**patersongroup**

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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

**www.patersongroup.ca**

May 24, 2018
File: PG4049-LET.03

**Mattamy Homes**
50 Hines Road, Suite 100
Ottawa, Ontario
K2K 2M5

Attention: **Ms. Jillian Normand**

Subject: **Sump Pump Feasibility Review**
**Summerside West Residential Development - Phases 4, 5 and 6**
**Tenth Line Road - Ottawa, Ontario**

Dear Madam,

Paterson Group Inc. (Paterson) has prepared the following letter to detail the results of our sump pump feasibility review for the undeveloped area within Summerside West Community. The letter report was prepared to provide available soil and groundwater information for the subject site to determine the applicability of sump pumps for the residential buildings.

It should be noted that post-development groundwater levels will be well below the currently reported groundwater levels based on the effect that development has on groundwater levels within a former agricultural field over a low permeability soil, such as a deep silty clay deposit.

Paterson also completed a supplemental soil review, consisting of a series of sieve and hydrometer tests on selected soil samples. The results of our sieve and hydrometer testing are attached to the present letter report. For additional details regarding soil profiles encountered within the proposed Summerside West development reference should be made to our geotechnical report presented under cover Report PG4049-2 dated May 14, 2018. Falling head (slug) testing was also completed as part of our review to determine hydraulic conductivity of the underlying soils. The results of our falling head testing are attached to the present letter report.

## 1.0 Groundwater Monitoring Program

The groundwater monitoring wells installed for the monitoring program within Phases 4, 5 and 6 of Summerside West were completed by a licensed well contractor under the supervision of Paterson personnel in February 2017. At that time, the well contractor installed two (2) groundwater monitoring wells at each of the seven (7) well cluster locations (MW 1 to MW 7). Two monitoring wells are installed at each well cluster location, a shallow and deep screen interval. The MW "A" designation indicates the deep installation and the MW "B" designation indicates the shallow installation. The monitoring well locations within Summerside West are presented in Drawing PG4049-1 - Test Hole Location Plan attached.

### Monitoring Well Installation

Typical monitoring well construction details are described below:

- ❏ 1.5 m of slotted 51 mm diameter PVC screen at the base of the aforementioned boreholes.
- ❏ 51 mm diameter PVC riser pipe from the top of the screen to the ground surface.
- ❏ No.3 silica sand backfill within annular space around screen.
- ❏ A minimum of 300 mm thick bentonite hole plug directly above PVC slotted screen.
- ❏ Clean backfill from top of bentonite plug to the ground surface.

The monitoring well details are also presented in the Soil Profile and Test Data sheets attached.

### Groundwater Monitoring Results

Paterson personnel completed the initial groundwater readings at MW 1 to MW 7 on May 2, 2017. Follow-up groundwater level readings were taken in August 10 and October 25, 2017 and May 11, 2018. The measured groundwater levels (GWLs) in the monitoring wells installed in the boreholes are summarized in Table 1 on the following page.

It should be noted that groundwater level observations based on our recovered soil samples at our borehole locations indicate the long-term groundwater level (pre-development) is located approximately 1.5 to 2.5 m below original ground surface (~85.5 to 83.5 m).

**Table 1 - Summary of Groundwater Level Readings**

| Test Hole Number | Ground Surface Elevation, m | Groundwater Levels, m | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | May 2, 2017 | | August 10, 2017 | | October 25, 2017 | | May 11, 2018 | |
| | | Depth | Elevation | Depth | Elevation | Depth | Elevation | Depth | Elevation |
| **MW 1A** | **86.76** | 0.19 | 86.57 | 1.03 | 85.73 | 0.30 | 86.46 | - | - |
| **MW 1B** | **86.76** | 0.20 | 86.56 | 0.83 | 85.93 | 0.23 | 86.53 | 0.54 | 86.22 |
| **MW 2A** | **86.40** | 0.29 | 86.11 | 0.44 | 85.96 | 0.42 | 85.98 | - | - |
| **MW 2B** | **86.40** | 0.30 | 86.10 | 0.77 | 85.63 | 0.08 | 86.32 | 0.71 | 85.69 |
| **MW 3A** | **86.82** | 0.12 | 86.70 | 1.03 | 85.79 | 0.30 | 86.52 | - | - |
| **MW 3B** | **86.82** | 0.28 | 86.54 | 0.80 | 86.02 | 0.44 | 86.38 | 0.81 | 86.01 |
| **MW 4A** | **86.41** | 0.48 | 85.93 | 0.76 | 85.65 | 1.16 | 85.25 | - | - |
| **MW 4B** | **86.41** | 0.34 | 86.07 | 0.73 | 85.68 | 0.63 | 85.78 | 0.62 | 85.79 |
| **MW 5A** | **86.55** | 0.60 | 85.95 | 0.62 | 85.93 | 0.60 | 85.95 | - | - |
| **MW 5B** | **86.55** | 0.38 | 86.17 | 0.75 | 85.80 | 0.49 | 86.06 | 0.42 | 86.13 |
| **MW 6A** | **86.17** | 0.62 | 85.55 | 0.37 | 85.80 | 0.45 | 85.72 | - | - |
| **MW 6B** | **86.17** | 0.10 | 86.07 | 0.40 | 85.77 | 0.18 | 85.99 | 0.25 | 85.92 |
| **MW 7A** | **86.60** | 0.38 | 86.22 | 0.45 | 86.15 | 0.48 | 86.12 | - | - |
| **MW 7B** | **86.60** | 0.17 | 86.43 | 0.75 | 85.85 | 0.16 | 86.44 | 0.30 | 86.30 |

Note: - The ground surface elevations at each borehole location were provided by J. D. Barnes Limited.

**Hydraulic Conductivity Testing Results**

Falling Head (Slug) testing was completed at the shallow well locations (MW1B, MW2B, MW3B, MW4B, MW5B, MW6B and MW7B) on May 11 and 16, 2018. Based on our testing results, a horizontal hydraulic conductivity varying between **5.07 x10-7 m/sec to 5.07 x10-8 m/sec** was observed at the selected monitoring well locations. The results of our testing are attached to the present letter report.

The range of fluctuations in groundwater elevations is consistent with expectations given the general composition of overburden materials on site. Silty clay has a typical hydraulic conductivity in the range of 1 x $10^{-7}$ to 1 x $10^{-9}$ m/sec, with the variability provided to account for differences in compaction and majority composition of the material at a given location. Similarly, the transmissivity of the soil, which is dependant on hydraulic conductivity, is also low, resulting in a limited ability for water to travel through the clay. The result of these low hydraulic properties is a minimal potential for groundwater elevation fluctuations, and an elevated probability that surface water will remain at surface rather than infiltrate the low permeability clay soils.

Based on the results of our falling head (slug) testing program, the soils below the proposed founding elevation are considered to have adequately met the requirement for a low permeability soil to be present below design underside of footing level for the subject buildings where sump pumps are required.

## 2.0 Summary and Recommendations

**These pre-development groundwater level readings recorded at our well cluster locations (Table 1) should not be considered for design of footing level for the proposed development due to the anticipated dewatering of the 'perched' water within the upper portion of the silty clay deposit.** This dewatering effect will occur once development of the site has initiated and service pipe alignments are installed. Typically, the recorded groundwater levels within the developed area are approximately located at or below spring level of the adjacent storm sewer pipes. It is anticipated that this same level of dewatering will occur within Summerside West, once service pipes have been installed. It is further expected that the proposed building sump pumps will handle water flows from precipitation events and during spring melt only, as per City guidelines.

**Based on the results of our groundwater review and observations within developed sites over clay deposits, the proposed design underside of footing elevations should be placed above the spring line of the storm service pipe for the subject site if sump pumps are to be used within the residential dwellings.**

It is further recommended that a post-development groundwater monitoring program be initiated for the development. A series of monitoring wells should be installed adjacent to foundations under construction to monitoring the dewatering activity, which occurs during the construction period. Long-term monitoring wells can be installed in public right-of-ways to further monitor the groundwater level lowering. Periodic reports summarizing groundwater levels can be submitted for discussion purposes. Additional details can be provided at a later date.

We trust the current submission meets your immediate requirements.

**Paterson Group Inc.**

Michael Laflamme, GIT


David J. Gilbert, P.Eng.

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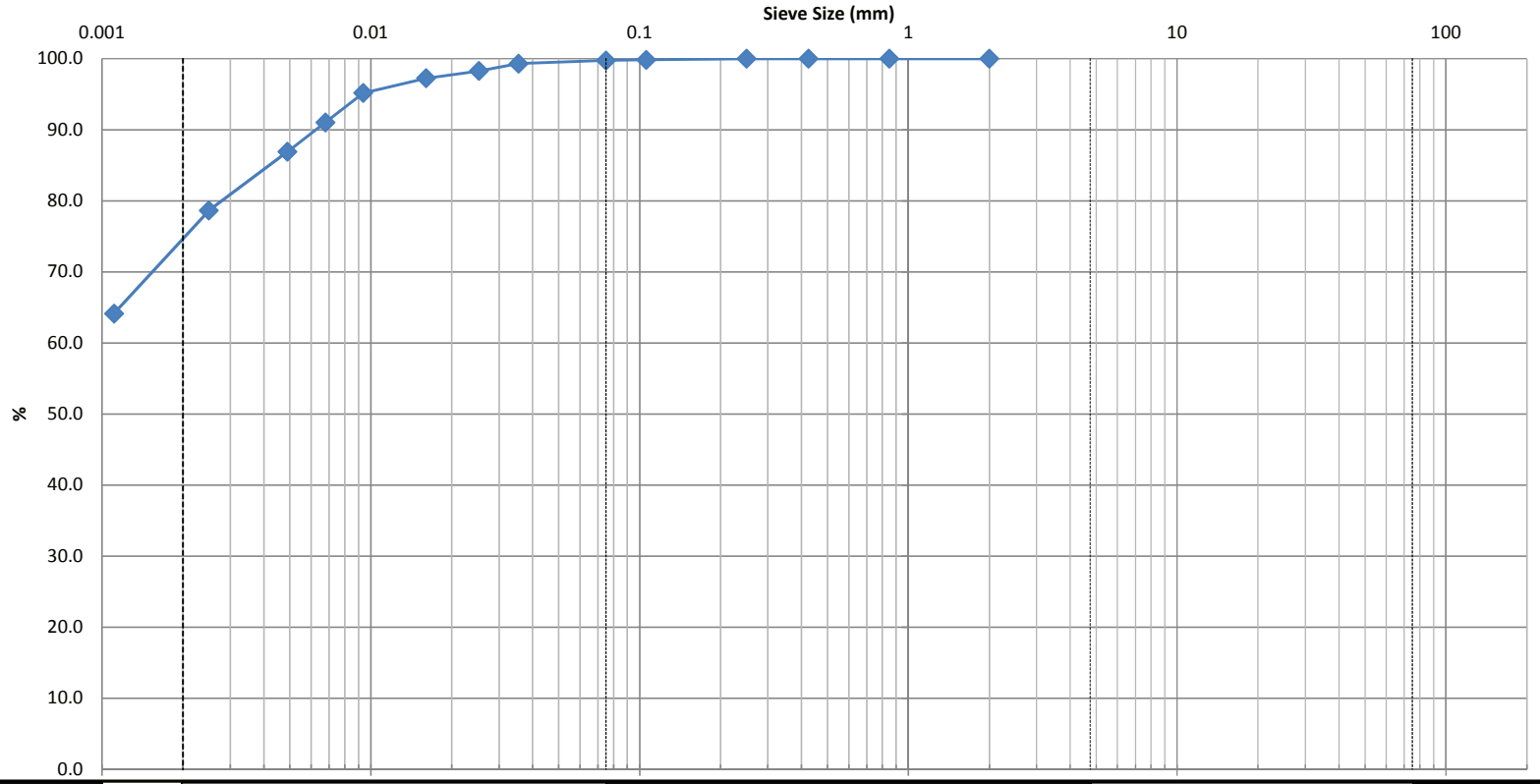
consulting engineers

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 2.6' - 4.6' | FILE NO: | PG4049 |
| CONTRACT NO.: | | BH OR TP No.: | BH46-18 | LAB NO: | 99000 |
| PROJECT: | Summerside West PH. 4 & 5 | | | DATE RECEIVED: | 14-Mar-18 |
| | | | | DATE TESTED: | 16-Mar-18 |
| DATE SAMPLED: | 22-Feb-18 | | | DATE REPORTED: | 19-Mar-18 |
| SAMPLED BY: | Paterson Group | | | TESTED BY: | D. Bertrand |




| | Clay | Silt | Sand | | | Gravel | | Cobble |
|---|---|---|---|---|---|---|---|---|
| | | | Fine | Medium | Coarse | Fine | Coarse | |

| Identification | Soil Classification | | | | | MC(%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 28.2 | | | | | |
| | D100 | D60 | D30 | D10 | Gravel (%) | Sand (%) | | Silt (%) | | Clay (%) | |
| | | | | | 0.0 | 0.3 | | 25.2 | | 74.5 | |

| Comments | |
|---|---|

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# HYDROMETER
# LS-702 ASTM-422

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 2.6' - 4.6' | FILE NO.: | PG4049 |
| PROJECT: | Summerside West PH. 4 & 5 | BH OR TP No.: | BH46-18 | DATE SAMPLED: | 22-Feb-18 |
| LAB No. : | 99000 | TESTED BY: | D. Bertrand | DATE RECEIVED: | 14-Mar-18 |
| SAMPLED BY: | Paterson Group | DATE REPT'D: | 19-Mar-18 | DATE TESTED: | 16-Mar-18 |

**SAMPLE INFORMATION**

| | | | |
|---|---|---|---|
| SAMPLE MASS | 125.1 | 50.02 | |
| SPECIFIC GRAVITY (Gs) | 2.700 | REMARKS | |
| HYGROSCOPIC MOISTURE | Tare No. | | |
| TARE Wt. | 50.00 | ACTUAL Wt. | |
| AIR DRY (Wa) | 150.00 | 100.00 | |
| OVEN DRY (Wo) | 145.55 | 95.55 | |
| F=(Wo/Wa) | 0.956 | | |
| INITIAL Wt. (Ma) | 50.02 | | |
| Wt. CORRECTED | 47.79 | | |
| Wt. AFTER WASH BACK SIEVE | 0.2 | | |
| SOLUTION CONCENTRATION | 40 g / L | | |

**GRAIN SIZE ANALYSIS**

| SIEVE DIAMETER (mm) | WEIGHT RETAINED (g) | PERCENT RETAINED | PERCENT PASSING |
|---|---|---|---|
| 63.0 | | | |
| 53.0 | | | |
| 37.5 | | | |
| 26.5 | | | |
| 19.0 | | | |
| 16.0 | | | |
| 13.2 | | | |
| 9.5 | | | |
| 4.75 | | | |
| 2.0 | **0.0** | 0.0 | 100.0 |
| Pan | **125.1** | | |
| | | | |
| 0.850 | **0.00** | 0.0 | 100.0 |
| 0.425 | **0.00** | 0.0 | 100.0 |
| 0.250 | **0.00** | 0.0 | 100.0 |
| 0.106 | **0.08** | 0.2 | 99.8 |
| 0.075 | **0.13** | 0.3 | 99.7 |
| Pan | **0.20** | | |
| SIEVE CHECK 0.0 | MAX = 0.3% | | |

**HYDROMETER DATA**

| ELAPSED | TIME (24 hours) | Hs | Hc | Temp. (°C) | DIAMETER | (P) | TOTAL PERCENT PASSING |
|---|---|---|---|---|---|---|---|
| 1 | 7:20 | 54.0 | 6.0 | 21.0 | 0.0355 | 99.3 | 99.3 |
| 2 | 7:21 | 53.5 | 6.0 | 21.0 | 0.0252 | 98.3 | 98.3 |
| 5 | 7:24 | 53.0 | 6.0 | 21.0 | 0.0161 | 97.2 | 97.2 |
| 15 | 7:34 | 52.0 | 6.0 | 21.0 | 0.0094 | 95.2 | 95.2 |
| 30 | 7:49 | 50.0 | 6.0 | 21.0 | 0.0068 | 91.0 | 91.0 |
| 60 | 8:19 | 48.0 | 6.0 | 21.0 | 0.0049 | 86.9 | 86.9 |
| 250 | 11:29 | 44.0 | 6.0 | 21.0 | 0.0025 | 78.6 | 78.6 |
| 1440 | 7:19 | 37.0 | 6.0 | 21.0 | 0.0011 | 64.1 | 64.1 |

**COMMENTS**

**Moisture Content = 28.2%**

| | | | |
|---|---|---|---|
| REVIEWED BY: | Curtis Beadow | APPROVED BY: | Joe Forsyth, P. Eng. |

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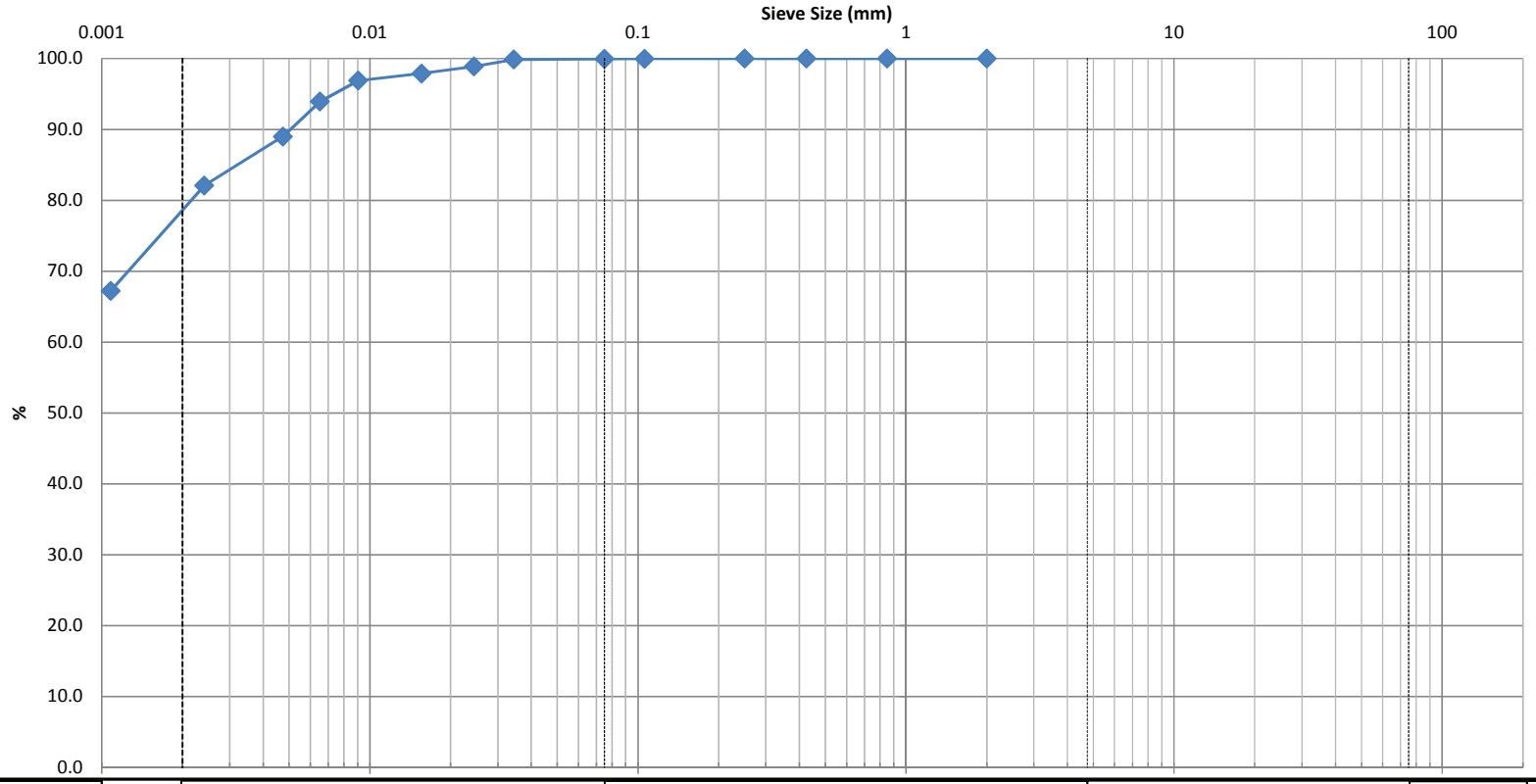
| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 15' - 16' | FILE NO: | PG4049 |
| CONTRACT NO.: | | BH OR TP No.: | BH48-18 | LAB NO: | 99001 |
| PROJECT: | Summerside West PH. 4 & 5 | | | DATE RECEIVED: | 14-Mar-18 |
| | | | | DATE TESTED: | 16-Mar-18 |
| DATE SAMPLED: | 23-Feb-18 | | | DATE REPORTED: | 19-Mar-18 |
| SAMPLED BY: | Paterson Group | | | TESTED BY: | D. Bertrand |




| | Clay | Silt | Sand | | | Gravel | | Cobble |
|---|---|---|---|---|---|---|---|---|
| | | | Fine | Medium | Coarse | Fine | Coarse | |

| Identification | Soil Classification | | | | | MC(%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 45.4 | | | | | |
| | D100 | D60 | D30 | D10 | Gravel (%) | Sand (%) | | Silt (%) | | Clay (%) | |
| | | | | | 0.0 | 0.1 | | 20.9 | | 79.0 | |

| Comments | |
|---|---|

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# HYDROMETER
# LS-702 ASTM-422

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 15' - 16' | FILE NO.: | PG4049 |
| PROJECT: | Summerside West PH. 4 & 5 | BH OR TP No.: | BH48-18 | DATE SAMPLED: | 23-Feb-18 |
| LAB No. : | 99001 | TESTED BY: | D. Bertrand | DATE RECEIVED: | 14-Mar-18 |
| SAMPLED BY: | Paterson Group | DATE REPT'D: | 19-Mar-18 | DATE TESTED: | 16-Mar-18 |

**SAMPLE INFORMATION**

| | | | |
|---|---|---|---|
| SAMPLE MASS | 95.8 | 50.00 | |
| SPECIFIC GRAVITY (Gs) | 2.700 | REMARKS | |
| HYGROSCOPIC MOISTURE | Tare No. | | |
| TARE Wt. | 50.00 | ACTUAL Wt. | |
| AIR DRY (Wa) | 150.00 | 100.00 | |
| OVEN DRY (Wo) | 150.00 | 100.00 | |
| F=(Wo/Wa) | 1.000 | | |
| INITIAL Wt. (Ma) | 50.00 | | |
| Wt. CORRECTED | 50.00 | | |
| Wt. AFTER WASH BACK SIEVE | 0.05 | | |
| SOLUTION CONCENTRATION | 40 g / L | | |

**GRAIN SIZE ANALYSIS**

| SIEVE DIAMETER (mm) | WEIGHT RETAINED (g) | PERCENT RETAINED | PERCENT PASSING |
|---|---|---|---|
| 63.0 | | | |
| 53.0 | | | |
| 37.5 | | | |
| 26.5 | | | |
| 19.0 | | | |
| 16.0 | | | |
| 13.2 | | | |
| 9.5 | | | |
| 4.75 | | | |
| 2.0 | **0.0** | 0.0 | 100.0 |
| Pan | **95.8** | | |
| | | | |
| 0.850 | **0.00** | 0.0 | 100.0 |
| 0.425 | **0.00** | 0.0 | 100.0 |
| 0.250 | **0.00** | 0.0 | 100.0 |
| 0.106 | **0.02** | 0.0 | 100.0 |
| 0.075 | **0.03** | 0.1 | 99.9 |
| Pan | **0.05** | | |
| SIEVE CHECK 0.0 | MAX = 0.3% | | |

**HYDROMETER DATA**

| ELAPSED | TIME (24 hours) | Hs | Hc | Temp. (°C) | DIAMETER | (P) | TOTAL PERCENT PASSING |
|---|---|---|---|---|---|---|---|
| 1 | 7:32 | 56.5 | 6.0 | 21.0 | 0.0344 | 99.9 | 99.9 |
| 2 | 7:33 | 56.0 | 6.0 | 21.0 | 0.0245 | 98.9 | 98.9 |
| 5 | 7:36 | 55.5 | 6.0 | 21.0 | 0.0156 | 97.9 | 97.9 |
| 15 | 7:46 | 55.0 | 6.0 | 21.0 | 0.0091 | 96.9 | 96.9 |
| 30 | 8:01 | 53.5 | 6.0 | 21.0 | 0.0065 | 93.9 | 93.9 |
| 60 | 8:31 | 51.0 | 6.0 | 21.0 | 0.0047 | 89.0 | 89.0 |
| 250 | 11:41 | 47.5 | 6.0 | 21.0 | 0.0024 | 82.1 | 82.1 |
| 1440 | 7:31 | 40.0 | 6.0 | 21.0 | 0.0011 | 67.2 | 67.2 |

**COMMENTS**

**Moisture Content = 45.4%**

| | | | |
|---|---|---|---|
| **REVIEWED BY:** | **Curtis Beadow** | **APPROVED BY:** | **Joe Forsyth, P. Eng.** |

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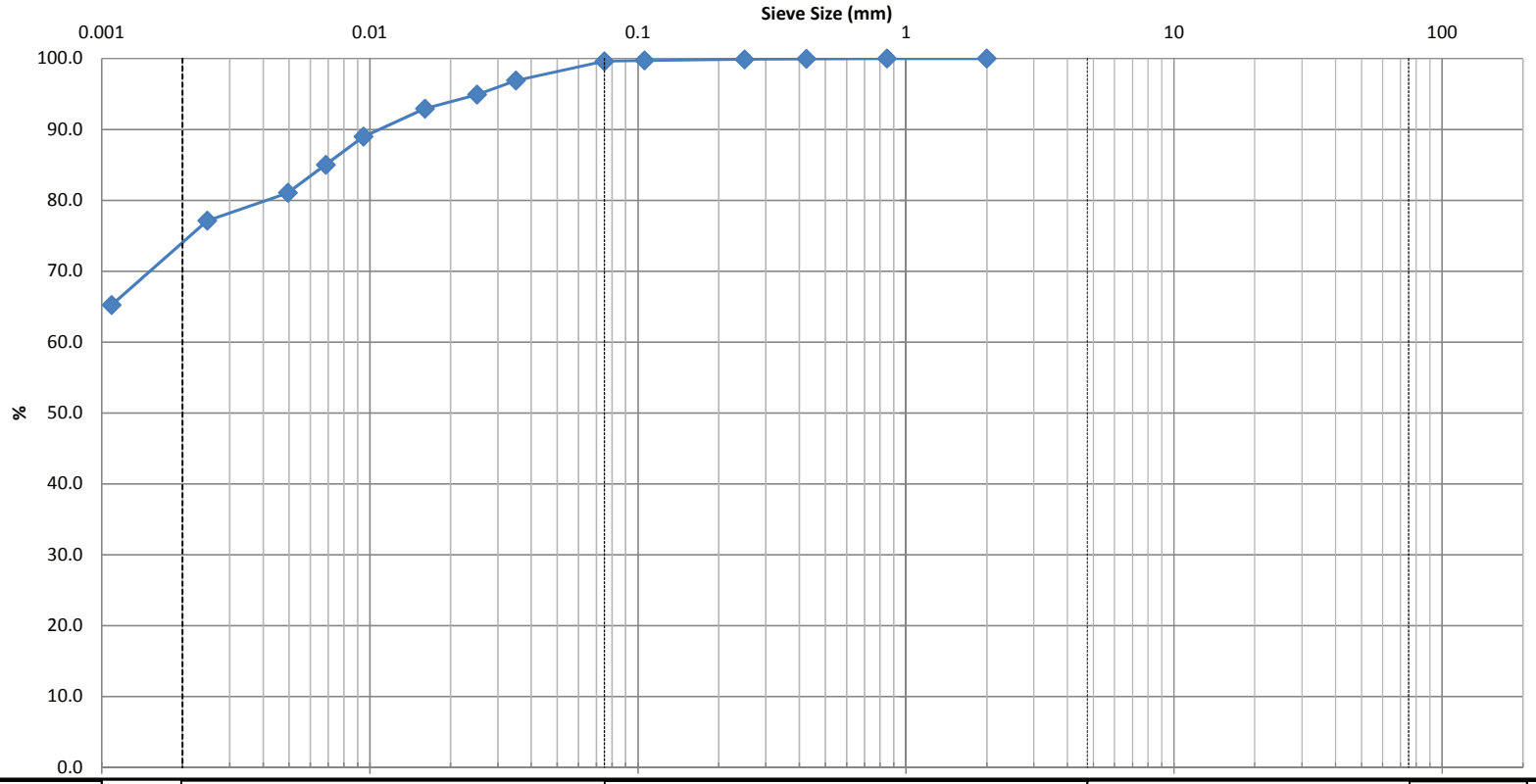
consulting engineers

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 2.6' - 4.6' | FILE NO: | PG4049 |
| CONTRACT NO.: | | BH OR TP No.: | BH413-18 | LAB NO: | 99002 |
| PROJECT: | Summerside West PH. 4 & 5 | | | DATE RECEIVED: | 14-Mar-18 |
| | | | | DATE TESTED: | 16-Mar-18 |
| DATE SAMPLED: | 23-Feb-18 | | | DATE REPORTED: | 19-Mar-18 |
| SAMPLED BY: | Paterson Group | | | TESTED BY: | D. Bertrand |




| | Clay | Silt | Sand | | | Gravel | | Cobble |
|---|---|---|---|---|---|---|---|---|
| | | | Fine | Medium | Coarse | Fine | Coarse | |

| Identification | Soil Classification | | | | | MC(%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 27.1 | | | | | |
| | D100 | D60 | D30 | D10 | Gravel (%) | Sand (%) | | Silt (%) | | Clay (%) | |
| | | | | | 0.0 | 0.4 | | 25.1 | | 74.5 | |

| Comments | |
|---|---|

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# HYDROMETER
# LS-702 ASTM-422

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 2.6' - 4.6' | FILE NO.: | PG4049 |
| PROJECT: | Summerside West PH. 4 & 5 | BH OR TP No.: | BH413-18 | DATE SAMPLED: | 23-Feb-18 |
| LAB No. : | 99002 | TESTED BY: | D. Bertrand | DATE RECEIVED: | 14-Mar-18 |
| SAMPLED BY: | Paterson Group | DATE REPT'D: | 19-Mar-18 | DATE TESTED: | 16-Mar-18 |

**SAMPLE INFORMATION**

| | | | |
|---|---|---|---|
| SAMPLE MASS | 128 | 50.01 | |
| SPECIFIC GRAVITY (Gs) | 2.700 | REMARKS | |
| HYGROSCOPIC MOISTURE | Tare No. | | |
| TARE Wt. | 50.00 | ACTUAL Wt. | |
| AIR DRY (Wa) | 150.00 | 100.00 | |
| OVEN DRY (Wo) | 150.00 | 100.00 | |
| F=(Wo/Wa) | 1.000 | | |
| INITIAL Wt. (Ma) | 50.01 | | |
| Wt. CORRECTED | 50.01 | | |
| Wt. AFTER WASH BACK SIEVE | 0.2 | | |
| SOLUTION CONCENTRATION | 40 g / L | | |

**GRAIN SIZE ANALYSIS**

| SIEVE DIAMETER (mm) | WEIGHT RETAINED (g) | PERCENT RETAINED | PERCENT PASSING |
|---|---|---|---|
| 63.0 | | | |
| 53.0 | | | |
| 37.5 | | | |
| 26.5 | | | |
| 19.0 | | | |
| 16.0 | | | |
| 13.2 | | | |
| 9.5 | | | |
| 4.75 | | | |
| 2.0 | **0.0** | 0.0 | 100.0 |
| Pan | **128** | | |
| | | | |
| 0.850 | **0.01** | 0.0 | 100.0 |
| 0.425 | **0.03** | 0.1 | 99.9 |
| 0.250 | **0.06** | 0.1 | 99.9 |
| 0.106 | **0.14** | 0.3 | 99.7 |
| 0.075 | **0.19** | 0.4 | 99.6 |
| Pan | **0.20** | | |
| SIEVE CHECK 0.0 | MAX = 0.3% | | |

**HYDROMETER DATA**

| ELAPSED | TIME (24 hours) | Hs | Hc | Temp. (°C) | DIAMETER | (P) | TOTAL PERCENT PASSING |
|---|---|---|---|---|---|---|---|
| 1 | 7:45 | 55.0 | 6.0 | 21.0 | 0.0351 | 96.9 | 96.9 |
| 2 | 7:46 | 54.0 | 6.0 | 21.0 | 0.0251 | 94.9 | 94.9 |
| 5 | 7:49 | 53.0 | 6.0 | 21.0 | 0.0161 | 92.9 | 92.9 |
| 15 | 7:59 | 51.0 | 6.0 | 21.0 | 0.0095 | 89.0 | 89.0 |
| 30 | 8:14 | 49.0 | 6.0 | 21.0 | 0.0069 | 85.0 | 85.0 |
| 60 | 8:44 | 47.0 | 6.0 | 21.0 | 0.0049 | 81.1 | 81.1 |
| 250 | 11:54 | 45.0 | 6.0 | 21.0 | 0.0025 | 77.1 | 77.1 |
| 1440 | 7:44 | 39.0 | 6.0 | 21.0 | 0.0011 | 65.2 | 65.2 |

**COMMENTS**

**Moisture Content = 27.1%**

| | | | |
|---|---|---|---|
| REVIEWED BY: | Curtis Beadow | APPROVED BY: | Joe Forsyth, P. Eng. |

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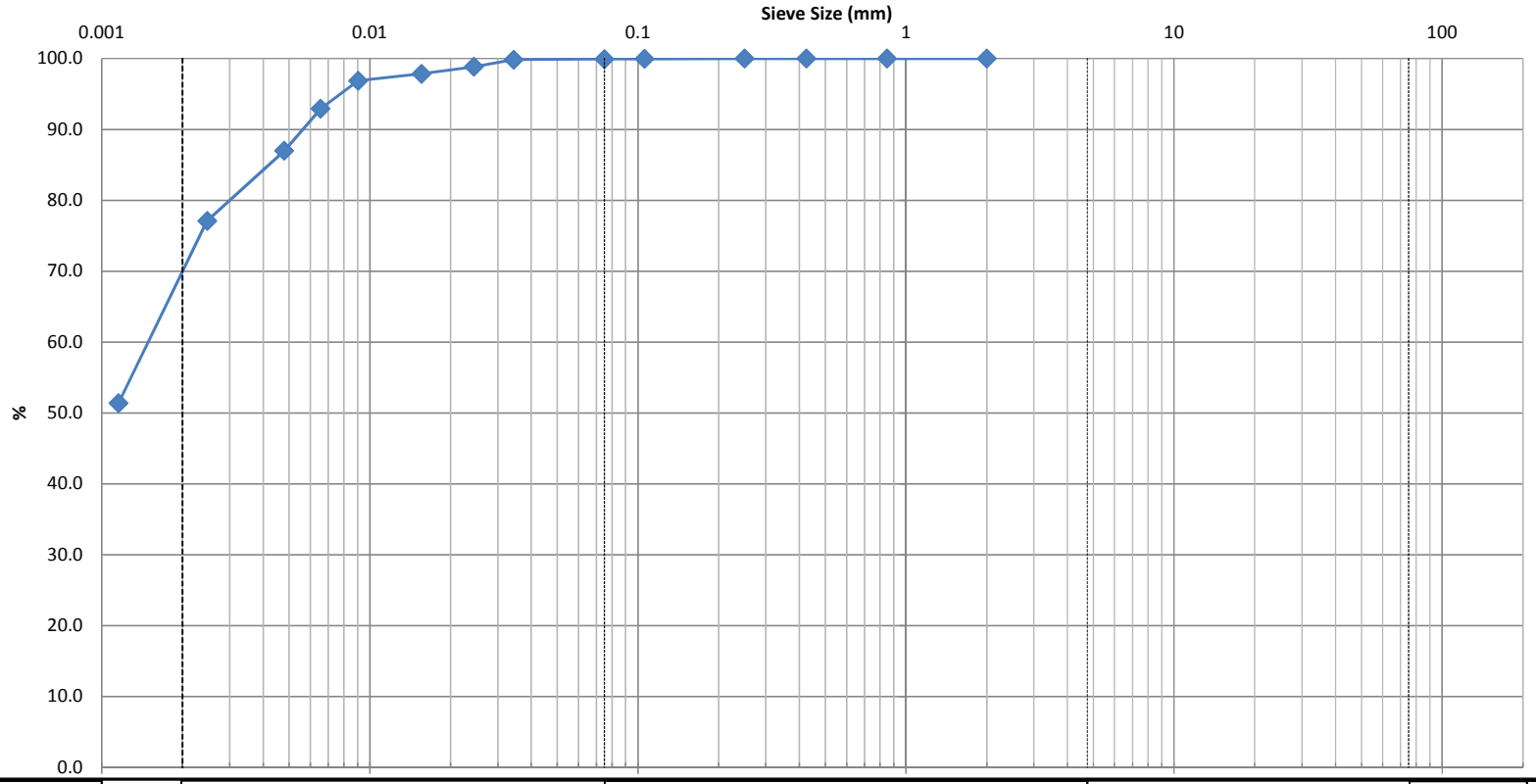
consulting engineers

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 10' - 11' | FILE NO: | PG4049 |
| CONTRACT NO.: | | BH OR TP No.: | BH416-18 | LAB NO: | 99003 |
| PROJECT: | Summerside West PH. 4 & 5 | | | DATE RECEIVED: | 14-Mar-18 |
| | | | | DATE TESTED: | 16-Mar-18 |
| DATE SAMPLED: | 23-Feb-18 | | | DATE REPORTED: | 19-Mar-18 |
| SAMPLED BY: | Paterson Group | | | TESTED BY: | D. Bertrand |




| | Clay | Silt | Sand | | | Gravel | | Cobble |
|---|---|---|---|---|---|---|---|---|
| | | | Fine | Medium | Coarse | Fine | Coarse | |

| Identification | Soil Classification | | | | | MC(%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 27.1 | | | | | |
| | D100 | D60 | D30 | D10 | Gravel (%) | Sand (%) | | Silt (%) | | Clay (%) | |
| | | | | | 0.0 | 0.1 | | 30.4 | | 69.5 | |

| Comments | |
|---|---|

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# HYDROMETER
# LS-702 ASTM-422

| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | 2447591 Ontario Inc | DEPTH: | 10' - 11' | FILE NO.: | PG4049 |
| PROJECT: | Summerside West PH. 4 & 5 | BH OR TP No.: | BH416-18 | DATE SAMPLED: | 23-Feb-18 |
| LAB No. : | 99003 | TESTED BY: | D. Bertrand | DATE RECEIVED: | 14-Mar-18 |
| SAMPLED BY: | Paterson Group | DATE REPT'D: | 19-Mar-18 | DATE TESTED: | 16-Mar-18 |

**SAMPLE INFORMATION**

| | | | |
|---|---|---|---|
| SAMPLE MASS | 107.1 | 50.02 | |
| SPECIFIC GRAVITY (Gs) | 2.700 | REMARKS | |
| HYGROSCOPIC MOISTURE | Tare No. | | |
| TARE Wt. | 50.00 | ACTUAL Wt. | |
| AIR DRY (Wa) | 150.00 | 100.00 | |
| OVEN DRY (Wo) | 150.00 | 100.00 | |
| F=(Wo/Wa) | 1.000 | | |
| INITIAL Wt. (Ma) | 50.02 | | |
| Wt. CORRECTED | 50.02 | | |
| Wt. AFTER WASH BACK SIEVE | 0.07 | | |
| SOLUTION CONCENTRATION | 40 g / L | | |

**GRAIN SIZE ANALYSIS**

| SIEVE DIAMETER (mm) | WEIGHT RETAINED (g) | PERCENT RETAINED | PERCENT PASSING |
|---|---|---|---|
| 63.0 | | | |
| 53.0 | | | |
| 37.5 | | | |
| 26.5 | | | |
| 19.0 | | | |
| 16.0 | | | |
| 13.2 | | | |
| 9.5 | | | |
| 4.75 | | | |
| 2.0 | **0.0** | 0.0 | 100.0 |
| Pan | **107.1** | | |
| | | | |
| 0.850 | **0.00** | 0.0 | 100.0 |
| 0.425 | **0.01** | 0.0 | 100.0 |
| 0.250 | **0.01** | 0.0 | 100.0 |
| 0.106 | **0.03** | 0.1 | 99.9 |
| 0.075 | **0.04** | 0.1 | 99.9 |
| Pan | **0.07** | | |
| SIEVE CHECK 0.0 | MAX = 0.3% | | |

**HYDROMETER DATA**

| ELAPSED | TIME (24 hours) | Hs | Hc | Temp. (°C) | DIAMETER | (P) | TOTAL PERCENT PASSING |
|---|---|---|---|---|---|---|---|
| 1 | 7:56 | 56.5 | 6.0 | 21.0 | 0.0344 | 99.8 | 99.8 |
| 2 | 7:57 | 56.0 | 6.0 | 21.0 | 0.0245 | 98.8 | 98.8 |
| 5 | 8:00 | 55.5 | 6.0 | 21.0 | 0.0156 | 97.9 | 97.9 |
| 15 | 8:10 | 55.0 | 6.0 | 21.0 | 0.0091 | 96.9 | 96.9 |
| 30 | 8:25 | 53.0 | 6.0 | 21.0 | 0.0066 | 92.9 | 92.9 |
| 60 | 8:55 | 50.0 | 6.0 | 21.0 | 0.0048 | 87.0 | 87.0 |
| 250 | 12:05 | 45.0 | 6.0 | 21.0 | 0.0025 | 77.1 | 77.1 |
| 1440 | 7:55 | 32.0 | 6.0 | 21.0 | 0.0012 | 51.4 | 51.4 |

**COMMENTS**

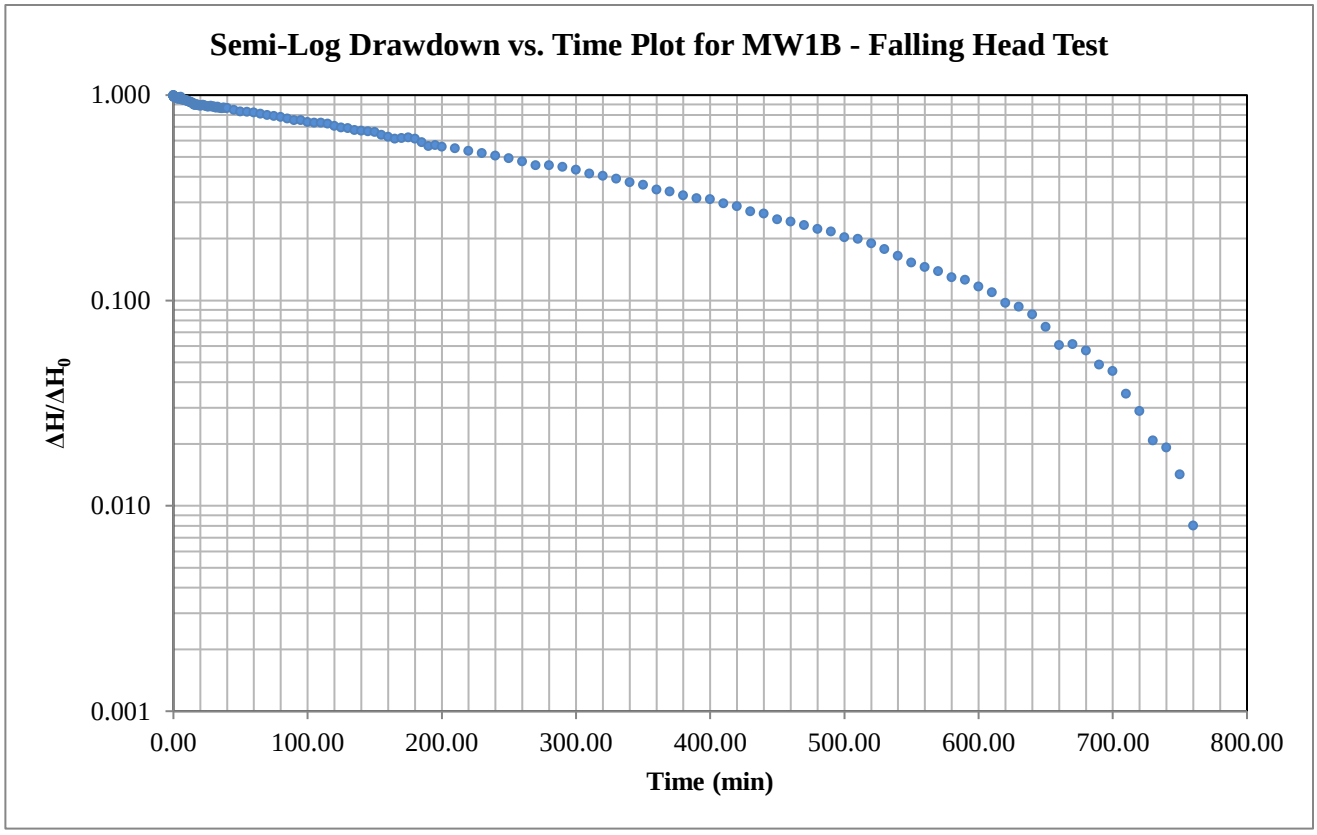
**Moisture Content = 41.1%**

| | | | |
|---|---|---|---|
| REVIEWED BY: | Curtis Beadow | APPROVED BY: | Joe Forsyth, P. Eng. |

Report: PG4049-1

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW1B
Test: Falling Head
Date: May 11, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

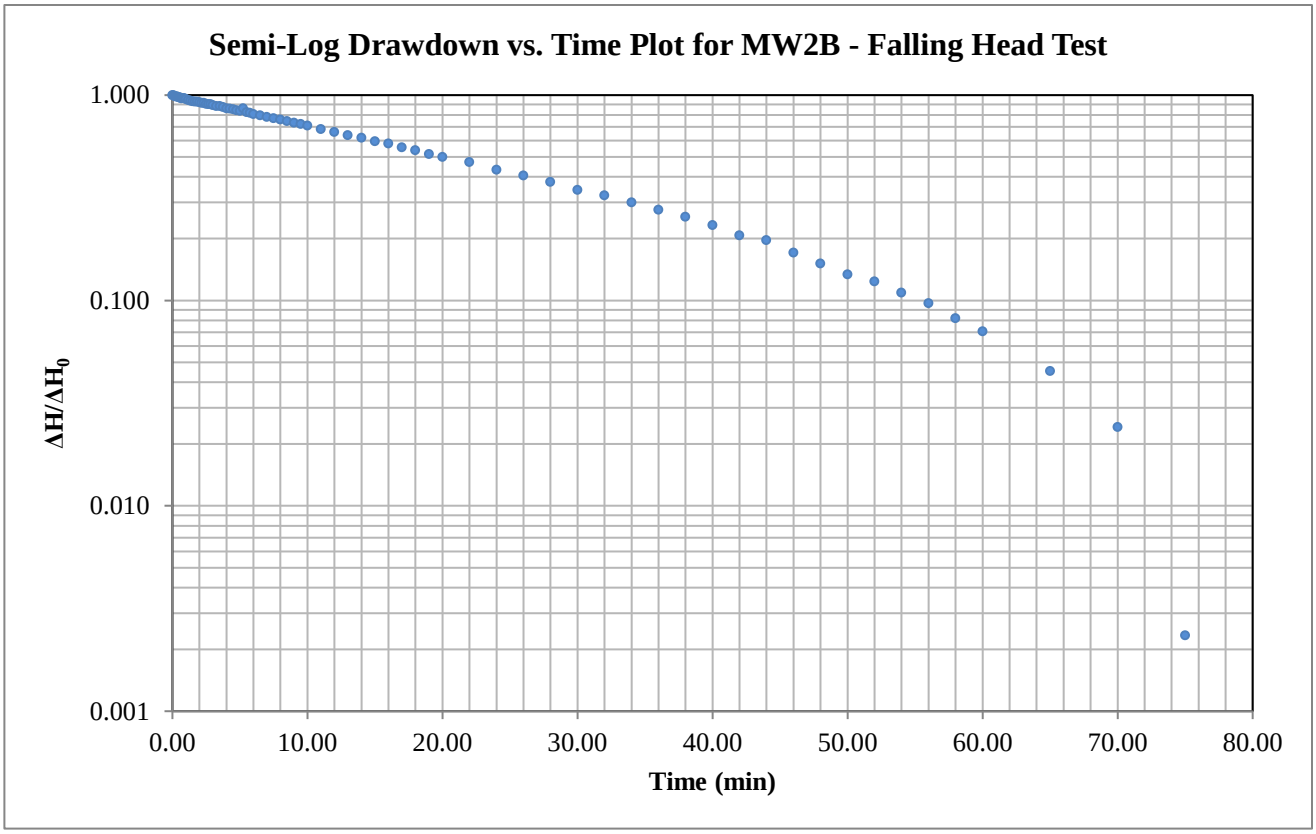
Data Points (from plot):

t*: 346.591 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 4.15E-08 m/sec**

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW2B
Test: Falling Head
Date: May 16, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

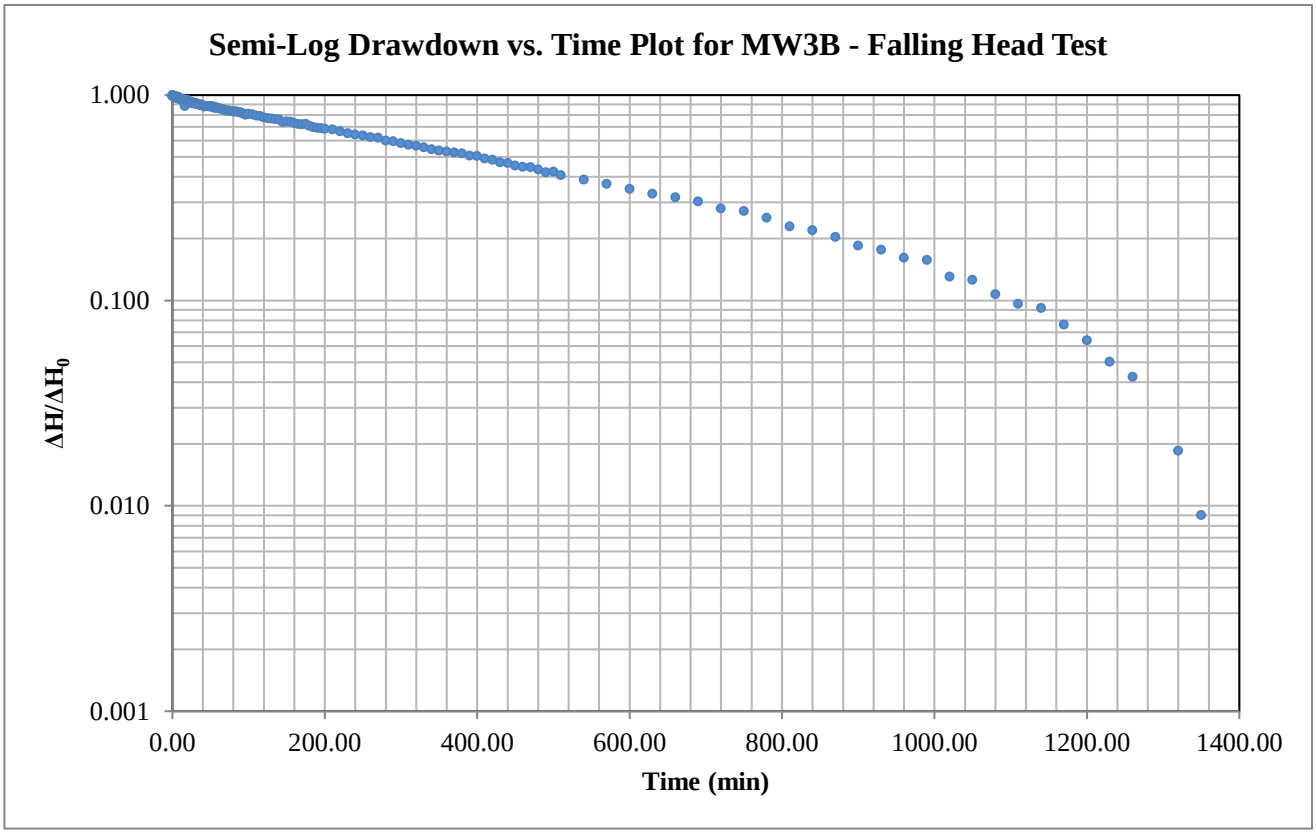
Data Points (from plot):

t*: 28.386 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 5.07E-07 m/sec**

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW3B
Test: Falling Head
Date: May 16, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

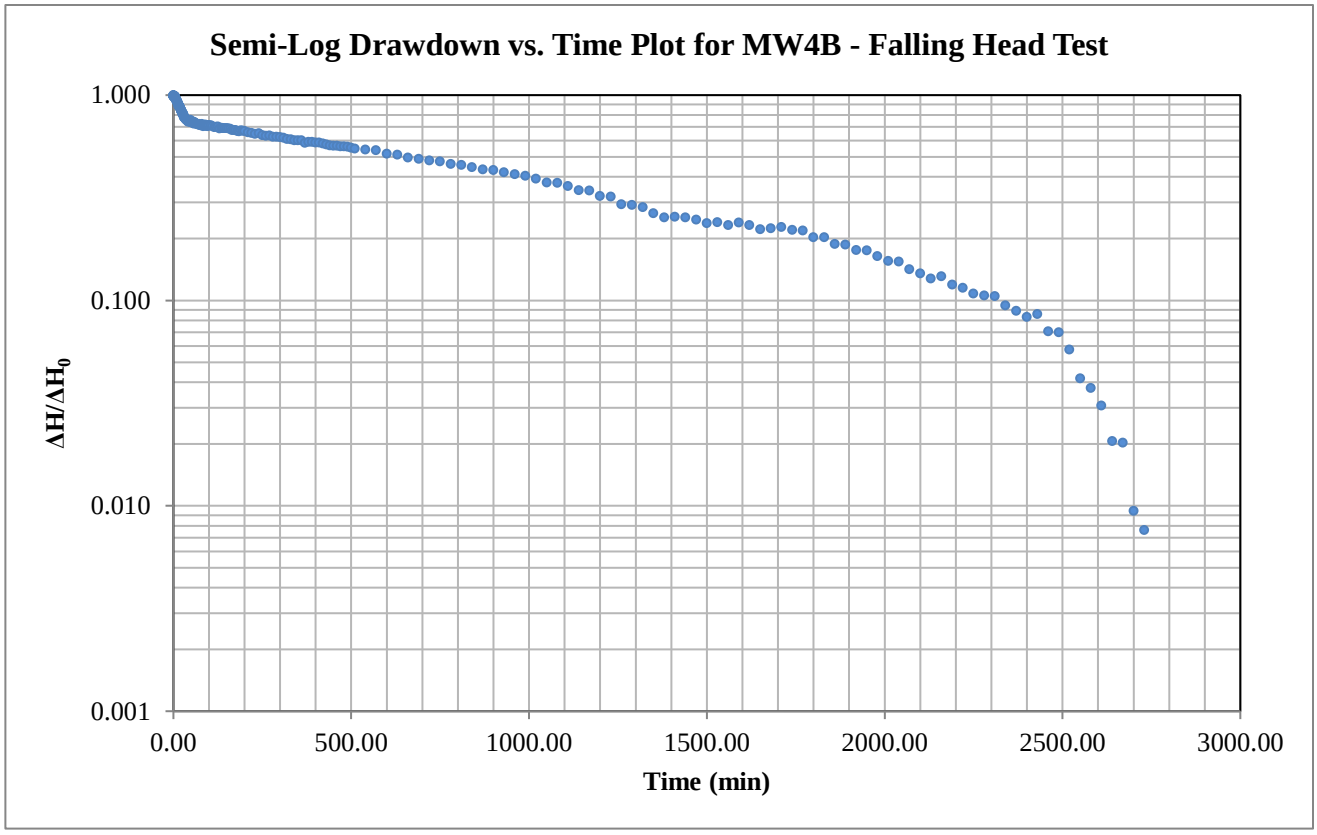
Data Points (from plot):

t*: 563.204 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 2.55E-08 m/sec**

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW4B
Test: Falling Head
Date: May 16, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

Data Points (from plot):

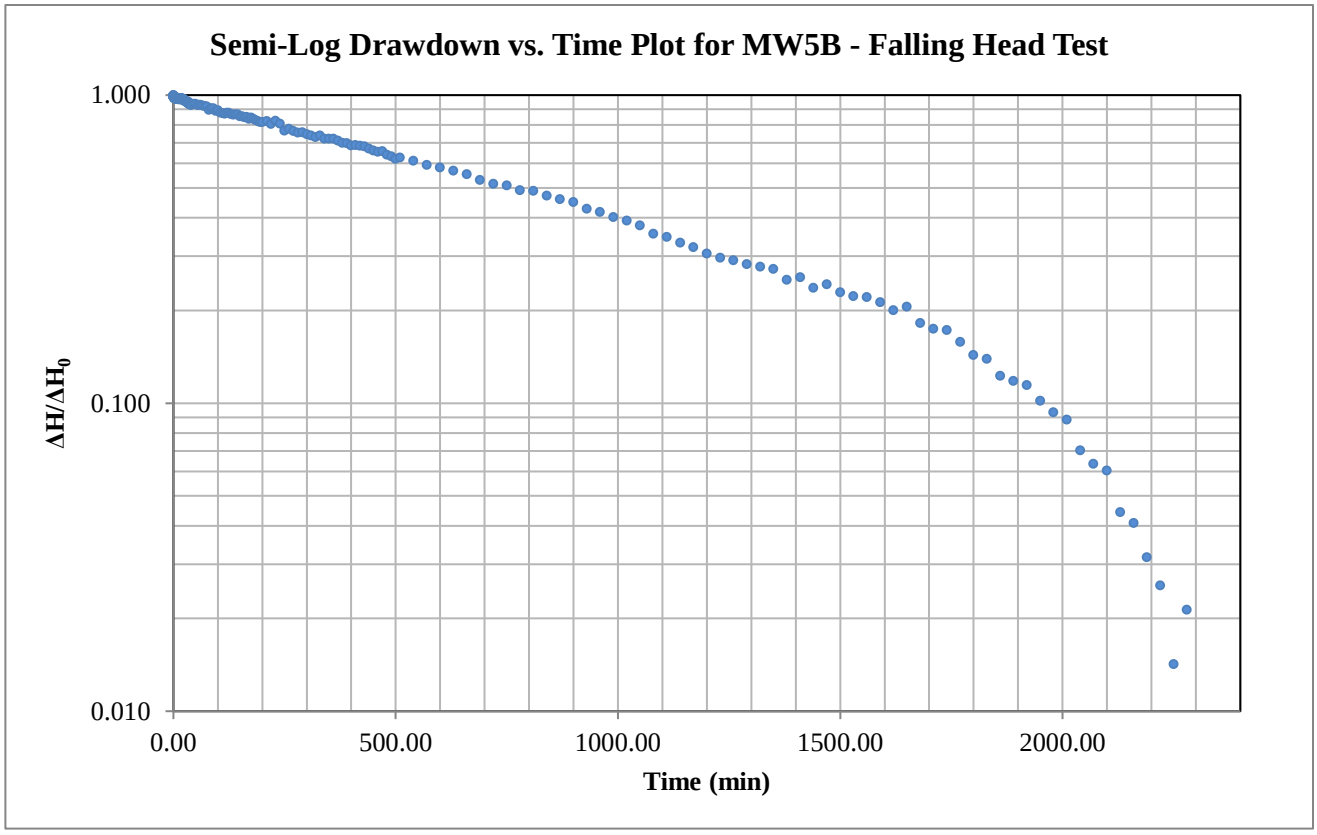
t*: 1085.013 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 1.33E-08 m/sec**

Report: PG4049-1

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW5B
Test: Falling Head
Date: May 11, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

Data Points (from plot):

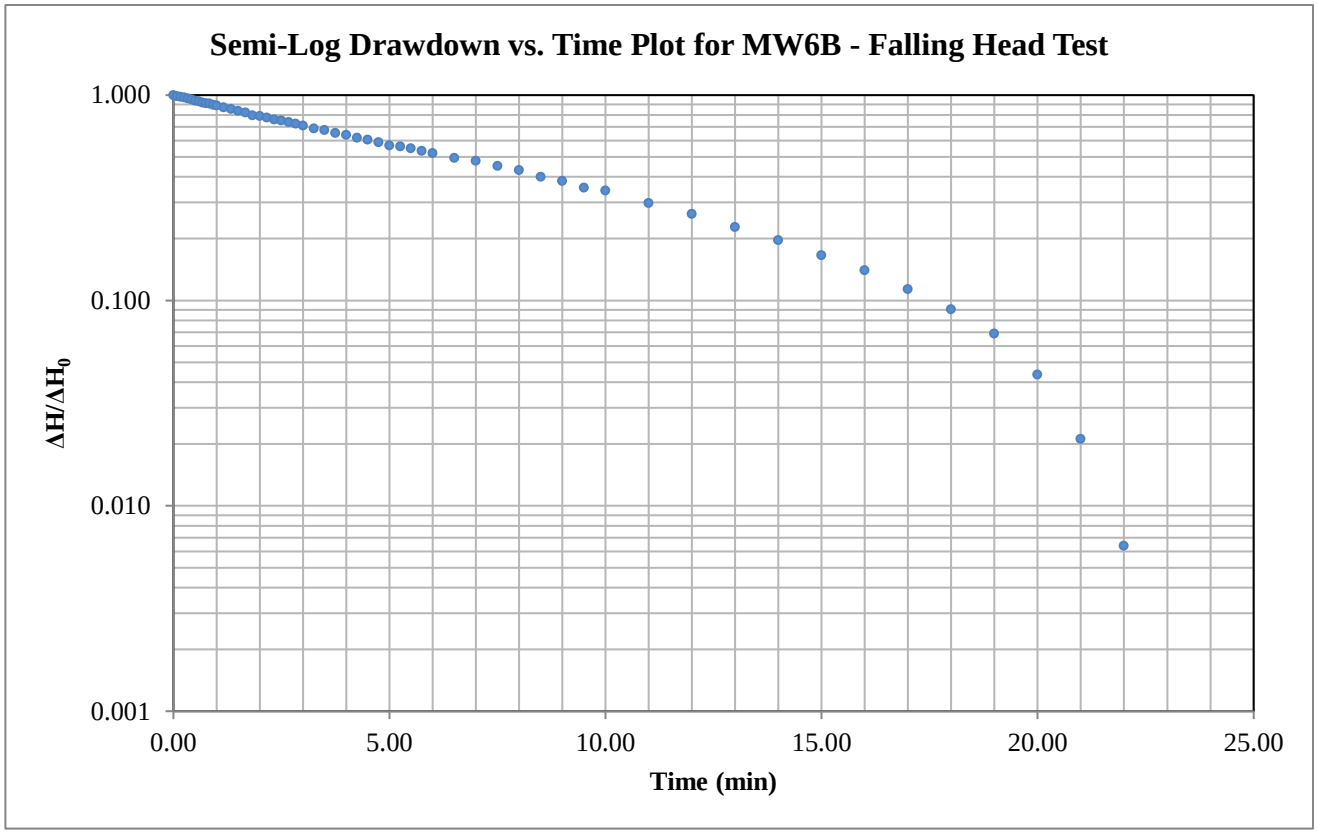
t*: 1063.982 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 1.35E-08 m/sec**

Report: PG4049-1

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW6B
Test: Falling Head
Date: May 16, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

Data Points (from plot):

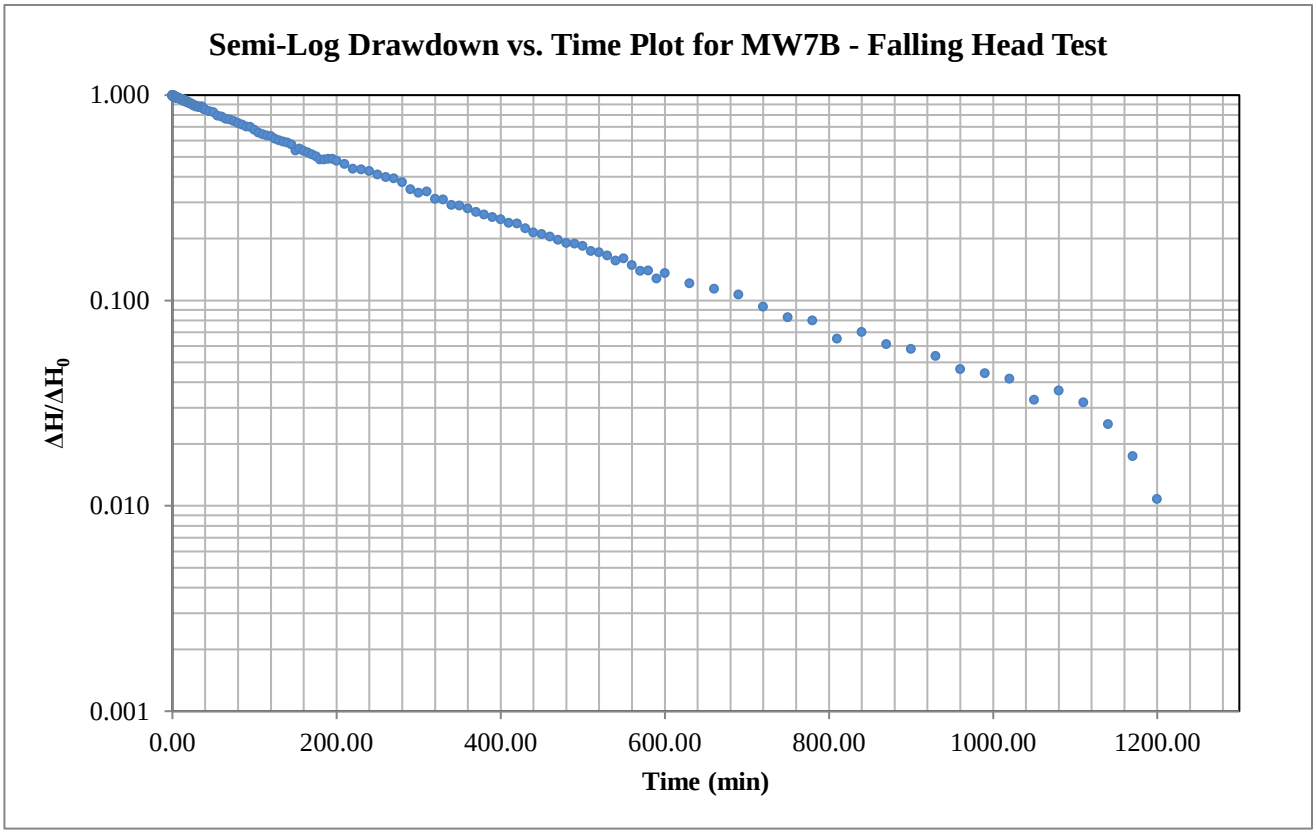
t*: 9.260 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 1.55E-06 m/sec**

Report: PG4049-1

## Hvorslev Hydraulic Conductivity Analysis

Project: PG4049 - Summerside West
Test Location: MW7B
Test: Falling Head
Date: May 11, 2018




Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

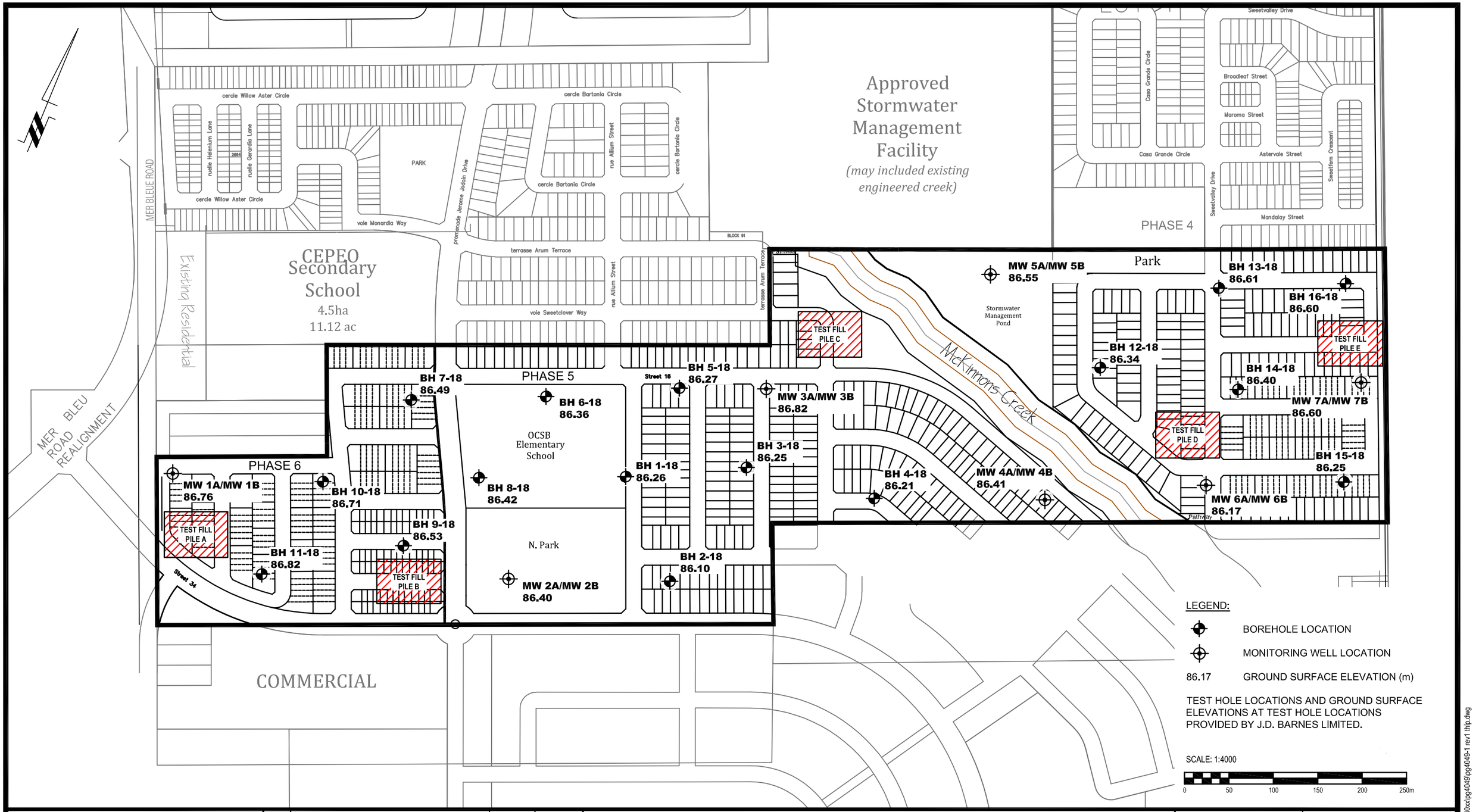
Well Parameters:

| | | | |
|---|---|---|---|
| L | 1.52 | m | Saturated length of screen or open hole |
| D | 0.0508 | m | Diameter of well |
| $r_c$ | 0.0254 | m | Radius of well |

Data Points (from plot):

t*: 283.934 minutes $\Delta H^*/\Delta H_0$: 0.37

**Horizontal Hydraulic Conductivity**
**K = 5.07E-08 m/sec**





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| NO. | REVISIONS | DATE | INITIAL |
|---|---|---|---|
| 0 | | | |

2447591 ONTARIO INC.

GEOTECHNICAL INVESTIGATION
RESIDENTIAL DEVELOPMENT - SUMMERSIDE WEST PHASES 4 & 5
OTTAWA, ONTARIO

Title:

# TEST HOLE LOCATION PLAN

| | |
|---|---|
| Scale: 1:4000 | Date: 03/2018 |
| Drawn by: MPG | Report No.: PG4049 |
| Checked by: SB | Dwg. No.: PG4049-1 |
| Approved by: DJG | Revision No.: 0 |

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