of infiltration. The two infiltration scenarios provide a conservative (20 mm) and target (25 mm) estimates of runoff reduction (and hence phosphorus reduction) from implementing LID techniques in the post development scenario. These two infiltration scenarios were later modified to account for recovery of the infiltration galleries between rain events, in response to the XCG peer review, and the phosphorus budget modified accordingly (see Section 6).

Figure 1a from the City of Toronto's Wet Weather Flow Management Guidelines (Figure 6; City of Toronto) presents a widely accepted distribution of Average Annual Rainfall Depth based on daily rainfall amounts. This figure was created using 16 different rain gauges in and around the City of Toronto and identifies that storm events with depths up to 20 mm and up to 25 mm typically account for 90% and 95% of total annual rainfall.

This chart has been used by The City of Toronto and the Toronto & Region Conservation Authority to support the sizing of LID's in many municipalities outside of the City of Toronto. The relationship between event rainfall depth and total annual precipitation provided in this figure was therefore used for Midhurst.

Figure 6. Proportion of Annual Precipitation Falling for Daily Rainfall Depths.



Notes: Source: City of Toronto 2006

4.3 Cropland Export Coefficients

The NVCA Tool derives the export coefficient for cropland based on the relationship between CANWET-derived phosphorus export for Lake Simcoe subwatersheds and soil loss (A) as estimated using the USLE (Section 2). The factors used in the USLE were developed for use in Ontario by the Ministry of Agriculture, Food and Rural Affairs (Stone and Hilborn, 2012) and details on the selection of these factors and resultant soil loss from the MSPA agricultural lands are presented in Appendix C.

A median P export coefficient of 0.164 kg/ha/yr (range 0.160 to 0.177) was derived for ~ 40 agricultural blocks based on the observed site conditions, slopes and soil classes (Table 4 of Appendix C). A sensitivity analysis (Appendix C) of the USLE factors crop system, tilling method, and support practice factor found that use of a variety of realistic values for soil loss factors between the ~ 40 agricultural blocks modelled had little influence on the cropland export coefficient (export ranged from 0.160 to 0.163 with median of 0.161 kg/ha/yr). An export coefficient of 0.161 kg/ha/yr for croplands was therefore selected, as it represented a conservative approach to the entire analysis, by estimating higher phosphorus loads under pre-development conditions.

Table 6. Summary of Soil Loss and P Export from MSPA Agricultural Lands

	Base Case		Sensitivity Analysis	
	Soil Loss (tonnes/ha/yr)	P Export (kg/ha/yr)	Soil Loss (tonnes/ha/yr)	P Export (kg/ha/yr)
Minimum	0.001	0.160	0.001	0.160
Maximum	0.104	0.177	0.021	0.163
Median	0.025	0.164	0.008	0.161
Mean	0.036	0.166	0.009	0.161

4.4 Runoff Coefficients

The runoff coefficient (Rv) for impervious surfaces is used in the derivation of phosphorus export coefficients for urban land use classes (residential, commercial, industrial, and transportation; Section 2). Runoff coefficients were provided by the project civil engineers (e.g. SCS Consulting Group Ltd. and Crozier and Associates) for the Phase 1 Post-Development land uses (Appendix D).

Detailed drainage plans were not available for the balance of the Full Build Out scenario, therefore runoff coefficients for urban lands for pre- and post-development were estimated using values provided by the civil engineers for the Phase 1 development (Appendix D).

5. Results

The pre- and post-development phosphorus budgets for the Phase 1 and Full Build Out scenarios are presented in Tables 7 to 12. Calculations are provided in Appendix D.

Phosphorus loadings were calculated for three post-development scenarios: no infiltration, 20 mm and 25 mm of infiltration. The two infiltration scenarios provide conservative (20 mm) and target (25 mm) estimates of runoff reduction (and hence phosphorus reduction) from implementing LID techniques in the post development scenario.

The amount of phosphorus removed under the two infiltration scenarios was estimated based on the amount of precipitation infiltrated by LIDs. The City of Toronto's Wet Weather Flow Management Guidelines estimates that approximately 90% and 95% of total annual precipitation falls within a daily depth of 20 mm and 25 mm (Figure 6). Infiltrating 90% and 95% of the precipitation will reduce the amount of runoff and phosphorus loading by the same factor. These values were applied to the post-development no infiltration phosphorus export estimates to estimate the amount of phosphorus reduction with 20 and 25 mm of infiltration. Phosphorus export from runoff from events exceeding 20 and 25mm was reduced by an additional 63% by "Enhanced Level" SWM ponds.

5.1 Phase 1 Scenario

The pre-development phosphorous export from the Phase 1 development is 46 kg/yr. Most of the land use is agriculture; as such 45 kg/yr of the phosphorus load is from cropland, with only 1 kg from forested areas (Table 7).

Table 7. Phase 1 Pre-Development Phosphorus Loads

Land Use	Area (ha)	Export Coefficient (kg/ha/yr)	P Load (kg/yr)
Cropland	278	0.161	45
Forest	20	0.06	1
Total	298		**46**

The post-development phosphorous export was calculated assuming no infiltration, 20 mm of infiltration and 25 mm of infiltration from LID techniques (Table 8). All three scenarios assumed 63% removal of TP from any runoff that was not infiltrated by "Enhanced Level" stormwater management. With no infiltration, the phosphorus load from the SWM Ponds was 213 kg/yr. This load was reduced six fold: to 21 kg/yr with 20 mm of infiltration, and by an additional 10 kg/yr, to 11 kg/yr, with 25 mm of infiltration.

This represents an overall reduction in phosphorus loadings from pre-development conditions (Table 8). For the 20 mm infiltration scenario, the Phase 1 development resulted in a 25 kg/yr (from 46 to 21) reduction of phosphorus export and under the 25 mm infiltration scenario the reduction was 35 kg/yr (46 to 11). This results in ~54% and 77% reductions respectively from the Phase 1 development over pre-development phosphorus loadings.

Table 8. Phase 1 Post Development Phosphorus Loads (kg/yr)

		LID Infiltration		
Subdivision	**Pond**	**None**	**20 mm**	**25 mm**
CDRI	North Pond	38.9	3.9	1.9
	Carson Rd. North Pond	14.8	1.5	0.7
	Carson Rd. South Pond	42.4	4.2	2.1
	South Pond	9.7	1.0	0.5
	CDRI total	105.8	10.6	5.3
Midhurst Heights	**Midhurst Heights Pond**	67.8	6.8	3.4
MDDRI	**Russell Rd. Pond**	39.3	3.9	2.0
Total Load from Phase 1		**213**	**21**	**11**
Pre-Development Load*		**46**	**46**	**46**
Change		**167**	**-25**	**-35**

*Notes: Loads incorporate 63% reduction from SWMP as applicable. Negative numbers indicate a reduction in P loads. *different infiltration scenarios were not modelled for pre-development conditions*

The additional load from the Midhurst WWTP (118 kg/yr) was added to account for cumulative phosphorus loading from both storm and sanitary sources from the Phase 1 development. The combined phosphorus export from both sources was 139 kg/yr and 129 kg/yr respectively for the 20 mm and 25 mm infiltration scenarios. This resulted in a net increase of 93 and 83 kg/yr of phosphorus loadings from the Phase 1 development to the watershed

Table 9. Phase 1 Summary

	LID Infiltration		
	none	**20 mm**	**25 mm**
Pre Development Load*	**46**	**46**	**46**
Post Development Load			
Stormwater	213	21	11
WWTP	118	118	118
Total Post Development Load	**331**	**139**	**129**
Net Change	**285**	**93**	**83**

Notes: Post-development loads incorporate 63% reduction from SWMP.
**different infiltration scenarios were not modelled for pre-development conditions*

5.2 Full Build Out Scenario

The pre-development phosphorus budget for the Full Build Out scenario was 134 kg/yr. More than 100 kg/yr of phosphorus was exported from cropland, with most of the balance from urban areas (Table 10).

Table 10. Full Build Out Pre-Development Phosphorus Loads

Land Use	Area (ha)	Export Coefficient (kg/ha/yr)	P Load (kg/yr)
Cropland	642	0.161	103
Forest	81	0.060	5
Hay/Pasture	2.1	0.010	0.02
Commercial/Industrial	5	1.568[a]	7
Residential	0	2.143[b]	1
Low Intensity Development	95	0.130	12
Open Water	1	0.260	0.2
Quarry	30	0.100[c]	3
Transitional	42	0.070	3
Wetland	2	0.050	0.1
Total	**899**		**134**

Notes: a – export coefficient estimated from Phase 1 commercial land uses, b- export coefficient estimated from residential phase 1 land uses, c - export coefficient from the Lake Simcoe P Tool (HESL 2012)

The Full Build Out post-development phosphorus budget was calculated for the redevelopable areas (outside of the Phase 1 development; Table 11) and added to the phosphorus budget calculated for Phase 1 (Table 12). Three scenarios were modelled: no infiltration and 20 mm and 25 mm of infiltration from LID techniques (Table 11). Without any infiltration, the phosphorus load from Full Build Out was 663 kg/ha/yr. The load was reduced ten fold with infiltration: to 66 kg/yr with 20 mm of infiltration, and by an additional 33 kg/yr, to 33 kg/yr, with 25 mm of infiltration (Table 12).

Table 11. Redevelopable Area Phosphorus Loads (kg/yr)

MSPA Land Use	P Budget Land Use	Area (ha)	Export Coefficient	P Load (kg)	After SWMP (63% removal)
Administration / Government	Commercial	72	1.428	102.8	
Commercial / Mixed Use	Commercial	10	1.428	14.2	
Employment	Industrial	90	3.214	288.8	
Future Development Potential	Residential	76	2.464	186.9	
Midhurst High Density Residential / Mixed Use	Residential	6	2.928	16.4	
Midhurst Low Density Residential	Residential	170	2.214	377.4	
Midhurst Medium Density Residential	Residential	19	2.214	42.6	
Midhurst Transition Residential	Residential	67	2.464	165.7	
Schools	Commercial	12	1.028	12.0	
Parklands (@ 5% residential, 2% other)	Low Intensity Residential	21	0.13	2.8	
SWMP	Open Water	17	0.26	4.5	
SWMP	Transition	17	0.07	1.2	
Environmental Protection Area I	Forest	0	0.06	0.0	
Environmental Protection Area II	Forest	19	0.06	1.1	
Total - no infiltration		**597**		**1216**	**450**
Total - 20 mm infiltration				**121.6**	**45.0**
Total - 25 mm infiltration				**60.8**	**22.5**

For both the 20 mm and 25 mm infiltration scenarios, an overall reduction in stormwater phosphorus loadings from pre-development conditions was modelled (Table 12). For the 20 mm infiltration scenario, stormwater loadings were reduced by 68 kg/yr. Under the 25 mm infiltration scenario, stormwater loadings were reduced by 101 kg/yr. These represent ~51% and 75% reductions respectively over pre-development phosphorus loadings from runoff at Full Build Out.

Table 12. Full Build Out Post-Development Phosphorus Load (kg/yr)

	Area	LID Infiltration		
		None	20 mm	25 mm
Phase 1	305	213	21	11
Redevelopable Area	597	450	45	23
Total Full Build Out	**902**	**663**	**66**	**33**
Pre-Development Load*		**134**	**134**	**134**
Change		**529**	**-68**	**-101**

Notes: Loads incorporate 63% reduction from SWMP as applicable.
Negative numbers indicate a reduction in P loads.
**different infiltration scenarios were not modelled for pre-development conditions*

6. Post – Event Recovery of Infiltration

On June 22, 2016, XCG Consulting Limited completed their peer review of the HESL report "Midhurst Secondary Plan Phosphorus Budget - Update, Draft for Discussion" on behalf of the NVCA. XCG's was favourable and generally agreed with the analysis and methods provided above.

XCG's primary comment in the peer review related to the infiltration calculations that were used. In brief, their comment was that the analysis did not provide for "recovery time" of the infiltration galleries between events and this should be accounted or in the calculations to assess the post development phosphorus reduction. Although they accepted that the infiltration galleries would infiltrate 20 mm, they would need to drain to recover their full design potential for infiltration between events. For example - a 20mm event would not infiltrate instantaneously, but would need time to make the 20mm capacity available for the next event. Thus, if the 20mm event was followed by a 15 mm event on the next day, not all of that 15 mm could be infiltrated. As a result, an additional model of infiltration recovery was developed to assess this implication to the phosphorus budgets derived for the 20 mm and 25 mm infiltration scenarios.

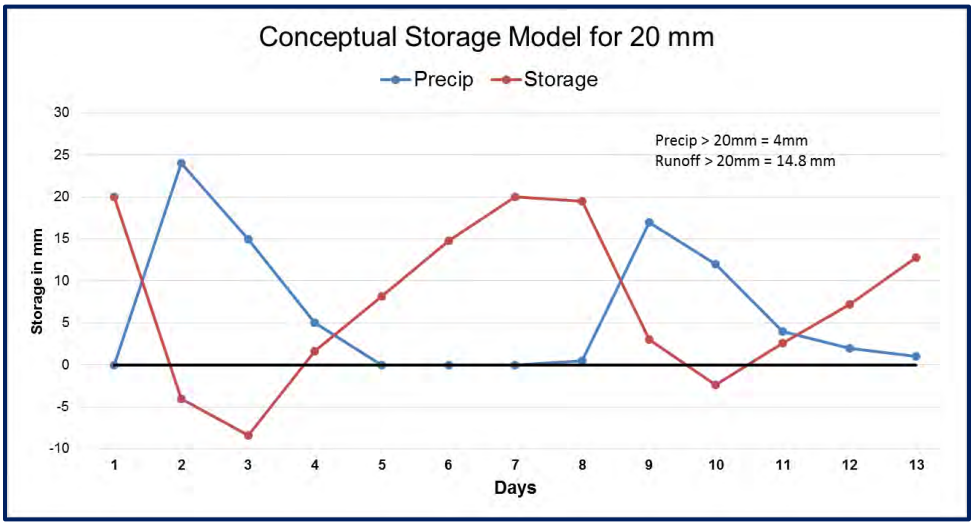
6.1 Conceptual Model

The infiltration design was provided by SCS Consulting Group (Jun 8 2014, memo: Steve Schaefer to Glenn Switzer NVCA) and contained the following requirement (p.2) *"Proposed infiltration measures are required to draw down over the CVC/TRCA maximum drawdown time for below grade infiltration measures of 72 hours."* Under a scenario of infiltration of a 20 mm storm event this maximum drawdown equates to 6.7 mm/day under a conservative assumption that the drawdown is linear and constant. Infiltration was therefore modelled with a recovery of 6.7 mm/day for full recovery of 20 mm in 3 days. Thus, if 20mm was infiltrated in one storm there would be 6.7 mm available on the day after and 13.4 mm available two days after, provided there was no additional precipitation. For the 25 mm infiltration scenario, 8.3 mm/day of recovery was modelled for full recovery in 3 days. Precipitation falling before recovery was complete would reduce the recovery time by the amount of additional precipitation.

Results of the 20 mm conceptual model are provided in Figure 7 below. It shows the response to events of 25, 15 and 5 mm on each of days 2, 3 and 4, with no precipitation on Days 5, 6 and 7, and events of 0.5, 17, 12, 4, 2 and 1 mm and 1 on Days 8-13. Storage never exceeds 20 mm, 6.7 mm of storage are recovered each day and the runoff (that precipitation which cannot be stored and infiltrated) is shown as negative values on the graph. This runoff would flow to the SWM pond and be treated there.

- The total runoff in the conceptual model (Figure 1) would be 4 mm in this scenario (the 24 mm event on Day 2) or 5% of the 80.4 mm of total precipitation (95% of the precipitation would be infiltrated).
- Incorporation of recovery time would increase total runoff in the conceptual model to 14.8 mm in this scenario (the 3 events with negative storage) or 18% of the 80.4 mm of total precipitation (82% of the precipitation would be infiltrated).

Figure 7. Conceptual precipitation storage and recovery model.



Midhurst Model

The City of Toronto's Wet Weather Flow Management Guidelines (Toronto 2006) were used to design the infiltration galleries. These guidelines estimate that approximately 90% and 95% of total annual precipitation falls within a daily depth of 20 mm and 25 mm (Fig. 6). The response at Midhurst was modelled using the Environment Canada Shanty Bay precipitation records for 2009-2015 as a local record and the infiltration target of all events up to the 20mm event. Table 13 shows, that, as for the City of Toronto, 90% of all storms were 20mm or less. The 25mm storms, based on Shanty Bay precipitation records, accounted for 94% of all annual precipitation, as opposed to 95% for the City of Toronto data.

The results for two typical years are shown in Figures 8 and 9. Negative values for "Available Storage" indicate the depth of precipitation from an event that ran off instead of being infiltrated. The summary of changes for each year is provided in Table 13.

Figure 8. Shanty Bay Model 2010

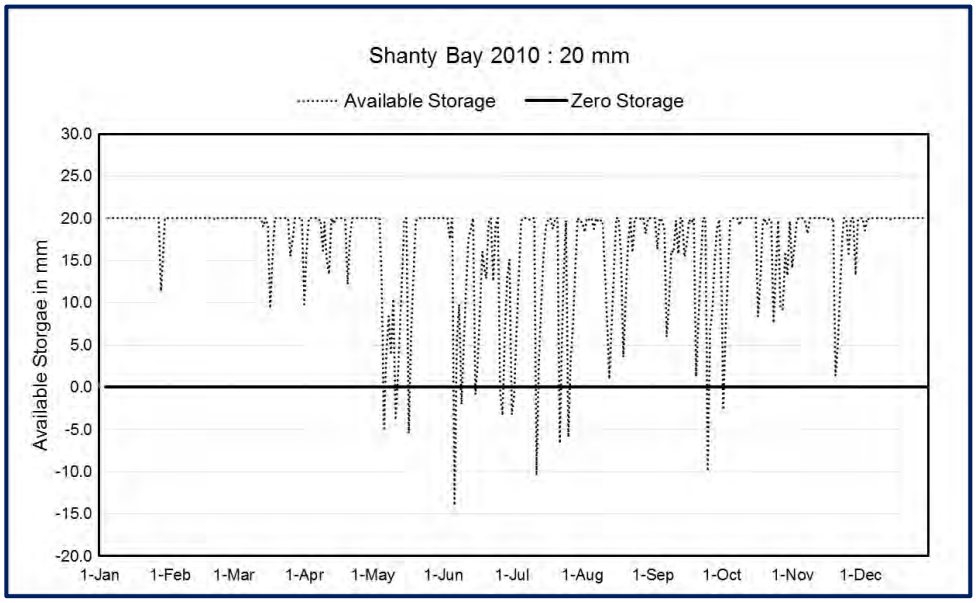
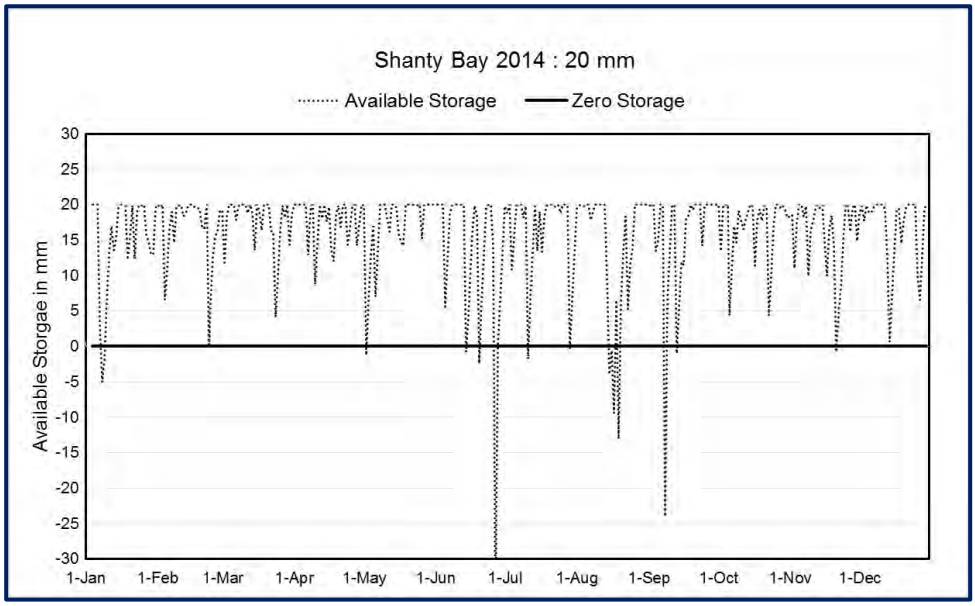


Figure 9. Shanty Bay Model 2014



The original analysis reviewed by XCG did not infiltrate any precipitation which exceeded 20 mm in a day.

- Total runoff in the Shanty Bay model for 2009-2015 in this scenario ranged from 56 to 94 mm/yr or 8-13% of the total annual precipitation (87-92% infiltration, Table 13).

Recovery time was modelled by not infiltrating any precipitation that exceeded the 20mm storage volume, as modified by the recovery of 6.7 mm/day.

- The total runoff in the Shanty Bay model for 2009-2015 increased to 75 to 128 mm/yr or 10-17% of the total annual precipitation (83-90% infiltration, Table 13).

Table 13. Effect of infiltration gallery recovery time on annual infiltration - 20 mm events.

	Total Precipitation	Original Calculations : No Recovery Consideration			Revised Calculations : Recovery Time Considered		
		Total>20	Percent of Total	No. of Events	Total Excess	Percent of Total	No. of Events
2009	723	56	8%	7	84	12%	11
2010	749	63	8%	12	75	10%	15
2011	693	89	13%	6	97	14%	6
2012	737	76	10%	7	114	16%	13
2013	737	94	13%	6	128	17%	14
2014	982	76	8%	10	103	10%	16
2015	786	73	9%	5	88	11%	10
Average	770	76	10%	8	100	13%	13

Table 13 shows that, for the seven years (2009-2015) modelled, on average, 10% of the annual depth of rainfall fell in events of >20mm and there was, on average, 8 days in which a total of 76mm of the annual total would not be captured in SWM features designed to infiltrate 20 mm, if we assume that there was complete recovery between events. If recovery time is considered, then, on average, 13% (100mm) of the annual rainfall would not be captured in SWM features designed to infiltrate 20mm of precipitation and recover 6.7mm of infiltration capacity each day. There was, on average, 13 days each year when the rainfall could not be infiltrated after recovery time was considered.

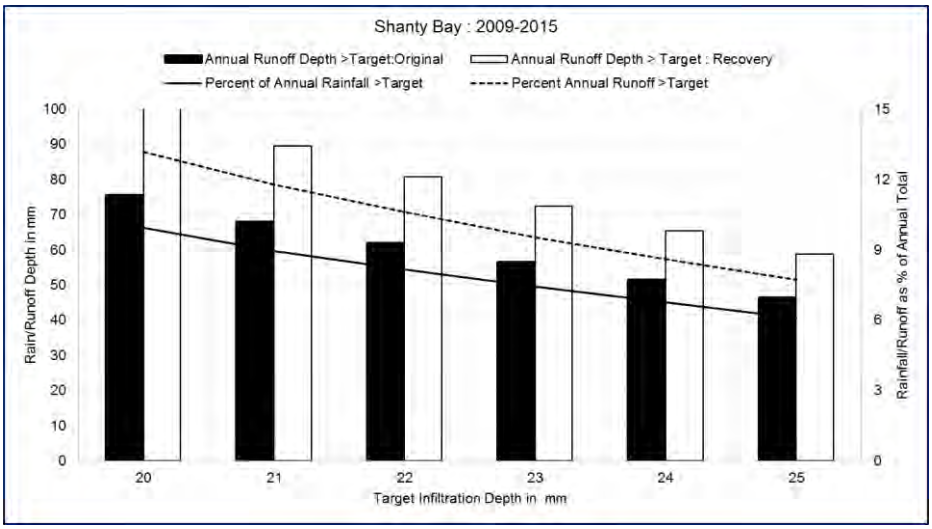
Infiltration Design Requirements.

Table 14 and Figure 10 show that infiltrating 90% of the rainfall volume from 20mm events can be met if infiltration galleries are designed for the 23mm event to account for recovery time between storms. Infiltrating 95% of the rainfall volume will require infiltration galleries designed for greater than the 25mm event, and is therefore not considered feasible given the soil conditions. Intermediate infiltration targets are also presented.

Table 14. Effect of infiltration gallery recovery time on annual infiltration: 20 - 25 mm events.

		Runoff Exceeding Target Original			Runoff Exceeding Target Corrected for Recovery		
	Target Event	Depth	% of Volume	No. of Events	Depth	% of Volume	No. of Events
Average Annual Rainfall = 770mm	20 mm	76	10%	8	100	13%	13
	21 mm	68	9%	6	90	12%	11
	22 mm	62	8%	6	81	11%	10
	23 mm	56	7%	5	72	10%	8
	24 mm	51	7%	5	65	9%	8
	25 mm	46	6%	5	59	8%	7

Figure 10. Infiltration and runoff with and without recovery time.



Implications to Phosphorus Budget

The phosphorus budget for the 20mm infiltration scenario was updated to account for Shanty Bay precipitation patterns and the need for a recovery time of the infiltration galleries between events. The calculations above (Table 13) showed that 87% (vs 90%) of the total annual precipitation would be infiltrated, and 13% (vs 10%) would be run off under that 20 mm infiltration scenario after accounting for recovery time. These values were applied to the post-development scenario to estimate the amount of phosphorus reduction with 20 mm of infiltration and recovery. Phosphorus export was reduced by an additional 63% to account for the SWM pond-treatment for the volumes that could not be infiltrated. Results are presented in Table 15.

Table 15. Updated Phosphorus Loadings (kg/yr) for 20 mm Infiltration Scenario Using Shanty Bay Precipitation Patterns and Considering Recovery Time.

	Phase 1		Full Build Out	
	Original	Recovery	Original	Recovery
Pre Development Load	46	46	134	134
Runoff	21	28	66	86
WWTP	118	118	134	134
Total Post Development Load	139	146	200	220
Change in P export	93	100	66	86

Accounting for recovery time increased the phosphorus export from 21 to 28 kg/yr and from 66 to 86 kg/yr for the Phase 1 and Full Build Out Scenarios, respectively. The net change from Pre-Development, after adding the WWTP loads, is therefore 100 and 86 kg/yr, for Phase 1 and Full Build Out respectively. This represents a 7 kg increase in Phase 1 and 20 kg increase in Full Build Out phosphorus loadings (Table 15) from original modelling results after accounting for recovery time of the infiltration galleries.

The amended values for infiltration were also applied to the post-development scenario for 25 mm of infiltration and recovery. Phosphorus export was reduced by an additional 63% to account for the SWM pond-treatment for the volumes that could not be infiltrated. Results are presented in Table 16.

Table 16. Updated Phosphorus Loadings (kg/yr) for 25 mm infiltration scenario using Shanty Bay Precipitation Patterns and considering recovery time.

	Phase 1		Full Build Out	
	Original	Recovery	Original	Recovery
Pre Development Load	46	46	134	134
Runoff	11	17	33	53
WWTP	118	118	134	134
Total Post Development Load	129	135	167	187
Change in P export	83	89	33	53

Accounting for recovery time increased the phosphorus export from 11 to 17 kg/yr, and from 33 to 53 kg/yr for the Phase 1 and Full Build Out Scenarios, respectively. The net change from Pre-Development, after adding the WWTP loads, is therefore 89 and 53 kg/yr, for Phase 1 and Full Build Out respectively. This represents a 6 kg increase in Phase 1 and 20 kg increase in Full Build Out phosphorus loadings (Table 16) from original modelling results after accounting for recovery time of the infiltration galleries.

To maintain the original phosphorus loading estimates achieved with 20mm infiltration of 21 and 66 kg/yr for Phase 1 and Full Build Out, respectively, 23 mm of infiltration is required to account for recovery time.

7. Net Environmental Evaluation

Overall, the implementation of effective LID techniques for stormwater management resulted in reduced phosphorus loadings to the Willow Creek subwatershed from the developed lands for both Phase 1 and Full Build Out compared to existing pre-development loads. These reductions partially offset the increased loadings from the discharge of treated effluent from the WWTP (Tables 15 and 16).

The phosphorus modelling for Phase 1 of the Midhurst Secondary Plan Area concluded that:

- The Phase 1 lands currently export 46 kg/yr of total phosphorus load. The modelling exercise did not account for the actual delivery of phosphorus to Willow Creek and so the total load of 46 kg/yr was conservatively assumed to be delivered to the creek.
- The proposed land use changes for the Phase 1 development will export 21 kg/yr of total phosphorus with LID techniques implemented to infiltrate the first 23 mm of runoff from all storms and BMPs and SWM techniques implemented for volumes > 23mm. The total load of 21 kg/yr was conservatively assumed to be delivered to the creek.
- This represents a reduction of 25 kg (54%) in loading to Willow Creek from runoff, clearly demonstrating the benefits of LID/BMP implementation.
- Treatment of municipal effluent to a total phosphorus limit of 0.05 mg/L for Phase 1 would add 118 kg/yr of total phosphorus to Willow Creek.
- The net change from urban land development and the WWTP would therefore be a total of 139 kg/yr, an increase of 93 kg/yr from pre-development conditions.

The phosphorus modelling for the Full Build Out of the Midhurst Secondary Plan Area concluded that:

- The Full Build Out lands currently export 134 kg/yr of total phosphorus load. The modelling exercise did not account for the actual delivery of phosphorus to Willow Creek and so the total load of 134 kg/yr was conservatively assumed to be delivered to the creek.
- Development of the Full Build Out lands will export 66 kg/yr with LID techniques implemented to infiltrate the first 23mm of runoff from all storms and BMPs and SWM techniques implemented for volumes > 23mm. The modelling exercise did not account for the actual delivery of phosphorus to Willow Creek and so the total load was conservatively assumed to be delivered to the creek.
- This represents a reduction of 68 kg (51%) in loading to Willow Creek, clearly demonstrating the benefits of LID/BMP implementation.
- Treatment of municipal effluent to a total phosphorus limit of 0.03 mg/L would add 134 kg/yr of total phosphorus to Willow Creek.
- The net change from urban land development and the WWTP would therefore be a total of 200 kg/yr, an increase of 66 kg/yr from pre-development conditions.

7.1 Water Quality

The Midhurst Secondary Plan Area will be developed using advanced LID/BMP techniques for the management of urban stormwater and advanced wastewater treatment which will treat phosphorus to the lowest levels deemed achievable by MOEE at present. Although the development will reduce the runoff of phosphorus from current land use practices by 51%, the need to treat and discharge municipal effluent to Willow Creek will result in a small cumulative increase in phosphorus load of 66 kg/yr to the creek at Full

Build Out. The implications of this increase must be reviewed in light of a) MOECC Policy for management of water quality and b) any impacts associated with the small increase in loading to the creek.

The Ontario Ministry of the Environment (MOE, 1994) provides two policies for management of surface water quality.

> Policy 1 states that *"In areas which have water quality better than the objectives, water quality shall be maintained at or above the objectives. Although some lowering of water quality is permissible in these areas, degradation below the Provincial Water Quality Objectives will not be allowed, ensuring continuing protection of aquatic communities and recreational uses."*
>
> Policy 2 states that *"Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives."*

Deviations from Policy 2 may be considered, however, under the regulation of a "Director's Deviation" from the MOE. *"...where it is clearly demonstrated that all reasonable and practical measures to attain Provincial Water Quality Objectives have been undertaken but where:*

1) the Provincial Water Quality Objectives are not attainable because of natural background water quality; or

2) the Provincial Water Quality Objectives are not attainable because of irreversible human-induced conditions; or

3) to attain or maintain the Provincial Water Quality Objectives would result in substantial and widespread adverse economic and social impact; or

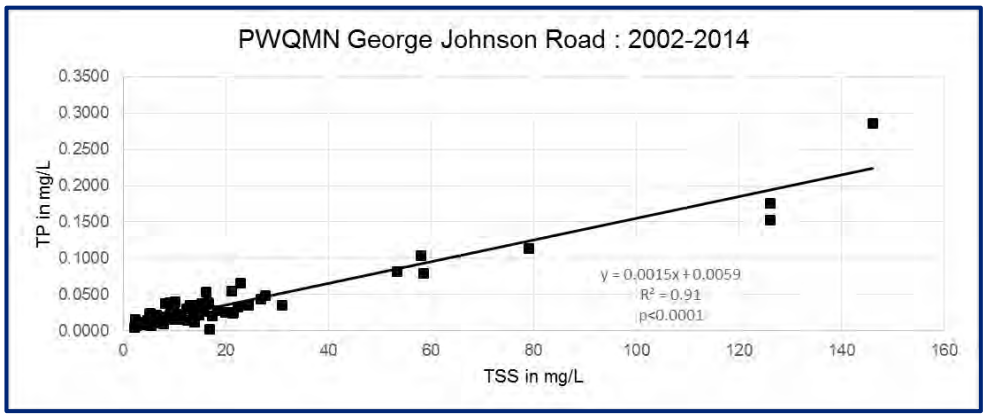
4) suitable pollution prevention techniques are not available.

Water quality data from the MOE's Provincial Water Quality Monitoring Network (PWQMN) station on Willow Creek at George Johnson Road was summarized for the period 2002-2014 to determine the Policy status for water quality as input to the Assimilative Capacity Study modelling exercise (HESL 2018). Data for 2015 were not yet available at the time of preparation of this report.

- These data established a 75th percentile Total Phosphorus (TP) concentration of 0.035 mg (median = 0.020 mg/L). Willow Creek is therefore considered a "Policy 2" receiver for TP as it exceeds MOE's Provincial Water Quality Objective (PWQO) of 0.03 mg/L. Policy 2 therefore requires that Willow Creek TP concentrations "…*shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives.*

Although Willow Creek is classified as a Policy 2 receiver for total phosphorus, the nature of the high TP values deserves some additional analysis. Figure 11 shows a highly significant ($p<0.00001$) relationship between total phosphorus and total suspended solids (TSS) in Willow Creek at the George Johnson Road PWQMN station.

Figure 11. TSS and TP Relationship in Willow Creek.



This indicates that runoff and erosion of particulate matter (soils) in the watershed from natural sources and land use practices is a significant factor in the high TP values and a major factor in the Policy 2 status of the creek. Solving the regression equation for the PWQO of 0.03 mg/L, for example, produces a TSS concentration of 20 mg/L such that, in general, PWQO exceedances are associated with TSS values over 20 mg/L. The individual data points show that the PWQO is maintained at all TSS values <8 mg/L. This relationship shows that that a) Willow Creek is a Policy 1 receiver for total phosphorus during clear flow periods when TSS concentrations are low and b) control of erosion in other parts of the watershed to reduce the TSS and hence the TP loading could be a useful management tool to offset increased loading from the proposed WWTP.

Further analysis shows a distinct seasonal distribution of TP and TSS concentrations in Willow Creek (Table 17). These data show that Willow Creek is Policy 1 for TP during much of the summer growth season and that, overall, it is very close to Policy 1 status - the 70th percentile concentration of TP is 0.028 mg/L. The addition of treated effluent will increase the 75th percentile concentration by 0.001 to 0.002 mg/L in Phase 1 and will decrease it by 0.001 mg/L in Phase 2, as calculated for the low 7Q20 flows. The discharge will have an even smaller impact during typical flows of Willow Creek.

Table 17. Monthly TP and TSS concentrations in Willow Creek.

	n =	Median TP	75th Percentile TP	Median TSS	75th Percentile TSS
March	1	0.286	0.286	146	146.00
April	6	0.038	0.071	22	48
May	12	0.022	0.026	13	17
June	15	0.026	0.037	10	19
July	12	0.024	0.032	10	17
August	19	0.019	0.022	7	12
September	11	0.017	0.026	7	9
October	16	0.012	0.024	9	14
November	8	0.019	0.027	6	9
December	1	0.037	0.037	17	17
Annual	101	0.020	0.035	9	16

Our modelling shows that there will be a small increase in annual load to Willow Creek for Phase 1 and the Full Build Out arising from loadings from the WWTP. We would note that there are significant reductions in the loads from runoff from the development of the MSPA as a result of infiltration practices which partially offset the WWTP loads. Although the small increase in annual load does not meet the NVCA target of no net increase in phosphorus loading to Willow Creek, the MOECC policy recognizes that there are circumstances where some increase should be permitted. The implementation of effective LID/BMP techniques and advanced wastewater treatment proposed for the MSPA represent clear demonstration "…*that all reasonable and practical measures to attain Provincial Water Quality Objectives have been undertaken."* and so a Director's Deviation is warranted to allow the discharge and the small exceedance of the target.

A requirement for offsetting of the additional phosphorus – measures taken elsewhere in the watershed to reduce phosphorus loadings from other sources so that a net reduction in loadings was achieved and water quality in the creek was maintained or improved would be one means of reducing the total loadings as a condition of any Director's Deviation for discharge to a Policy 2 water body. Although offsetting has been successfully implemented in Ontario, projects have been approved in the absence of a formal framework for implementation and with the recognition that there are uncertainties associated with demonstration and assurance of their effectiveness.

The additional loads of phosphorus calculated are 66 kg/yr at Full Build Out, but the additional load at Full Build Out would be added at an effluent limit of 0.03 mg/L. This would reduce the 75th percentile phosphorus concentrations in Willow Creek at the critical low flow periods, representing improved water quality. Therefore, the long term status of Willow Creek would represent a net improvement in water quality from current conditions as a result of the MSPA development.

We conclude that the environmental effects of the development results in a small net increase in phosphorus loads that do not warrant the implementation of a phosphorus offsetting program as part of any Director's Deviation or Environmental Compliance Approval (ECA) for the WWTP. The development plan has demonstrated that water quality in Willow Creek will not "…*be degraded further and all practical measures shall be taken to upgrade the water quality to the objectives",* as required by the MOECC, through the commitment to advanced wastewater treatment, implementation of highly effective infiltration practices for stormwater management and a monitoring and adaptive management plan for the development. However, we note that offsetting opportunities are available in the Matheson / Willow Creek and implementing measures such as establishing vegetative buffers, exclusion fencing, septic system removal, etc. would reduce phosphorous loads in Willow Creek.

The water quality status of Willow Creek is presently degraded as confirmed in a review of Nottawasaga Valley Conservation Authority (NVCA) materials provided by Beacon Environmental. (Beacon Environmental, Correspondence to Midhurst Landowners Group September 19, 2013). The NVCA conclude that *"near their confluence ... Matheson and Willow Creeks are considered "below potential", with stream health continuing to decline as Willow Creek enters an agricultural plain upstream of Minesing Swamp. NVCA has identified several factors that contribute to the existing water quality impacts to this reach of Willow Creek, namely the general absence of riparian cover and unrestricted livestock access. Stream health is considered "below potential" from the confluence of Willow and Matheson*

Creeks to the point where the main branch of Willow Creek enters the Minesing Wetlands". Erosion controls and associated reductions in TSS and TP are therefore a feasible means to improve overall stream health.

We therefore recommend that some watershed management measures be implemented to reduce the concentration of TSS and associated TP associated with existing land uses in Willow Creek. These could include investigation of target sites and opportunities to implement:

- Fencing livestock out of stream channels,
- Increased use of vegetative buffers along stream corridors that traverse agricultural lands, and
- A program of riparian plantings to stabilize stream banks.

8. Implications to the Minesing Wetland

The Minesing Wetland (Minesing) is a 6000 hectare network of swamps, fens, bogs and marshes with an extremely large (approximately 2600 km^2) catchment area. The Minesing Wetland is considered by the Ontario Ministry of Natural Resources and Forestry to be the largest and best example of fen bog in southern Ontario, and provides a reservoir for spring floodwater which is gradually released into the Nottawasaga River during the summer (NCC, 2016). The wetland has been designated as a Provincially Significant Wetland (PSW) and Life Science Area of Natural and Scientific Interest (ANSI) and is an internationally significant natural area under the RAMSAR convention (NVCA 2007).

Minesing is divided into two distinct hydrological zones: in the east it is a fen-dominated boreal wetland sustained by groundwater discharge which is isolated from the surface water processes that influence the western portion which is mixed boreal swamp (Hanna, 1982; NVCA 2007; Spoelstra and Post, 2012). Minesing is fed by four major watercourses, including the Nottawasaga River, Mad River, Coates Creek and, in the northeast, Willow Creek, where the proposed WWTP discharge will occur. Near its confluence with Matheson Creek (1.67 km upstream of the proposed WWTP effluent discharge point), the ecological status of Willow Creek is considered "below potential" and, owing to the absence of riparian cover and unrestricted livestock access to the creek, exhibits declining stream health as it enters the agricultural plain upstream of Minesing Swamp (NVCA 2001).

8.1 Background

The NVCA requested an assessment of the potential for effects to the Minesing Wetland from the discharge of treated municipal effluent from the proposed WWTP to Willow Creek, 4.07 km upstream, as part of the Master Drainage Plan for the Midhurst Secondary Plan Area and the associated Phosphorus Budget. Several questions were raised by the NVCA. Responses to these specific questions are provided in the following sections:

1. Is the temporal distribution of nutrients to the Minesing Wetland important to its function? How might any change in timing of phosphorus loading from the MSPA affect the Minesing Wetland?
2. What are the seasonal dynamics of PWQO exceedances in Willow Creek and how might these change post development? During what flow periods will the loading from the WWTP increase TP in Willow Creek above the PWQO?

3. How is the continuous phosphorus loading from the WWTP under the post-development scenario likely to affect Willow Creek, relative to pulse loading from rain events under the current scenario? Is there a difference and is it important?
4. Will there be more bioavailable phosphorus post-development from the WWTP?

8.2 Temporal Distribution of nutrient loads to the wetland

Flood pulsing is recognized as an essential component of wetland ecosystem function (Middleton 2001). Wetlands are complex ecosystems whose abiotic conditions such as soil oxygen and moisture, nutrient availability and chemical transformations are dependent on flood pulsing (Junk et al. 1989). Flood pulsing is critical in wetland ecosystem functions such as production and decomposition (Grubaugh and Anderson, 1988; Sparks et al., 1990), and plays an important role in species succession and biotic community structure (van der Valk 1981; Blom and Voesenek, 1996; Chase 2007; Drinkard et al. 2011). The flooding regime imposed on wetland ecosystems influences many physical and biotic properties that affect phosphorus mobility and availability (Aldous et al. 2005). Variations in water levels and flows across multiple temporal scales also drive key ecological processes that maintain wetlands and their biodiversity (Keough et al., 1999; Keddy, 2002; Desgranges et al. 2006). For example, soil and water pH and redox status control the forms of metals, such as iron, that will bind or release phosphorus (Frossard et al. 1995; Schlesinger 1997), and biologically mediated processes, such as organic matter decomposition, that may contribute to phosphorus release (Koerselman et al. 1993; Boers and Zedler 2008).

Seasonal patterns of nutrient uptake and release are characteristic of many wetlands. In temperate regions, nutrient retention is generally greatest in the growing season, due to higher microbial activity in the water column and sediments and increased macrophyte productivity. Peak phosphorus retention, however, is not necessarily universal amongst all wetland types, for example, previous research has demonstrated that peak retention occurred in the summer in three wetland types in Ontario (Devito et al. 1989), but in spring in a bog in northern Minnesota (Verry and Timmons 1982). Uptake of phosphorus by macrophytes is often highest during the peak growing season (Wilkins, 1984) or during early spring growth (Boyd, 1970; Garver et al., 1988; Smith et al., 1988) before the maximum growth period, perhaps to provide a competitive advantage during the periods of maximum demand (Reddy et al. 1995). Emergent macrophytes in the Minesing Wetland, particularly those with more supportive tissue, such as Typha spp., provide significant potential for P storage (Reddy and DeBusk, 1987; Reddy et al. 1995).

In the Minesing wetland, flows, and therefore flood pulsing and nutrient delivery, are highly seasonal – flooding into the wetland occurs during spring.(NVCA 2001). Specific hydrological information on the flood frequency and dynamics of Willow Creek were not available, however field evidence summarized as a part of the Minesing Biological Inventory (NVCA 2010) suggests that the Nottawasaga River floodplain is only inundated for several weeks during spring flooding (NVCA, 2007). Furthermore, based on available hydrological data collected between 2006 and 2016,the median daily flows of Willow Creek during the summer low flow period, when the creek does not flood, varied between 1000 and 2000 L/s, with peak daily flows as high as 6000 L/s (HESL 2018). By contrast, the estimated effluent discharge to the creek is 142.53 L/s at full build out (HESL 2018), with estimated increases to the depth of the creek of only 7 cm accompanied by an increase in average flow velocity of 0.01 - 0.02 m/s (PECG, 2014). Willow Creek median daily flows peak as high as 12000 L/s during spring (2006-2013, HESL, 2014) when the creek floods into the wetland, suggesting that a significant increase in flow would be necessary to change the flood regime of the creek. The proposed WWTP effluent discharge of 143 L/sec at full build out

represents a very small fraction (1.2-2.4%) of peak spring and summer flows and will not be sufficient to change the flooding frequency or magnitude of Willow Creek.

Discharge of treated effluent from the proposed WWTP at the proposed effluent limit of 0.05 mg/L for the Phase 1 development will increase the 75th percentile of total phosphorus concentration in Willow Creek from the current value of 0.035 mg/L to 0.037 mg/L. The median concentration would increase from 0.02 mg/L to 0.022 mg/L, and would therefore remain within the PWQO of total phosphorus of 0.03 mg/L.

Discharge of treated effluent from the proposed WWTP at the proposed effluent limit of 0.03 mg/L for the Full Build Out development will decrease the 75th percentile of total phosphorus concentration in Willow Creek from the current value of 0.035 mg/L to 0.034 mg/L. The median concentration would increase from 0.02 mg/L to 0.022 mg/L, and would therefore remain within the PWQO of total phosphorus of 0.03 mg/L.

TP concentrations in Willow Creek ranged from 0.002 - 0.286 mg/L annually (2002-2014) while summer concentrations ranged from 0.007 to 0.176 mg/L (Table 6, Section 6). The small changes associated with discharge of treated WWTP effluent will not alter the nutrient dynamics of the Minesing wetland. The increased loading from the MSPA is orders of magnitude below the published threshold for nutrient alteration of a wetland of Richardson and Qian, (1999), who reported a wetland assimilative capacity of 1g/m2/y beyond which wetlands lost native species, became P saturated and exported P downstream at unacceptable rates. The total annual phosphorus loading to the Minesing wetland is not known but increased phosphorus loads of 93 and 66 kg/yr at 20 mm of infiltration from the MSPA represent 0.001 to 0.0016 g/m2/y of incremental loading to the 6000 hectare area of the Minesing wetland, or 0.1 - 0.16 % of the reported capacity

The timing of the existing major pulse of flow and nutrients to the wetland in the spring will not change in response to the MSPA development because the relative changes in flow are very small and distributed evenly year round. The median measured flow in Willow Creek (2006-2016, HESL 2018) was 2,040 L/sec and the median TP concentration was 0.02 mg/L, corresponding to an average daily TP load of 3.5 kg/day. The small increases in nutrient loading associated with the cumulative discharge of storm water and WWTP effluent in Phase 1 (93 kg/yr = 0.26 kg/day) and Full Build Out (66 kg/yr = 0.18 kg/day) represent increases of 7.4 and 5.2% respectively in average daily loads. These changes are not measurable and are ecologically insignificant.

The timing of P loading to the wetland will not change as nutrients in the creek are isolated from the wetland during low flow periods. Furthermore, as a result of infiltration practices; changes in surface runoff in the post-development area, together with loadings from the WWTP will represent very small increases in flow in the creek.

8.3 Seasonal dynamics of PWQO exceedances in Willow Creek

We reviewed data collected by the PWQMN at George Johnson Road to assess the seasonal dynamics of PWQO exceedances in Willow Creek. Concentrations of total phosphorus were closely correlated with those of total suspended solids (R^2 = 0.91, $p<0.001$), were seasonally variable and lowest during the summer growth period (Section 6). It is common for TP concentrations in rivers draining agricultural catchments to increase with seasonal and storm flow (Calow 2009) and so the observed seasonal decline

after the spring freshet and the association of TP with TSS in Willow Creek are both indicative of inputs from TSS in runoff and erosion during higher flows. HESL (2014) presented results from the 2013 baseline survey showing that the highest average phosphorus concentration in the creek was recorded at the furthest downstream site (Avg = 0.02 mg/L) and lowest at the furthest upstream site (Avg = 0.015 mg/L), while TP concentrations only exceeded PWQO during periods of high flow (HESL, 2014). Between these sites Willow Creek flows through extensive agricultural lands dominated by Hay Pasture (Figure 3 in NVCA 2010) suggesting that surface run-off from the nutrient–rich agricultural soils contributed significantly to elevated TP.

The increased flows associated with effluent discharge also have the potential to increase erosion, and potentially increase TSS and TP. We assessed whether this would occur as a result of the development of the MSP and determined that it would not. At full buildout, effluent discharge flows of 0.17 m^3/s are estimated. Geomorphological assessment (PECG 2014) demonstrated that this increase in flow would translate to a 0.01 – 0.03 m increase in depth and an average velocity increase of 0.01 m/s, which would be immeasurable during high flow and not result in enhanced erosion in the creek (PECG, 2014).

8.4 Post-development vs. Current Phosphorus Loading

In Willow Creek, the close correlation between total phosphorus concentration and total suspended solids, which is typical in agricultural streams (Calow 2009) results in significant variability in phosphorus concentrations, and is believed to reduce system health in Willow Creek, particularly where it passes through agricultural lands (NVCA 2007). Land use changes associated with the MSPA development represents a development area of 9 km^2 of the 339 km^2 Willow Creek watershed, less than 3% of the watershed, or 0.1% of the drainage area of the Minesing Swamp. The remaining 97% of the watershed of Willow Creek will not be altered by the MSPA development and will continue to function as it does now, dominated by pulses of surface flow from the catchment during freshet and major storm events.

Mass-balance modelling undertaken for the Assimilative Capacity Study with the proposed effluent concentration of 0.05 mg/L during Phase 1 would increase the 75^{th} percentile concentration of total phosphorus by 0.001 - 0.002 mg/L (HESL, 2018). At Full Build Out, the effluent criterion will be 0.03 mg/L, and 75^{th} percentile total phosphorus (TP) concentrations in the creek will decrease by 0.001 mg/L during low flow periods. The TP contributions to the creek from the WWTP are small in comparison to those from the rest of the watershed, thus the increased flows and TP loads associated with the continuous discharge of effluent from an advanced treatment plant will have no environmental significance on Willow Creek.

8.5 How is the bioavailability of phosphorus likely to change post-development from the WWTP?

Phosphorus removal by alum addition followed by filtration of the effluent is the common practice in advanced treatment works but removal is not complete as the efficiency of the process declines significantly at low phosphorus concentrations (e.g. effluent quality limits estimated of 0.005-0.04 mg/L (Takács 2006)). For older plants and processes, phosphorus in effluent is commonly soluble phosphorus, primarily phosphate (Dueñas et al. 2003; Neal et al. 2005) and is generally considered to be bioavailable. Recent bioassay research, however, suggests that P speciation and bioavailability varied greatly between treatment plants. Effluent phosphorus was frequently >60% recalcitrant (not available) for algal growth (Li

2014) and so not all of the phosphorus in the WWTP discharge will be bioavailable. Brett and Li (2015) reviewed information on the bioavailability of phosphorus in WWTP effluent and concluded that *"… the bioavailability and P species composition varies with the nutrient removal process and that in most cases a large portion (>50%) of the effluent P was recalcitrant to algal growth. Comparisons between different technologies indicate higher chemical doses, which also achieved lower effluent P concentrations, decreased the fraction of the phosphorus that was bioavailable (BAP%)."* and concluded *"Algal phosphorus uptake experiments also suggest that P species with high bioavailability, including some organic P species, are unlikely to persist in natural surface waters because their uptake kinetics are very rapid. Finally, these results further suggest recalcitrant P compounds, such as humic-metal-P complexes, phytic acid, and/or apatite may be the dominant components of the recalcitrant dissolved P pool in effluents identified in this and other studies…"* These results indicate that a modern treatment plant with advanced removal of phosphorus, as is proposed for Midhurst, will produce effluent in which phosphorus is largely recalcitrant, not bioavailable and with minimal impacts to plant growth downstream.

Predevelopment TP concentrations in Willow Creek are strongly correlated with TSS as a result of surface runoff and erosion of agricultural soils, suggesting that much of the current TP concentrations are particulate and not readily available. During storm events, research suggests that average particulate phosphorus concentrations in streams in forested and agricultural catchments have increased by 614% and total phosphorus by 200%; however on average only 20% of particulate P is bioavailable, thus bioavailable TP only increased 70% (Ellison and Brett 2006). This variability makes it difficult to quantitatively estimate the change in bioavailability of P post-development. Some portion (<50%) of WWTP discharge will be bioavailable but, even if it all is assumed to be so, it will represent only ~ 6% (0.002 of 0.035 mg/L at 75th percentile values) of the total phosphorus in the creek. The current concentrations of bioavailable phosphorus in Willow Creek are not known but low level total phosphorus and orthophosphate are analyzed in water samples collected from four water quality sampling locations in Willow Creek as part of the baseline monitoring program (HESL 2018b). PWQMN data, including dissolved phosphorus, is also reviewed annually and incorporated into the baseline monitoring datasets. The robust baseline datasets will allow for future comparison to determine the presence or absence of any impacts associated with treated effluent as part of the Adaptive Management Plan for the MSPA..

9. Conclusions

In June 2014 the Midhurst Landowners Group submitted a preliminary phosphorus budget for the MSPA. The budget was completed by Hutchinson Environmental Sciences (HESL 2014a) at a Secondary Plan level to provide an assessment of the cumulative loadings of phosphorus to the Willow Creek subwatershed from treated stormwater runoff and discharge of treated municipal wastewater effluent.

More detailed land use, storm water management, and LID design descriptions have now been developed in connection with approved draft plans of subdivisions. These descriptions were used to refine and update the initial phosphorus budget with modelling and assessment at finer resolution. The phosphorus budget , was modified to incorporate recovery time between rain events for the infiltration galleries in response to a peer review by XCG Consulting Ltd.

For the Phase 1 Development the following phosphorus loadings were estimated:

- 46 kg/yr from current land uses (agriculture and forest)

- 213 kg/yr of phosphorus loadings without implementation of LID techniques and BMPs
- The guidelines for infiltration of 20 mm of precipitation would need to be increased to 23 mm to account for recovery between events.
- Post development phosphorus loadings of 21 kg/yr would be achieved with 23 mm infiltration of stormwater by LID techniques. BMPs and SWM techniques implemented for volumes > 23 mm would result in a 25 kg/yr reduction from pre-development conditions
- Treatment of municipal effluent to a total phosphorus limit of 0.05 mg/L for Phase 1 would add 118 kg/yr of total phosphorus to Willow Creek
- 139 kg/yr phosphorus loadings to the Willow Creek subwatershed with 23 mm of infiltration, BMPs, and SWM techniques implemented for volumes > 23mm and the WWTP load. This is an increase of 93 kg/yr from pre-development conditions.

For Full Build Out the following phosphorus loadings were estimated:

- 134 kg/yr from current mixed land uses
- 663 kg/yr of post development phosphorus loadings from stormwater without implementation of LID techniques and BMPs
- The guidelines for infiltration of 20 mm of precipitation would need to be increased to 23 mm to account for recovery between events.
- Post development phosphorus loadings of 66 kg/yr with 23 mm infiltration of stormwater by LID techniques, BMPs and SWM techniques implemented for volumes > 23 mm would result in a 68 kg/yr reduction from pre-development conditions
- Treatment of municipal effluent to a total phosphorus limit of 0.03 mg/L would add 134 kg/yr of total phosphorus to Willow Creek.
- 200 kg/yr of phosphorus loadings to the Willow Creek subwatershed with 23 mm of infiltration, BMPs, and SWM techniques implemented for volumes > 23mm, and WWTP load. This is an increase of 66 kg/yr from pre-development conditions.

Table 18. Summary of Phosphorus Loadings (kg/yr) from the redevelopment of MSPA

	Phase 1		Full Build Out	
Infiltration	**None**	**23 mm**	**None**	**23 mm**
Pre-development	**46**	**46**	**134**	**134**
Runoff	213	21	663	66
WWTP Load	118	118	134	134
Total Post Development	**331**	**139**	**797**	**200**
Change in P export	**285**	**93**	**663**	**66**

Notes: Post-development loads incorporate 63% reduction from SWMP.

Additional analyses concluded that the minor increase in phosphorus loadings would have no effect on the Minesing Wetland, that the TP limit of 0.03 mg/L for discharge of treated municipal effluent would

reduce the 75th percentile phosphorus concentrations in Willow Creek, thus improving water quality and recommended against implementing a phosphorus offsetting program for the Willow Creek watershed.

This report is based on land use, stormwater management and LID techniques proposed for the development in 2016. The phosphorus budget should be revisited to confirm our conclusions in the event that any aspects of stormwater management for the development are altered.

10. References

Aldous A, McCormick P, Ferguson C, Graham S, Craft C. 2005.
Hydrologic regime controls soil phosphorus fluxes in restoration and undisturbed wetlands. Restoration Ecology 13: 341–347

Berger 2010.
Estimation of Phosphorus Loadings to Lake Simcoe. Prepared for the Lake Simcoe Region Conservation Authority by the Louis Berger Group. September 2010.

Blom CWPM, Voesenek LACJ, 1996.
Flooding: the survival strategies of plants. T.R.E.E. 2: 290-295.

Boyd CE 1970.
Chemical analyses of some vascular aquatic plants. Arch. Hydrobiol. 67:78-85.

Calow P. 2009.
Rivers Handbook: The Science and Management of River Environments. John Wiley and Sons. pp. 536.

Chase JM 2007.
Drought mediates the importance of stochastic community assembly. Proceedings of the National Academy of Science of the United States of America 104:17430–17434

City of Toronto, 2006. Wet Weather Flow Management Guidelines. November 2016

Correll, D.L. 1998.
The role of phosphorus in eutrophication of receiving waters: A review. 27: 261-266.

Crozier & Associates Inc. 2014. Summary Documents For OMB Proceedings. Proposed Midhurst Heights Devleopment. Prepared for the Township of Springwater. 218 pgs.

Devito KJ, Dillon PJ, Lazerte BD 1989.
Phosphorus and nitrogen retention in five Precambrian shield wetlands. Biogeochemistry 8: 185-204.

Desgranges JL, Ingram J, Drolet B, Morin J, Savage C, Borcard D. 2006.
Modelling wetland bird response to water level changes in the Lake Ontario-St. Lawrence River hydrosystem. Environmental Monitoring and Assessment 113: 329-365.

Drinkard MK, Kershner MW, Romito A, Nieset J, de Szalay FA. 2011.
Responses of plants and invertebrates to water level fluctuation in headwater wetlands. Journal of the North American Benthological Society 30:981-996.

Dueñas JF, Alonso JR, Rey AF, Ferrer AS 2003.
Characterisation of phosphorous forms in wastewater treatment plants. Journal of Hazardous Materials B97:193-205.

Ellison ME, Brett MT 2006.
Particulate phosphorus bioavailability as a function of stream flow and land cover. Water Research 40: 1258-1268.

Frossard E, Brossard M, Hedley MJ, Metherell A 1995.

Reactions controlling the cycling of P in soils. In: Tiessen H (ed) Phosphorus cycling in terrestrial and aquatic ecosystems: a global perspective. SCOPE/Wiley, New York, pp 107–137

Garver EG, Dubbe DR, Pratt DC 1988.
Seasonal patterns in accumulations and partitioning of biomass and macronutrients in Typha spp. Aq. Bot. 32:115–127.

Grubaugh JW, Anderson RV. 1988.
Spatial and temporal availability of floodplain habitat: Long-term changes at Pool 19, Mississippi River. American Midland Naturalist 119: 402–411.

Hanna R 1982.
A Detailed Life Science Inventory Check-sheet for Minesing Swamp.

Hutchinson Environmental Sciences Ltd. (HESL) 2012. Phosphorus Budget Tool in Support of Sustainable Development for the Lake Simcoe Watershed. Report prepared for the Ontario Ministry of the Environment.

Hutchinson Environmental Sciences Ltd. (HESL) 2014a.
Phosphorus Budget for Midhurst Secondary Plan Area. Memorandum from Neil Hutchinson and Deborah Sinclair to Steve Schaefer, SCS Consulting Group dated June 5, 2014.

Hutchinson Environmental Sciences Ltd. 2014b.
Managing New Urban Development in Phosphorus-Sensitive Watersheds – Final Report and Database Tool. Prepared for Nottawasaga Valley Conservation Authority. October 2014. 82pp.

Hutchinson Environmental Sciences Ltd. 2014c.
Baseline Aquatic Studies for Midhurst Development - Willow Creek.

Hutchinson Environmental Sciences Ltd. 2018.
Willow Creek Assimilative Capacity Study. Prepared for the Township of Springwater c/o Ainley and Associates. May 2018 59 pp.

Hutchinson Environmental Sciences Ltd. 2018b.
Baseline Aquatic Studies for Midhurst Secondary Plan Midhurst Village 2015-2016. Prepared for Midhurst Landowner Group, January 2018. 21 pp.

Junk WJ, Bayley PB, Sparks RE 1989.
The flood pulse concept in river-floodplain systems. In Dodge DP (ed). Proceedings of the International Large River Symposium. Can. Spec. Publ. Fish. Aquat. Sci. 106.

Keddy PA 2002.
Wetland Ecology: Principles and Conservation, Cambridge University Press, Great Britain.

Keough JR, Thompson TA, Guntenspurgen GR, and Wilcox DA 1999.
Hydrogeomorphic factors and ecosystem responses in coastal wetlands of the Great Lakes. Wetlands 19:821–34.

King DL 1985.
Nutrient cycling in wetlands and possible effects of water level. In: Prinee HH & D'Itri FM (Eds) Coastal Wetlands (pp 69-86) Lewis Publ., Chelsea, MI

Koerselman W, Van Kerkhoven MB and Verhoeven JTA 1993.

Release of inorganic nitrogen, phosphorus and potassium in peat soils: effect of temperature, water chemistry and water level. Biogeochemistry 20:63–81.

Li B 2014. The Study of Phosphorus Bioavailability in Effluents from Advanced Nutrient Removal Treatments. PhD. Thesis. University of Washington.

Middleton BA 2001.
Flood Pulsing in Wetlands: Restoring the Natural Balance. John Wiley and Sons, New York.

Nature Conservancy Canada. 2016.
http://www.natureconservancy.ca/en/where-we-work/ontario/our-work/minesing-wetlands.html?referrer=https://www.google.ca/

Neal C, Jarvie HP, Neal M, Love AJ, Hill L, Wickham H. 2005.
Water quality of treated sewage effluent in a rural area of the upper Thames Basin, southern England, and the impacts of such effluents on riverine phosphorus concentrations. Journal of Hydrology 304: 103-117.

Nottawasaga Valley Conservation Authority. 2001.
Willow Creek Subwatershed Plan.

Nottawasaga Valley Conservation Authority. 2007.
Minesing Wetlands Biological Inventory.

Nottawasaga Valley Conservation Authority. 2010.
Integrated Minesing Wetlands Monitoring Program – 2009 Results

Nottawasaga Valley Conservation Authority. 2013.
Watershed Report Card 2013.

Ontario Geological Survey. 2003.
Surficial Geology of Southern Ontario.

Palmer Environmental Consulting Group Inc. 2014.
Fluvial Geomorphological Assessment of Willow Creek Downstream of Proposed WWTP Discharge near Highway 26, Midhurst, ON.

Pelster D, Burke JM, Couling K., Luke SH, Smith DW, Prepas EE 2008.
Water and nutrient inputs, outputs, and storage in Canadian boreal forest wetlands: a review. J. Environ. Eng. Sci. 7: S35-S50.

Reddy KR and DeBusk WF 1987.
Nutrient storage capabilities of aquatic and wetland plants.
In: Aquatic Plants for Water Treatment and Resource Recovery, KR Reddy and WH Smith, Eds. Magnolia Publ., pp. 337–357.

Reddy KR, Flaig EG 1995.
Phosphorus dynamics in the Lake Okeechobee watershed, Florida. Special Issue. Ecological Eng. 5:121–331.

Reddy KR, Kadlec RH, Flaig E, Gale PM 1999.
Phosphorus Retention in Streams and Wetlands: A Review. Critical Reviews in Environmental Science and Technology, 29:1, 83 -146

Richardson, CJ, Qian, SS. 1999.

Long-Term Phosphorus Assimilative Capacity in Freshwater Wetlands: A New Paradigm for Sustaining Ecosystem Structure and Function. Environmental Science and Technology 33: 1545-1551.

Schlesinger WH 1997.
Biogeochemistry: An Analysis of Global Change. 2nd ed. Elsevier Academic Press, Amsterdam.

Smith CS, Adams MS, and Gustafson TD 1988.
The importance of belowground mineral element stores in cattail (typha latifolia L.). Aquat. Bot. 30:343–352

Sparks RE, Bayley PB, Kohler SL, Osborne LL. 1990.
Disturbance and recovery of large floodplain rivers. Environmental Management 14: 699–709.

Spoelstra J, Post R. 2012.
Hydrogeochemical characterization of the eastern Minesing Wetlands. National Water Research Institute, Report Number 12-001. Environment Canada. 20 pp.

Stone, R.P., Hilborn, D., 2012. Universal Soil Loss Equation (USLE) Factsheet, Ministry of Agriculture, Food and Rural Affairs, Ontario.

Takács I 2006.
Modeling chemical phosphorus removal processes. Session P2 in WERF, 2006.

van der Valk AG 1981.
Succession in wetlands: a Gleasonian approach. Ecology 62:688–696.
Verry ES, Timmons DR 1982. Waterbourne nutrient flow through an upland peatland watershed in Minnesota. Ecology 63: 1456-1467.

Wilkins MB 1984.
Advanced Plant Physiology. Pitman Publishing, Ltd., London.

Appendix A. Master Drainage Plan Information

SCS consulting group ltd

File #: 1168/1194
Date: June 8, 2014

Mr. Glenn Switzer, P. Eng.
Director of Engineering and Technical Services
Nottawasaga Conservation Authority
8195 8th Line
Utopia, Ontario, L0M 1T0

Dear Mr. Switzer:

Re: **Midhurst Master Drainage Plan – Phase 1**
Item #5 – Maximize Infiltration – 25mm Rainfall Target
Midhurst, Ontario

Further to our submissions of May 2, 2014 and May 27, 2014, please accept the following supplemental information in support of the Maximum Infiltration analysis (Item #4) of the Phase 1 work program for the Master Drainage Plan for your review and approval.

As per NVCA's correspondence of May 29, 2014, the target statement for Maximum Infiltration is:

> *Infiltrate as much water back into the ground as possible aiming for the first 25mm of rainfall runoff. This will assist in the volume control and the water quality control.*

As requested by the NVCA, an analysis was completed to determine a preliminary maximum achievable infiltration volume, with a goal of retaining the entire 25mm rainfall event on-site through infiltration, and more specifically, low impact development strategies.

The existing hydraulic conductivity of the site soils have been characterized by Golder in the attached memo. As shown, the average hydraulic conductivity in the Doran and Carson lands is 10^{-5} cm/s. The associated infiltration rate is 30 mm/hour per the table provided by NVCA, taken from the LID SWM Planning and Design Guide, CVC & TRCA.

As discussed with NVCA, the infiltration potential of the site was modeled using the Initial Abstraction (IA) parameter, which was developed based on the following parameters:

- Infiltration rates are not to be included in the analysis at this stage, the entire volume of runoff to be infiltrated from the 25mm storm event needs to be available on site,
- Proposed infiltration measures are required to drawdown over the CVC/TRCA maximum drawdown time for below grade infiltration measures of 72 hours,
- A factor of safety of 2.5 needs to be applied per the CVC/TRCA Design Guide,

- Develop overall infiltration volume capacity for each SWM Pond drainageshed and average over drainage area to provide weighted IA to be used in hydrologic modelling, and
- Update hydrologic model with revised IA parameters to determine the impact on the proposed infrastructure and downstream receivers.

To determine which LID's were applicable, they were broken into two types: private lot level LID's and LID's within the public realm. The following LID's are what has been utilized in the analysis:

Private Lot Level LID's

- *Soakaway pits*
  - Located in both the front and rear yards, the soakaway pits will be connected directly to the roof leaders and infiltrate all roof runoff from the 25mm storm event,
  - The soakaway pits have been located in areas that would not be disturbed by a typical homeowner and can be put on title to ensure that they are to be maintained, and
  - As roof runoff is considered clean runoff, no pre-treatment is necessary.
- *RLCB exfiltration trenches*
  - In any instance where an RLCB is necessary, RLCB exfiltration trenches will provide adequate infiltration volume to infiltrate all roof and rear lot drainage from the 25 mm storm event,
  - The exfiltration trenches can be located in areas that would not be disturbed by a typical homeowner and can be put on title to ensure that they are to be maintained, and
  - As roof and rear lot runoff is considered clean runoff, no pre-treatment is necessary.
- *Increased Topsoil Depth*
  - Landscaped areas on a lot level basis (lawns) will have a minimum topsoil depth of 300 mm to encourage additional IA potential.

LID's within Public Realm

- *Infiltration Galleries*
  - In each park area, it has been assume that there is the potential for an infiltration galley that can utilize up to 50% of the park surface area,
  - It was assumed that the infiltration galleries would consist of a 1.0 m deep stone trench, and

- As the drainage directed to the park areas will be directly connected to the municipal storm sewer, pre-treatment will be required prior to flows entering the proposed facilities.

→ *Permanent Pool Drawdown*

- A $2m^3$/linear meter trench is proposed around the majority of the perimeter of each SWM Pond,
- The first 0.5-1.0 m of permanent pool will be directed to the drawdown trench and infiltrated,
- This practice infiltrates water that is warmest in the pond, while increasing pond capacity between storm events.

→ *Municipal Rain Gardens/Bio-swales on Single Loaded ROW's*

- Where appropriate (only anticipated on Doran) single loaded roads that are loaded by a green space on the non-loaded side provide an ideal location to direct surface runoff to at grade infiltration measures such as rain gardens or bioswales, and
- The entire 25 mm runoff from the municipal ROW adjacent to the bio-swale can be infiltrated.

→ *Increased Topsoil Depth*

- Landscaped areas within the municipal lands (boulevards and park areas) will have a minimum topsoil depth of 300 mm to encourage additional IA potential.

Low Impact Development techniques for the conveyance system have been chosen in the park and pond areas as opposed to exfiltration systems within the right of way for the following reasons:

→ Pre-treatment should be provided

- Several conveyance exfiltration systems have been installed without pre-treatment, however in discussions with MOE, their current preference is to provide pre-treatment for road runoff to remove oil and grit particles prior to the flow entering the groundwater system. This would require an oil grit separator at each manhole which would result in a considerable long term capital cost for the municipality for both maintenance and replacement
- If pre-treatment is not provided, the exfiltration systems will be both subject to more frequent cleaning or replacement and there is a greater potential for contamination of groundwater supplies from direct deposition of hydrocarbons, heavy metals and other deleterious materials.

→ Potential for long term settlement

- Construction of conveyance exfiltration systems along the right of way includes a stone trench wrapped with filter cloth as well as anti-seepage collars spaced at approximately 80 to 100m to avoid the exfiltration trench acting as an underground conduit.
  - There is a risk of long term road settlement if there is any breach or construction issue with the filter cloth around the stone trench, which could result in the native ground migrating into the stone voids, which is most concerning under a road
  - Should there be any breaches in the anti-seepage collars, there is a risk of increased velocities through the stone trenches, which also increase the risk of long term road settlement

→ Long term municipal capital maintenance cost

- Placing the exfiltration trenches under the road surface (asphalt) would result in the highest potential long term maintenance cost and disturbance to the residents, and has therefore been avoided to the extent possible.
- Placing the exfiltration trenches in the boulevards would result in an over-depth requirement to avoid conflict with the sanitary, storm and water service connections, and would also result in direct resident disturbance during any long term maintenance or replacement

Based on the inclusion of applicable LID's for each SWM Pond drainage shed, Table 3 outlines the potential volumes of infiltration that are available.

SWM Pond	Weighted IA with No LID's	Weighted IA with Lot Level LID's	Weighted IA with Lot Level and Municipal LID's	Resultant Rainfall Event with no Runoff*
North Pond	2.8 mm	9.9 mm	20 mm	23.3
Carson Road North Pond	2.8 mm	12 mm	18.7 mm	22.5
Carson Road South Pond	2.7 mm	9.2 mm	20.3 mm	23.4
South Pond	2.9 mm	10.6 mm	21.5 mm	23.0
Russell Road Pond	2.7 mm	8.9 mm	23.5 mm	24.6

* 25 mm subtract runoff volume from 25 mm event modelling from each outlet, included in Item #2 – Peak Flows

As shown above, an average of 20 mm of rainfall runoff can be retained on-site and infiltrated. This volume accounts for approximately 90% of average annual rainfall. All supporting calculations are appended.

Please call the undersigned if you have any questions or require any additional information.

Sincerely,

SCS Consulting Group Ltd.

for Steve Schaefer, P. Eng.
Principal
sschaefer@scsconsultinggroup.com

Attachments: Attachment A - Infiltration Calculations
Attachment B - Golder Memo Re: Hydraulic Conductivity Rates

c. Mr. Wayne Wilson, NVCA
Mr. Chris Hibbard, NVCA
Mr. Brad Sokach, Township of Springwater
Mr. Brent Spagnol, Township of Springwater
Mr. Joe Mullan, Ainley
Mr. Greg Marek, Simcoe County
Ms. Shauna Dudding, Geranium Corporation
Mr. Matthew Cory, Malone Given Parsons

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ATTACHMENT A

INFILTRATION CALCULATIONS

SCS consulting group ltd

Step 1 - Determine In-Situ Infiltration Rates (i)

Per Tables 1 & 2 in the Hydraulic Conductivity Estimates Memo (Golder, June 3, 2014) the average Hydraulic Conductivity for both the Carson Road and Doran Road sites is approximately 10-5.

Using Table C1 from the CVC/TRCA LID SWM Manual, an approximate Infiltration Rate for a Hydraulic Conductivity of 10-5 is 30 mm/hr.

Step 2 - Determine Drawdown Time (t_s)

Per the CVC/TRCA LID SWM Manual (pg. 4-61) the maximum acceptable length of drawdown time is 72 hours

Step 3 - Factor of Safety (Fs)

Per the CVC/TRCA LID SWM Manual a safety factor of 2.5 has been applied.

Step 4 - Max Depth of Stone Trenches (all LIDs proposed have below grade stone based storage)

$d_{r\ max} = i * t_s / V_{r\ /\ Fs}$

Fs=	2.5	
i=	30	mm/hr
t_s=	48	hr
V_r=	0.4	(Void ration, assuming 50 mm clearstone)

$d_{r\ max}$ = 1.44 m

Therefore the maximum depth of 1.44 m is acheivable. To be conservative, we have assumed a depth of 1.0 m for all infiltration measures.

Average IA for Single Detached Lots without RLCB's

Assumptions:
- all runoff from roof to soakaway pits for 25mm event
- excess topsoil in landscape areas, IA for lawns increased from 5 to 7, accounting for 20-40% reduction in runoff per STEP document titled, evaluation of residential lot level stormwater management practices (http://dev.sustainabletechnologies.ca/wp/wp-content/uploads/2013/09/Residential-Lot-Level-SWM-practices_FINAL-2013.pdf)

Land Use	Average Area (%)	Infiltration Capacity (mm)
Roof	46%	25
Driveway	8%	0
Landscape	46%	7
Total	100%	14.8

Average IA for Single Detached Lots with RLCB's

Assumptions:
- all runoff from roof to soakaway pits for 25mm event
- excess topsoil in landscape areas, IA for lawns increased from 5 to 7, accounting for 20-40% reduction in runoff per STEP document titled, evaluation of residential lot level stormwater management practices (http://dev.sustainabletechnologies.ca/wp/wp-content/uploads/2013/09/Residential-Lot-Level-SWM-practices_FINAL-2013.pdf)
- all runoff from area directed to RLCB to be infiltrated from 25mm event (*assume 50% landscape area)

Land Use	Average Area (%)	Infiltration Capacity (mm)
Roof	46%	25
Driveway	8%	0
Landscape	46%	16
Total	100%	18.9

* = (7*0.5 + 25*0.5)

Mixed Use/School Blocks

Public Property LID's

Average IA for Township ROW (proposed previously by SCS)

Land Use	Width (m)	Average Area (%)	Infiltration Capacity (mm)
Asphalt & Curb	9	45%	0
Sidewalk	3	15%	0
Landscape	8	40%	5
Total	20	100%	2.0

Average IA for Single Loaded Township ROW with Bioretention

Assumptions:
- all runoff from non-loaded side of road to be infiltrated for 25mm event

Land Use	Width (m)	Average Area (%)	Infiltration Capacity (mm)
Asphalt & Curb	9	45%	12.5
Sidewalk	3	15%	12.5
Landscape	8	40%	15
Total	20	100%	13.5

Average IA for Infiltration Galleries in Park Areas

- Maximum volume available = 50% park surface area * 1m * 0.4 stone voids
- Determine volume directed to park infiltration gallery in 25mm event
- Use lesser of two numbers

Averate IA for Permanent Pool Drawdown

- Maximum volume available = 3.5m * 1.4m * 0.4 * NWL Perimeter
*Some ponds were assumed to have additional areas for infiltration based on layout.

North Pond IA

Total Weighted IA to North Pond without Public Property LIDs

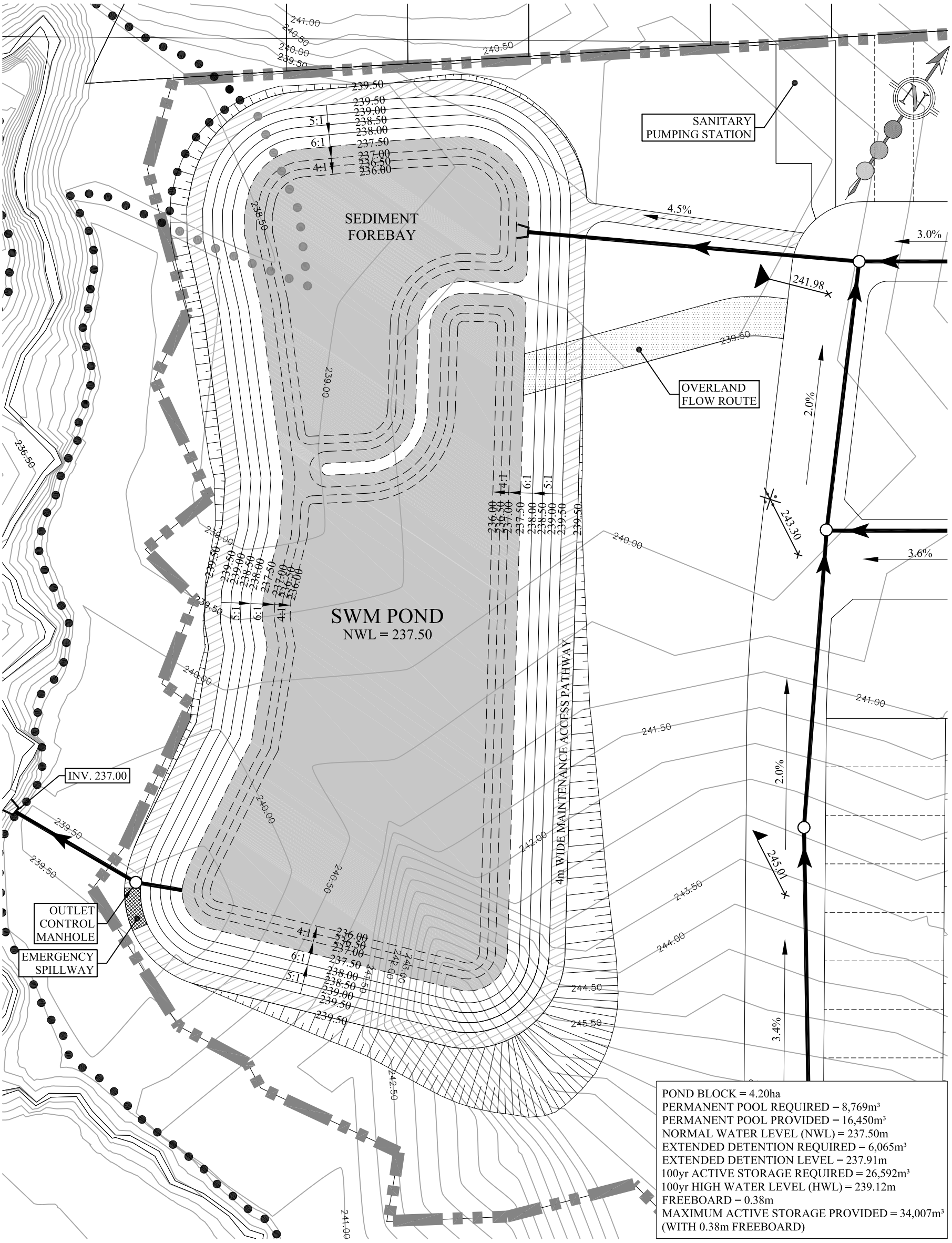
Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
Single Detached	36.88	14.8	5455
Single Detached w RLCB	1.02	18.9	193
Townhomes	0	2.0	0
Mixed Use/School	0	15.0	0
Standard ROWs	19.16	2.0	383
Parks/Open Space*	6.33	8.0	506
SWM Ponds	3.65	4.0	146
TOTAL (w/o Public LIDs)	**67.04**	**10.0**	**6684**

*IA assumed based on extra topsoil depth and volume of plantings

Total Weighted IA to North Pond Including Public Property LIDs

Land Use	Upstream Drainage Area	Available Runoff	Available Storage	Proposed Infiltration Volume
Block 819	28.1	4224	6200	4224
Block 341	10.2	1533	1140	1140
Pond Infiltration Gallery	67.04	4713	1340	1340

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
TOTAL (w all LIDs)	**67.04**	**20.0**	**13387**



LEGEND:

- LIMIT OF DEVELOPMENT APPLICATION
- EXISTING FLOODLINE
- PROPOSED FLOODLINE
- MAX. 3:1 SLOPE
- 243.00 — EXISTING CONTOUR
- × 246.50 — PROPOSED GRADE
- ×237.59EX — EXISTNG GRADE
- OVERLAND FLOW
- 238.50 — POND CONTOUR
- PROPOSED MAINTENACE ACCESS ROAD
- PROPOSED EMERGENCY SPILLWAY
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED STORM SEWER

CARSON ROAD DEVELOPMENT INC. (CRDI)

PRELIMINARY SWM POND GRADING - NORTH POND

CARSON ROAD DEVELOPMENT INC.
3190 STEELES AVE. EAST, SUITE 3000
MARKHAM, ONTARIO L3R 1G9
TEL: (905) 477-1177
FAX: (905) 477-1279

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

DATE:	APRIL 2013	CHECKED BY:	J.M.P
SCALE:	1:1000	DRAWN BY:	Y.K.
PROJECT No:	1194	FIGURE No:	4.4.1

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Carson Road North Pond IA

Total Weighted IA to North Pond without Public Property LIDs

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
Single Detached	21.08	14.8	3118
Single Detached w RLCB	0	18.9	0
Townhomes	0	2.0	0
Mixed Use/School	4.48	20.0	896
Standard ROWs	5.59	2.0	112
Parks/Open Space*	1.5	8.0	120
SWM Ponds	1.17	4.0	47
TOTAL (w/o Public LIDs)	**33.82**	**12.7**	**4293**

*IA assumed based on extra topsoil depth and volume of plantings

Total Weighted IA to North Pond Including Public Property LIDs

Land Use	Upstream Drainage Area	Available Runoff	Available Storage	Proposed Infiltration Volume
Block 819	19.5	2400	540	540
Pond Infiltration Gallery	33.82	3622	1500	1500

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
TOTAL (w all LIDs)	**33.82**	**18.7**	**6333**

POND BLOCK = 1.30ha
PERMANENT POOL REQUIRED = 4,980m³
PERMANENT POOL PROVIDED = 5,278m³
NORMAL WATER LEVEL (NWL) = 264.00m
EXTENDED DETENTION REQUIRED =3,776m³
EXTENDED DETENTION LEVEL = 264.65m
100yr ACTIVE STORAGE REQUIRED = 15,993m³
100yr HIGH WATER LEVEL (HWL) = 266.21m
FREEBOARD = 0.09m
MAXIMUM ACTIVE STORAGE PROVIDED = 16,812m³
(WITH 0.09m FREEBOARD)

PARK

OPEN SPACE

SWM POND
NWL = 264.00

SEDIMENT FOREBAY

EMERGENCY SPILLWAY

OVERLAND FLOW ROUTE

MAINTENANCE ACCESS ROAD

MAINTENANCE ACCESS ROAD

TO BLACK CREEK VIA EXISTING CARSON ROAD CULVERT

CARSON ROAD SOUTH POND OUTLET

CARSON ROAD WEST

NOTE: SCHEMATIC LAYOUT ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

CARSON ROAD DEVELOPMENT INC.
3190 STEELES AVENUE EAST, SUITE 300
MARKHAM, ONTARIO L3R 1G9
TEL: (905) 477-1177
FAX: (905) 477-1279

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

LEGEND:
- MAX. 3:1 SLOPE
- LIMIT OF DEVELOPMENT APPLICATION
- PROPOSED FLOODLINE
- 290.00 EXISTING CONTOUR
- × 166.50 PROPOSED GRADE
- 291.70 POND CONTOUR
- OVERLAND FLOW
- PROPOSED MAINTENACE ACCESS ROAD
- PROPOSED EMERGENCY SPILLWAY
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED STORM SEWER

CARSON ROAD DEVELOPMENT INC. (CRDI)

PRELIMINARY SWM POND GRADING - CARSON ROAD NORTH POND

DRAWN BY:	S.F.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	MAY 2014
PROJECT No:	1194	FIGURE No:	4.4.2

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DRAFT PLAN OF SUBDIVISION

Micks

SP-T-1004

Part of Lot 14
Concession 6
Township of Springwater
County of Simcoe

EXISTING RURAL

Wilson Drive

WILSON DRIVE

Block 343
Pumping Station
0.05 ha

Block 342
Stormwater Management Pond Block
3.65 ha

Block 341
Park
0.57 ha

Block 361
Environmental Protection Area
0.07 ha

Block 360
Environmental Protection Area
0.07 ha

Block 359
Reserve Block
0.15 ha

Block 344 - Residential Reserve
Block 345 - Residential Reserve
Block 346 - Residential Reserve
Block 347 - Residential Reserve
Block 348 - Residential Reserve
Block 349 - Residential Reserve
Block 350 - Residential Reserve
Block 351 - Residential Reserve
Block 352 - Residential Reserve
Block 353 - Residential Reserve
Block 354 - Residential Reserve
Block 355 - Residential Reserve
Block 356 - Residential Reserve
Block 357 - Residential Reserve
Block 358 - Residential Reserve

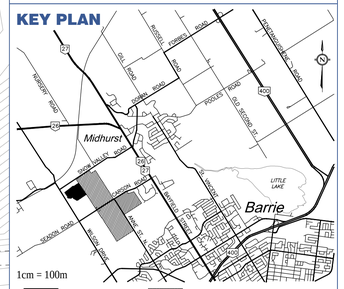
STREET 'A'
STREET 'B'
STREET 'C'
STREET 'D'
STREET 'E'
STREET 'F'

OTHER LANDS OWNED BY APPLICANT

EXISTING RURAL

EXISTING RURAL

KEY PLAN



Subject Lands Other Lands Owned by Applicant

SCHEDULE OF LAND USE

LOT/BLOCK	LAND USE	LAND USE	UNITS	AREA (ha)
Lots 1-340	Low Density Residential			
	Single Detached - 15.25m (A units)		19	
	Single Detached - 12.2m (B units)		158	12.38
	Single Detached - 9.75m (C units)		125	
	Single Detached - 10.5m (D units)		38	
Block 341	Park			0.57
Block 342	Storm Water Management			3.65
Blocks 343	Pumping Station			0.05
Blocks 344-359	Residential Reserve			
Block 360-361	Environmental Protection Area			0.14
Roads	23.0m ROW	540m		6.87
	20.0m ROW	2,775m		
TOTAL		3,315m	340	23.96

Net Density* - 340 units / 23.89 ha = 14.2 upha
* Excludes Environmental Protection Area

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

SEE ORIGINAL
1757704 Ontario Inc. Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

SEE ORIGINAL
Paul Edward
Ontario Land Surveyor
R-PE Surveying Ltd. Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13(R.S.O. 1990).
(a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Sand loam & loamy sand.
(h),(k) - Full services & water supply to be provided.

Prepared by:
MALONE GIVEN PARSONS LTD.
140 Renfrew Drive, Suite 201
Markham, Ontario, L3R 6B3
Tel: (905) 513-0170
www.mgp.ca

MATTHEW J. CORY
REGISTERED PROFESSIONAL PLANNER
R.P.P.

mbtw watchorn

Scale: 1:1000

Date: Dec 23, 2009
Project No.: 12-2139

Date	Revision	#
April 26/13	Revised draft plan - Stormwater Management	1
April 8/14	Revised as per Township & Agency Comments	2
May 14/14	Revised as per Township & Agency Comments	3

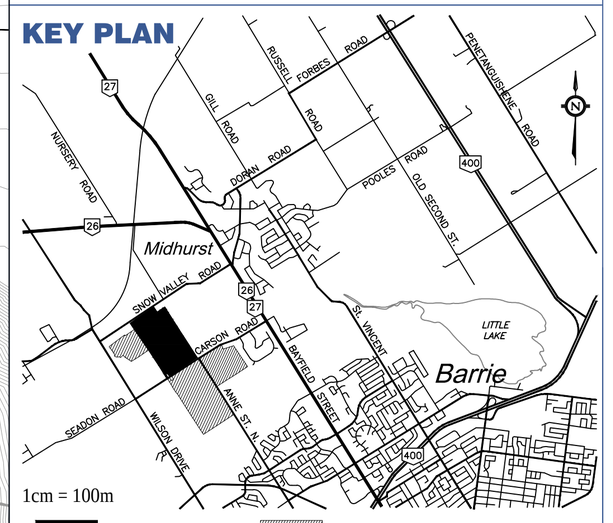
DRAFT PLAN OF SUBDIVISION

D. Hickling

SP-T-1005

Part of Lot 14 & 15
Concession 6
Township of Springwater
County of Simcoe

KEY PLAN



1cm = 100m

Subject Lands | Other Lands Owned by Applicant

SCHEDULE OF LAND USE

LOT/BLOCK	LAND USE	UNITS	AREA (ha)
Lots 1-798	Low Density Residential		28.31
	Single Detached - 15.25m (A units)	47	
	Single Detached - 12.2m (B units)	235	
	Single Detached - 9.75m (C units)	448	
	Single-Detached (flankage) - 10.5m (D units)	68	
Blocks 799-817	Residential Reserves		0.65
Blocks 818	Park		2.88
Blocks 819	Parkette		0.27
Blocks 820-824	Open Space		1.05
Blocks 825-826	Environmental Protection Area		29.49
Block 827	Mixed Use / Senior's Housing		0.99
Block 828	Mixed Use / School		3.49
Block 829	Stormwater Management Pond		1.17
Blocks 830-832	Road Widenings		1.03
Blocks 833-835	Reserves		0.17
Roads Streets A-Q	23.0m ROW 1,420m 20.0m ROW 5,045m		14.62
TOTAL	6,465m	798	84.12

Net Density* - 798 units / 54.63 ha = 14.6 uph
* Excludes Environmental Protection Area

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

SEE ORIGINAL
1757688 Ontario Inc. — Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

SEE ORIGINAL
Paul Edward
Ontario Land Surveyor
RPE Surveying Ltd. — Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13(R.S.O. 1990).
(a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Sand loam, loamy sand.
(h),(k) - Full services & Water Supply to be provided.

Prepared by:
MALONE GIVEN PARSONS LTD.
140 Renfrew Drive, Suite 201
Markham, Ontario, L3R 6B3
Tel: (905) 513-0170
www.mgp.ca

MATTHEW J. CORY — REGISTERED PROFESSIONAL PLANNER — R.P.P. — ONTARIO PROFESSIONAL PLANNERS INSTITUTE

mbtw watchorn

Scale: 1:2000

Date: Dec 23, 2009
Project No.: 12-2139

Date	Revision	#
Apr 8/14	Revised as per Township & Agency Comments	1
May 14/14	Revised as per Township & Agency Comments	2

Carson Road South Pond IA

Total Weighted IA to Carson Road South Pond without Public Property LIDs

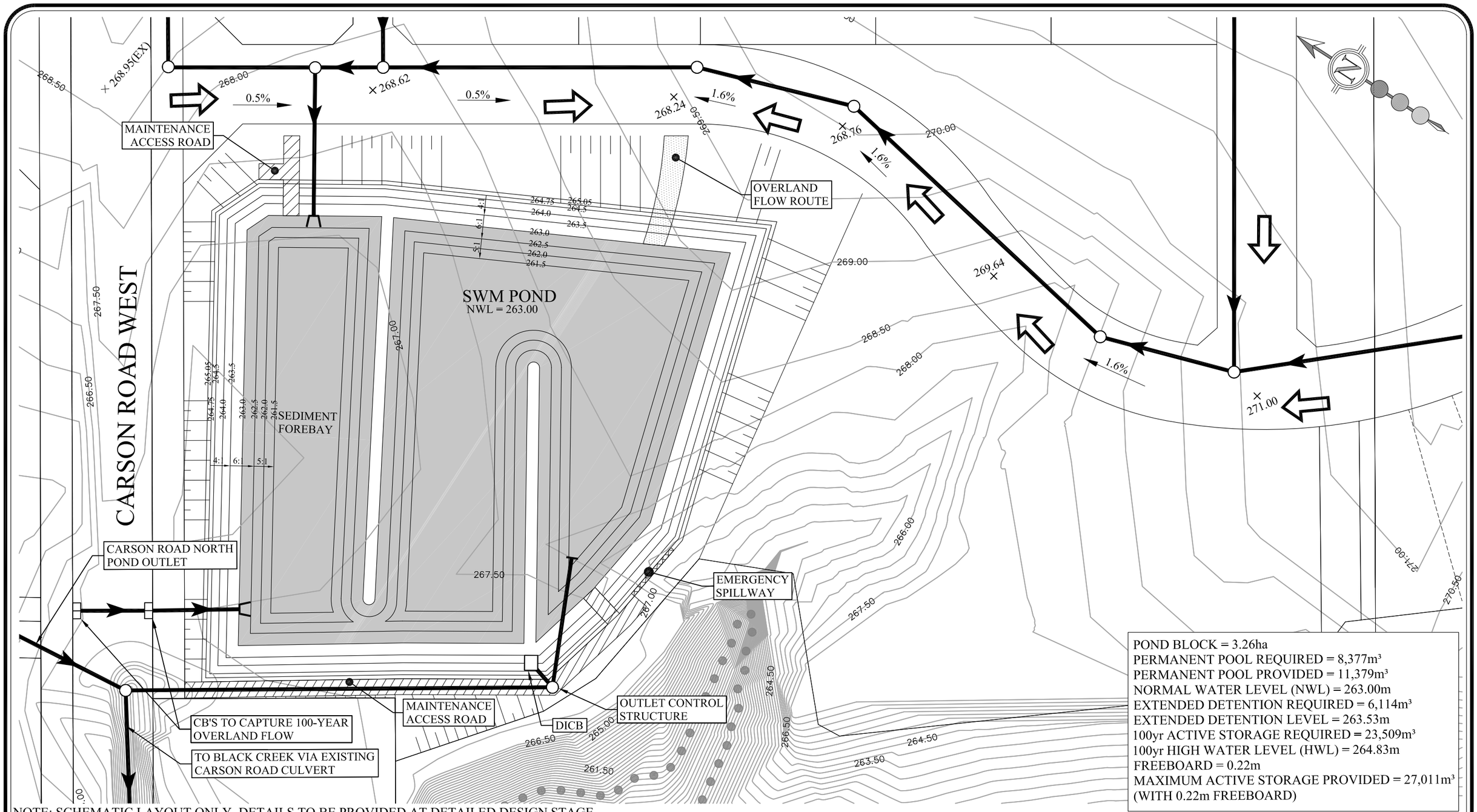
Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
Single Detached	19.87	14.8	2939
Single Detached w RLCB	5.03	18.9	950
Townhomes	5.09	2.0	102
Mixed Use/School	3.17	20.0	634
Standard ROWs	16.95	2.0	339
Parks/Open Space*	9.68	8.0	774
SWM Ponds	2.11	4.0	84
TOTAL (w/o Public LIDs)	**61.9**	**9.4**	**5823**

*IA assumed based on extra topsoil depth and natural cover

Total Weighted IA to Carson Road South Pond Including Public Property LIDs

Land Use	Upstream Drainage Area	Available Runoff	Available Storage	Proposed Infiltration Volume
Block 331	6.2	967	960	960
Block 536	10.2	1590	1920	1590
Block 535	59.3	9246	2920	2920
Pond Infiltration Gallery	61.9	4181	1250	1250

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
TOTAL (w all LIDs)	**61.9**	**20.3**	**12544**



NOTE: SCHEMATIC LAYOUT ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

POND BLOCK = 3.26ha
PERMANENT POOL REQUIRED = 8,377m³
PERMANENT POOL PROVIDED = 11,379m³
NORMAL WATER LEVEL (NWL) = 263.00m
EXTENDED DETENTION REQUIRED = 6,114m³
EXTENDED DETENTION LEVEL = 263.53m
100yr ACTIVE STORAGE REQUIRED = 23,509m³
100yr HIGH WATER LEVEL (HWL) = 264.83m
FREEBOARD = 0.22m
MAXIMUM ACTIVE STORAGE PROVIDED = 27,011m³
(WITH 0.22m FREEBOARD)

CARSON ROAD DEVELOPMENT INC.
3190 STEELES AVENUE EAST, SUITE 300
MARKHAM, ONTARIO L3R 1G9
TEL: (905) 477-1177
FAX: (905) 477-1279

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

LEGEND:

- MAX. 3:1 SLOPE
- PROPOSED FLOODLINE
- 290.00 EXISTING CONTOUR
- × 166.50 PROPOSED GRADE
- 291.70 POND CONTOUR
- OVERLAND FLOW
- PROPOSED MAINTENACE ACCESS ROAD
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED STORM SEWER

CARSON ROAD DEVELOPMENT INC. (CRDI)

PRELIMINARY SWM POND GRADING - CARSON ROAD SOUTH POND

DRAWN BY:	S.F.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	MAY 2014
PROJECT No:	1194	FIGURE No:	4.4.3

File: P:\1194 Midhurst Carson Road\Drawings\FSP\Figs\Report Figures\1194D-PREL-POND-CARS-SOTH-4.4.3.dwg – Revised by <MCOUGLER> : Mon, May 26 2014 – 4:39pm

South Pond IA

Total Weighted IA to South Pond without Public Property LIDs

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
Single Detached	7.43	14.8	1099
Single Detached w RLCB	2.85	18.9	539
Townhomes	0	2.0	0
Mixed Use/School	0	20.0	0
Standard ROWs	4.73	2.0	95
Parks/Open Space*	1.46	8.0	117
SWM Ponds	1.18	4.0	47
TOTAL (w/o Public LIDs)	**17.65**	**10.7**	**1896**

*IA assumed based on extra topsoil depth and volume of plantings

Total Weighted IA to South Pond Including Public Property LIDs

Land Use	Upstream Drainage Area	Available Runoff	Available Storage	Proposed Infiltration Volume
Block 819	9.75	1390	2000	1390
Pond Infiltration Gallery	17.65	1126	500	500

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
TOTAL (w all LIDs)	**17.65**	**21.5**	**3786**

POND BLOCK = 0.95 ha
PERMANENT POOL REQUIRED = 2,229 m³
PERMANENT POOL PROVIDED = 3,258 m³
NORMAL WATER LEVEL (NWL) = 264.25 m
EXTENDED DETENTION REQUIRED = 5,130 m³
EXTENDED DETENTION LEVEL = 265.37 m
100yr ACTIVE STORAGE REQUIRED = 6,789 m³
100yr HIGH WATER LEVEL (HWL) = 265.68 m
FREEBOARD = 0.37m
MAXIMUM ACTIVE STORAGE PROVIDED = 9,002 m³
(WITH 0.37m FREEBOARD)

EMERGENCY SPILLWAY

SWM POND
NWL = 264.25

MAINTENANCE ACCESS ROAD

SEDIMENT FOREBAY

OVERLAND FLOW ROUTE

OVERLAND FLOW ROUTE

MAINTENANCE ACCESS ROAD

ONTARIO HYDRO EASEMENT

NOTE: SCHEMATIC LAYOUT ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

CARSON ROAD DEVELOPMENT INC.
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TEL: (905) 475-1900
FAX: (905) 475-8335

LEGEND:

- LIMIT OF DEVELOPMENT APPLICATION
- PROPOSED FLOODLINE
- 290.00 EXISTING CONTOUR
- × 166.50 PROPOSED GRADE
- 291.70 POND CONTOUR
- PROPOSED MAINTENACE ACCESS ROAD
- PROPOSED EMERGENCY SPILLWAY
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED STORM SEWER

CARSON ROAD DEVELOPMENT INC. (CRDI)

PRELIMINARY SWM POND GRADING - SOUTH POND

DRAWN BY:	S.F.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	MAY 2014
PROJECT No:	1194	FIGURE No:	4.4.4

File: P:\1194 Midhurst Carson Road\Drawings\FSP\Figs\Report Figures\1194D-PREL-POND-SOTH-4.4.4.dwg – Revised by <YKASPIN> : Wed, Sep 30 2009 – 5:02pm

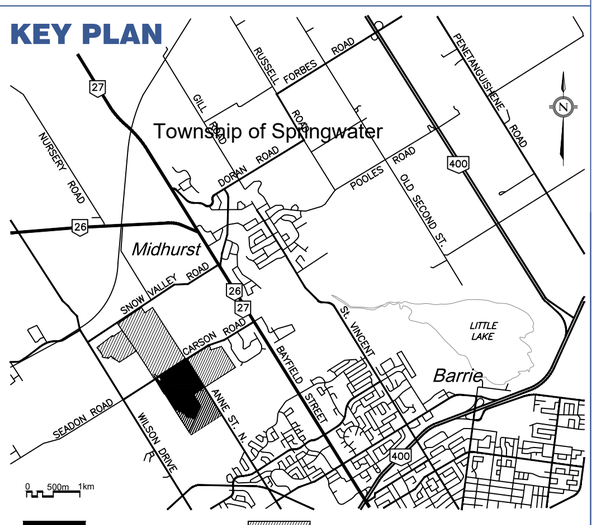
DRAFT PLAN OF SUBDIVISION

A. Hickling & R. Hickling

SP-T-1006

Part of Lots 16 & 17
Concession 6
Township of Springwater
County of Simcoe

KEY PLAN



Subject Lands Other Lands Owned by Applicant

SCHEDULE OF LAND USE

LOT/BLOCK	LAND USE	LAND USE	UNITS	AREA (ha)
Lots 1-511	Low Density Residential			
	Single Detached - 12.2m (B units)		225	18.78
	Single Detached - 9.75m (C units)		229	
	Single-Detached - 10.5m Flankage(D units)		57	
Blocks 512-533	4.5m Laneway Townhouses (LWTH)		169	3.02
Block 534	Mixed Use			1.95
Block 535-537	Parks			3.42
Blocks 538	Environmental Protection Area			7.71
Blocks 539-544	Open Space			3.39
Blocks 545-546	Stormwater Management Pond			3.29
Blocks 547-548	Servicing Blocks			0.10
Blocks 549-555	Future Development			0.15
Blocks 556-558	Future Road			0.18
Blocks 559-561	Road Widenings			0.75
Streets A-C	23.0m ROW	996m		11.87
Streets B-O	20.0m ROW	4,380m		
Lanes 1-4	10.0m Lane	362m		
TOTAL		5,738m	680	54.61

Net Density - 680 units / 44.95 ha = 15.1 upha
(Excludes Environtmental Protection Area and High Density / Mixed Use Block)

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

SEE ORIGINAL
1757690 Ontario Inc. Date

SEE ORIGINAL
1757689 Ontario Inc. Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

SEE ORIGINAL
Paul Edward Date
Ontario Land Surveyor
RPE Surveying Ltd.

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13(R.S.O. 1990).
(a),(e),(f),(g),(j),(l) - As shown on the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Sandy loam.
(h),(k) - Full services and water supply to be provided.

Prepared by:

140 Renfrew Drive, Suite 201
Markham, Ontario, L3R 6B3
Tel: (905) 513-0170
www.mgp.ca

G:\2012\12-2139 Geranium Midhurst\Graphics\JPEGs\MBTW_WAI_COLOUR.png

Scale: 1:2000

Date: December 23, 2009
Project No.: 12-2139

Date	Revision	Rev.#
April 8, 2014	Revised as per Township and agency comments	1
May 14, 2014	Revised as per Township and agency comments	2

DRAFT PLAN OF SUBDIVISION

Rome

SP-T-1007

Part of Lot 16
Concession 5
Township of Springwater
County of Simcoe

EXISTING RURAL
LOT 15
CONCESSION 5

CARSON ROAD WEST

BLOCK 334
8m ROAD WIDENING
0.422 ha

N57°53'30"E 468.21

N72°21'45"E 40.96

Subject To Easement

To Carson Road
South Pond

BLOCK 328
MIXED USE
1.22 ha

BLOCK 312
LWTH
8 units

BLOCK 313
LWTH
8 units

BLOCK 314
LWTH
8 units

BLOCK 315
LWTH
8 units

LANE 3

LANE 4

STREET C

STREET D

BLOCK 316
LWTH
8 units

BLOCK 317
LWTH
8 units

BLOCK 318
LWTH
8 units

BLOCK 319
LWTH
8 units

BLOCK 332
WALKWAY 0.01 ha

STREET B

STREET C

STREET D

LANE 2

BLOCK 331
PARK
0.48 ha

STREET A

EXISTING RURAL

FUTURE DEVELOPMENT

ANNE STREET

BLOCK 330 -- Open Space -- 1.59 ha
(Ontario Hydro Corridor Easement)

Ontario Hydro Corridor Easement

BLOCK 335
3m ROAD WIDENING
0.18 ha

N32°49'30"W 615.03

BLK 336
SERVICING BLOCK
0.12 ha

BLK. 320
LWTH
7 units

BLK. 321
LWTH
6 units

BLK. 322
LWTH
6 units

BLK. 323
LWTH
6 units

BLK. 327
LWTH
7 units

BLK. 326
LWTH
6 units

BLK. 325
LWTH
6 units

BLK. 324
LWTH
6 units

LANE 1

STREET I

STREET H

STREET G

STREET B

STREET F

STREET E

STREET I

STREET B

BLOCK 329
ENVIRONMENTAL
PROTECTION AREA
12.83 ha

BLOCK 333
WALKWAY
0.02 ha

COL 16
CONCESSION 5

EXISTING RESIDENTIAL

N72°22'25"E 207.53

N17°34'10"W 76.20

N33°46'20"W 470.57

N57°01'00"E 215.95

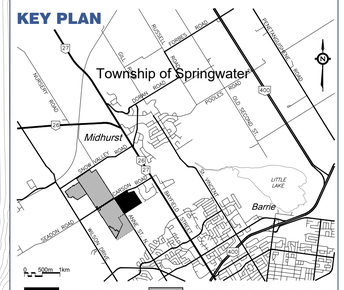
N57°26'05"E 244.58

N56°39'25"E 108.40

N57°22'10"E 126.79

EXISTING RURAL

KEY PLAN



SCHEDULE OF LAND USE

LOT/BLOCK	LAND USE	LAND USE	UNITS	AREA (ha)
Lots 1-311	Low Density Residential			
	Single Detached - 18.30m (AA units)		13	13.47
	Single Detached - 15.25m (A units)		99	
	Single Detached - 12.2m (B units)		85	
	Single Detached - 9.75m (C units)		77	
	Single Detached - 11.6m (E units)		37	
Blocks 312-327	Laneway Townhouse Residential LWTH		114	2.07
Block 328	Mixed Use			1.22
Blocks 329	Environmental Protection Area			12.83
Blocks 330	Open Space			1.59
Block 331	Park			0.48
Blocks 332-333	Walkways			0.03
Blocks 334-335	Road Widenings			0.60
Block 336	Servcing Block			0.12
Streets A ,B & F	23.0m ROW	1,269m		7.62
Streets C-E, G-J	20.0m ROW	1,884m		
Lanes 1-4	10.0m Lane	681m		
TOTAL		3,834m	425	40.03

Net Density - 425 units / 27.16 ha = 15.6 upha
(Excludes Environmental Protection Area)

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

SEE ORIGINAL
1757699 Ontario Inc. Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

SEE ORIGINAL
Paul Edward Date
Ontario Land Surveyor
R-PE Surveying Ltd.

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(i) - Sandy loam and loamy sand.
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Prepared by:

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www.mgp.ca

MATTHEW J. CORY REGISTERED PROFESSIONAL PLANNER R.P.P.

mbtw watchorn

Scale: 1:1250

Date: December 23, 2009
Project No.: 12-2139

Date	Revision	Rev.#
April 8, 2014	Revised as per Township and agency comments	1
May 14, 2014	Revised as per Township and agency comments	2

Russell Road Pond IA

Total Weighted IA to North Pond without Public Property LIDs

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
Single Detached	31.07	14.8	4596
Single Detached w RLCB	5.81	18.9	1098
Townhomes	9.52	2.0	190
Mixed Use/School	3.44	20.0	688
Standard ROWs	23.62	2.0	472
Parks/Open Space*	7.4	8.0	592
SWM Ponds	4.39	4.0	176
TOTAL (w/o Public LIDs)	**85.25**	**9.2**	**7812**

*IA assumed based on extra topsoil depth and volume of plantings

Total Weighted IA to North Pond Including Public Property LIDs

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
Single Loaded ROW w Bioretention	2.5	13.5	338

Land Use	Upstream Drainage Area	Available Runoff	Available Storage	Proposed Infiltration Volume
Main Park Infiltraiton Gallery	53.5	8472	3200	3200
Block 558	0.6	95	150	95
Future 1	1.9	301	360	301
Future 2	1.2	190	66	66
Future 3	4.6	728	1008	728
Future 4	0.8	127	232	127
Block 553	7.25	1053	1900	1053
Block 553A	4.25	673	1016	673
Block 553B	4.75	451	1100	451
Block 553C	6.5	963	1100	963
Block 555/556/557	66	2921	2980	2921
Pond Infiltration Gallery	85.25	2584	1300	1300

Land Use	Total Area (ha)	Average Infiltration Depth (mm)	Infiltration Volume (m^3)
TOTAL (w all LIDs)	**85.25**	**23.5**	**20028**

POND BLOCK = 4.39ha
PERMANENT POOL REQUIRED = 11,744m³
PERMANENT POOL PROVIDED = 23,064m³
NORMAL WATER LEVEL (NWL) = 280.00m
EXTENDED DETENTION REQUIRED = 8,041m³
EXTENDED DETENTION LEVEL = 280.32m
100yr ACTIVE STORAGE REQUIRED = 36,372m³
100yr HIGH WATER LEVEL (HWL) = 281.34m
FREEBOARD = 0.96m
MAXIMUM ACTIVE STORAGE PROVIDED = 65,473m³
(WITH 0.96m FREEBOARD)

RUSSELL ROAD

POOLES ROAD

PARK

SWM POND
NWL = 280.00

SEDIMENT FOREBAY

SEDIMENT FOREBAY

INLET STRUCTURE

OVERLAND FLOW ROUTE

4.0m WIDE MAINTENANCE ACCESS ROAD

4.0m WIDE FLAT BERM

MAX 3:1 TO MATCH EXISTING

EMERGENCY SPILLWAY

4.0m WIDE MAINTENANCE ACCESS ROAD

DICB

OUTLET CONTROL STRUCTURE

OVERLAND FLOW ROUTE

TO EXISTING MUNICIPAL OUTLET

NOTE: SCHEMATIC LAYOUT ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

MIDHURST DEVELOPMENT DORAN ROAD INC.
3190 STEELES AVE EAST, SUITE 300
MARKHAM, ONTARIO L3R 1G9
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LEGEND:

- LIMIT OF DEVELOPMENT APPLICATION
- MAX. 3:1 SLOPE
- 290.00 EXISTING CONTOUR
- × 166.50 PROPOSED GRADE
- × 287.59 EX EXISTNG GRADE
- 291.70 POND CONTOUR
- OVERLAND FLOW
- PROPOSED MAINTENACE ACCESS ROAD
- PROPOSED EMERGENCY SPILLWAY
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED STORM SEWER

MIDHURST DEVELOPMENT DORAN ROAD INC. (MDDRI)

PRELIMINARY SWM POND GRADING - RUSSELL ROAD POND

DRAWN BY: S.F.	CHECKED BY: J.M.P.
SCALE: 1:1500	DATE: MAY 2014
PROJECT No: 1168	FIGURE No: 4.4.1

File: P:\1168 Midhurst – Doran Road\Drawings\FSP\Fig\Report Figures\1168–PREL–POND–RUSL–4.4.1.dwg – Revised by <KPESENGCO> : Wed, May 28 2014 – 5:00pm

EXISTING RURAL

Doran Road

BLOCK 625
SERVICING BLOCK
0.06 ha.

BLOCK 626
8.0m ROAD WIDENING
0.79 ha.

BLOCK 623
WALKWAY
0.01 ha.

BLOCK 619
OPEN SPACE
0.17 ha.

BLOCK 627
8.0m ROAD WIDENING
0.77 ha.

RUSSELL ROAD

BLOCK 622
ENVIRONMENTAL PROTECTION
10m BUFFER
0.16 ha.

BLOCK 621
ENVIRONMENTAL PROTECTION AREA
0.07 ha.

BLOCK 618
OPEN SPACE
0.05 ha.

BLOCK 566 LWTH 8 Units
BLOCK 567 LWTH 8 Units
BLOCK 568 LWTH 8 Units
BLOCK 569 LWTH 8 Units
BLOCK 570 LWTH 8 Units
BLOCK 571 LWTH 7 Units
BLOCK 572 LWTH 8 Units
BLOCK 573 LWTH 8 Units
BLOCK 574 LWTH 8 Units
BLOCK 575 LWTH 8 Units
BLOCK 576 LWTH 8 Units
BLOCK 577 LWTH 6 Units
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BLOCK 604 LWTH 6 Units
BLOCK 605 LWTH 7 Units
BLOCK 606 LWTH 8 Units
BLOCK 607 LWTH 6 Units
BLOCK 608 LWTH 8 Units
BLOCK 609 LWTH 8 Units
BLOCK 610 LWTH 8 Units

BLOCK 611
MIXED USE
0.96 ha.

BLOCK 612
PUBLIC ELEMENTARY SCHOOL
2.45 ha.
6.1 ac.

BLOCK 613
PARK
0.95 ha.

BLOCK 614
PARK
1.62 ha.

BLOCK 615
PARK
0.51 ha.

BLOCK 616
PARK
0.61 ha.

BLOCK 617
PARKETTE
0.37 ha.

BLOCK 620
OPEN SPACE
0.14 ha.

BLOCK 624
WALKWAY
0.03 ha.

LANE 1
LANE 2
LANE 3
LANE 4
LANE 5
LANE 6
LANE 7
LANE 8
LANE 9
LANE 10

STREET 'A'
STREET 'B'
STREET 'C'
STREET 'D'
STREET 'E'
STREET 'F'
STREET 'G'
STREET 'H'
STREET 'I'
STREET 'J'
STREET 'K'
STREET 'L'
STREET 'M'
STREET 'N'
STREET 'O'
STREET 'P'
STREET 'R'
STREET 'S'
STREET 'Z'

Future 1
Future 2
Future 3
Future 4

OTHER LANDS OWNED BY APPLICANT

Russell Road Pond Block

Pooles Road

RESIDENTIAL

EXISTING RURAL

BLOCK F
REG PLAN 51M-181
COLE'S COURT
ROSEWOOD AVENUE
FRID BOULEVARD
SILVERWOOD CRESCENT
BLK 124
BLK 125 (WALKWAY)
BLK 127 (RES)
EWOOD DRIVE
D AVENUE

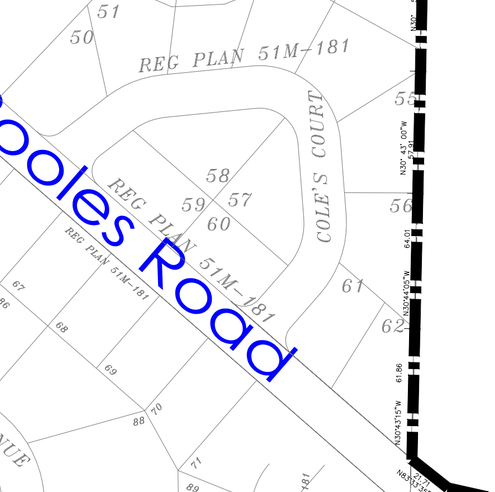
DRAFT PLAN OF SUBDIVISION

Bell-Coutts-Rusdor

SP-T-1001

Part of Lots 13 & 14
Concession 3
Township of Springwater
County of Simcoe

KEY PLAN



SCHEDULE OF LAND USE

LOT/BLOCK	LAND USE		UNITS	AREA (ha)
Lots 1-565				
	Single Detached - 12.2m (B units)		244	20.68
	Single Detached - 9.75m (C units)		214	
	Single Detached - 10.5m (D units)		52	
	Single Detached -11.6m (E units)		55	
Blocks 566-610	Townhouse Residential LWTH 4.50m		339	5.65
Block 611	Mixed Use			0.96
Block 612	Public Elementary School			2.45
Blocks 613-616	Parks			3.69
Block 617	Parkette			0.37
Blocks 618-620	Open Space			0.36
Block 621	Environmental Protection Area			0.07
Block 622	Environmental Protection 10 Buffer			0.16
Blocks 623-624	Walkways			0.04
Block 625	Servicing Block			0.06
Blocks 626-627	Road Widenings			1.56
Roads	23.0m ROW	1,440m		14.47
	20.0m ROW	4,637m		
	10.0m ROW	1,660m		
TOTAL	Totals	7,737m	904	50.52

Net Density* - 904 units / 50.45 ha = 17.9 upha
* Excludes Environmental Protection Area

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

SEE ORIGINAL SUBMISSION
1754866 Ontario Inc. — Date

SEE ORIGINAL SUBMISSION
1754865 Ontario Inc. — Date

SEE ORIGINAL SUBMISSION
1755571 Ontario Inc. — Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

SEE ORIGINAL SUBMISSION
Paul Edward
Ontario Land Surveyor
RPE Surveying Ltd. — Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13(R.S.O. 1990).
(a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Sandy loam.
(h),(k) - Full services & Water Supply to be provided.

Prepared by:
MALONE GIVEN PARSONS LTD.
140 Renfrew Drive, Suite 201
Markham, Ontario, L3R 6B3
Tel: (905) 513-0170
www.mgp.ca

C:\Graham Users\Matt\Matthew Cory RPP Stamp.JPG

mbtw watchorn

Scale: 1:2000

Date: Dec 23, 2009
Project No.: 12-2139

Date	Revision	#
April 26/13	Revised Plan Limits	1
April 8/14	Revisions as per Township & Agency Comments	2
April 17/14	Add Public Elementary School Block	3
April 22/14	Revise Park and Public Elementary School Block	4
May 14/14	Revisions as per Township & Agency Comments	5

ATTACHMENT B

HYDRAULIC CONDUCTIVITY ESTIMATES, GOLDER, 2014

SCS consulting group ltd

TECHNICAL MEMORANDUM

DATE June 3, 2014 **PROJECT No.** 13-1170-0040

TO John Priamo, P.Eng.
SCS Consulting Group Ltd.

CC

FROM Jim Regier, CET; John Easton, M.Sc., P.Geo. **EMAIL** John_Easton@golder.com

HYDRAULIC CONDUCTIVITY ESTIMATES

Dear Sir,

We have been able to estimate the hydraulic conductivity of soils throughout the Carson Road Development Inc. (CRDI) and the Midhurst Developments Doran Road Inc. (MDDRI) lands using grain size analyses obtained from samples taken from test pits. The Ministry of the Environment (MOE) design manual for septic disposal beds (MOE, 1984) contains type curves for various soils. An approximate relationship among grain size curves, hydraulic conductivity, and T-time is presented in the manual. Laboratory testing conducted as part of the field work for this project (Figures 3A to 4B), the type grain size curves (MOE, 1984), and correlation table (MOE, 1984) forms the basis of the analysis contained herein.

The test pit locations with grain size analyses for the Carson Road Neighbourhood are shown on Figure 1. The grain size analyses for the Carson Road Neighbourhood are shown on Figures 3A to 3E. The MOE Type Curve that the soils most closely match the above noted analysis locations and the corresponding hydraulic conductivity are shown on Table 1.

The test pit locations with grain size analyses for the Doran Road area are shown on Figure 2. The grain size analyses for the Doran Road area are shown on Figures 4A and 4B. The MOE Type Curve that the soils most closely match the above noted analysis locations and the corresponding hydraulic conductivity are shown on Table 2.

Golder Associates Ltd.

JPR/JAE/plc

Reference:
Ministry of the Environment, 1984. Manual of Policy. Procedure, and Guidelines for Private Sewage Disposal Systems. Ontario Ministry of the Environment, Toronto.

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Golder Associates Ltd.
121 Commerce Park Drive, Unit L, Barrie, Ontario, Canada L4N 8X1
Tel: +1 (705) 722 4492 Fax: +1 (705) 722 3786 www.golder.com
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Attachments: Table 1 – Carson Road Development Inc. Test Pits
Table 2 – Midhurst Development Doran Road Inc. Test Pits

Figure 1 – Carson Road Area Test Pits and Quaternary Soils
Figure 2 – Doran Road Area Test Pits and Quaternary Soils
Figure 3A – Midhurst Carson Road Development Inc. Sieve Analysis (D Hickling Site)
Figure 3B - Carson Road Development Inc. Sieve Analysis (A Hickling Site)
Figure 3C - Carson Road Development Inc. Sieve Analysis (R Hickling Site)
Figure 3D - Carson Road Development Inc. Sieve Analysis (Rome Site)
Figure 3E - Carson Road Development Inc. Sieve Analysis (Micks Site)
Figure 4A – Midhurst Development Doran Road Inc. Sieve Analysis Wright Test Pits
Figure 4B - Midhurst Development Doran Road Inc. Sieve Analysis (Pooles Site)

SOIL INFILTRATION ASSESSMENT
TABLE 1: CARSON ROAD NEIGHBOURHOOD TEST PITS

Geological Material	TP #	Depth	Classification	Hydraulic Conductivity
See Figure 1 for Legend		Mbgs	(CH, SC, ML, etc)	(cm/s)
5b	1	4.6 - 5.0		
5b	3	3.1 - 3.5	SC	$1x10^{-4}$ to $1x10^{-6}$
5b	4	2.3 - 2.8	SC	10^{-4} to 10^{-6}
5b	8	3.1 - 3.5	SM	10^{-3} to 10^{-5}
5b	12	1.2 - 1.8	ML	10^{-5} to 10^{-6}
5b	14	0.6 - 1.2	SC	10^{-4} to 10^{-6}
5b	18	0.6 - 1.2	CH	10^{-7}
8a	19	4.6 - 4.9	SC	10^{-4} to 10^{-6}
5b	21	4.5 - 4.8	SM	10^{-3} to 10^{-5}
8a	22	1.2 - 1.8	SC	10^{-4} to 10^{-6}
8a	25	0.2 -0.6	SC	10^{-4} to 10^{-6}
*5b	28	0.6 - 1.2	SC	10^{-4} to 10^{-6}

SE = 1x10-4 to 1x10-6 cm/sec

SP = 10-1 to 10-3 cm/sec

ML = 10-5 to 10-6 cm/sec

SM = 10-3 to 10-5 cm/sec

CH = 10-7 or Lower

CL = 10-6 or Lower

Note - (*) Test Pit No Grain Size Analysis Performed

SOIL INFILTRATION ASSESSMENT
TABLE 2: DORAN ROAD NEIGHBOURHOOD TEST PITS

Geological Material	TP #	Depth	Classification	Hydraulic Conductivity
See Figure 1 for Legend		Mbgs	(CH, SC, ML, etc)	(cm/s)
9c	39	0.6 - 1.2	CL	$1x10^{-6}$ OR LOWER
5b	41	1.2 - 1.8	SM	$1x10^{-3}$ to $1x10^{-5}$
5b	42	1.2 - 1.8	SC	10^{-4} to 10^{-6}
5b	43	3.0 - 3.2	SC	10^{-4} to 10^{-6}
5b	45	0.6 - 1.2	ML	10^{-5} to 10^{-6}

SE = 1x10-4 to 1x10-6 cm/sec

SP = 10-1 to 10-3 cm/sec

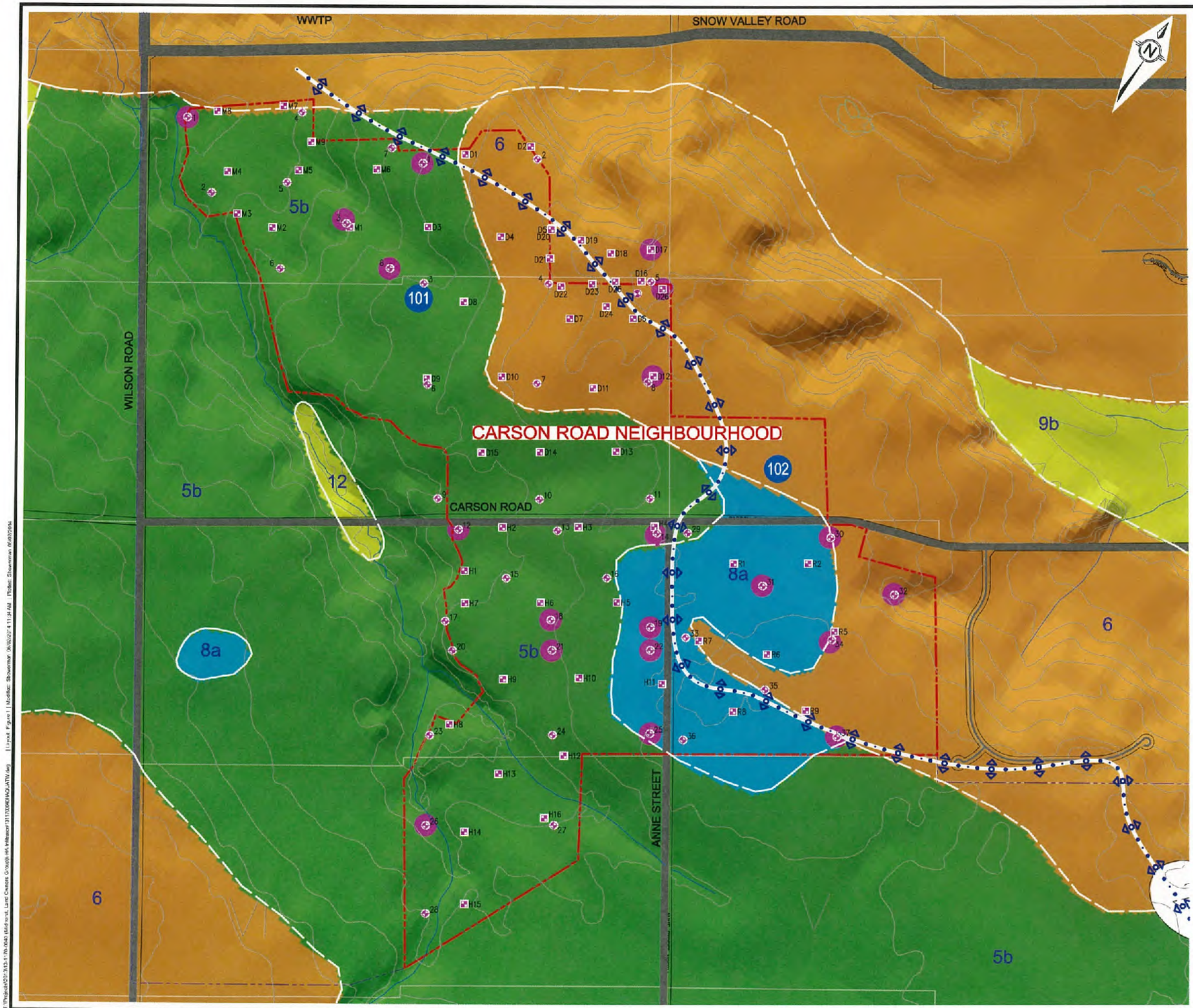
ML = 10-5 to 10-6 cm/sec

SM = 10-3 to 10-5 cm/sec

CH = 10-7 or Lower

CL = 10-6 or Lower

Note - (*) Test Pit No Grain Size Analysis Performed



LEGEND:

- Development Property Limits
- 20 — Organic Deposits: Peat, Muck, Marl
- 12 — Fluvial or Deltaic Sediments: Sand, Minor Gravel, Silt & Clay
- 9b — Glaciolacustrine Coarse Grained Deposits: Gravel, Sand gravel, and Gravelly Sand
- 9c — Glaciolacustrine Coarse Grained Deposits: f Sands, Silt
- 8a — Glaciolacustrine Fine Grained Deposits: Silt and Clay
- 6 — Glaciofluvial Ice-contact Stratified Deposits: Gravel, Sand gravel, and Gravelly Sand
- 5b — Till (Newmarket): Stoney Silty Sand / Sand Till
- Existing Grade Contours (5 masl interval)
- Surface Water / Inferred Shallow Water Table Divide
- 100 — Surface Water Basin ID
- Test Pit Location
- Test Pit Grain Size Analysis

REFERENCES:

1. Map Base courtesy SCS Consulting, digital CAD files
2. Map to be read in conjunction with the accompanying Report
3. Ontario Base Map contours, ESRI Geography Network

0 100 250 500 750 metres

Datum is UTM NAD 83 Zone 17

PROJECT: SOIL INFILTRATION ASSESSMENT

TITLE: CARSON ROAD NEIGHBOURHOOD TEST PITS AND QUATERNARY SOILS

Golder Associates

PROJECT No	13-1170-0040		FILE No.	1311700040HAQUATW
DESIGN			SCALE	AS SHOWN
CADD	JPR	2014-05-15	FIGURE	1
CHECK	AP	30 Apr 14		
REVIEW	JAE	30 Apr 14		

I:\Projects\2013\13-1170-0040 (Aldershot Land Owners Group)\HA\Intransor\1311700040HAQUATW.dwg [Layout: Figure1] [Modified: Showerman, 06/02/2014 11:31 AM - Plotted: Showerman, 06/02/2014]

NEIGHBOUHOOD #2 (By Others)

DORAN ROAD

WALT ROAD

OLD SECOND ROAD

RUSSELL ROAD

POOLES ROAD

ST VINCENT STREET

DORAN ROAD NEIGHBOURHOOD
DORAN ROAD AREA

DORAN ROAD NEIGHBOURHOOD
POOLES ROAD AREA

123 122 121 112 111 100

B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B22 B24 B25 B26 B32 B33 B34 B35 B36 B37 B38 B41 B42 B43 B44 B45

W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23

C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20

20 9b 9c 8a 6 5b 12

LEGEND:

- Development Property Limits
- 20 Organic Deposits — Peat, Muck, Marl
- 12 Fluvial or Deltaic Sediments — Sand, Minor Gravel, Silt & Clay
- 9b Glaciolacustrine Coarse Grained Deposits — Gravel, Sand gravel, and Gravelly Sand
- 9c Glaciolacustrine Coarse Grained Deposits — f Sands, Silt
- 8a Glaciolacustrine Fine Grained Deposits — Silt and Clay
- 6 Glaciofluvial Ice-contact Stratified Deposits — Gravel, Sand gravel, and Gravelly Sand
- 5b Till (Newmarket) — Stoney Silty Sand / Sand Till
- Existing Grade Contours (5 masl interval)
- Surface Water / Inferred Shallow Water Table Divide
- 100 Surface Water Basin ID
- Test Pit Location
- Test Pit Grain Size Analysis

REFERENCES:

1. Map Base courtesy SCS Consulting, digital CAD files
2. Map to be read in conjunction with the accompanying Report
3. Ontario Base Map contours, ESRI Geography Network

0 100 250 500 750
metres

Datum is UTM NAD 83 Zone 17

PROJECT
SOILS INFILTRATION ASSESSMENT

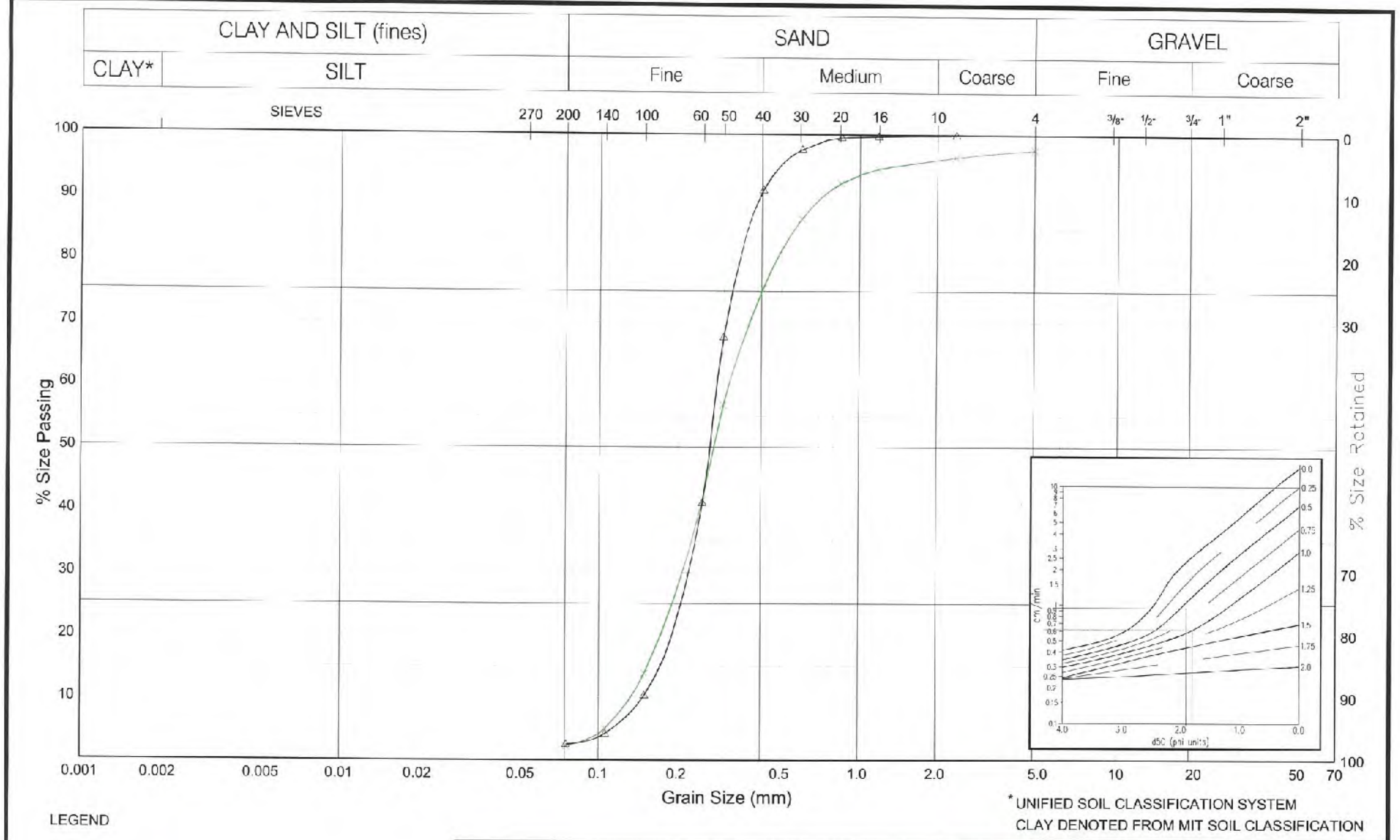
TITLE
DORAN ROAD NEIGHBOURHOOD
TEST PITS AND QUATERNARY SOILS

Golder Associates

PROJECT No.	13-1170-0040		FILE No.	1311700040HAQUATE
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CHECK	AP	30 Apr 14		
REVIEW	JAE	2014-05-15		

T:\projects\2013\13-1170-0040 (PENfield) Land Owners Group\3-HA\Infiltration\1311700040HAQUATE.dwg | Layout: Figure 2 | Modified: mcgar 05/16/2014 12:13 PM | Plotted: mcgar 05/16/2014

PLOT DATE: June 3, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\~HA-Infiltration\1311700040HASVE W1.dwg



LEGEND

× D17 - 10'
△ D26 - 12'

MOE TYPE SP (Poorly Graded Sands)

* UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

TITLE

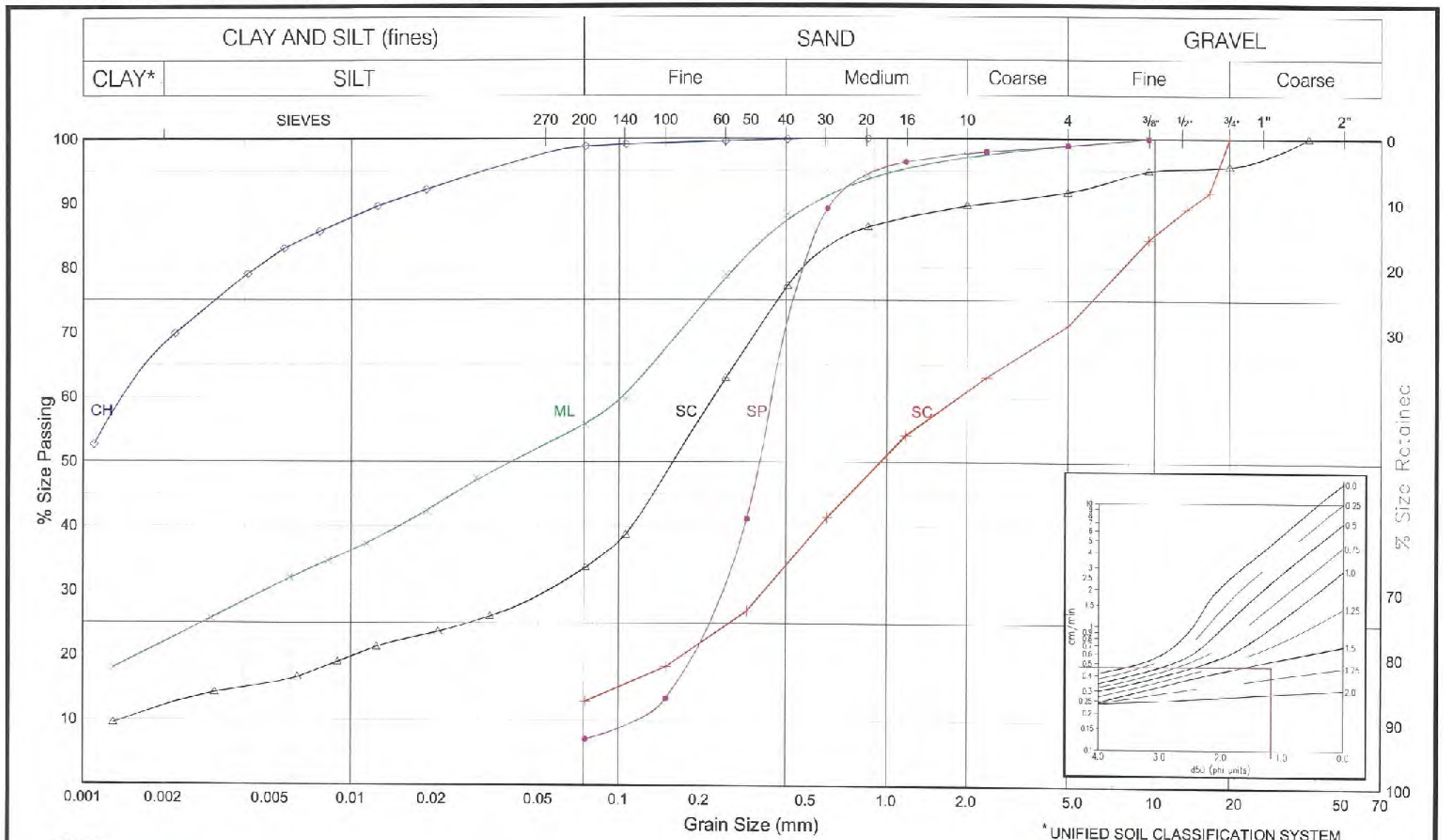
SIEVE ANALYSIS

Golder Associates
Barrie, Ontario, Canada

MIDHURST DEVELOPMENT
CARSON ROAD INC (D HICKLING SITE)

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040HASVE-W1.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	3A

PLOT DATE: June 3, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-HA-Infiltration\1311700040HASVE-W2.dwg



LEGEND

- BH12 1.2-1.8 m
- BH14 0.6-1.2 m
- BH18 0.6-1.2 m
- BH19 4.6-4.9 m
- BH19 6.1-6.3 m*

MOE TYPE CH (Inorganic Clays) to SC (Clay / Sand Mixtures)
* DEEPER SAND SAMPLE - MOE TYPE SP (Poorly Sorted Sand)

* UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

TITLE

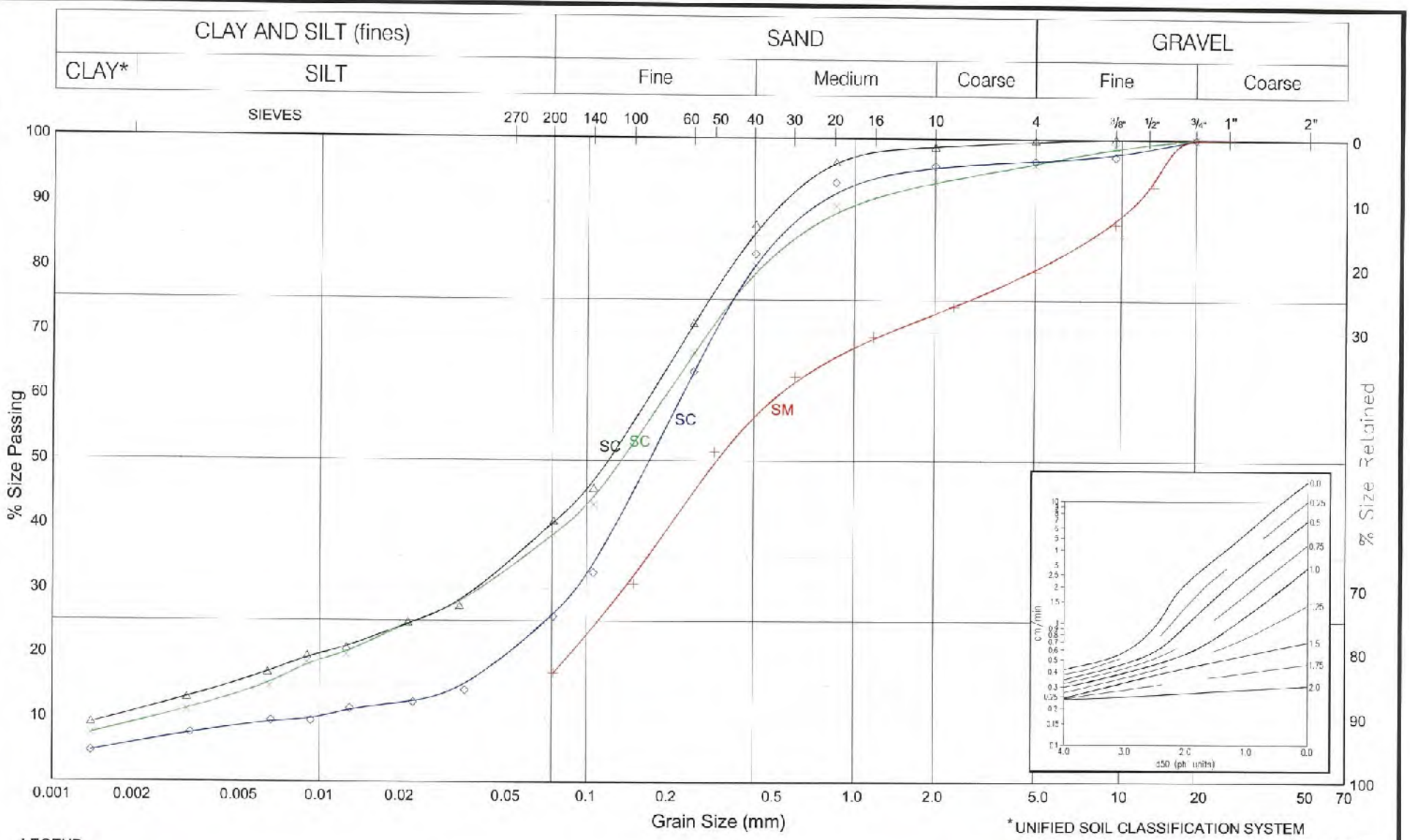
SIEVE ANALYSIS

MIDHURST DEVELOPMENT
CARSON ROAD INC (A HICKLING SITE)

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040HASVE-W2.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	3B

PLOT DATE: June 3, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\-HA-Infiltration\1311700040HASVE-W3.dwg



LEGEND

- BH22 1.2-1.8m
- BH25 0.2-0.6m
- BH28 0.6-1.2m
- BH21 4.5-4.8m

MOE TYPE SM (Silty Sands) to SC (Clay / Sand Mixtures)

*UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

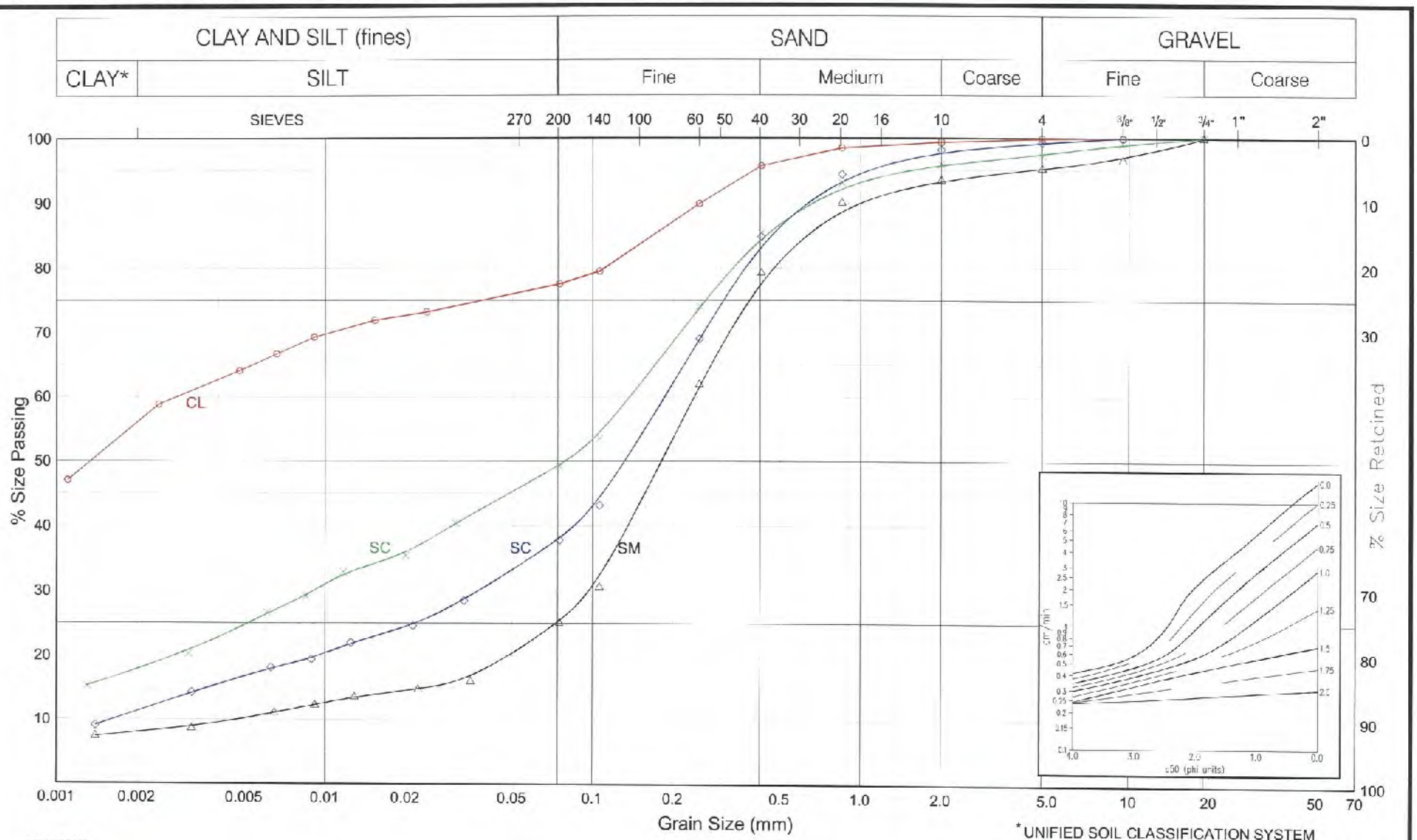
TITLE: **SIEVE ANALYSIS**

Golder Associates
Barrie, Ontario, Canada

MIDHURST DEVELOPMENT
CARSON ROAD INC (R HICKLING SITE)

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
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FILE No.	1311700040HASVE-W3.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	3C

PLOT DATE: June 3, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)_HA-Infiltration\1311700040HASVE-W4.dwg



*UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

LEGEND

- BH30 0.6-1.2m
- BH32 0.6-1.2m
- BH34 1.2-1.8m
- BH37 1.2-1.8m

MOE TYPE SM (Silty Sands) to SC (Clay / Sand Mixtures)
TYPE CL (Inorganic Clays)

TITLE

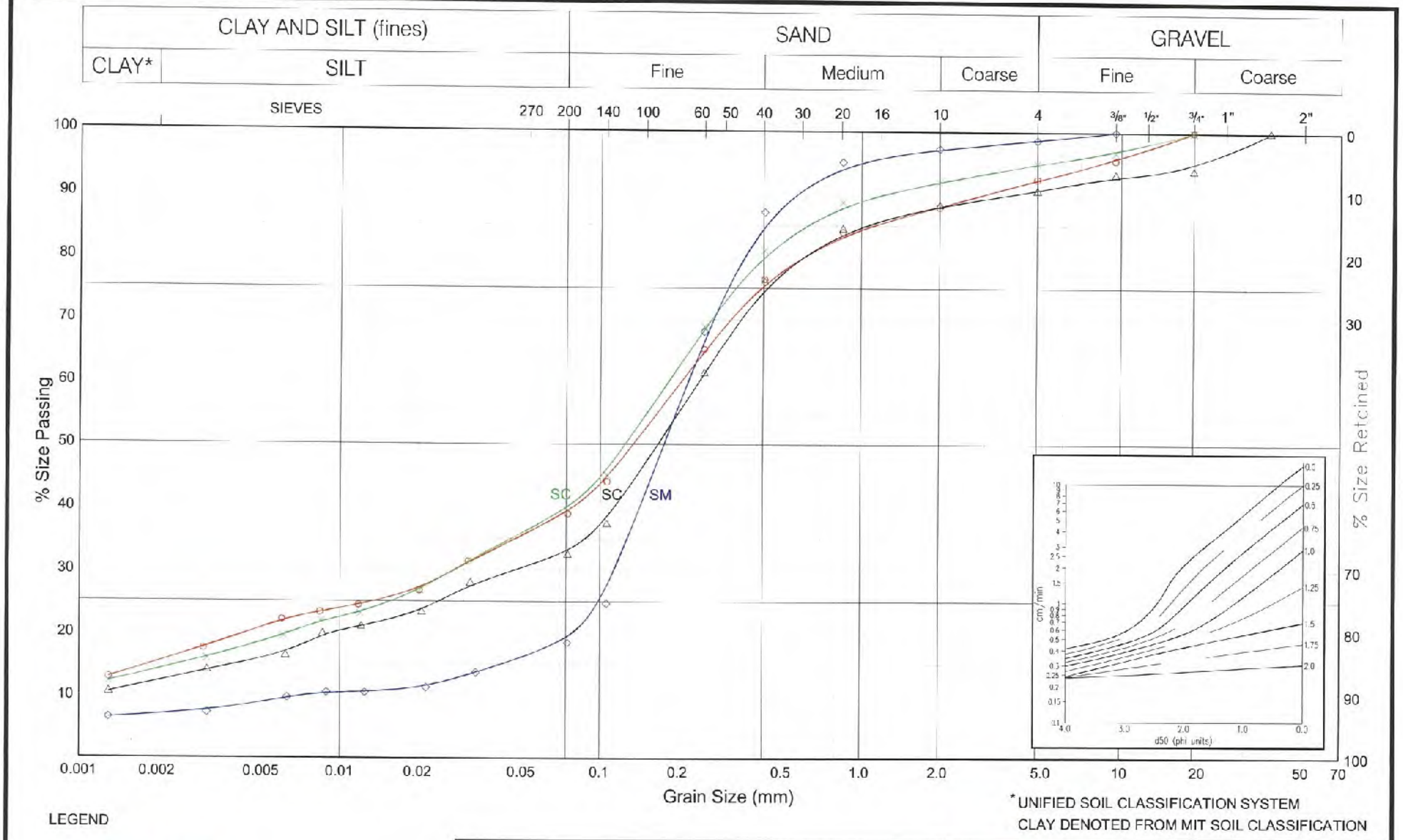
SIEVE ANALYSIS

MIDHURST DEVELOPMENT
CARSON ROAD INC (ROME SITE)

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
CHECK	
REVIEW	
FILE No.	1311700040HASVE-W4.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	3D

PLOT DATE: June 3, 2014
FILENAME: T:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\1-IIA-Infiltration\1311700040HASVE_W5.dwg



*UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

LEGEND

- BH1 4.6-5.0m
- BH3 3.1-3.5m
- BH4 2.3-2.8m
- BH8 3.1-3.5m

MOE TYPE SM (Silty Sands) to SC (Clay / Sand Mixtures)

TITLE

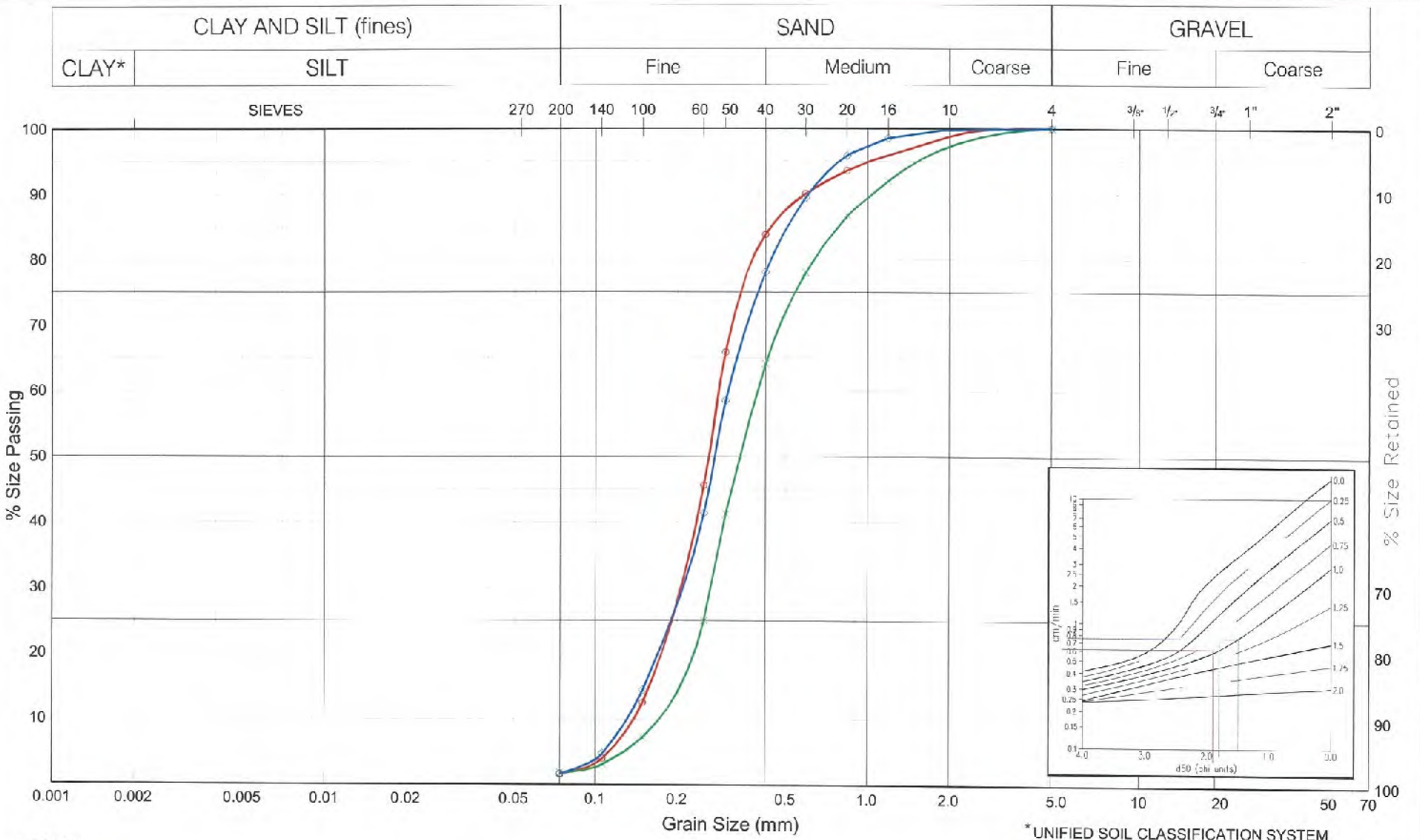
SIEVE ANALYSIS

MIDHURST DEVELOPMENT
CARSON ROAD INC (MICKS SITE)

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
CHECK REVIEW	
FILE No.	1311700040HASVE-W5.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	3E

PLOT DATE: June 3, 2014
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*UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

LEGEND

- TP6-6ft
- TP4-9ft
- TP7-8ft

MOE TYPE SP (Poorly Graded Sands)

TITLE

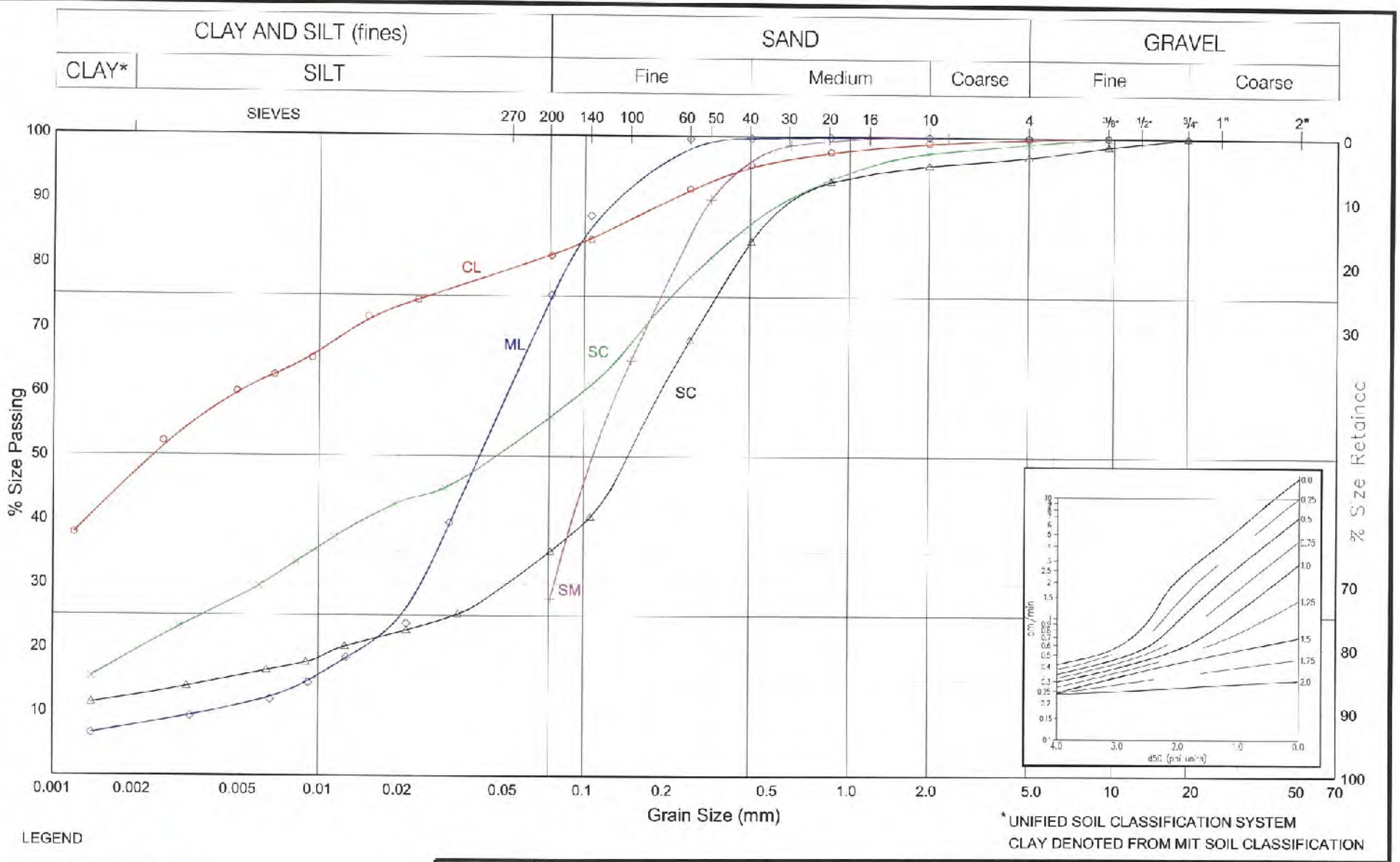
SIEVE ANALYSIS
WRIGHT TEST PITS

MIDHURST DEVELOPMENT
DORAN ROAD INC.

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
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REVIEW	
FILE No.	1311700040HASVE-E1.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	4A

PLOT DATE: June 3, 2014
FILENAME: C:\Projects\2013\13-1170-0040 (Midhurst, Land Owners Group)\1-HA-Infiltration\1311700040HASVE-E2.dwg



LEGEND

- BH39 0.6-1.2m
- BH42 1.2-1.8m
- BH43 3.0-3.2m
- BH45 0.6-1.2m
- BH41 1.2-1.8m

MOE TYPE SM (Silty Sands) to SC, ML, CL

* UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY DENOTED FROM MIT SOIL CLASSIFICATION

TITLE

SIEVE ANALYSIS

MIDHURST DEVELOPMENT
DORAN ROAD INC (POOLES SITE)

Golder Associates
Barrie, Ontario, Canada

SCALE	AS SHOWN
DATE	2014-05-16
CAD	JPR
CHECK	
REVIEW	
FILE No.	1311700040HASVE-E2.dwg
PROJECT No.	13-1170-0040
REV.	
FIGURE	4B

Appendix B. Land Use Descriptions

Table B1. Land Use Descriptions in the NVCA Tool

Land Use	Description
Forest	Tree cover >60% of the land area. Includes ELC Forest (FO) and Cultural Plantation (CUP) classes. Also includes ELC Cultural Woodland (CUW) classes with tree cover between 35% and 60%).
Transition	Tree cover generally <60% and often with a large proportion of non-native plant species. Includes ELC Cultural Meadow (CUM), Cutltural Thicket (CUT), Open Alvar (ALO) and Open Tallgrass Prairie (TPO) classes.
Wetland	Water generally <2 m deep, with variable flooding regimes, standing water or saturated soils. Includes ELC Swamp (SW), Fen (FE), Bog (BO), Marsh (MA) and Shallow Water (SA) classes.
Turf/Sod	Turf/sod farms. Includes Golf courses, including lane ways, but not the isolated woodlots within, unless the area of the woodlots is < 0.5 ha.
Hay/Pasture	Hay and pasture fields, including the related agricultural buildings such as barns, silos and the farm residence. Fields are dominated with herbaceous vegetation and grasses with an understory of similar material in a state of decay. Weedy hay and/or pasture covers more than 50% of the area.
Low Intensity Residential	Cleared areas with a low density of trees, including lawns and landscaping. Land use is dominated by gardens, parkland and lawns, e.g., cemeteries, urban parks, ski hills and residential estate properties with a minimum size of 2 ha or with <5% impervious area. Includes rail lines and associated cleared adjacent areas and rural development properties not directly associated with an agricultural operation. On developed portions, these properties are under intensive use. Based on canopy cover, these areas will often appear as Cultural Savannah or Cultural Woodland in aerial photographs or satellite imagery. However, the presence of buildings and manicured lands identify the properties as Rural Development.
Unpaved Roads	Unpaved roads and associated shoulders. Excludes driveways and unpaved parking lots.
Open Water	Water generally >2 m deep, with no tree or shrub cover, as per ELC Open Water (OW) class. Also includes streams and rivers.
Cropland	Cultivated row crops, including the related agricultural buildings (e.g., barns, silos and the farm residence), producing crops in varying degrees (e.g., corn and wheat) and includes specialty agriculture (i.e., orchards, market gardens, Christmas tree plantations and nurseries).
Residential	Urban related land uses with >10% impervious area. Includes residential properties (single, semi-detached and strip dwellings, apartment buildings and associated out-buildings, driveways, parking lots and paved roadways). Excludes green land areas such as parks or river valleys.
Commercial	Impervious properties that contain a building and an adjacent parking lot (e.g., shopping and strip malls, power centres, scrap yards). Excludes green land areas such as parks or river valleys. Exludes roadways.
Industrial	Impervious properties that are not commercial and include industrial operations e.g., factories, manufacturing facilities, processing facilities, bulk fuel storage. Excludes green land areas such as parks or river valleys. Excludes roadways.
Transportation	Includes major transportation corridors (highways) and paved roadways that are not considered in other land use designations. Excludes driveways.

Notes: ELC is the provincial Ecological Land Classification for Southern Ontario

Table B2 Land use designations provided by civil engineers

Drainage Plan Land Use[1]	
Single Detached	Residential
Single Detached w RLCB	Residential
Townhomes	Residential
Standard ROWs	Residential
Mixed Use/School	Commercial
Commercial	Commercial
Parks/Open Space*	Low Intensity Residential
SWM Ponds (perimeter)	Transitional
SWM Ponds (water)	Open Water

Notes: 1 – Provided by civil engineers

Table B3. Redevelopable Land Use Areas (Outside of Phase 1)

MSPA Land Use	P Budget Land Use	Area (ha)
Administration / Government	Commercial	72
Commercial / Mixed Use	Commercial	10
Employment	Industrial	90
Future Development Potential	Residential	76
Midhurst High Density Residential / Mixed Use	Residential	6
Midhurst Low Density Residential	Residential	170
Midhurst Medium Density Residential	Residential	19
Midhurst Transition Residential	Residential	67
Schools	Commercial	12
Parklands (@ 5% residential, 2% other)	Low Intensity Residential	21
SWMP	Open Water	17
SWMP	Transition	17
Environmental Protection Area I	Forest	0
Environmental Protection Area II	Forest	19
Total		**597**

Notes: Split SWMP blocks into 50% water and 50% transition to represent water and perimeter portions, parkland estimated as 2% of urban areas and 5% of all other land use areas, SWMP estimated at 6% of land use areas, and schools estimated as2 % of land uses.

Appendix C. Derivation of Cropland Export Coefficients

Appendix C. Derivation of the Export Coefficient for Croplands Using the Universal Soil Loss Equation (USLE)

1. Overview

Phosphorus export from cropland is calculated in the NVCA Tool as a function of soil loss, determined using the Universal Soil Loss Equation (USLE). USLE is an established tool to predict long-term average annual rates of soil loss by sheet or till erosion from an agricultural slope based on rainfall, soil type, topography, crop system and management practices.

The USLE calculates soil loss (A) in tonnes/ha/yr as:

A = R x K x LS x C x P

Where:

R is the rainfall and runoff factor for the geographic location as defined by the Upper Tier Municipality Designation.

K is a soil erodibility factor (tonnes/ha), which is a measure of the susceptibility of soil particles to detachment and transport by rain and runoff relative to a "standard" slope of 22.13 m at a steepness of 9%. It is specific to each soil type (texture and organic matter content) in cultivated, continuous fallow.

LS is the slope length-gradient factor that describes the potential soil loss from a given length of slope at a given grade relative to a "standard" slope of 22.13 m at a steepness of 9%.

C is the crop/vegetation and management factor. This takes into account the crop type and tillage method on soil export relative to continuously fallow and tilled land. For example, crops like hay and pasture are associated with better soil retention than beans and canola. Similarly, no-till produces less soil erosion than plowing.

P is the support practice factor. This factor reflects the impact of agricultural best management practices (BMPs) on reducing runoff and thereby soil loss.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) recommends factors for use in the USLE for Ontario agricultural lands (Stone and Hilborn, 2012).

2. Determination of USLE Factors

The following provides the methods and rationale for determining factors for use in calculating soil loss for croplands in the Midhurst development area using the USLE.

1. Rainfall and Runoff Factor (R)

A Rainfall and Runoff Factor (R) of 0.90 for the Upper Tier Municipality Designation of Simcoe County was applied to all cropland blocks.

2. Soil Erodibility Factor (K)

The Soil Erodibility Factor (K) is specific to the textural classification of soils. Soil textural classes were assigned to each cropland block based on the dominant Quaternary surficial deposits described by the Ontario Geological Survey (2003) and following the soil texture classification system of the United Stated Department of Agriculture (Soil Survey Division Staff, 1993) (Figure 1, Table 1). K was selected for each cropland block according to the soil textural class and assuming average organic matter content of the soils.

Table 1. Textural Classes of Soils Corresponding to Quaternary Surficial Soil Classes in the Development Area and Associated Soil Erodibility Factors

Assigned Textural Class	Soil Erodibility (K Factor - tonnes/ha)[1]			Quaternary Surficial Geology[3]		
	Average OMC[2]	Less than 2% OMC	More than 2% OMC	Soil Class	Deposit	Description
Sand	0.04	0.07	0.02	9	Coarse-textured glaciolacustrine deposits	Sand, gravel, minor silt & clay
Sandy clay loam	0.45		0.45	6	Ice-contact stratified deposits	Sand & gravel, minor silt, clay & till
Sandy loam	0.29	0.31	0.27	5b	Till	Stone-poor, sandy silt to silty sand-textured till
Silty clay	0.58	0.61	0.58	8a	Fine-textured glaciolacustrine deposits	Silt & clay, minor sand & gravel

Notes: [1]from Stone and Hilborn (2012); [2]OMC = Organic Matter Content; [3]from Ontario Geological Survey (2003)

3. Slope Length-Gradient Factor (LS)

The Slope Length-Gradient Factor (LS) is a function of a given length of slope (in m) and the grade of that slope (as %) calculated as:

$$[0 \qquad]\left(\frac{\qquad}{\qquad}\right)$$

Where, the *constant* is the standard slope length of 22.13 m, and NN varies by slope (Table X).

Table 2. NN Values for Calculating the Slope Length-Gradient Factor (from Stone and Hilborn, 2012)

% Slope	<1	1 ≤ Slope < 3	3 ≤ Slope < 5	≥ 5
NN	0.2	0.3	0.4	0.5

To calculate the slope and slope lengths, elevations for the study area were determined using the 20-m digital elevation model data provided by the Canadian digital elevation model (geogratis) Agricultural

fields with variable topography were divided into smaller blocks of relatively uniform slopes. For each block, the slope length was taken as the maximum distance measured from the maximum elevation on the field to the lowest elevation at the field boundary (Figure 2). The slope for each slope length was calculated as:

$$\left[\text{———————————————}\right]$$

4. Crop/Vegetation and Management Factor (C) and Support Practice Factor (P)

The Crop/Vegetation and Management Factor (C) is the product of the Crop Type Factor and the Tillage Method Factor, and the Support Practice Factor relates to planting practices (Table 3).

Table 3. Crop Type and Tillage Method Factors for Calculation of the Crop/Vegetation and Management Factor (C) and Support Practice Factors (P) in the USLE (from Stone and Hilborn (2012))

Crop Type	Factor	Tillage Method	Factor	Support Practice	P Factor
Cereals (spring & winter)	0.35	Fall plow	1.00	Contour farming	0.50
Fruit trees	0.10	Mulch tillage	0.60	Cross slope	0.75
Grain corn	0.40	No-till	0.25	Strip cropping, contour	0.25
Hay and pasture	0.02	Ridge tillage	0.35	Strip cropping, cross slope	0.37
Seasonal horticultural crops	0.50	Spring plow	0.90	Up & down slope	1.0
Silage corn, beans & canola	0.50	Zone tillage	0.25		

A site reconnaissance investigation was completed on October 15, 2015 to document to the extent possible the crop type, tilling method and support practice of the agricultural fields in the Phase 1 development for the selection of Crop Type, Tillage Method and Support Practice factors for use in the USLE.

At the time of the investigation, the dominant crop type was soy, followed by corn and winter wheat. Soy was assigned a Crop Type factor of 0.5 for “seasonal horticultural crops”. Grain corn and silage corn could not be differentiated from the site investigation and so the lower factor for “grain corn” (0.4) was assigned to corn fields as a conservative measure (a lower value results in lower estimates of soil loss and hence phosphorus export). The crop type factor of 0.35 for “cereals (spring and winter)” was applied to winter wheat fields. Fields for which the crop type could not be reliably determined during the site investigation (e.g., due to restricted access) were considered as hay and pasture lands for phosphorus load calculations as a conservative approach recognizing that hay and pasture have lower soil loss and hence phosphorus export than cereal or horticultural crops. Fallow fields were assigned the crop type factor of 0.35 used for “cereals (spring and winter)” as a conservative estimate recognizing that a) fallow

fields are not hay or pasture, and b) would likely be planted with winter wheat, corn or soy or other horticultural crops.

Tillage Method and Support Practice factors were assigned to each agricultural field based on information from the site investigation and following the classifications in Table 2. The most conservative factors for Tillage Method (0.25) and Support Practise (0.25) were selected for any field that could not be accessed to determine the tillage and planting practices.

3. Soil Loss and Export Coefficient

Factors and supporting data (Section 2) and the resultant soil loss calculated using the USLE (Equation 1) are provided in Table 4 for all cropland blocks within the Midhurst development area. Soil loss ranged from 0.001 to 0.104 tonnes/ha/yr, with a median export coefficient of 0.164 kg/ha/yr (Table 4)

A sensitivity analysis was conducted with the following USLE factors: crop system (type of crops) and tilling method, and support practice factor (agricultural BMPs), as these can factors vary from year to year, and may differ from site observations. All crop types were changed to spring and winter cereals, tilling method was changed to no-till, and support factor was set to contour strip cropping. These are conservative estimates of conditions, and resultant soil loss decreased to 0.001 to 0.021 tonnes/ha/yr,under this scenario. Export coefficients ranged from 0.160 to 0.163 kg/ha/yr, with a median of 0.161 kg/ha/yr (Table 5).

Table 4. Factors and Supporting Data Used to Calculate Soil Loss and the Cropland Export Coefficient

Field Block #	Field Obervations			Slope Characteristics				Crop Type and Management Characteristics					Soil Characteristics		Soil Loss (tonnes/ha/yr)	P export
Field Block #	Crop	Planting Practice	Tilling Practice	Slope Length (m)	% slope	NN	LS	Crop_type	Crop_type_factor	Till_factor	C	P	SoilType	K	A	(kg/ha/yr)
0	winter wheat	up and down slope	ridge	570.15	2.52	0.3	0.029	Cereals (spring & winter)	0.35	0.35	0.12	1.00	Sandy loam	0.29	0.093	0.175
1	fallow	N/A	N/A	595.40	2.53	0.3	0.029	Cereals (spring & winter)	0.35	0.25	0.09	0.25	Sandy loam	0.29	0.017	0.163
2	corn	up and down slope	N/A	328.63	2.51	0.3	0.029	Grain corn	0.40	0.25	0.10	1.00	Sandy loam	0.29	0.075	0.172
3	winter wheat	up and down slope	ridge	411.65	3.43	0.4	0.022	Cereals (spring & winter)	0.35	0.35	0.12	1.00	Sandy loam	0.29	0.072	0.171
4	soy	up and down slope	N/A	377.64	3.72	0.4	0.025	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sandy loam	0.29	0.082	0.173
5	soy	up and down slope	N/A	689.89	3.78	0.4	0.026	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sandy loam	0.29	0.084	0.174
6	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
7	fallow	N/A	ridge	400.94	1.42	0.3	0.016	Cereals (spring & winter)	0.35	0.35	0.12	0.25	Sandy clay loam	0.45	0.020	0.163
8	winter wheat	up and down slope	N/A	534.31	1.30	0.3	0.015	Cereals (spring & winter)	0.35	0.25	0.09	1.00	Silty clay	0.58	0.066	0.171
9	soy	up and down slope	N/A	686.65	1.46	0.3	0.016	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sand	0.04	0.007	0.161
10	corn	cross slope	N/A	453.16	2.88	0.3	0.034	Grain corn	0.40	0.25	0.10	0.75	Sand	0.04	0.009	0.161
11	fallow	N/A	N/A	731.61	0.96	0.2	0.024	Cereals (spring & winter)	0.35	0.25	0.09	0.25	Sand	0.04	0.002	0.160
12	fallow	N/A	ridge	472.40	1.25	0.3	0.014	Cereals (spring & winter)	0.35	0.35	0.12	0.25	Sand	0.04	0.002	0.160
13	winter wheat	up and down slope	ridge	301.41	1.59	0.3	0.018	Cereals (spring & winter)	0.35	0.35	0.12	1.00	Sand	0.04	0.008	0.161
14	winter wheat	up and down slope	ridge	192.80	1.27	0.3	0.014	Cereals (spring & winter)	0.35	0.35	0.12	1.00	Sandy loam	0.29	0.046	0.167
15	corn	up and down slope	N/A	365.09	0.82	0.2	0.022	Grain corn	0.40	0.25	0.10	1.00	Sandy loam	0.29	0.057	0.169
17	fallow	N/A	ridge	464.65	0.61	0.2	0.018	Cereals (spring & winter)	0.35	0.35	0.12	0.25	Silty clay	0.58	0.030	0.165
18	residual	up and down slope	N/A	287.54	1.74	0.3	0.019	Cereals (spring & winter)	0.35	0.25	0.09	1.00	Sandy loam	0.29	0.044	0.167
19	winter wheat	up and down slope	ridge	350.89	0.57	0.2	0.018	Cereals (spring & winter)	0.35	0.35	0.12	1.00	Sand	0.04	0.008	0.161
20	soy	up and down slope	ridge	216.59	1.39	0.3	0.015	Seasonal horticultural crops	0.50	0.35	0.18	1.00	Sand	0.04	0.010	0.162
21	fallow	N/A	N/A	370.32	1.08	0.3	0.012	Cereals (spring & winter)	0.35	0.25	0.09	0.25	Sand	0.04	0.001	0.160
22	residual	up and down slope	N/A	N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sand	N/A	N/A	N/A
23	soy	N/A	N/A	185.06	1.67	0.3	0.018	Seasonal horticultural crops	0.50	0.25	0.13	0.25	Sand	0.04	0.002	0.160
24	soy and corn	up and down slope	ridge	202.67	1.57	0.3	0.017	Grain corn	0.40	0.35	0.14	1.00	Sand	0.04	0.009	0.161
25	soy	N/A	N/A	504.70	1.27	0.3	0.014	Seasonal horticultural crops	0.50	0.25	0.13	0.25	Sand	0.04	0.002	0.160
26	soy and corn	up and down slope	N/A	363.41	2.64	0.3	0.031	Grain corn	0.40	0.25	0.10	1.00	Sand	0.04	0.011	0.162
27	no access	N/A	N/A	N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
28	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
29	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
31	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Silty clay	N/A	N/A	N/A
32	corn	up and down slope	N/A	619.31	2.19	0.3	0.025	Grain corn	0.40	0.25	0.10	1.00	Sandy loam	0.29	0.064	0.170
34	residual	up and down slope		N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sand	N/A	N/A	N/A
35	soy	up and down slope	no till	658.40	1.37	0.3	0.015	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sandy loam	0.29	0.050	0.168
36	soy	up and down slope	no till	949.87	1.05	0.3	0.012	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sandy loam	0.29	0.040	0.166
37	soy	up and down slope	no till	363.82	1.92	0.3	0.021	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sandy loam	0.29	0.070	0.171
38	soy	up and down slope	no till	231.43	4.34	0.4	0.032	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sandy loam	0.29	0.104	0.177
39	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
40	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
41	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sandy loam	N/A	N/A	N/A
42	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sand	N/A	N/A	N/A
43	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sand	N/A	N/A	N/A
44	N/A			N/A	N/A	N/A	N/A	Hay and pasture	N/A	N/A	N/A	N/A	Sand	N/A	N/A	N/A
45	soy	up and down slope	no till	285.13	3.13	0.4	0.020	Seasonal horticultural crops	0.50	0.25	0.13	1.00	Sand	0.04	0.009	0.161
Minimum				**185.06**	**0.57**	**0.2**	**0.012**				**0.09**	**0.25**		**0.04**	**0.001**	**0.160**
Maximum				**949.87**	**4.34**	**0.4**	**0.034**				**0.18**	**1.00**		**0.58**	**0.104**	**0.177**
Median				**389.29**	**1.58**	**0.3**	**0.019**				**0.12**	**1.00**		**0.29**	**0.025**	**0.164**
Mean				**438.85**	**1.93**	**0.3**	**0.021**		**15.30**		**0.12**	**0.79**		**0.21**	**0.036**	**0.166**

Table 5. Sensitivity Analysis of Factors and Supporting Data Used to Calculate Soil Loss and the Cropland Export Coefficient

Field Block #	Field Obervations			Slope Characteristics				Crop Type and Management Characteristics							Soil Characteristics			Soil Loss (tonnes/ha/yr)	P export
Field Block #	Crop	Planting Practice	Tilling Practice	Slope Length (m)	% slope	NN	LS	Crop_type	Crop_type_ factor	Till_meth	Till_factor	C	Practice	P	SoilClass	SoilType	K	A	(kg/ha/yr)
0	winter wheat	up and down slope	ridge	570.15	2.52	0.3	0.029	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.017	0.163
1	fallow	N/A	N/A	595.40	2.53	0.3	0.029	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.017	0.163
2	corn	up and down slope	N/A	328.63	2.51	0.3	0.029	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.016	0.163
3	winter wheat	up and down slope	ridge	411.65	3.43	0.4	0.022	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.013	0.162
4	soy	up and down slope	N/A	377.64	3.72	0.4	0.025	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.014	0.162
5	soy	up and down slope	N/A	689.89	3.78	0.4	0.026	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.015	0.162
6	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
7	fallow	N/A	ridge	400.94	1.42	0.3	0.016	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	6	Sandy clay loam	0.45	0.014	0.162
8	winter wheat	up and down slope	N/A	534.31	1.30	0.3	0.015	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	8a	Silty clay	0.58	0.017	0.163
9	soy	up and down slope	N/A	686.65	1.46	0.3	0.016	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
10	corn	cross slope	N/A	453.16	2.88	0.3	0.034	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.003	0.160
11	fallow	N/A	N/A	731.61	0.96	0.2	0.024	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.002	0.160
12	fallow	N/A	ridge	472.40	1.25	0.3	0.014	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
13	winter wheat	up and down slope	ridge	301.41	1.59	0.3	0.018	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
14	winter wheat	up and down slope	ridge	192.80	1.27	0.3	0.014	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.008	0.161
15	corn	up and down slope	N/A	365.09	0.82	0.2	0.022	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.013	0.162
17	fallow	N/A	ridge	464.65	0.61	0.2	0.018	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	8a	Silty clay	0.58	0.021	0.163
18	residual	up and down slope	N/A	287.54	1.74	0.3	0.019	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.011	0.162
19	winter wheat	up and down slope	ridge	350.89	0.57	0.2	0.018	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
20	soy	up and down slope	ridge	216.59	1.39	0.3	0.015	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
21	fallow	N/A	N/A	370.32	1.08	0.3	0.012	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
22	residual	up and down slope	N/A	N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	9	Sand	N/A	N/A	N/A
23	soy	N/A	N/A	185.06	1.67	0.3	0.018	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
24	soy and corn	up and down slope	ridge	202.67	1.57	0.3	0.017	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
25	soy	N/A	N/A	504.70	1.27	0.3	0.014	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.001	0.160
26	soy and corn	up and down slope	N/A	363.41	2.64	0.3	0.031	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.002	0.160
27	no access	N/A	N/A	N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
28	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
29	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
31	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	8a	Silty clay	N/A	N/A	N/A
32	corn	up and down slope	N/A	619.31	2.19	0.3	0.025	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.014	0.162
34	residual	up and down slope		N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	9	Sand	N/A	N/A	N/A
35	soy	up and down slope	no till	658.40	1.37	0.3	0.015	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.009	0.161
36	soy	up and down slope	no till	949.87	1.05	0.3	0.012	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.007	0.161
37	soy	up and down slope	no till	363.82	1.92	0.3	0.021	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.012	0.162
38	soy	up and down slope	no till	231.43	4.34	0.4	0.032	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	5b	Sandy loam	0.29	0.018	0.163
39	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
40	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
41	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	5b	Sandy loam	N/A	N/A	N/A
42	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	9	Sand	N/A	N/A	N/A
43	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	9	Sand	N/A	N/A	N/A
44	N/A			N/A	N/A	N/A	N/A	Cereals (spring & winter)	N/A	No-till	N/A	N/A	Strip cropping, contour	N/A	9	Sand	N/A	N/A	N/A
45	soy	up and down slope	no till	285.13	3.13	0.4	0.020	Cereals (spring & winter)	0.35	No-till	0.25	0.09	Strip cropping, contour	0.25	9	Sand	0.04	0.002	0.160
Minimum				**185.06**	**0.57**	**0.2**	**0.012**					**0.09**		**0.25**			**0.04**	**0.001**	**0.160**
Maximum				**949.87**	**4.34**	**0.4**	**0.034**					**0.09**		**0.25**			**0.58**	**0.021**	**0.163**
Median				**389.29**	**1.58**	**0.3**	**0.019**					**0.09**		**0.25**			**0.29**	**0.008**	**0.161**
Mean				**438.85**	**1.93**	**0.3**	**0.021**		**15.30**			**0.09**		**0.25**			**0.21**	**0.009**	**0.161**

Figure 1:
Quaternary Surficial Deposits
in the Midhurst Development Area

Road
Crop Lands
Redevelopment Area
CRDI Lands
MDDRI Lands
Midhurst Heights Dev.
Midhurst Settlement

Soil Type

5b: Stone-poor, carbonate-derived silty to sandy till
6: Ice-contact stratified deposits
7a: Sandy deposits
8a: Massive-well laminated
9b: Littoral-foreshore deposits
9c: Foreshore-basinal deposits
12: Older alluvial deposits
19: Modern alluvial deposits
20: Organic deposits

N

0 0.25 0.5 1 1.5 km

Prepared by: Eric Dilligeard
Data Source: HESL, MGP, OGS, CDED, Ontario Land
Coordinate System: NAD 1983 UTM Zone 17N

Project Lead: Deborah Sinclair
Project: Midhurst Secondary Plan - Phosphorus Budget
Project#: 140051

May 5, 2016

Hutchinson
Environmental Sciences Ltd.

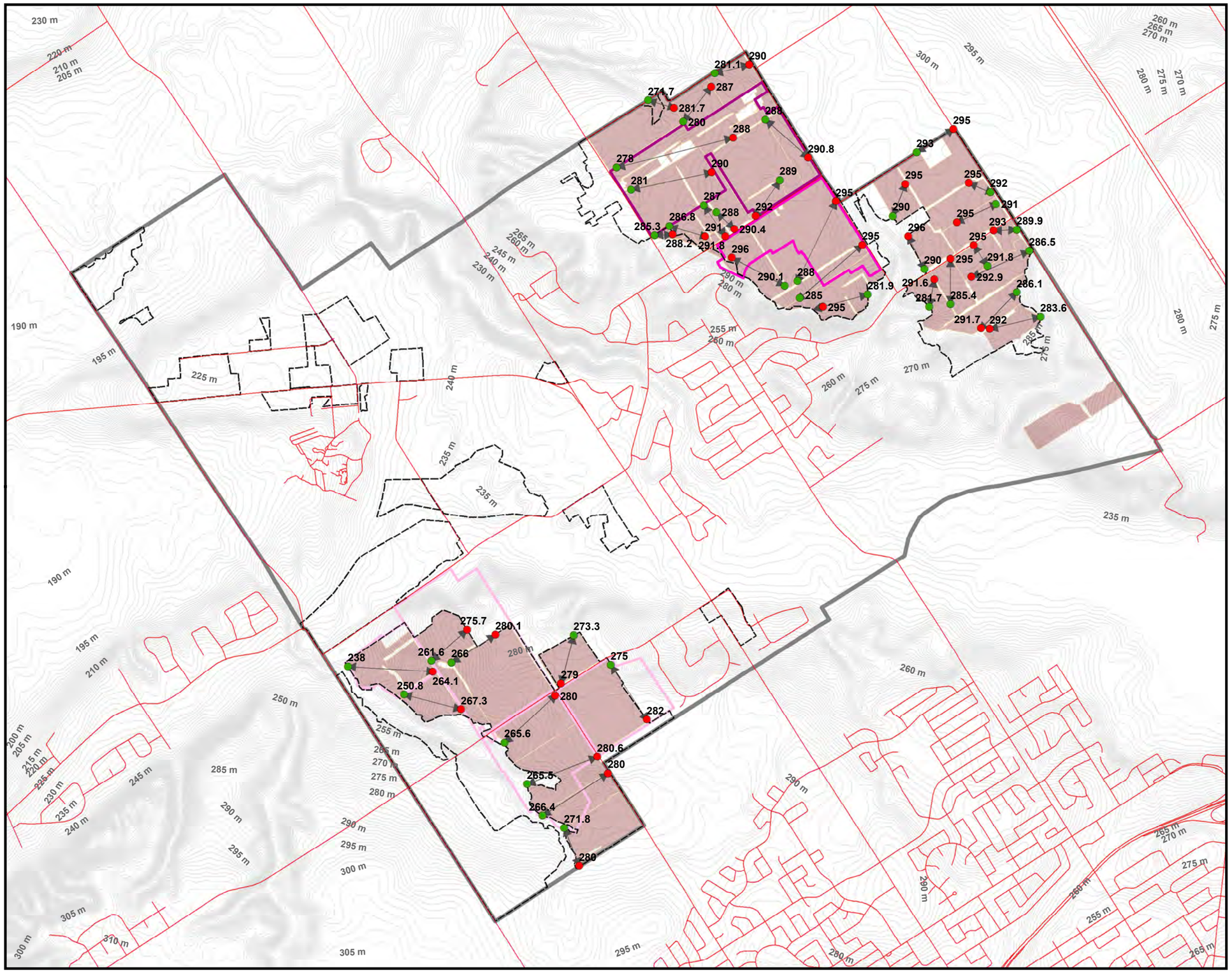


Figure 2:
Slope lengths for Each Agricultural Field Block Used for Calculation of the Slope Length-Gradient Factor (LS)

- Maximum Elevation
- Minimum Elevation
- Slope Length
- 1 m Contourline
- Road
- Redevelopment Area
- CRDI Lands
- MDDRI Lands
- Midhurst Heights Dev.
- Midhurst Settlement
- Crop Lands

Prepared by: Eric Dilligeard
Data Source: HESL, MGP, OGS, CDED, Ontario Land
Coordinate System: NAD 1983 UTM Zone 17N

Project Lead: Deborah Sinclair
Project: Midhurst Secondary Plan - Phosphorus Budget
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May 5, 2016

Hutchinson Environmental Sciences Ltd.

Appendix D. Phosphorus Budget Calculations

Phase 1 - Post Development P Budget Calculations

North Pond

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)	After SWMP (63% removal)
Single Detached	26.69	0.62	0.9	967.7	0.41	2.214	59.1	
Single Detached w RLCB	1.02	0.62	0.9	967.7	0.41	2.214	2.3	
Townhomes	0	0.83	0.9	967.7	0.41	2.964	0.0	
Standard ROWs	19.16	0.62	0.9	967.7	0.41	2.214	42.4	
Mixed Use/School (Commercial)	0	0.59	0.9	967.7	0.2	1.019	0.0	
Parks/Open Space*	5.43	0.27				0.130	0.7	
SWM Ponds (Transitional)	1.825	0.55				0.070	0.1	
SWM Ponds (Open Water)	1.825	0.55				0.260	0.5	
Total - no infiltration	**55.95**						**105.1**	**38.9**
Total - 20 mm infiltration							**10.5**	**3.9**
Total - 25 mm infiltration							**5.3**	**1.9**

Carson Road North

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)	After SWMP (63% removal)
Single Detached	10.28	0.62	0.9	967.7	0.41	2.214	22.8	
Single Detached w RLCB	0	0.62	0.9	967.7	0.41	2.214	0.0	
Townhomes	0	0.83	0.9	967.7	0.41	2.964	0.0	
Standard ROWs	5.59	0.62	0.9	967.7	0.41	2.214	12.4	
Mixed Use/School (Commercial)	4.48	0.59	0.9	967.7	0.2	1.019	4.6	
Parks/Open Space*	1.5	0.27				0.130	0.2	
SWM Ponds (Transitional)	0.585	0.55				0.070	0.0	
SWM Ponds (Open Water)	0.585	0.55				0.260	0.2	
Total - no infiltration	**23.02**						**40.1**	**14.8**
Total - 20 mm infiltration							**4.0**	**1.5**
Total - 25 mm infiltration							**2.0**	**0.7**

Carson Road South

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)	After SWMP (63% removal)
Single Detached	19.87	0.62	0.9	967.7	0.41	2.214	44.0	
Single Detached w RLCB	5.03	0.62	0.9	967.7	0.41	2.214	11.1	
Townhomes	5.09	0.83	0.9	967.7	0.41	2.964	15.1	
Standard ROWs	16.95	0.66	0.9	967.7	0.41	2.341	39.7	
Mixed Use/School (Commercial)	3.17	0.59	0.9	967.7	0.2	1.019	3.2	
Parks/Open Space*	8.38	0.27				0.130	1.1	
SWM Ponds (Transitional)	1.055	0.55				0.070	0.1	
SWM Ponds (Open Water)	1.055	0.55				0.260	0.3	
Total - no infiltration	**60.6**						**114.6**	**42.4**
Total - 20 mm infiltration							**11.5**	**4.2**
Total - 25 mm infiltration							**5.7**	**2.1**

Phase 1 - Post Development P Budget Calculations

South Pond

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)	After SWMP (63% removal)
Single Detached	4.11	0.62	0.9	967.7	0.41	2.214	9.1	
Single Detached w RLCB	2.85	0.62	0.9	967.7	0.41	2.214	6.3	
Townhomes	0	0.83	0.9	967.7	0.41	2.964	0.0	
Standard ROWs	4.73	0.62	0.9	967.7	0.41	2.214	10.5	
Mixed Use/School (Commercial)	0	0.59	0.9	967.7	0.2	1.028	0.0	
Parks/Open Space*	0.75	0.27				0.130	0.1	
SWM Ponds (Transitional)	0.555	0.55				0.070	0.0	
SWM Ponds (Open Water)	0.555	0.55				0.260	0.1	
Total - no infiltration	**13.55**						**26.2**	**9.7**
Total - 20 mm infiltration							**2.6**	**1.0**
Total - 25 mm infiltration							**1.3**	**0.5**

Russell Road Pond

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)	After SWMP (63% removal)
Single Detached	20.58	0.62	0.9	967.7	0.41	2.214	45.6	
Single Detached w RLCB	0	0.62	0.9	967.7	0.41	2.214	0.0	
Townhomes	5.71	0.83	0.9	967.7	0.41	2.964	16.9	
Standard ROWs	16.27	0.67	0.9	967.7	0.41	2.392	38.9	
Mixed Use/School (Commercial)	3.41	0.59	0.9	967.7	0.2	1.028	3.5	
Parks/Open Space*	4.26	0.27				0.130	0.6	
SWM Ponds (Transitional)	2.195	0.55				0.070	0.2	
SWM Ponds (Open Water)	2.195	0.55				0.260	0.6	
Total - no infiltration	**54.62**						**106.2**	**39.3**
Total - 20 mm infiltration							**10.6**	**3.9**
Total - 25 mm infiltration							**5.3**	**2.0**

Midhurst Heights - to SWMP

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)	After SWMP (63% removal)
Single Detached	40.456	0.58	0.9	967.7	0.41	2.071	83.8	
Townhomes & Multi	13.865	0.58	0.9	967.7	0.41	2.071	28.7	
Standard ROWs	25.665	0.58	0.9	967.7	0.41	2.071	53.2	
Mixed Use/School	2.067	0.58	0.9	967.7	0.2	1.010	2.1	
Commercial	1.479	0.82	0.9	967.7	0.2	1.428	2.1	
Parks/Open Space*	5.827					0.130	0.8	
SWM Ponds (Transitional)	2.7225					0.070	0.2	
SWM Ponds (Open Water)	2.7225					0.260	0.7	
Total - no infiltration	**54.62**						**171.5**	**63.5**
Total - 20 mm infiltration							**17.2**	**6.3**
Total - 25 mm infiltration							**8.6**	**3.2**

Phase 1 - Post Development P Budget Calculations

Midhurst Heights - Area Bypassing SWMP

Land Use	Total Area (ha)	Runoff Coefficient	Pj	Precipitation	TPi	P Coeff	P Load (kg)
Single Detached	1.503	0.58	0.9	967.7	0.41	2.071	3.1
Townhomes & Multi	0	0.58	0.9	967.7	0.41	2.071	0.0
Standard ROWs	0.264	0.58	0.9	967.7	0.41	2.071	0.5
Mixed Use/School	0.619	0.58	0.9	967.7	0.2	1.010	0.6
Commercial	0	0.82	0.9	967.7	0.2	1.428	0.0
Parks/Open Space*	0.049	0.14				0.130	0.006
Total - no infiltration	**54.62**						**4.3**
Total - 20 mm infiltration							**0.4**
Total - 25 mm infiltration							**0.2**

Full Build Out - Redevelopable Area Phosphorus Budget

MSPA Land Use	P Budget Land Use	Area (ha)	RC	Notes	Pj	Precipitation (mm/yr)	Tpi (mg/L)	P Coeff	P Load (kg)	After SWMP (63% removal)
Administration / Government	Commercial	72	0.82	Crozier value for commercial	0.9	967.7	0.2	1.428	102.8	
Commercial / Mixed Use	Commercial	10	0.82	Crozier value for commercial	0.9	967.7	0.2	1.428	14.2	
Employment	Industrial	90	0.90	SCS pers comm.	0.9	967.7	0.41	3.214	288.8	
Future Development Potential	Residential	76	0.69	SCS average for residential	0.9	967.7	0.41	2.464	186.9	
Midhurst High Density Residential / Mixed Use	Residential	6	0.82	SCS value for townhomes	0.9	967.7	0.41	2.928	16.4	
Midhurst Low Density Residential	Residential	170	0.62	SCS value for single detached	0.9	967.7	0.41	2.214	377.4	
Midhurst Medium Density Residential	Residential	19	0.62	SCS value for single detached	0.9	967.7	0.41	2.214	42.6	
Midhurst Transition Residential	Residential	67	0.69	SCS average for residential	0.9	967.7	0.41	2.464	165.7	
Schools	Commercial	12	0.59	SCS value for schools/mixed use	0.9	967.7	0.2	1.028	12.0	
Parklands (@ 5% residential, 2% other)	Low Intensity Residential	21						0.13	2.8	
SWMP	open waer	17						0.26	4.5	
SWMP	transitional	17						0.07	1.2	
Environmental Protection Area I	Forest	0						0.06	0.0	
Environmental Protection Area II	Forest	19						0.06	1.1	
Total - no infiltration		597							**1216**	**450**
Total - 20 mm infiltration									**122**	**45**
Total - 25 mm infiltration									**61**	**23**

Appendix E. XCG Consultants Ltd. Review Comments

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January 29, 2016

XCG File No.: 3-2984-02-01

J. A. Mullan, P.Eng.
President & CEO,
Ainley Group
280 Pretty River Parkway,
Collingwood, Ontario L9Y 4J5

Re: Midhurst Secondary Plan: Phosphorus Budget

Dear J.A. Mullan:

The purpose of this letter is to provide initial comments on the workplan of Hutchinson Environmental Sciences Limited (HESL) for refinement of the Midhurst Secondary Plan Area Phosphorus Budget. The HESL workplan is described in the letter of March 9, 2015 addressed to Mr. Glenn Switzer of Nottawasaga Valley Conservation Authority (NVCA).

Information Reviewed

To prepare the following comments, XCG Consulting Limited (XCG) has reviewed the workplan, as well as the following documents that were provided to us at the initial meeting we had on December 22, 2015 and subsequent emails we received on December 23, 2015.

- HESL, 2014a. Memorandum dated June 5, 2014, regarding "Phosphorus Budget for Midhurst Secondary Plan Area", prepared for SCS Consulting Group.
- HESL, 2014b. "Managing New Urban Development in Phosphorus Sensitive Watersheds – Final Report", prepared for NVCA, dated October 31, 2014.
- Ontario Municipal Board (OMB), Minutes of Settlement for OMB Case Nos. PL131125 et al., dated July 3, 2014.
- Greenland International Consulting Ltd (GICL), 2014. Correspondence addressed to Hutchinson Environmental Sciences Ltd., dated June 12, 2014 "RE: Technical Peer Review of 'Phosphorus Budget for Midhurst Secondary Plan Area'" (5 pages); and correspondence to Hutchinson Environmental Sciences Ltd., dated June 19, 2014, regarding "Technical Peer Review of 'Phosphorus Budget for Midhurst Secondary Plan Area', Reply to Comment response Based on 12 June 2014 Greenland Phase 1 Comments" (12 pages), File No. G14-3221.

As well we have considered the information we received at the December 22nd meeting regarding the current status of infrastructure planning for the Secondary Plan Area.

Context

The Midhurst Secondary Plan Area (MSPA) includes a total potential urban development area of 756 hectares within the Midhurst Settlement Area (approximately 2,813 hectares). At present, 300 of the 756 hectares can proceed to development, based on partial withdrawal of an OMB appeal in November 2012. Draft Plans of Subdivision for the 300

hectares have proceeded to OMB approval, with conditions and requirements set out in the OMB Minutes of Settlement of July 2014.

Requirements for drainage management in the proposed development area are set out in the OMB Minutes. Our understanding is that these requirements have been set out by the OMB to address concerns and requirements of the NVCA. With respect to nutrient loadings and stormwater volume control, key requirements in the OMB Minutes are as follows:

- No additional nutrient loading downstream from both the land development and the wastewater treatment plant (WWTP).
- As much water as possible to be infiltrated back into the ground, aiming for the first 25 mm of rainfall; and demonstrate the ability of the stormwater management system to hold back the 25 mm storm runoff for 48 hours.
- At each drainage outlet there will be no increase in the volume of post-development runoff volume from the pre-development condition. However, some increase in post-development runoff may be permitted for infrequent storms, if it is demonstrated that there will be no cumulative downstream impacts, taking into consideration all of the subdivisions in the Midhurst Secondary Plan Area.

The MSPA drains to Willow Creek, which in turn flows to the Nottawasaga River via the Minesing Swamp. The foregoing targets are directed at controlling nutrient loadings to Willow Creek and Minesing Swamp, and ensuring maintenance of local hydrologic water budget.

Within the MSPA, current land use includes existing residential development in the Village of Midhurst, along with cultivated farm fields, wooded areas, institutional properties (County of Simcoe Administrative Centre, Archives and Museum, and Simcoe County District School Board), the Barrie Community Sports Complex, some commercial properties and a rail corridor. The Village of Midhurst is served by municipal water supply system, but all homes have private on-site sewage systems (i.e. septic tank systems).

The proposed development will be served by a new WWTP that will discharge its effluent to Willow Creek.

Preliminary Phosphorus Budget

HESL (2014a) presents a preliminary phosphorus budget for the MSPA. This analysis included pre-development and post-development total phosphorus (TP) loading estimates for 881.7 hectares of potential urban development area within the Midhurst Settlement Area. In summary this analysis indicated the following:

- Conversion of what currently is predominantly crop land, to urban development (i.e. without any urban stormwater treatment or other measures to reduce urban stormwater load) has the potential to increase annual non-point sources (NPS) TP loading from the 881.7 ha by an estimated 979 kg (increase from 144 kg to 1,123 kg).
- Based on analysis of historical daily precipitation at Shanty Bay, it was estimated by HESL that "infiltration of the first 20 mm of all rain events (all precipitation for events up to 20 mm and the first 20 mm of grater magnitude events) results in

infiltration of 83% of the total annual precipitation, leaving only 17% for run off and treatment by SWM Ponds".

- On this basis, it was estimated that if infiltration practices within the new urban development were able to infiltrate the first 20 mm of rain, that would result in 83% reduction in urban NPS phosphorus loading.
- In combination with stormwater treatment (63% P load reduction) for runoff from the residual 17% of precipitation, the result was post-development NPS loading from the development area that is less than the pre-development condition (reduced from 144 kg to 69 kg).
- However, with the addition of the future effluent load from the proposed Midhurst WWTP of 135 kg, the net result was an estimated increase in total load (i.e. non-point sources plus point sources) of 60 kg per year (69+135-144=60).

The preliminary analysis clearly indicated that the primary means of reducing the NPS TP load from the development area would be through infiltration practices, and that infiltrating more than 80% of precipitation will likely be required to meet the objective of no net increase in total phosphorus (TP) loading to Willow Creek.

Refined Phosphorus Budget Required

XCG's understanding is that a refined phosphorus budget ("P Budget") will be prepared by HESL to address the OMB Minutes requirements. XCG's understanding is as follows.

- To address the OMB Minutes, the P Budget will address the annual phosphorus budget; that is, the phosphorus budget for an "average" year in terms of precipitation.
- The P Budget will need to address all non-point sources (NPS) and point sources within the MSPA including the proposed WWTP. The MSPA is understood to be the entirety of the Midhurst Settlement Area (approximately 2,813 ha). The area that the P budget needs to encompass should be clarified (see below).
- The P Budget will be carried out for the "Phase 1" development scenario (300 hectares of urban development) and the "full build-out" development scenario (756 ha).
- Under current land-use conditions, NPS will include all surface drainage and stormwater runoff, as well as any loadings that may be attributable to private sewage systems (septic systems) in the MSPA.
- Under interim and ultimate future scenarios, NPS will include stormwater runoff from the proposed urban development, along with any of the remaining current sources. Point sources will include the effluent discharge from the proposed Midhurst WWTP.

Clarification Required:

The foregoing is our current understanding of the P Budget requirements. However, clarification is needed as follows.

- **Geographic Scope:** The geographic area to be encompassed by the P Budget should be confirmed. Will it be the entirety of the Midhurst Settlement Area (approx. 2,813 ha)?; or only that portion of the Settlement Area which drains to Willow Creek?; or only the development lands themselves (i.e. 300 ha in Phase 1, 756 at full build-out)?

- **Phosphorus Only:** The OMB Minutes refer to "no additional nutrient loading". In the HESL workplan, the first paragraph under "Constituents Modelled" appears to state that phosphorus is the only nutrient of concern. As well, the correspondence of June 19, 2014 from Greenland indicates that NVCA has stated that phosphorus is the nutrient of primary concern. If not already done, we believe that it should be clarified with NVCA that other nutrients (i.e. nitrogen compounds) are not at issue.
- **Seasonal Considerations:**
  - The "no additional nutrient loading" requirement is presumed to relate to average annual loading (as opposed to the loading generated in the ice-free period only). This should be confirmed with NVCA, so that it is clear as to whether the P Budget needs to consider winter and spring melt conditions.
  - Clarification from NVCA may be needed with respect to the requirement to infiltrate as much water as possible, with the target being the first 25 mm of rainfall. It is presumed that this requirement applies only within the ice-free period. This should be confirmed, again so that it is clear as to whether hydrologic analysis to support the P Budget needs to consider winter and spring melt conditions.
- **Each Outlet:**
  - Confirmation that P Budget should be completed for each separate drainage outlet from the MSPA, as opposed to only the MSPA as a whole.

HESL Proposed Methodology and Tools

The March 9, 2015 workplan document states that the "NVCA Tool" (HESL, 2014b) will be applied in the P Budget.

In general, we believe there needs to be elaboration on how proposed infiltration practices within the urban development blocks will be represented in application of the NVCA Tool. Because of the primary role that infiltration practices will play in the load-control strategy, we believe the analysis needs to clearly document how they have been represented.

Our understanding is that TP export from existing and proposed urban area will be estimated using Equation 3.

- Will engineered infiltration practices within the development area be accounted for by way of Equation 3?
- Or will Equation 3 be used only to compute the "unmitigated" load (Module 2), with volume reductions by infiltration practices then accounted for in Module 3 (per Table 11)?

Some specific questions we have regarding application of Equation 3:

- **Precip:** will this be total annual precipitation (i.e. all 12 months of the year, for Shanty Bay average 969 mm over 2009-2014, 30-year normal 968 mm)?
- **Fraction of annual precipitation that produces runoff (Pj):** How will this be estimated? Will this parameter be used in the analysis to account for on-site infiltration practices and if so, how?

- **Runoff coefficient (Rv):** Will this be computed using the Equation 5 and if so, how will fraction of impervious area be estimated? Will the runoff coefficient be used to account for on-site infiltration practices and if so, what methods will be used to adjust it?

Our understanding is that engineering consultants working for the land developers are working on the design of engineered infiltration practices to be installed at various locations within the development area to meet the infiltration targets. XCG understands that HESL staff will be consulting with the developers' engineers to obtain relevant information about the proposed locations and expected effectiveness of the infiltration practices, and then using that information to complete the P Budget using the NVCA Tool. In our opinion, this linkage needs to be documented as part of the P Budget analysis, in order to substantiate whatever parameter values or methods are used in the NVCA Tool to represent the proposed infiltration practices.

Precipitation Analysis:

The NVCA Tool manual (HESL, 2014b), Section 5.1.1, presents a discussion regarding how infiltration practices can be represented or accounted for in applying the Tool. This includes results of analysis of daily precipitation data from 2009 to 2014, for the meteorological station at Shanty Bay.

As noted above, HESL's analysis of these precipitation data led to the conclusion that "infiltration of the first 20 mm of all rain events (all precipitation for events up to 20 mm and the first 20 mm of greater magnitude events) results in cumulative infiltration of 83% of the total annual precipitation, leaving only 17% for run off and treatment by other methods".

This is a significant outcome that was built into the preliminary P budget (HESL, 2014a). We wish to note some points regarding this precipitation analysis.

- The wording in Section 5.1.1 is inconsistent with respect to whether the statements made apply to only the portion of annual precipitation that occurs as rainfall, or total annual precipitation (rainfall and snow). The HESL analysis quotes an average annual rainfall amount of 717.3 mm of rainfall at Shanty Bay, which we have confirmed is rainfall only (i.e. does not include any snowfall).
- The analysis of "events" presented by HESL appears to be based on considering rainfall only. While the statement that "68% of annual ***rainfall*** events fell in events of up to 20 mm precipitation" may be valid, the following statement that infiltration of the first 20 mm "results in cumulative infiltration of 83% of ***total annual precipitation***" (emphasis ours) may not be supported.
- Another important consideration regarding this analysis is how "events" are defined. The HESL analysis appears to have been based on considering each rain day a separate "event". In other words, there was no requirement for an intervening number of days without rain to separate individual events. For example, it appears that two consecutive days with rainfall were considered to be two "events". When considering what may achievable by engineered infiltration practices, this specific analysis may not be appropriate. It does not appear to consider the fact that infiltration practices may require recovery time (i.e. time for infiltration of one event to occur before the facility has capacity available for the next event). For example, if infiltration practices

are designed to completely infiltrate a "design event" of 20 mm rainfall, but require a recovery time of one day to recover capacity, then it may be more appropriate to define individual rain events based on a minimum separation of one day with zero rain. The HESL analysis appears to effectively assume zero recovery time (i.e. precipitation is infiltrated as quickly as it occurs). The result may be a significant over-estimate of what infiltration practices can achieve.

We believe that the precipitation analysis and the conclusions derived from it regarding the potential runoff-volume reduction by infiltration, should be reviewed. Presumably such review could take into account whatever analysis and information will become available from the engineering consultants working on design of the proposed infiltration practices.

Pre-Development Validation using Monitoring Data

Defensible estimation of NPS load under existing conditions will be important. Can any recent or ongoing monitoring data from the Willow Creek watershed be used to validate the pre-development analysis?

Additional Considerations

As a final comment, while not directly within the scope of what we have been asked to comment upon, we wish to note that analysis and documentation of feasibility and acceptability of on-site stormwater infiltration practices should make reference to any existing Source Protection Plans (i.e. the South Georgian Bay Lake Simcoe Source Protection Plan) that may apply to the area.

If there are questions on the above, please do not hesitate to contact the undersigned.

Yours very truly,
XCG CONSULTING LIMITED



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