# PRELIMINARY HYDROGEOLOGICAL INVESTIGATION

# PROPOSED SUBDIVISION – 101 MAIN STREET, MARKDALE, ON

**Prepared for:**

**Nivas Development Ltd.**

**C/O: Delbrook Triumphant Builders Inc.)**

**By:**

**Orbit Engineering Limited**

**Project No. OE211312AG**

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**Attention: Mehdi Shafiei**

**Dear Mr. Shafiei,**

**RE: Hydrogeological Investigation**
**Proposed Subdivision – 101 Main Street, Markdale, ON**

Enclosed please find the Preliminary Hydrogeological Investigation report related to the above noted site.

For and on behalf of Orbit Engineering Limited,

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# TABLE OF CONTENTS

## TABLES



## DRAWINGS



## APPENDICES

# LIST OF ACRONYMS AND DEFINITIONS

| | |
|---|---|
| BH | Borehole |
| EASR | Environmental Activity and Sector Registry |
| K | Hydraulic Conductivity |
| mbgs | Metres Below Ground Surface |
| MOECC | Ontario Ministry of the Environment and Climate Change |
| ORCA | Otonabee Region Conservation Authority |
| O.Reg.903 | Ontario's Wells Regulation |
| PTTW | Permit to Take Water |
| PHCs | Petroleum Hydrocarbons |
| VOCs | Volatile Organic Compounds |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| WWIS | Water Well Information System |
| WWR | Water Well Records |

# 1 INTRODUCTION

## 1.1 General

Orbit Engineering Limited (Orbit) was retained by Nivas Development Ltd. (the Client) to complete a Preliminary Hydrogeological Investigation to evaluate the existing site conditions for the proposed subdivision located at the East of Grey Rd 12 and North of Cambrai Road, Markdale, ON (the Site). The approximate location of the proposed structure (the Site) and the approximate borehole location plan are shown on **Drawings 1** and **2.**

It is our understanding that the project will entail a residential/commercial subdivision consisting of 14 semi-detached, 155 townhouses, 18 dwellings above commercial building, 48-unit apartment building, sewer, watermain, and roads. Final grades were not available at the time of writing this report, so the existing grades were assumed and has been presented in this report.

## 1.2 Purpose

The purpose of the Hydrogeological Investigation was to characterize the existing hydrogeological conditions at and in the vicinity of the Site, assess the groundwater regime, and provide recommendations for groundwater control/dewatering (if needed) during the construction of the proposed subdivision development at the Site by means of ten (10) exploratory boreholes (BH1-BH10), and also to provide associated hydrogeological recommendations for the construction activities. For the Hydrogeological Investigation, three (3) boreholes (BH/MW2, BH/MW4, and BH/MW6) were converted to monitoring wells to assess groundwater level fluctuations and groundwater quality at the Site.

The hydrogeological investigation was also requested to evaluate the potential impacts on the local groundwater system in the vicinity of the Site as a consequence of the proposed construction activities and to identify appropriate mitigative measures, if and where necessary. This investigation will also act as a guideline in the assessment of the substructure and the perimeter drainage flow (permanent dewatering) if needed. The hydrogeological investigation was performed based on the information and drawings provided to Orbit by the Client (**Appendix E**).

# 2 METHOD OF INVESTIGATION

## 2.1 General

This Hydrogeological Investigation began with a review of the previously completed geotechnical report by Orbit (Orbit, 2022) and published information within the Site area, including previously published regional physiographic and geologic mapping from Ontario Geological Survey (OGS). Many of these documents are referred to throughout various sections of this report and the relevant details can be found in the **References** section following the text of the report.

In particular, the work completed during this Hydrogeological Investigation consisted of the following tasks:

- Reviewing and interpreting of available reports and publicly published data;
- Developing Health and Safety and, the Field Sampling and Analysis Plans for work at the Site;
- Assessing the current Site conditions, areas of interest and to confirm the previous borehole locations;
- Reviewing water well records available from the Ministry of the Environment, Conservation and Parks (MECP);
- Developing the groundwater monitoring wells installed at the Site;
- Completion of in-situ hydraulic conductivity tests (slug tests) at three (3) monitoring wells;
- Measuring groundwater levels in the monitoring wells located at the Site;
- Collecting and analyzing groundwater quality samples from the monitoring wells;
- Evaluating potential dewatering requirements for the proposed construction at the Site;
- Estimation of the underfloor and perimeter drainage flow for permanent dewatering (if needed); and,
- Preparation of this Hydrogeological Investigation report that provides a summary and interpretation of hydrogeological data collected during the investigation program, as well as an assessment and quantification of groundwater control/dewatering requirements for construction.

## 2.2 Boreholes and Monitoring Wells

Orbit carried out a Geotechnical Investigation at the Site on January 7, 2022 and drilled ten (10) boreholes (BH1-BH10). For this hydrogeological investigation, three (3) boreholes were converted into groundwater monitoring wells ((BH/MW2, BH/MW4, and BH/MW6).

The logs of the ten boreholes are provided in **Appendix A**. The approximate borehole locations are shown in **Drawing 2.**

The ground surface elevation at the borehole locations were inferred from a topography plan provided to Orbit by the Client. The elevations of the boreholes are presented on the borehole log sheets attached in **Appendix A**. The construction details of the monitoring wells are summarized in **Table 2.1** below.

**Table 2.1: Information on Groundwater Monitoring Wells**

| Monitoring Well / Borehole ID | Northing | Easting | Approximate Ground Surface Elevation (mASL) | Depth of Well / Borehole (mBGS) |
|---|---|---|---|---|
| | NAD 83, UTM Zone 17T | | | |
| BH1 | 4907980.51 | 528651.44 | 417.3 | 5.2 |
| BH/MW2 | 4907902.97 | 528683.15 | 416.5 | 5.2 |
| BH3 | 4769625.45 | 585542.15 | 416.8 | 3.9 |
| BH/MW4 | 4907870.79 | 528618.07 | 417.0 | 4.9 |
| BH5 | 4907887.27 | 528554.85 | 419.0 | 5.5 |
| BH/MW6 | 4907807.26 | 528540.2 | 421.5 | 5.2 |
| BH7 | 4907778.29 | 528464.89 | 425.3 | 4.7 |
| BH8 | 4907676.92 | 528585.71 | 425.8 | 5.1 |
| BH9 | 4907800.96 | 528694.16 | 417.3 | 3.8 |
| BH10 | 4907873.8 | 528758.61 | 417.0 | 5.2 |

## 2.3 Groundwater Monitoring and Sampling

Orbit's staff visited the site on February 15, 2022, to collect groundwater samples to be analyzed under City of Toronto Sanitary and Storm Sewer Use By-laws. Prior to sampling and hydraulic conductivity testing, the monitoring wells (BH/MW2, BH/MW4 and BH/MW6) were developed using a low-density polyethylene tubing and a Waterra foot valves.

The development of the monitoring well was conducted by purging and surging the well water to stress the formation around the well screen so that mobile particulates were removed. The purpose of the well development is to improve the hydraulic connection between the well and the geologic materials in the vicinity of the well, and to subsequently obtain a groundwater sample representative of the in-situ conditions. The groundwater level was measured in the monitoring wells after completing the development process.

The collected samples were submitted to Eurofins Laboratories, a member of the Canadian Association for Laboratory Accreditation (CALA), for chemical analysis. Copies of the laboratory certificates of analysis are provided in **Appendix B**.

### 2.4 In-Situ Hydraulic Conductivity Testing

Single well response tests were conducted on the monitoring wells BH/MW2 and BH/MW4 to assess the subsurface hydraulic conductivity conditions. The test was not conducted at BH/MW6 due to less water column in the well.

A summary of the single well response test (hydraulic conductivity test) methodology was as follows:

- At the start of the test, the static groundwater level in the monitoring well was initially measured and recorded;
- A datalogger was installed in the well below the water level and configured to measure absolute pressure (water pressure + atmospheric pressure) on a regular interval;
- Falling head tests were carried out using a solid slug of known volume introduced into the well, and the reverse technique was also carried out (i.e., slug removal) for a corresponding rising head test;
- The water level was then measured and recorded at regular time intervals and until the water level had recovered to a level close to the static water level measured before the start of the test.

The water level data from the monitoring well were analysed using AQTESOLV Professional V4.5 and the Bouwer-Rice equation to estimate the hydraulic conductivity (K) of the geologic materials adjacent to the screened portion of the well.

## 3 SITE CONDITIONS

### 3.1 Physical Setting

The subject site is located at the East of Grey Rd 12 and North of Cambrai Road, Markdale, ON. The site topography is relatively flat at the North side whereas at South side it slopes towards Northeast. The site is located in a moderately developed area consisting of residential development in the south and west side, constructed in different years, whereas in the North and East side the site is surrounded by open and vacant

land. The project site is currently vacant. **Drawings 1** and **2** present a site plan and approximate boreholes and monitoring wells location. According to the Oak Ridges Moraine Atlas, which is available online at (https://www.ontario.ca/page/oak-ridges-moraine) and the Niagara Escarpment Plan (NEP) Maps available online at (https://www.escarpment.org/home), the Site is not located within an area where either the Oak Ridges Moraine Conservation Plan or the Niagara Escarpment Plan would be applicable.

## 3.2 Climatic Conditions

Average monthly climate data from an Environment Canada climate station located at the Proton Station (Station ID 6116750), approximately 20 km Southeast of the Site, for the period between 1981 and 2010 is provided in **Table 3.1** (www.climate.weather.gc.ca/climate_normals/). The data indicates that the climate in the study area is typical continental with cold winters and warm summers and precipitation records showing local seasonal variation. As shown **Table 3.1**, below, the mean annual precipitation is 1106.3mm/year, with an annual mean rainfall of 785.5mm/year (71.0% of total precipitation). Average monthly precipitation ranged from 72.1mm in April to 110.9mm in November. The mean annual daily temperature is 5.2 degrees Celsius (°C), ranging from -8.3 °C in January to 17.8 °C in July.

**Table 3.1: Climate Data Summary (1981 – 2010) –Proton Station (ID 6116750)**

| MONTH | Daily Average Temperature (°C) | Average Rainfall (mm) | Average Snow (cm) | Average Precipitation (mm) |
|---|---|---|---|---|
| January | -8.3 | 24.6 | 83.1 | 107.8 |
| February | -7.4 | 24.0 | 60.3 | 84.3 |
| March | -3.4 | 35.0 | 44.2 | 79.2 |
| April | 4.5 | 59.0 | 13.1 | 72.1 |
| May | 10.8 | 89.3 | 0.5 | 89.8 |
| June | 15.5 | 93.5 | 0.0 | 93.5 |
| July | 17.8 | 77.9 | 0.0 | 77.9 |
| August | 17.1 | 91.9 | 0.0 | 91.9 |
| September | 12.9 | 104.2 | 0.2 | 104.4 |
| October | 7.1 | 86.7 | 5.6 | 92.3 |
| November | 0.9 | 71.3 | 39.7 | 110.9 |
| December | -5.0 | 28.1 | 74.1 | 102.1 |
| Year | 5.2 | 785.5 | 320.8 | 1106.3 |
| NOTE: Data was obtained from the Environment Canada website (Environment Canada, 2017). | | | | |

## 3.3 Physiography and Drainage

The Site is located in the physiographic region known as the Horseshoe Moraines. The physiographic landform in which the Site exists is called the Till Plains. This physiographic region consists of a broad belt of north-south trending moraines (of sand and salt tills) lying west of the Niagara Escarpment, between

Orangeville and Acton (Chapman and Putman, 1984). Soils of this physiographic region are coarse-grained and more permeable than in other parts of the study area, allowing for significant recharge (infiltration) of water to underground aquifers (Credit valley Conservation, 2007b).

Local, shallow, groundwater flow patterns are expected to mimic local topography and be directed to the North towards Georgian Bay.

## 3.4 Geological Mapping

A review of available published surficial geology mapping from OGS (2010) indicates that sandy silt to silty sand-textured till on Paleozoic terrain deposits occur in the immediate vicinity of the Site. As shown in **Drawing # 4**, two (2) primary surficial geologic unit are interpreted by OGS to occur within the vicinity of the Site, including (chronologically from older to younger units)

- Unit 5b: Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain.
- Unit 6: Ice-contact stratified deposits, sand and gravel, minor silt, clay and till

## 3.5 Subsurface Soil Conditions

The subsurface soil conditions encountered during boreholes advanced at the Site are shown on the borehole logs attached in **Appendix A**. A summary of the soil conditions is provided below. The borehole logs indicate the subsurface conditions only at the borehole locations. Note that the material boundaries indicated on the attached logs are approximate and based on visual observations. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should be pointed out that the subsurface conditions will vary across this Site.

## 3.6 Soil Conditions

The soils explored in the boreholes generally consisted of surficial topsoil and native soil layers.

### 3.6.1 Topsoil

The thickness of the topsoil explored in the boreholes generally ranged from 150 to 200 mm. The data provided here pertaining to the topsoil thickness is confirmed at the borehole locations only and may vary between and beyond the boreholes. This information is not considered to be sufficient for estimating topsoil quantities and associated costs.

### 3.6.2 Weathered/Disturbed Sand and Silt

The Upper Weathered Zone to depths ranging from 0.8 to 1.5 m below the existing grade consisted of weathered/disturbed sand and silt, trace clay and gravel, trace organics and rootlets, dark brown, moist, and in loose to compact state. The measured moisture contents of sand and silt deposits were ranging from 7 to 40.2%

Typical grain size distribution curve of clayey silt soil samples in borehole BH/MW2 show the following gradation:

| | |
|---|---|
| Gravel: | 1 % |
| Sand: | 55 % |
| Silt: | 39 % |
| Clay: | 5 % |

### 3.6.3 Silty Sand Till

Layer of silty sand till was encountered below the weathered and/or disturbed zone generally consisted of silty sand till, moist, brown to reddish brown, and in loose to compact state, extending to depths ranging from 1.5 to 3.2 m below the existing grade. The measured moisture contents of silty sand till deposits were ranging from 5.4 to 21.5%.

Standard Penetration tests yielded N-values of 2 to 20 blows/0.3 m. The results indicate that the relative density of the silty sand deposit can be described as loose to compact.

Typical grain size distribution curve of silty sand till samples in borehole BH/MW4 show the following gradation:

| | |
|---|---|
| Gravel: | 26 % |
| Sand: | 39 % |
| Silt: | 30 % |
| Clay: | 5 % |

### 3.6.4 Sand and Gravel

Below silty sand till, a layer of sand and gravel was encountered at depths ranging for 0.8 to 2.1m below the existing ground level and extended to the end of boreholes. This layer consisted of sand and gravel, weathered limestone, some silt, moist to wet, brown to light brown and in dense to very dense state. The measured moisture contents of the native sand and gravel deposits were ranging from 7.8 to 20.9%.

Standard Penetration tests yielded N-values of 3 to 105 blows/0.3 m. The results indicate that the relative density of the sand and gravel deposits can be described as compact to very dense.

Typical grain size distribution curve of sand and gravel samples at different depths in boreholes BH/MW2 and BH/MW6 show the following gradation:

| | |
|---|---|
| Gravel: | 21-38 % |
| Sand: | 39-45 % |

Silt: 16-33 %

Clay: 1-7 %

# 4 GROUNDWATER CONDITIONS

## 4.1 Regional Groundwater Recharge

Recharge is the process by which groundwater is replenished and involves the vertical infiltration of water through the subsoil deposits and geologic materials to the saturated zone. The major sources of recharge in the study area are a result of precipitation and freshet. The amount of groundwater recharge in a particular area depends on surficial geology, topography, and the extent of land development in that area. Generally, regional groundwater recharge is irregularly distributed temporally and spatially as interpreted from specific climatic conditions, local geology, and land development status.

The Site is located in a moderately developed area, surrounded by residential development lots contained impermeable paved surfaces and rooftops in the South and West side, whereas in the North and East side the site is surrounded by open and vacant land. The groundwater recharge is expected in the green open spaces located at the North and East of Site. Generally, the area of the Site is expected to have a moderate to high groundwater recharge rate due to the presence of Stone-poor, sandy silt to silty sand-textured till at the surface. The proposed site is located in an unrestricted unpaved area and no major changes are expected in the groundwater recharge rate due to the planned construction.

## 4.2 Groundwater Level Fluctuations

The groundwater level data collected from the monitoring wells are provided in **Table 4.1**, below and in the borehole logs in **Appendix A**. The groundwater level elevations range from a low of 415.0 mASL in well BH/MW2 to a high of 418.4 mASL in well BH/MW6

It should be noted that groundwater conditions vary depending on factors such as temperature, season, precipitation, construction activity, and other situations, which may be different from those encountered at the time of the monitoring. The possibility of groundwater level fluctuations at the Site should be considered when designing and developing the construction plans for the project.

Regional groundwater flow in the area typically reflects the local topography and generally occurs from topographic highs to topographic lows. The dominant regional groundwater flow direction is expected to be north towards the Georgian Bay.

## 4.3 Inferred Hydrostratigraphy

The subsurface investigations revealed that beneath the surficial materials, the subsurface conditions encountered in the boreholes consisted of Topsoil, overlaying native geologic material of weathered/disturbed sand and silt,undisturbed silty sand till and, sand and gravel. The native undisturbed soil was encountered at depths of 0.9m - 2.3m below the existing ground surface to the end of boreholes.

Groundwater was encountered in boreholes BH1, BH/MW2, BH3 and BH/MW4. Conditions encountered in the monitoring wells in the native layer indicated that the groundwater in this layer can be considered under unconfined aquifer conditions.

**Table 4.1: Summary of Groundwater Level Observations in Monitoring Wells**

| Well No. | Date of Drilling | Date of Water Measurement | Depth of Monitoring Well (m) | Depth/Elevation of Groundwater (m) |
|---|---|---|---|---|
| BH/MW2 | Jan 7, 2022 | During drilling | 4.3 | 0.60 / 415.9 |
| | | Feb 15, 2022 | | 1.50 / 415.0 |
| BH/MW4 | Jan 7, 2022 | During drilling | 4.5 | 3.05 / 413.9 |
| | | Feb 15, 2022 | | 1.50 / 415.5 |
| BH/MW6 | Jan 7, 2022 | During drilling | 3.2 | -- |
| | | Feb 15, 2022 | | 3.10 / 418.4 |

## 4.4 Results of In-Situ Hydraulic Conductivity Tests

**Table 4.2** summarizes the results of the slug testing (hydraulic conductivity) estimated using AQTESOLV-Pro Software for the collected data and the hydro-stratigraphic units in which the monitoring wells were screened. Monitoring wells BH/MW2 and BH/MW4 were tested for hydraulic conductivity. The hydraulic conductivity data analysis sheets are presented in **Appendix C**.

**Table 4.2: Summary of In-Situ Hydraulic Conductivity Test Results**

| Monitoring Well ID | Analytical Method | Type of Slug Test | Hydraulic Conductivity (cm/Sec) | Screened Stratigraphic Unit(s) |
|---|---|---|---|---|
| BH/MW2 | Bouwer Rice | Falling Head | $1.22 \times 10^{-4}$ | **Sand and Gravel:** some silt, brown, wet, loose |
| BH/MW4 | Bouwer Rice | Falling Head | $1.051 \times 10^{-4}$ | **Sand and Gravel:** some silt, weathered limestone, light brown, wet, compact |

## 4.5 Groundwater Use in the Study Area

A review of the available data from the MECP Water Well Information System (WWIS) database was carried out to identify active wells near the Site. The database search was requested for the area located within 500m from the Site. This search identified records for one water supply wells and three monitoring wells.

**Drawing 5** presents the locations of the identified wells as well as the associated water use categories within 500 m around the Site. A detailed table showing water well record (WWR) information for these wells is provided in **Appendix D**.

The observation wells identified in the database search are considered most likely to be associated with recent construction activities and/or infrastructure upgrades in the area. It is assumed that one well installed in 2002, which is approximately 200m south-east of the site is used as domestic water supply well. This is consistent with the expectations that potable water in the study area is available from the Municipality of Grey Highlands.

Based on the hydrogeological information and data analysis in this report, the potential impacts to surface water and groundwater resources in the vicinity of the Site due to construction of the proposed structure at the Site are not considered significant. The area of the Site is currently serviced with the municipal water supply from the Municipality of Grey Highlands.

## 4.6 Groundwater Quality for Temporary Dewatering

Orbit understands that during construction, the groundwater pumped in conjunction with excavation dewatering (where required) may be discharged into the Municipality of Grey Highlands sanitary and storm sewer systems. In this case, the discharge water quality will have to conform to the discharge limits identified in the municipal By-Law.

As part of the hydrogeological investigation, Orbit collected water samples from wells BH/MW4 for chemical analysis. The purpose of the chemical analysis was to identify potential disposal options for excess water generated during the construction. The water samples were examined in the field for aesthetic evidence of impacts (i.e. debris, staining, and odours). In accordance with the Ministry of the Environment, Conservation and Parks (MECP) sampling protocols, the water samples were placed directly into laboratory supplied containers for chemical analysis.

Eurofins Laboratories of Ottawa, Ontario conducted the chemical analyses on the collected samples. Eurofins is a member of the Canadian Association for Laboratory Accreditation Inc. (CALA) and meets the requirements of Section 47 of Ontario Regulation 153/04 (O. Reg. 153/04) certifying that the analytical laboratory is accredited in accordance with the International Standard ISO/IEC 17025 and with standards developed by the Standards Council of Canada. The results of the water samples submitted to chemical analyses were compared to the City of Toronto Sanitary and Storm Sewer Guidelines, which are more stringent.

The laboratory certificates of analysis are provided in **Appendix B**. These results showed that most concentrations of analyzed parameters were found to be below the City of Toronto Sanitary and Storm sewer limits, except for the trichloroethylene in the storm sewer guidelines. **Table 4.3** summarizes the water quality exceedances from the City of Toronto Storm Sewer By-Law guidelines.

Based on these results, it is anticipated that groundwater removed for dewatering purposes during excavation can be discharged into the Municipality of Grey Highlands sanitary and storm sewer system, provided that a discharge permit is obtained from the Municipality of Grey Highlands. Care should be taken to prevent the movement of sediment with the groundwater, a proper filtration or sediment settlement

tank should be used. In addition to that, care should be taken with regards to the trichloroethylene that were found to be exceeding the City of Toronto storm sewer guidelines.

**Table 4.3: Summary of the Water Quality Exceedances from the City of Toronto Storm Guidelines – Well BH/MW4**

| Guideline | Group | Analyte |
|---|---|---|
| City of Toronto - Storm | Volatiles | Trichloroethylene |

# 5 GROUNDWATER DEWATERING ESTIMATES

## 5.1 Introduction

Based on the information provided to us by the client, we understand that the project will entail a residential/commercial subdivision consisting of 14 semi-detached, 155 townhouses, 18 dwellings above commercial building, 48-unit apartment building, sewer, watermain, and roads.

It is our further understanding that the foundations for the proposed structures will be designed on undisturbed native soils or engineered fill. The maximum anticipated depth of footing would be about 1.5m-2.0m below the existing grade, if the basement has been planned for the proposed townhouses. The highest groundwater level measured in the monitoring wells installed at the Site was about 1.5m below the ground surface (i.e., 215.0mASL) measured in monitoring well BH/MW2. It is assumed that the base of the footings will be below/above the groundwater table. Therefore, dewatering during excavation construction may be required for the proposed structure to keep ground water level at least 1.0m below the excavation level.

The summary of preliminary assessment of dewatering requirements is presented in **Table 5.1**

**Table 5.1: Summary of Preliminary Assessment of Dewatering Requirements**

| Planned Construction Information | | | | | | Groundwater Information | | | Dewatering Estimation Information | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Structure Name | Approx. Length of Excavation (m) | Approx. Width of Excavation (m) | Ground Surface Elevation (mASL) | Elevation of Approx. Depth of Excavation [A] (mASL) | Approx. Depth of Excavation (m) | Representative Monitoring Well | Measured Highest Groundwater Level Elevation [B] (mASL) | Estimated Drawdown (m) [B-A+1[1]] | Construction Dewatering Needed? (Yes/No) | Dominant Soil Type(s) | Hydraulic Conductivity (cm/s) |
| Commercial Development with 18 Dwelling Units | 104 | 60 | 422 | 420.5 | 1.5 | BH/MW6 | 418.4 | - | No | Sand and Gravel | - |
| Apartments (48 Dwelling Units) | 94 | 37 | 416.9 | 415.4 | 1.5 | BH/MW4 | 415.5 | 1.1 | Yes | Sand and Gravel | $1.051x10^{-4}$ |
| Townhouses (1-9) | 63 | 51 | 423.5 | 421.5 | 2.0 | BH/MW6 | 418.4 | - | No | Sand and Gravel | |
| Townhouses (10-33) | 150 | 36 | 421 | 419 | 2.0 | BH/MW4 | 415.5 | - | No | Sand and Gravel | |
| Townhouses (34-57) | 155 | 36 | 419.7 | 417.7 | 2.0 | BH/MW4 | 415.5 | - | No | Sand and Gravel | |
| Townhouses (58-72) | 96 | 36 | 417.5 | 415.5 | 2.0 | BH/MW2 | 415.0 | 0.5 | Yes | Sand and Gravel | $1.22x10^{-4}$ |
| Townhouses (73-86) | 69 | 48 | 417.5 | 415.5 | 2.0 | BH/MW2 | 415.0 | 0.5 | Yes | Sand and Gravel | $1.22x10^{-4}$ |
| Townhouses (87-93) | 48 | 36 | 417 | 415.0 | 2.0 | BH/MW2 | 415.0 | 1.0 | Yes | Sand and Gravel | $1.22x10^{-4}$ |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Townhouses (94-104) | 72 | 36 | 421 | 419.0 | 2.0 | BH/MW4 | 415.5 | - | No | Sand and Gravel | |
| Townhouses (105-115) | 69 | 36 | 423 | 421.0 | 2.0 | BH/MW4 | 415.5 | - | No | Sand and Gravel | |
| Townhouses (116-127) | 75 | 36 | 425 | 423.0 | 2.0 | BH/MW6 | 418.4 | - | No | Sand and Gravel | |
| Semi-Detached (128-135) | 74 | 36 | 428.8 | 426.8 | 2.0 | BH/MW6 | 418.4 | - | No | Sand and Gravel | |
| Townhouses (136-150) | 97 | 36 | 425 | 423.0 | 2.0 | BH/MW6 | 418.4 | - | No | Sand and Gravel | |
| Townhouses (151-160) | 66 | 36 | 423 | 421.0 | 2.0 | BH/MW4 | 415.5 | - | No | Sand and Gravel | |
| Townhouses (161-169) | 62 | 36 | 421 | 419.0 | 2.0 | BH/MW2 | 415.0 | - | No | Sand and Gravel | |
| SWM Pond | 150 | 50 | 417.5 | 415.0 | 2.5 | BH/MW2 | 415.0 | 1.0 | Yes | Sand and Gravel | $1.22x10^{-4}$ |

## 5.2 Dewatering Rate Estimation

Anticipated daily dewatering rates were estimated using the equations provided in the reference book "Construction Dewatering and Groundwater Control: New Methods and Applications - Third Edition. New York, New York: John Wiley & Sons (Powers et. al., 2007)", for a trench excavation. Steady flow to the excavation was assumed for the purpose of the analysis. The "trench excavation" referred to herein is an excavation configuration of a rectangular, where the ratio of the length to the width is less than 1.5. The referred equation considers a total groundwater inflow rate ($Q_T$) to an excavation trench consisting of two (2) components, $Q_M$ and $Q_R$, as follows:

$$Q_T = Q_M + Q_R$$

Where

$Q_M$ Linear flow rate for the trench section;

$Q_R$ Radial flow through the two ends of the excavated trench.

Using this equation and considering the proposed excavation area, and based on the hydrogeological parameters of the formation expected to be encountered as well as the drawdown needed (assumed 1.0 m below the invert of the trench excavation), the estimated daily pumping rate to achieve the required drawdown was calculated as follows:

The linear flow component QM [$m^3$/d], represents groundwater inflow portion to the trench through the excavation length. The linear flow rate depends on the aquifer properties such as hydraulic conductivity, thickness, and static water level as well as excavation length and depth, and the zone of influence. The linear flow rate calculation equation is as follows:

$$Q_M = \frac{x K \left(H^2 - h^2\right)}{L_o}$$

Where:

- x Length of the trench [m];
- K Hydraulic conductivity [m/d];
- H Distance from static water level to the bottom of the aquifer [m];
- h Distance from lowered water level to the bottom of the aquifer [m], and;
- L Distance from a point of greatest drawdown to a point where there is no drawdown (zone of influence) [m]. It was estimated approximately using the following empirical relationship developed by Sichart:
- $L_o = 3000(H - h)K^{0.5}$ (K in m/s) (Powers et al., 2007).

The radial flow component, $Q_R$ [$m^3$/d], represents the groundwater inflow portion to the trench through the two ends of the excavated trench. The radial flow rate depends on aquifer properties such as

hydraulic conductivity, thickness, and static water level, as well as the excavation length, width, and depth, and the zone of influence. The radial flow rate calculation equation is as follows:

$$Q_R = \frac{\pi K \left( H^2 - h^2 \right)}{\ln \left( \frac{R}{r_e} \right)}$$

Where:

K Hydraulic conductivity [m/d];

H Distance from static water level to the bottom of the aquifer [m];

h Distance from lowered water level to the bottom of the aquifer [m];

R Radius of the cone of depression (zone of influence) [m], estimated approximately using the following empirical relationship developed by Sichart

$$R_o = r_s + C(H - h)\sqrt{K}$$

C = constant (unitless; 3,000 for radial flow to pumped wells and between 1,500 and 2,000 for line flow to trenches or to a line of wellpoints)

$r_s$ equivalent radius estimated to be equal to half the width of the trench (Cashman and Preene, 2001).

**To lower the water table 1 m below the bottom of the excavation ,**it is estimated that the total dewatering rate for the whole site with 100% contingency to be approximately 163.6 $m^3$/day. The total flow at any time will depend on the length of excavation that needs dewatering and the expected rate of progress. The zone of influence ($R_o$) for each structure in the project is provided in Table 5.2.

The calculated groundwater daily pumping rate for any structure (Table 5.2) in the project does not exceed the MECP threshold of 50 $m^3$/day for EASR registration if the excavation for each structure is carried out individually or grouped in a way that dewatering quantity does not exceed threshold. However, EASR will be applicable if the excavation for the whole project will be carried out at the same time as the total dewatering quantity for the project site (163.6 m3/day) exceeds MECP threshold for EASR registration. The maximum dewatering rate for an individual excavation segment (SWM Pond) within the project with a contingency 100% was estimated to be 44.3 $m^3$/day and the maximum zone of influence (R) was estimated to be 52m.

Orbit understands that the Client plans it to limit the excavation works for one structure at each time or structures grouped in a way that dewatering quantity does not exceed threshold of 50 $m^3$/day. Then in this case ESAR registration is not required for this project.

It is expected that there will be variations and changes in the amount of groundwater that can be pumped from any part of the site, thus, allowing a **100%** contingency for the variability in hydraulic conductivity

that could be experienced, the maximum expected pumping rate needed for each excavation segment (Table 5.2) is anticipated to be **less than 50 $m^3$/day**.

In this calculation, water volume due to precipitation has not been considered and it was assumed that the contractor would prevent the surface water from entering the excavation. However, in an unlikely event, if the quantities more than 50 $m^3$/day was encountered during the construction for one structure, Orbit should be contacted for further advice.

Based on the assumptions and the results of the Dewatering Assessment presented herein, it is recommended that the water-taking activity may not be filed on MECP's EASR system, in accordance with the requirements of O.Reg. 63/16 (as amended).

It is important to address that the assumed excavation depths and areas for the dewatering volume estimation in this report are based on our assumptions and understanding of the proposed development and the information provided by the Client. In the case of any modifications of the design or the assumed depths and areas are changed compared to the data provided by the client during report preparation time, Orbit must be consulted, and the dewatering estimation may need to be revised accordingly. It is known that the subsurface soil conditions may change significantly between and beyond the onsite boreholes. As the information obtained and assumptions made in this investigation report are based on the results obtained from a limited number of investigated locations, unexpected water bearing zones with a hydraulic conductivity higher than that used in these calculations may be present. In addition, the above estimated dewatering volumes are based on the estimated hydraulic conductivities (K-value) from limited in-situ slug tests.

It should be noted that it is the responsibility of the contractor to ensure dry conditions are always maintained within the excavation works.

**Table 5.2** summarizes the estimated groundwater dewatering requirements to lower the water table to 1 m below the bottom of the excavation.

**Table 5.2: Summary of Estimated Groundwater Dewatering Requirements for the Construction of Apartments, Townhouses and SWM Pond**

| Planned Construction Information | | | Wells and Groundwater Information | | | Dewatering Estimation Information | | |
|---|---|---|---|---|---|---|---|---|
| Construction Type | Ground Surface Elevation (mASL) | Elevation of Approximate Depth of Excavation (mASL) | Representative Monitoring Well | Measured Highest Groundwater Level Elevation (mASL) | Hydraulic Conductivity (cm/s) | Estimated Dewatering Rate ($m^3$/day) | Estimated Dewatering Rate with 100% Contingency ($m^3$/day) | Zone of Influence ($R_o$) (m) |
| Apartments (48 Dwelling Units`) | 416.9 | 415.4 | BH/MW4 | 415.5 | $1.051x10^{-4}$ | 15.9 | 31.8 | 36.7 |
| Townhouses (58-72) | 417.5 | 415.5 | BH/MW2 | 415.0 | $1.22x10^{-4}$ | 16.5 | 33.1 | 34.8 |
| Townhouses (73-86) | 417.5 | 415.5 | BH/MW2 | 415.0 | $1.22x10^{-4}$ | 16.2 | 32.4 | 34.1 |
| Townhouses (87-93) | 417 | 415.0 | BH/MW2 | 415.0 | $1.22x10^{-4}$ | 11.0 | 22.0 | 26.6 |
| SWM Pond | 417.5 | 415.0 | BH/MW2 | 415.0 | $1.22x10^{-4}$ | 22.1 | 44.3 | 52.0 |

### 5.3 Long-Term Drainage System

The long-term drainage plan will be provided in the final report, When the basement finish floor will be finalized and provided to Orbit

## 6 PREDICTED EFFECTS

Based on the hydrogeological information and data analysis in this report, the potential impacts to surface water and groundwater resources in the vicinity of the Site due to construction of the proposed structure at the Site are described below.

### 6.1 Groundwater Use

As indicated in Section 4.5, the search of the MECP water well records indicated that about one well to a depth of 12.8m was installed in 2002, which is approximately 200m south-east of the site and is assumed to be used as domestic water supply well. The area of the Site is currently serviced with a municipal water supply from the Municipality of Grey Highlands. Since the amount of dewatering is limited (44.3 $m^3$/day) for the SWM Pond excavation segment, interference with off-Site groundwater users due to the short-term construction-related dewatering for this project is not anticipated. Therefore, a water well survey is not recommended for this project.

### 6.2 Surface Water Resources

No permanent surface water streams are present within the estimated zone of influence. Based on this assessment, impacts to the surface water are not anticipated.

### 6.3 Potential Ground Settlement

Potential ground settlement/subsidence related to existing pavements, sidewalks, buildings, utilities, sewers, and other structures/infrastructure within the possible dewatering radius of influence ($R_o$) has not been assessed under this hydrogeological investigation. Orbit recommends that the construction contractor retain a qualified and an experienced engineer to complete this assessment based on the estimated dewatering $R_o$ and the magnitude of drawdown required to allow for the construction of the planned project at the Site.

# 7 SUMMARY AND CONCLUSION

Based on the results of the subsurface investigation, hydrogeological assessment, and analysis of hydraulic conductivity testing and groundwater level monitoring data, the following summary of conclusions and recommendations is provided:

- The soil lithology in the proposed construction area is generally composed of Topsoil, overlaying native geologic material of weathered/disturbed sand and silt, undisturbed silty sand till and, sand and gravel. The native undisturbed soil was encountered at depths of 0.9m - 2.3m below the existing ground surface to the end of boreholes.
- Groundwater table fluctuations within the project Site were encountered between 1.5 to 3.1m below the existing grade. The highest groundwater table observed in the site was 1.5m below ground surface. For the purpose of dewatering assessment, monitoring well BH/MW2 and BH/MW4 data was considered.
- it is estimated that the total dewatering rate for the whole site with 100% contingency to be approximately 163.6 $m^3$/day. The total flow at any time will depend on the length of excavation that needs dewatering and the expected rate of progress. The highest zone of influence ($R_o$) was estimated to be approximately 52m.The calculated groundwater daily pumping rate for any structure in the project does not exceed the MECP threshold of 50 $m^3$/day for EASR registration if the excavation for each structure is carried out individually or grouped in a way that dewatering quantity does not exceed threshold. However, EASR will be applicable if the excavation for the whole project will be carried out at the same time as the total dewatering quantity for the project site (163.6 m3/day) exceeds MECP threshold for EASR registration.
- It is recommended that the short-term dewatering system be designed and evaluated by a qualified engineer and performed by a licensed dewatering contractor. The dewatering engineer/contractor should be reminded that during the dewatering activities, care must be taken to prevent the removal of fine soil particles with the pumped water or to use proper filtration prior to discharge to the city sewer system.
- No surface water within the zone of influence was observed. Based on this assessment, impacts to the surface water are not anticipated.
- Discharge from temporary dewatering (if required) during the construction can potentially be directed into the Municipality of Grey Highlands sanitary and storm sewer system, provided that a discharge permit is obtained from the Municipality of Grey Highlands. Care should be taken to prevent the movement of sediment with the groundwater, a proper filtration or sediment settlement tank should be used. In addition to that, care should be taken with regards to the trichloroethylene that were found to be exceeding the City of Toronto storm sewer guidelines. The groundwater should be tested prior to discharge into the sanitary sewer for the parameters identified in the Municipality of Grey Highlands Sanitary Sewer Use By-Law.
- Orbit recommends the decommissioning of existing groundwater monitoring wells after completion of the construction of the project. In conformance with Ontario's Wells Regulation

(O.Reg.903) of the Ontario Water Resources Act, the installation and eventual decommissioning of groundwater wells must be carried out by a licensed well contractor. If a well will be damaged/destroyed during the construction activities, then the well should be properly decommissioned in advance of that work.

- Potential ground settlement/subsidence related to existing pavements, sidewalks, buildings, utilities, sewers, and other structures/infrastructure within the possible dewatering radius of influence ($R_o$) has not been assessed under this hydrogeological investigation. Orbit recommends that the construction contractor retain a qualified and an experienced engineer to complete this assessment based on the dewatering $R_o$ and magnitude of drawdown required to allow for the construction of the planned project at the Site.

# 8 STATEMENT OF LIMITATIONS

The contents of this report are subject to the attached 'Limitations of Report' sheet attached to this report. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for proper use and interpretation of this report. The Statement of Limitations is not intended to reduce the level of responsibility accepted by Orbit, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

This report was prepared by Orbit exclusively for the account of Nivas Development Ltd. (the CLIENT). Other than by the CLIENT, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of Orbit. Any use, reliance on or decision made by any person other than CLIENT based on this report is the sole responsibility of such other person. The CLIENT and Orbit make no representation or warranty to any other person with regard to this report and the work referred to in this report and the CLIENT and Orbit accept no duty of care to any other person or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred by any other person as a result of the use of, reliance on, any decision made or any action taken based on this report or the work referred to in this report.

# 7 CLOSURE

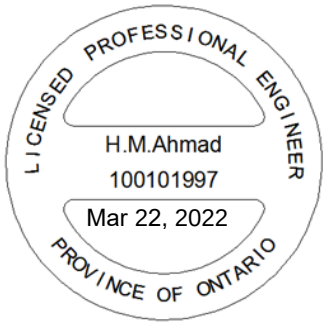
We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

For and on behalf of Orbit,

**Aly Ahmed,** Ph.D., P.Eng
Senior Engineer


Reviewed by

**Hafiz Muneeb Ahmad,** M.Eng., M.Sc., P.Eng., $QP_{ESA}$
Senior Principal



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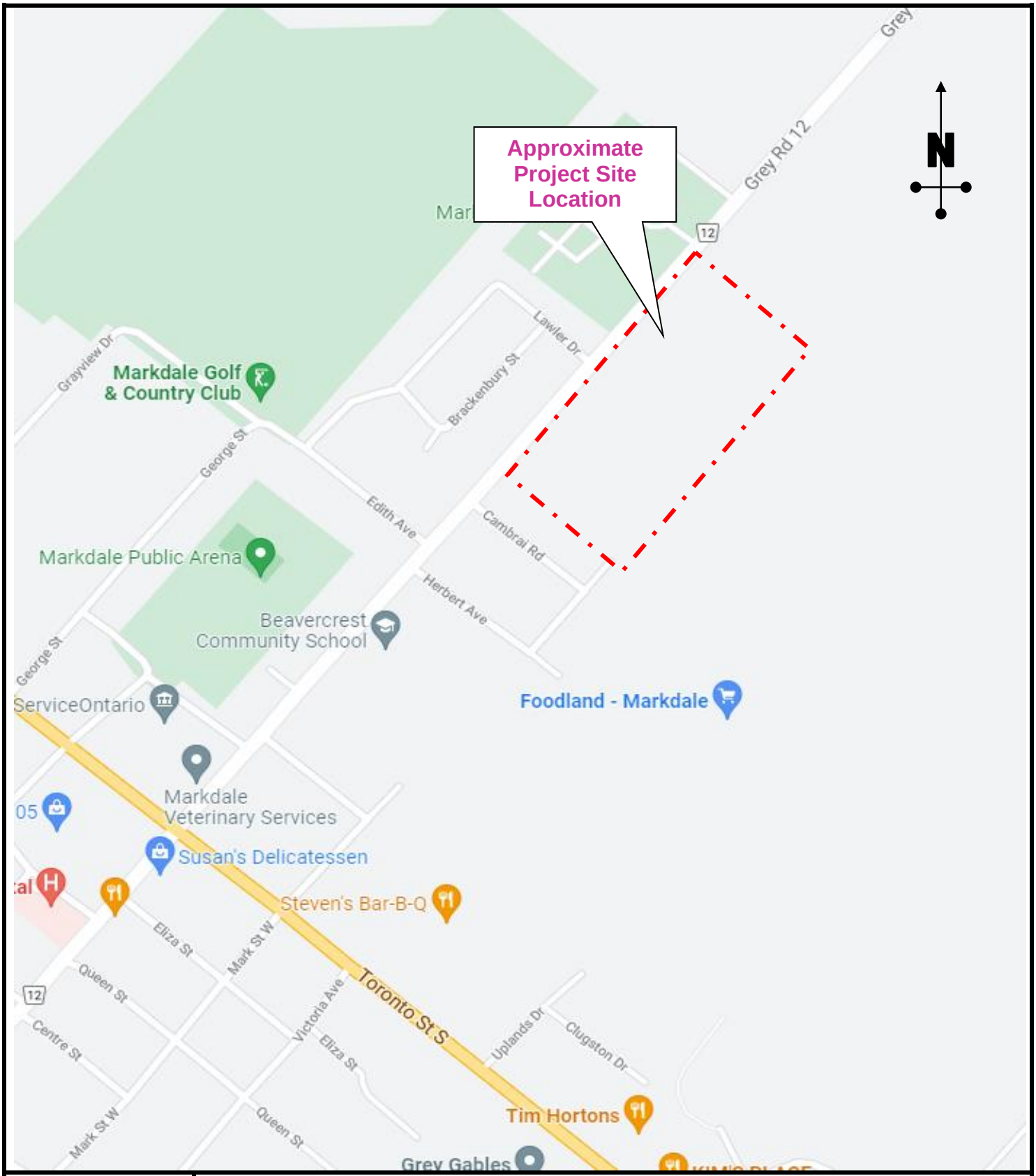
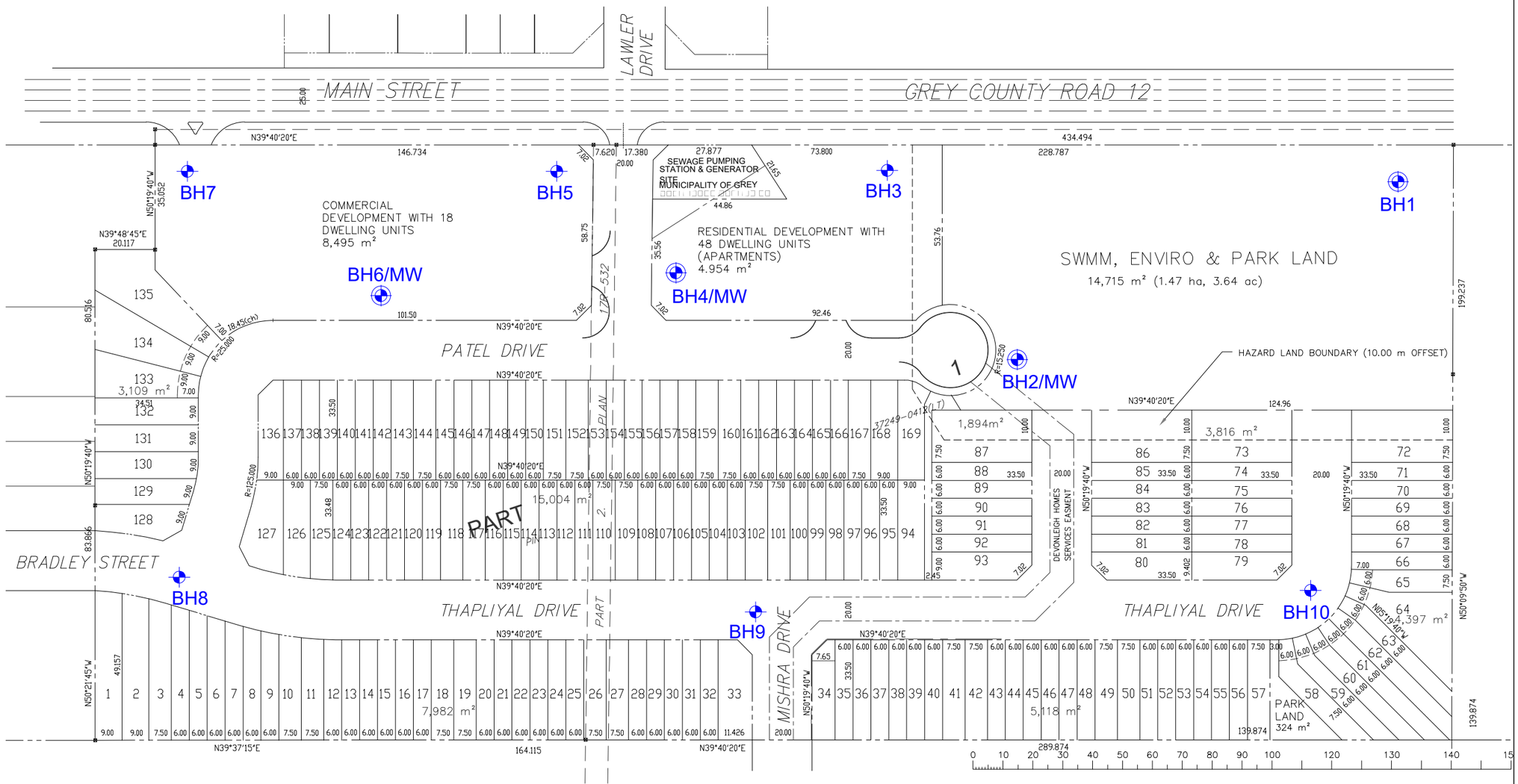
# Drawings




| | | | |
|---|---|---|---|
| ORBITENGINEERING | **APPROXIMATE SITE LOCATION PLAN** | | |
| | Date: **March 2022** | **Hydrogeological Investigation**<br>**Proposed Residential and Commercial Subdivision** | Prepared By: **MR** |
| | | | Reviewed By: **HA** |
| | Project: **OE211312AG** | Prepared for:<br>**Nivas Development Ltd** | Drawing No. **1** |




NOTES:

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for three months and then destroyed unless the client advises an extended time period is required.
3. Granular base fill quantities should not be established from the information provided at the borehole locations.
4. Borehole elevations should not be used to design building(s) or floor slab(s) or parking lot(s) grades.
5. This drawing forms part of the report (project number as referenced) and should only be used in conjunction with this report.

**LEGEND**

- Approximate Borehole Location
- BH/MW Approximate Borehole/Monitoring Well Location

| | |
|---|---|
| Drawn | ZA |
| Approved | HA |
| Date | FEB 2022 |
| Scale | AS SHOWN |
| Original size | TABLOID |

ORBIT ENGINEERING
Consulting Engineers

Client: NIVAS DEVELOPMENT LTD. C/O: DELBROOK TRIUMPHANT BUILDERS INC

Project: PRELIMINARY HYDROGEOLOGICAL INVESTIGATION
PROPOSED SUBDIVISION - 101 MAIN STREET, MARKDALE, ON

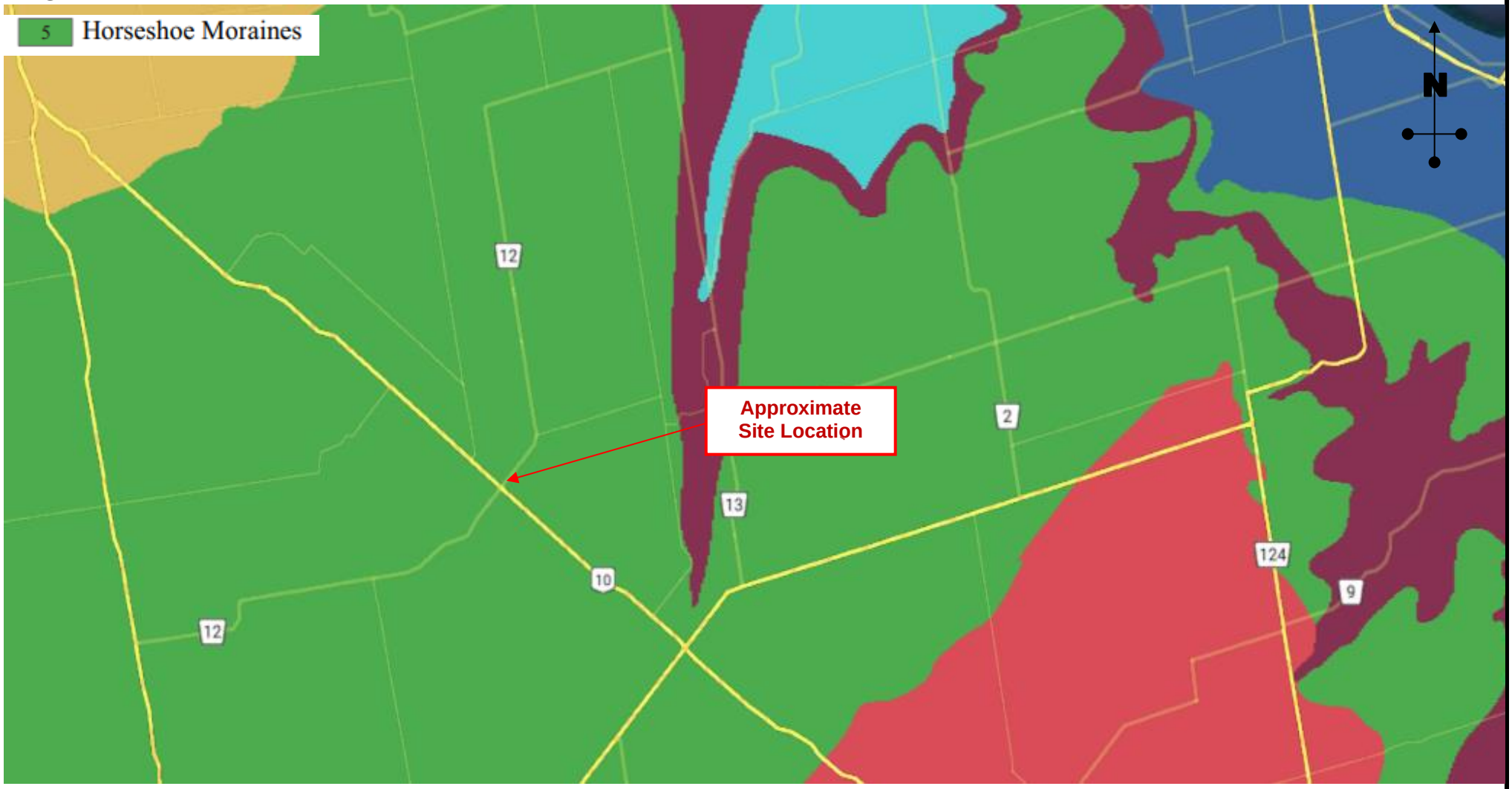
Title: APPROXIMATE BOREHOLE LOCATION PLAN

Project no: OE211312AG

Drawing no: 2

C:\Users\Orbit Engineering\Orbit Engineering Limited\Orbit Projects - Documents\Projects\2021 Projects\OE211312AG - Nivas - 101 Main Street Markdale - Geot Hydro\Drawings\Drawing Bore Hole Location.dwg

**LEGEND**




# Site Physiography

ORBITENGINEERING

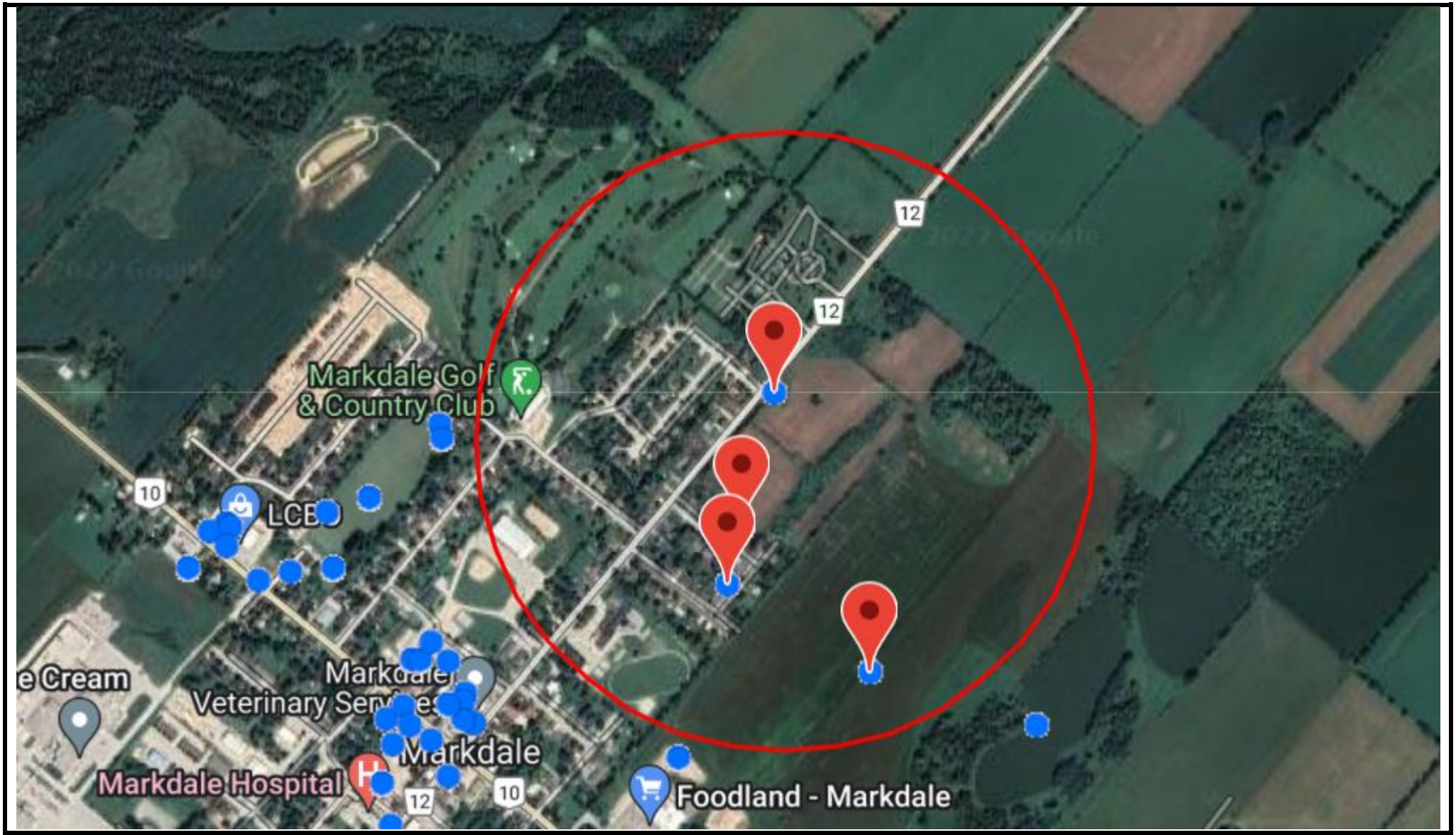
| | | |
|---|---|---|
| Date: **FEB 2022** | **PRELIMINARY HYDROGEOLOGICAL PROPOSED SUBDIVISION – 101 MAIN STREET, MARKDALE, ON** | Prepared By: **Z.A.** |
| Project: **OE211312AG** | | Reviewed By: **H.A.** |
| | Prepared for: **Nivas Development Ltd. (c/o Delbrook Triumphant Builders Inc.)** | Drawing No.: **3** |

LEGEND


# Surficial Geology

ORBITENGINEERING

| | | |
|---|---|---|
| Date: FEB 2022 | PRELIMINARY HYDROGEOLOGICAL INVESTIGATION PROPOSED SUBDIVISION – 101 MAIN STREET, MARKDALE, ON | Prepared By: Z.A. |
| Project: OE211312AG | | Reviewed By: H.A. |
| | Prepared for: Nivas Development Ltd. (c/o Delbrook Triumphant Builders Inc.) | Drawing No.: 4 |




# MECP Water Well Records Near the Site

ORBITENGINEERING

| | | |
|---|---|---|
| Date: **Mar 2022** | **PRELIMINARY HYDROGEOLOGICAL INVESTIGATION 101 MAIN STREET E, MARKDALE, ON** | Prepared By: **Z.A.** |
| Project: **OE211312AG** | | Reviewed By: **H.A.** |
| | Prepared for: **Nivas Development Ltd** | Drawing No.: **5** |

# Appendix A

## Borehole Logs

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# LOG OF BOREHOLE BH1

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907980.51 E 528651.44

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 2

| SOIL PROFILE (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | SAMPLES NUMBER | TYPE | "N" BLOWS 0.3 m | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 10 20 30 | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 417.3 | | | | | | | | | | | |
| 0.0 | **Topsoil:** 150mm | | | | | | | | | | |
| 417.1 | | | | | | | | | | | |
| 0.2 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, loose | | 1 | SS | 2 | | 417 | | | | |
| 1 | | | 2 | SS | 4 | | | | | | |
| 416.1 | | | | | | | 416 | | | | |
| 1.2 | **Silty Sand Till:** some gravel, trace clay, brown, moist, loose<br>wet below 1.5m | | 3 | SS | 4 | | | | | | |
| 2 | | | 4 | SS | 8 | | 415 | | | | |
| 3 | | | | | | | | | | | |
| 414.2 | | | | | | | | | | | |
| 3.1 | **Sand and Gravel:** weathered limestone, some silt, brown, moist to wet, dense | | 5 | SS | 34 | | 414 | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | 6 | SS | 41 | | 413 | | | | |
| 412.1 | | | | | | | | | | | |
| 5.2 | **End of Borehole:** | | | | | | | | | | |

Notes:

Water Levels:
(i) During Drilling: 0.8 m

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH/MW2

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907902.97 E 528683.15

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 3

| (m) ELEV / DEPTH | DESCRIPTION | NUMBER | TYPE | BLOWS 0.3 m "N" | ELEVATION | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|
| 416.5 | | | | | | |
| 0.0 / 416.3 | **Topsoil:** 150mm | | | | | |
| 0.2 / 415.7 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark brown, moist, loose | 1 | SS | 14 | 416 | |
| 0.8 | **Silty Sand Till:** some gravel, trace clay, reddish brown, wet, loose | 2 | SS | 2 | | 1 55 39 5 |
| 1 | wet below 1.5m | 3 | SS | 4 | 415 | |
| 2 / 414.4 | | | | | | |
| 2.1 | **Silty Sand Till:** weathered lime stone, reddish brown, wet, compact | 4 | SS | 19 | 414 | |
| 3 / 413.3 | | | | | | |
| 3.2 | **Sand and Gravel:** some silt, trace clay, brown, wet, compact | 5 | SS | 11 | 413 | 38 45 16 1 |
| 4 | | | | | | |
| 5 / 411.3 | | 6 | SS | 10 | 412 | |
| 5.2 | **End of Borehole:** | | | | | |

W. L. 415.0 m
Feb 15, 2022

Notes:

Water Levels:
(i) During Drilling: 0.6 m
(ii) At Completion: 50mm monitoring well installed
(iii) February 15, 2022: 1.5m

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH3

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4769625.45 E 585542.15

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 4

| (m) ELEV / DEPTH | DESCRIPTION | NUMBER | TYPE | BLOWS 0.3 m "N" | GROUND WATER CONDITIONS | ELEVATION |
|---|---|---|---|---|---|---|
| 416.8 | | | | | | |
| 0.0 / 416.7 | **Topsoil:** 150mm | | | | | |
| 0.2 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | 1 | SS | 10 | | |
| 1 | | 2 | SS | 11 | | 416 |
| 415.4 | | | | | | |
| 1.4 | **Silty Sand Till:** trace clay and gravel, brown, wet, compact | 3 | SS | 14 | | 415 |
| 2 / 414.7 | | | | | | |
| 2.1 | **Sand and Gravel:** some silt, trace clay, brown, wet, dense | 4 | SS | 36 | | 414 |
| | wet spoon below 2.5m | | | | | |
| 3 | | 5 | SS | 34 | | |
| 412.9 | Auger refusal at 3.9m | | | | | 413 |
| 3.9 | **End of Borehole:** | | | | | |

Notes:
(i) Depth to Cave: 2.1m

Water Levels:
(i) During Drilling: 2.5m

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT $w_P$ | NATURAL MOISTURE CONTENT $w$ | LIQUID LIMIT $w_L$

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH/MW4

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907870.79 E 528618.07

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 5

| (m) ELEV / DEPTH | DESCRIPTION | NUMBER | TYPE | BLOWS 0.3 m "N" | GROUND WATER CONDITIONS | ELEVATION | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|
| 417.0 | | | | | | | |
| 0.0 / 416.8 | **Topsoil:** 200mm | | | | | | |
| 0.2 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | 1 | SS | 4 | | | |
| 1 | | 2 | SS | 13 | | 416 | |
| 415.5 | | | | | | | |
| 1.5 | **Silty Sand Till:** some gravel, trace clay, light brown, wet, compact | 3 | SS | 10 | W. L. 415.5 m Feb 15, 2022 | | 26 39 30 5 |
| 2 / 414.9 | wet below 1.8m | | | | | 415 | |
| 2.1 | **Sand and Gravel:** weathered limestone, some silt, light brown, wet, compact | 4 | SS | 29 | | | |
| 3 | | 5 | SS | 16 | | 414 | |
| | very dense below 3.8m | 6 | SS | 50 / 150mm | | | |
| 4 / 412.1 | | | | | | 413 | |
| 4.9 | **End of Borehole:** | | | | | | |

Notes:

Water Levels:
(i) During Drilling: 3.1 m
(ii) At Completion: 50mm monitoring well installed
(iii) February 15, 2022: 1.5m

DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20 40 60 80 100

SHEAR STRENGTH (kPa) — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT $w_P$ — NATURAL MOISTURE CONTENT $w$ — LIQUID LIMIT $w_L$

WATER CONTENT (%) — 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $\varepsilon$=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH5

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907887.27 E 528554.85

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 6

| SOIL PROFILE (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | SAMPLES NUMBER | TYPE | BLOWS 0.3 m "N" | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 10 20 30 | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 419.0 | | | | | | | | | | | |
| 0.0 / 418.9 | **Topsoil:** 150mm | | | | | | | | | | |
| 0.2 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | | 1 | SS | 19 | | | | | | |
| 418.2 | | | | | | | | | | | |
| 0.8 | **Silty Sand Till:** trace clay and gravel, brown, moist, compact | | 2 | SS | 16 | | 418 | | | | |
| 1 | | | 3 | SS | 15 | | 417 | | | | |
| 2 / 416.7 | | | | | | | | | | | |
| 2.3 | **Sand and Gravel:** weathered limestone, some silt, brown, moist to wet, dense | | 4 | SS | 38 | | 416 | | | | |
| 3 | | | 5 | SS | 48 | | 415 | | | | |
| 4 | | | 6 | SS | 87 | | 414 | | | | |
| 5 | Auger refusal at 5.5m | | | | | | | | | | |
| 413.5 | | | | | | | | | | | |
| 5.5 | **End of Borehole:** | | | | | | | | | | |

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $\varepsilon_f$=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH/MW6

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907807.26 E 528540.2

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 7

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) (10 20 30) | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 421.5 | | | | | | | | | | | | |
| 0.0 / 421.4 | **Topsoil:** 150mm | | | | | | | | | | | |
| 0.2 / 420.7 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | | 1 | SS | 6 | | 421 | | | | | |
| 0.8 / 419.4 | **Silty Sand Till:** some gravel, trace clay, reddish brown, moist, compact | | 2 | SS | 18 | | 420 | | | | | |
| | | | 3 | SS | 20 | | | | | | | |
| 2.1 | **Sand and Gravel:** weathered lime stone, some silt, reddish brown, moist, very dense | | 4 | SS | 60 | | 419 | | | | | 21 39 33 7 |
| | | | 5 | SS | 52 | ▽ W. L. 418.4 m Feb 15, 2022 | 418 | | | | | |
| | | | 6 | SS | 105 | | 417 | | | | | |
| 416.3 | | | | | | | | | | | | |
| 5.2 | **End of Borehole:** | | | | | | | | | | | |

Notes:

Water Levels:
(i) At Completion: 50mm monitoring well was installed
(ii) February 15, 2022: 3.1m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH7

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907778.29 E 528464.89

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 8

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (10 20 30) | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 425.3 | | | | | | | | | | | | |
| 0.0 / 425.2 | **Topsoil:** 150mm | | | | | | | | | | | |
| 0.2 / 424.5 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | | 1 | SS | 4 | | 425 | | | | | |
| 0.8 / 423.0 | **Silty Sand Till:** some gravel, trace clay, brown, moist, compact | | 2 | SS | 16 | | 424 | | | | | |
| | | | 3 | SS | 20 | | | | | | | |
| 2.3 / 420.6 | **Sand and Gravel:** weathered limestone, some silt, brown, moist to wet, dense to very dense | | 4 | SS | 89 | | 423 | | | | | |
| | | | 5 | SS | 32 | | 422 | | | | | |
| | | | 6 | SS | 50 / 50mm | | 421 | | | | | |
| 4.7 | **End of Borehole:** | | | | | | | | | | | |

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH8

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907676.92 E 528585.71

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 9

| (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ / WATER CONTENT (%) (10 20 30) | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 425.8 | | | | | | | | | | | | |
| 0.0 / 425.6 | **Topsoil:** 150mm | | | | | | | | | | | |
| 0.2 / 425.0 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | | 1 | SS | 2 | | | | | | | |
| 0.8 / 424.3 | **Silty Sand Till:** some gravel, trace clay, brown, moist, compact | | 2 | SS | 4 | | 425 | | | | | |
| 1.5 | **Sand and Gravel:** weathered limestone, some silt, brown, moist to wet, compact | | 3 | SS | 25 | | 424 | | | | | |
| | | | 4 | SS | 10 | | 423 | | | | | |
| | | | 5 | SS | 11 | | 422 | | | | | |
| | very dense below 4.6m | | 6 | SS | 97 | | 421 | | | | | |
| 5.1 / 420.7 | **End of Borehole:** | | | | | | | | | | | |

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH9

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907800.96 E 528694.16

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-07-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 10

| SOIL PROFILE (m) ELEV / DEPTH | DESCRIPTION | STRATA PLOT | SAMPLES NUMBER | TYPE | BLOWS 0.3 m "N" | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 10 20 30 | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 417.3 | | | | | | | | | | | |
| 0.0 / 417.2 | **Topsoil:** 150mm | | | | | | | | | | |
| 0.2 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | | 1 | SS | 4 | | 417 | | | | |
| 416.5 | | | | | | | | | | | |
| 0.8 | **Sand and Gravel:** some silt, brown, moist, compact | | 2 | SS | 18 | | 416 | | | | |
| 1 | | | | | | | | | | | |
| | | | 3 | SS | 10 | | | | | | |
| 2 | | | | | | | | | | | |
| 415.0 | | | | | | | | | | | |
| 2.3 | **Sand and Gravel:** weathered limestone, some silt, brown, moist to wet, dense | | 4 | SS | 41 | | 415 | | | | |
| 3 | | | | | | | | | | | |
| | | | 5 | SS | 40 | | 414 | | | | |
| 413.5 | Auger refusal at 3.8m | | | | | | | | | | |
| 3.8 | **End of Borehole:** | | | | | | | | | | |

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

ORBITENGINEERING

# LOG OF BOREHOLE BH10

PROJECT: Geotechnical Investigation for Residential Development

CLIENT: Nivas Development Ltd.

PROJECT LOCATION: 101 Main Street, Markdale, ON

DATUM: Geodetic

BH LOCATION: Refer to Borehole Location Plan (Drawing 1A) N 4907873.8 E 528758.61

**DRILLING DATA**

Method: Solid Stem Auger

Diameter: 150mm

Date: Jan-06-2022

PROJECT NO.: OE211312AG

DRAWING NO.: 11

| ELEV / DEPTH (m) | DESCRIPTION | NUMBER | TYPE | BLOWS 0.3 m "N" | ELEVATION |
|---|---|---|---|---|---|
| 417.0 / 0.0 | **Topsoil:** 150mm | | | | |
| 416.9 / 0.2 | **Sand and Silt:** weathered/disturbed, trace clay and gravel, trace organics and rootlets, dark bown, moist, compact | 1 | SS | 5 | |
| 416.2 / 0.8 | **Silty Sand Till:** trace clay and gravel, dark brown, moist, loose | 2 | SS | 8 | 416 |
| | | 3 | SS | 8 | 415 |
| 414.4 / 2.6 | **Sand and Gravel:** weathered limestone, some silt, brown, wet, compact | 4 | SS | 18 | |
| | wet spoon below 3.1m | 5 | SS | 14 | 414 |
| | | | | | 413 |
| | | 6 | SS | 20 | 412 |
| 411.8 / 5.2 | **End of Borehole:** | | | | |

Notes:

Water Levels:
(i) During Drilling: 3.1m

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT $w_P$ — NATURAL MOISTURE CONTENT $w$ — LIQUID LIMIT $w_L$

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

40.2

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $\varepsilon_f$=3% Strain at Failure

# Appendix B

## Water Quality Certificates of Analysis

# Certificate of Analysis


Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering


Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628



**Dear Mohammed Razeen:**

**Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).**

Report Comments:

APPROVAL: _____
Yasna Hassanabadi, Organics Technician

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

# Certificate of Analysis

eurofins | Environment Testing


Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering


Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

| | | | | Lab I.D. | 1610728 |
|---|---|---|---|---|---|
| | | | | Sample Matrix | WW |
| | | | | Sample Type | |
| | | | | Sampling Date | 2022-02-15 |
| | | | | Sample I.D. | BH/MW-4 |
| **Group** | **Analyte** | **MRL** | **Units** | **Guideline** | |
| Anions | F | 0.10 | mg/L | MAC 10 | 0.14 |
| General Chemistry | BOD5 | 1 | mg/L | MAC 300 | <1 |
| | pH | 1.00 | | 6.0-11.5 | 7.94 |
| | Phenols | 0.001 | mg/L | MAC 1.0 | <0.001 |
| | Total Suspended Solids | 2 | mg/L | MAC 350 | <2 |
| Mercury | Hg | 0.0001 | mg/L | MAC 0.01 | <0.0001 |
| Metals | Ag | 0.01 | mg/L | MAC 5 | <0.01 |
| | Al | 0.1 | mg/L | MAC 50 | <0.1 |
| | Aqua-Regia Digest | | | | Y |
| | As | 0.02 | mg/L | MAC 1 | <0.02 |
| | Cd | 0.008 | mg/L | MAC 0.7 | <0.008 |
| | Co | 0.01 | mg/L | MAC 5 | <0.01 |
| | Cr | 0.05 | mg/L | MAC 4 | <0.05 |
| | Cr(VI) | 0.01 | mg/L | MAC 2 | <0.01 |
| | Cu | 0.01 | mg/L | MAC 2 | <0.01 |
| | Mn | 0.01 | mg/L | MAC 5 | <0.01 |
| | Mo | 0.01 | mg/L | MAC 5 | <0.01 |
| | Ni | 0.01 | mg/L | MAC 2 | <0.01 |
| | Pb | 0.01 | mg/L | MAC 1 | <0.01 |
| | Sb | 0.01 | mg/L | MAC 5 | <0.01 |
| | Se | 0.02 | mg/L | MAC 1 | <0.02 |
| | Sn | 0.1 | mg/L | MAC 5 | <0.1 |
| | Ti | 0.1 | mg/L | MAC 5 | <0.1 |
| | Zn | 0.04 | mg/L | MAC 2 | <0.04 |
| Microbiology | Escherichia Coli | 0 | ct/100mL | | 0 |

**Guideline = Sanitary Sewer - Toronto** *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

# Certificate of Analysis

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Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering


Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

| | | | | Lab I.D. | 1610728 |
|---|---|---|---|---|---|
| | | | | Sample Matrix | WW |
| | | | | Sample Type | |
| | | | | Sampling Date | 2022-02-15 |
| | | | | Sample I.D. | BH/MW-4 |
| **Group** | **Analyte** | **MRL** | **Units** | **Guideline** | |
| Nutrients | Total Kjeldahl Nitrogen | 0.100 | mg/L | MAC 100 | 0.464 |
| | Total P | 0.020 | mg/L | MAC 10 | <0.020 |
| Oil and Grease | Oil & Grease - Mineral | 1 | mg/L | MAC 15 | <1 |
| | Oil & Grease - Non-mineral | 1 | mg/L | MAC 150 | <1 |
| | Oil & Grease - Total | 1 | mg/L | | <1 |
| PAH | 1-methylnaphthalene | 0.1 | ug/L | | <0.1 |
| | 2-methylnaphthalene | 0.1 | ug/L | | <0.1 |
| | 7H-Dibenzo(c,g)carbazole | 0.2 | ug/L | | <0.2 |
| | Anthracene | 0.1 | ug/L | | <0.1 |
| | Benzo(a)anthracene | 0.1 | ug/L | | <0.1 |
| | Benzo(a)pyrene | 0.01 | ug/L | | <0.01 |
| | Benzo(b+j+k)fluoranthene | 0.1 | ug/L | | <0.1 |
| | Benzo(e)pyrene | 0.2 | ug/L | | <0.2 |
| | Benzo(g,h,i)perylene | 0.1 | ug/L | | <0.1 |
| | Chrysene | 0.05 | ug/L | | <0.05 |
| | Dibenz(a,j)acridine | 0.2 | ug/L | | <0.2 |
| | Dibenzo(a,h)anthracene | 0.1 | ug/L | | <0.1 |
| | Dibenzo(a,i)pyrene | 0.1 | ug/L | | <0.1 |
| | Fluoranthene | 0.1 | ug/L | | <0.1 |
| | Fluorene | 0.1 | ug/L | | <0.1 |
| | Indeno(1,2,3-c,d)pyrene | 0.1 | ug/L | | <0.1 |
| | Naphthalene | 0.1 | ug/L | | <0.1 |
| | PAH (Total) | 2.0 | ug/L | MAC 5 | <2.0 |
| | Perylene | 0.1 | ug/L | | <0.1 |
| | Phenanthrene | 0.1 | ug/L | | <0.1 |

**Guideline = Sanitary Sewer - Toronto** *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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# Certificate of Analysis

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering

Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

| Group | Analyte | MRL | Units | Guideline | 1610728 WW 2022-02-15 BH/MW-4 |
|---|---|---|---|---|---|
| | Lab I.D. | | | | 1610728 |
| | Sample Matrix | | | | WW |
| | Sample Type | | | | |
| | Sampling Date | | | | 2022-02-15 |
| | Sample I.D. | | | | BH/MW-4 |
| PAH | Pyrene | 0.1 | ug/L | | <0.1 |
| PCBs | Polychlorinated Biphenyls (PCBs) | 0.1 | ug/L | MAC 1 | <0.1 |
| Semi-Volatiles | 3,3'-dichlorobenzidene | 0.5 | ug/L | MAC 2 | <0.5 |
| | Bis(2-ethylhexyl)phthalate | 0.4 | ug/L | MAC 12 | 1.4 |
| | Di-n-butylphthalate | 1.3 | ug/L | MAC 80 | <1.3 |
| | Pentachlorophenol | 1.0 | ug/L | MAC 5 | <1.0 |
| Subcontract | Nonylphenol Ethoxalate (Total) | 2 | ug/L | MAC 200 | <2.0 |
| | Nonylphenols (Total) | 1 | ug/L | MAC 20 | <1.0 |
| Subcontract-Inorg | Cyanide (total) | 0.01 | mg/L | MAC 2 | <0.01 |
| VOCs Surrogates | 1,2-dichloroethane-d4 | 0 | % | | 107 |
| | 4-bromofluorobenzene | 0 | % | | 86 |
| | Toluene-d8 | 0 | % | | 96 |
| Volatiles | 1,1,2,2-tetrachloroethane | 0.5 | ug/L | MAC 1400 | <0.5 |
| | 1,2-dichlorobenzene | 0.4 | ug/L | MAC 50 | <0.4 |
| | 1,4-dichlorobenzene | 0.4 | ug/L | MAC 80 | <0.4 |
| | Benzene | 0.5 | ug/L | MAC 10 | <0.5 |
| | c-1,2-Dichloroethylene | 0.4 | ug/L | MAC 4000 | <0.4 |
| | Chloroform | 0.5 | ug/L | MAC 40 | <0.5 |
| | Dichloromethane | 4.0 | ug/L | MAC 2000 | <4.0 |
| | Ethylbenzene | 0.5 | ug/L | MAC 160 | <0.5 |
| | m/p-xylene | 0.4 | ug/L | | <0.4 |
| | o-xylene | 0.4 | ug/L | | <0.4 |
| | t-1,3-Dichloropropylene | 0.2 | ug/L | MAC 140 | <0.2 |
| | Tetrachloroethylene | 0.3 | ug/L | MAC 1000 | <0.3 |
| | Toluene | 0.4 | ug/L | MAC 16 | 1.2 |

**Guideline = Sanitary Sewer - Toronto**

*** = Guideline Exceedence**

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

# Certificate of Analysis

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Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering


Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

| | | | | Lab I.D. | 1610728 |
|---|---|---|---|---|---|
| | | | | Sample Matrix | WW |
| | | | | Sample Type | |
| | | | | Sampling Date | 2022-02-15 |
| | | | | Sample I.D. | BH/MW-4 |
| **Group** | **Analyte** | **MRL** | **Units** | **Guideline** | |
| Volatiles | Trichloroethylene | 0.3 | ug/L | MAC 400 | 46.4 |
| | Xylene; total | 0.5 | ug/L | MAC 1400 | <0.5 |

**Guideline = Sanitary Sewer - Toronto** *** = Guideline Exceedence**

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## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| **Run No** 417225 **Analysis/Extraction Date** 2022-02-18 **Analyst** L V<br>**Method** AMBCOLM1 | | | |
| Escherichia Coli | | | |
| **Run No** 417248 **Analysis/Extraction Date** 2022-02-17 **Analyst** Z S<br>**Method** SM 3500-Cr B | | | |
| Chromium VI | <0.01 mg/L | 94 | 80-120 |
| **Run No** 417267 **Analysis/Extraction Date** 2022-02-17 **Analyst** IP<br>**Method** SM5530D/EPA420.2 | | | |
| Phenols | <0.001 mg/L | 56 | 50-120 |
| **Run No** 417269 **Analysis/Extraction Date** 2022-02-17 **Analyst** AaN<br>**Method** M SM3112B-3500B | | | |
| Mercury | <0.0001 mg/L | 115 | 76-123 |
| **Run No** 417287 **Analysis/Extraction Date** 2022-02-17 **Analyst** SD<br>**Method** EPA 200.8 | | | |
| Titanium | <0.1 mg/L | 103 | 80-120 |
| **Run No** 417302 **Analysis/Extraction Date** 2022-02-17 **Analyst** AsA<br>**Method** SM2320,2510,4500H/F | | | |
| F | <0.10 mg/L | 105 | 90-110 |
| pH | | 99 | 90-110 |

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## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| **Run No** 417317 **Analysis/Extraction Date** 2022-02-22 **Analyst** Z S<br>**Method** SM 5210B | | | |
| BOD5 | <1 mg/L | 76 | 75-125 |
| **Run No** 417330 **Analysis/Extraction Date** 2022-02-18 **Analyst** SKH<br>**Method** EPA 365.1 | | | |
| Total P | <0.020 mg/L | 97 | 80-120 |
| **Run No** 417377 **Analysis/Extraction Date** 2022-02-18 **Analyst** SKH<br>**Method** EPA 351.2 | | | |
| Total Kjeldahl Nitrogen | <0.100 mg/L | 983 | 70-130 |
| **Run No** 417466 **Analysis/Extraction Date** 2022-02-23 **Analyst** SD<br>**Method** EPA 200.8 | | | |
| Silver | <0.01 mg/L | 110 | 70-130 |
| Aluminum | <0.1 mg/L | 101 | 70-130 |
| Aqua-Regia Digest | | | |
| Arsenic | <0.02 mg/L | 96 | 70-130 |
| Cadmium | <0.008 mg/L | 105 | 70-130 |
| Cobalt | <0.01 mg/L | 105 | 70-130 |
| Chromium Total | <0.05 mg/L | 106 | 70-130 |
| Copper | <0.01 mg/L | 116 | 70-130 |

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## *QC Summary*

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|---|---|---|---|
| Manganese | <0.01 mg/L | 105 | 70-130 |
| Molybdenum | <0.01 mg/L | 92 | 70-130 |
| Nickel | <0.01 mg/L | 110 | 70-130 |
| Lead | <0.01 mg/L | 98 | 70-130 |
| Antimony | <0.01 mg/L | 98 | 70-130 |
| Selenium | <0.02 mg/L | 114 | 70-130 |
| Sn | <0.1 mg/L | 75 | 70-130 |
| Zinc | <0.04 mg/L | 98 | 70-130 |
| **Run No** 417472 **Analysis/Extraction Date** 2022-02-23 **Analyst** SKH<br>**Method** C SM2540 | | | |
| Total Suspended Solids | <2 mg/L | 98 | 90-110 |
| **Run No** 417473 **Analysis/Extraction Date** 2022-02-17 **Analyst** C M<br>**Method** P 8270 | | | |
| Methlynaphthalene, 1- | <0.1 ug/L | 80 | 50-140 |
| Methlynaphthalene, 2- | <0.1 ug/L | 80 | 50-140 |
| 7H-Dibenzo(c,g)carbazole | <0.2 ug/L | 60 | |
| Anthracene | <0.1 ug/L | 78 | 50-140 |
| Benz[a]anthracene | <0.1 ug/L | 82 | 50-140 |

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## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Benzo[a]pyrene | <0.01 ug/L | 79 | 50-140 |
| Benzo(b+j+k)fluoranthene | <0.1 ug/L | 127 | |
| Benzo(e)pyrene | <0.2 ug/L | 84 | |
| Benzo[ghi]perylene | <0.1 ug/L | 78 | 50-140 |
| Chrysene | <0.05 ug/L | 83 | 50-140 |
| Dibenz(a,j)acridine | <0.2 ug/L | 28 | |
| Dibenz[a h]anthracene | <0.1 ug/L | 74 | 50-140 |
| Dibenzo(a,i)pyrene | <0.1 ug/L | 52 | |
| Fluoranthene | <0.1 ug/L | 80 | 50-140 |
| Fluorene | <0.1 ug/L | 80 | 50-140 |
| Indeno[1 2 3-cd]pyrene | <0.1 ug/L | 78 | 50-140 |
| Naphthalene | <0.1 ug/L | 78 | 50-140 |
| Perylene | <0.1 ug/L | 68 | |
| Phenanthrene | <0.1 ug/L | 82 | 50-140 |
| Pyrene | <0.1 ug/L | 80 | 50-140 |
| **Run No** 417476 **Analysis/Extraction Date** 2022-02-17 **Analyst** C M<br>**Method** B 625/P 8270 | | | |
| Dichlorobenzidine, 3,3'- | <0.5 ug/L | 60 | 20-140 |

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## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Bis(2-ethylhexyl)phthalate | <0.4 ug/L | 90 | 20-140 |
| Di-n-butylphthalate | <1.3 ug/L | 84 | 20-140 |
| **Run No** 417481 **Analysis/Extraction Date** 2022-02-17 **Analyst** C M<br>**Method** B 625/P 8270 | | | |
| Pentachlorophenol | <1.0 ug/L | 90 | 20-150 |
| **Run No** 417487 **Analysis/Extraction Date** 2022-02-20 **Analyst** YH<br>**Method** EPA 8260 | | | |
| Tetrachloroethane, 1,1,2,2- | <0.5 ug/L | 100 | 60-130 |
| Dichlorobenzene, 1,2- | <0.4 ug/L | 82 | 60-130 |
| Dichlorobenzene, 1,4- | <0.4 ug/L | 85 | 60-130 |
| Benzene | <0.5 ug/L | 88 | 60-130 |
| Dichloroethylene, 1,2-cis- | <0.4 ug/L | 87 | 60-130 |
| Chloroform | <0.5 ug/L | 90 | 60-130 |
| Methylene Chloride | <4.0 ug/L | 117 | 60-130 |
| Ethylbenzene | <0.5 ug/L | 82 | 60-130 |
| m/p-xylene | <0.4 ug/L | 84 | 60-130 |
| o-xylene | <0.4 ug/L | 91 | 60-130 |
| Dichloropropene,1,3-trans- | <0.2 ug/L | 84 | 60-130 |

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## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Tetrachloroethylene | <0.3 ug/L | 81 | 60-130 |
| Toluene | <0.4 ug/L | 88 | 60-130 |
| Trichloroethylene | <0.3 ug/L | 88 | 60-130 |
| **Run No** 417489 **Analysis/Extraction Date** 2022-02-23 **Analyst** YH<br>**Method** EPA 8260 | | | |
| Xylene Mixture | | | |
| **Run No** 417526 **Analysis/Extraction Date** 2022-02-23 **Analyst** R G<br>**Method** SM 5520B/F | | | |
| Oil & Grease - Mineral | <1 mg/L | 90 | 60-120 |
| Oil & Grease - Non-mineral | <1 mg/L | | 60-120 |
| Oil & Grease - Total | <1 mg/L | 100 | 60-120 |
| **Run No** 417558 **Analysis/Extraction Date** 2022-02-24 **Analyst** C M<br>**Method** P 8270 | | | |
| PAH (Total) | | | |
| **Run No** 417592 **Analysis/Extraction Date** 2022-02-24 **Analyst** QL<br>**Method** EPA 8081B | | | |
| Polychlorinated Biphenyls | <0.1 ug/L | 88 | 60-140 |
| **Run No** 417630 **Analysis/Extraction Date** 2022-02-24 **Analyst** AET<br>**Method** SUBCONTRACT-A | | | |

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## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Nonylphenol Ethoxalate (Total) | | | |
| Nonylphenols (Total) | <1.0 ug/L | 92 | |
| **Run No** 417800 **Analysis/Extraction Date** 2028-20-22 **Analyst** R S<br>**Method** SUBCONTRACT P-INORG | | | |
| Cyanide (total) | <0.01 mg/L | 94 | |

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**Dear Mohammed Razeen:**

**Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).**

Report Comments:

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

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| | | | | Lab I.D. | 1610728 |
|---|---|---|---|---|---|
| | | | | Sample Matrix | WW |
| | | | | Sample Type | |
| | | | | Sampling Date | 2022-02-15 |
| | | | | Sample I.D. | BH/MW-4 |
| **Group** | **Analyte** | **MRL** | **Units** | **Guideline** | |
| Anions | F | 0.10 | mg/L | | 0.14 |
| General Chemistry | BOD5 | 1 | mg/L | MAC 15 | <1 |
| | pH | 1.00 | | 6.0-9.5 | 7.94 |
| | Phenols | 0.001 | mg/L | MAC 0.008 | <0.001 |
| | Total Suspended Solids | 2 | mg/L | MAC 15 | <2 |
| Mercury | Hg | 0.0001 | mg/L | MAC 0.0004 | <0.0001 |
| Metals | Ag | 0.01 | mg/L | MAC 0.12 | <0.01 |
| | Al | 0.1 | mg/L | | <0.1 |
| | Aqua-Regia Digest | | | | Y |
| | As | 0.02 | mg/L | MAC 0.02 | <0.02 |
| | Cd | 0.008 | mg/L | MAC 0.008 | <0.008 |
| | Co | 0.01 | mg/L | | <0.01 |
| | Cr | 0.05 | mg/L | MAC 0.08 | <0.05 |
| | Cr(VI) | 0.01 | mg/L | MAC 0.04 | <0.01 |
| | Cu | 0.01 | mg/L | MAC 0.04 | <0.01 |
| | Mn | 0.01 | mg/L | MAC 0.05 | <0.01 |
| | Mo | 0.01 | mg/L | | <0.01 |
| | Ni | 0.01 | mg/L | MAC 0.08 | <0.01 |
| | Pb | 0.01 | mg/L | MAC 0.12 | <0.01 |
| | Sb | 0.01 | mg/L | | <0.01 |
| | Se | 0.02 | mg/L | MAC 0.02 | <0.02 |
| | Sn | 0.1 | mg/L | | <0.1 |
| | Ti | 0.1 | mg/L | | <0.1 |
| | Zn | 0.04 | mg/L | MAC 0.04 | <0.04 |
| Microbiology | Escherichia Coli | 0 | ct/100mL | MAC 200 | 0 |

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|---|---|---|---|---|---|
| | | | | Sample Matrix | WW |
| | | | | Sample Type | |
| | | | | Sampling Date | 2022-02-15 |
| | | | | Sample I.D. | BH/MW-4 |
| **Group** | **Analyte** | **MRL** | **Units** | **Guideline** | |
| Nutrients | Total Kjeldahl Nitrogen | 0.100 | mg/L | | 0.464 |
| | Total P | 0.020 | mg/L | MAC 0.4 | <0.020 |
| Oil and Grease | Oil & Grease - Mineral | 1 | mg/L | | <1 |
| | Oil & Grease - Non-mineral | 1 | mg/L | | <1 |
| | Oil & Grease - Total | 1 | mg/L | | <1 |
| PAH | 1-methylnaphthalene | 0.1 | ug/L | | <0.1 |
| | 2-methylnaphthalene | 0.1 | ug/L | | <0.1 |
| | 7H-Dibenzo(c,g)carbazole | 0.2 | ug/L | | <0.2 |
| | Anthracene | 0.1 | ug/L | | <0.1 |
| | Benzo(a)anthracene | 0.1 | ug/L | | <0.1 |
| | Benzo(a)pyrene | 0.01 | ug/L | | <0.01 |
| | Benzo(b+j+k)fluoranthene | 0.1 | ug/L | | <0.1 |
| | Benzo(e)pyrene | 0.2 | ug/L | | <0.2 |
| | Benzo(g,h,i)perylene | 0.1 | ug/L | | <0.1 |
| | Chrysene | 0.05 | ug/L | | <0.05 |
| | Dibenz(a,j)acridine | 0.2 | ug/L | | <0.2 |
| | Dibenzo(a,h)anthracene | 0.1 | ug/L | | <0.1 |
| | Dibenzo(a,i)pyrene | 0.1 | ug/L | | <0.1 |
| | Fluoranthene | 0.1 | ug/L | | <0.1 |
| | Fluorene | 0.1 | ug/L | | <0.1 |
| | Indeno(1,2,3-c,d)pyrene | 0.1 | ug/L | | <0.1 |
| | Naphthalene | 0.1 | ug/L | | <0.1 |
| | PAH (Total) | 2.0 | ug/L | MAC 2 | <2.0 |
| | Perylene | 0.1 | ug/L | | <0.1 |
| | Phenanthrene | 0.1 | ug/L | | <0.1 |

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| Group | Analyte | MRL | Units | Guideline | 1610728 WW 2022-02-15 BH/MW-4 |
|---|---|---|---|---|---|
| | Lab I.D. | | | | 1610728 |
| | Sample Matrix | | | | WW |
| | Sample Type | | | | |
| | Sampling Date | | | | 2022-02-15 |
| | Sample I.D. | | | | BH/MW-4 |
| PAH | Pyrene | 0.1 | ug/L | | <0.1 |
| PCBs | Polychlorinated Biphenyls (PCBs) | 0.1 | ug/L | MAC 0.4 | <0.1 |
| Semi-Volatiles | 3,3'-dichlorobenzidene | 0.5 | ug/L | MAC 0.8 | <0.5 |
| | Bis(2-ethylhexyl)phthalate | 0.4 | ug/L | MAC 8.8 | 1.4 |
| | Di-n-butylphthalate | 1.3 | ug/L | MAC 15.0 | <1.3 |
| | Pentachlorophenol | 1.0 | ug/L | MAC 2.0 | <1.0 |
| Subcontract | Nonylphenol Ethoxalate (Total) | 2 | ug/L | MAC 10 | <2.0 |
| | Nonylphenols (Total) | 1 | ug/L | MAC 1.0 | <1.0 |
| Subcontract-Inorg | Cyanide (total) | 0.01 | mg/L | MAC 0.02 | <0.01 |
| VOCs Surrogates | 1,2-dichloroethane-d4 | 0 | % | | 107 |
| | 4-bromofluorobenzene | 0 | % | | 86 |
| | Toluene-d8 | 0 | % | | 96 |
| Volatiles | 1,1,2,2-tetrachloroethane | 0.5 | ug/L | MAC 17 | <0.5 |
| | 1,2-dichlorobenzene | 0.4 | ug/L | MAC 5.6 | <0.4 |
| | 1,4-dichlorobenzene | 0.4 | ug/L | MAC 6.8 | <0.4 |
| | Benzene | 0.5 | ug/L | MAC 2.0 | <0.5 |
| | c-1,2-Dichloroethylene | 0.4 | ug/L | MAC 5.6 | <0.4 |
| | Chloroform | 0.5 | ug/L | MAC 2.0 | <0.5 |
| | Dichloromethane | 4.0 | ug/L | MAC 5.2 | <4.0 |
| | Ethylbenzene | 0.5 | ug/L | MAC 2.0 | <0.5 |
| | m/p-xylene | 0.4 | ug/L | | <0.4 |
| | o-xylene | 0.4 | ug/L | | <0.4 |
| | t-1,3-Dichloropropylene | 0.2 | ug/L | MAC 5.6 | <0.2 |
| | Tetrachloroethylene | 0.3 | ug/L | MAC 4.4 | <0.3 |
| | Toluene | 0.4 | ug/L | MAC 2.0 | 1.2 |

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MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

# Certificate of Analysis

eurofins | Environment Testing


Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering


Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

| | | | | Lab I.D. | 1610728 |
|---|---|---|---|---|---|
| | | | | Sample Matrix | WW |
| | | | | Sample Type | |
| | | | | Sampling Date | 2022-02-15 |
| | | | | Sample I.D. | BH/MW-4 |
| **Group** | **Analyte** | **MRL** | **Units** | **Guideline** | |
| Volatiles | Trichloroethylene | 0.3 | ug/L | MAC 7.6 | 46.4* |
| | Xylene; total | 0.5 | ug/L | MAC 4.4 | <0.5 |

**Guideline = Storm Sewer - Toronto** *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Attention: Mr Mohammed Razeen
PO#:
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Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| **Run No** 417225 **Analysis/Extraction Date** 2022-02-18 **Analyst** L V<br>**Method** AMBCOLM1 | | | |
| Escherichia Coli | | | |
| **Run No** 417248 **Analysis/Extraction Date** 2022-02-17 **Analyst** Z S<br>**Method** SM 3500-Cr B | | | |
| Chromium VI | <0.01 mg/L | 94 | 80-120 |
| **Run No** 417267 **Analysis/Extraction Date** 2022-02-17 **Analyst** IP<br>**Method** SM5530D/EPA420.2 | | | |
| Phenols | <0.001 mg/L | 56 | 50-120 |
| **Run No** 417269 **Analysis/Extraction Date** 2022-02-17 **Analyst** AaN<br>**Method** M SM3112B-3500B | | | |
| Mercury | <0.0001 mg/L | 115 | 76-123 |
| **Run No** 417287 **Analysis/Extraction Date** 2022-02-17 **Analyst** SD<br>**Method** EPA 200.8 | | | |
| Titanium | <0.1 mg/L | 103 | 80-120 |
| **Run No** 417302 **Analysis/Extraction Date** 2022-02-17 **Analyst** AsA<br>**Method** SM2320,2510,4500H/F | | | |
| F | <0.10 mg/L | 105 | 90-110 |
| pH | | 99 | 90-110 |

**Guideline = Storm Sewer - Toronto** *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

# Certificate of Analysis

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering

Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| **Run No** 417317 **Analysis/Extraction Date** 2022-02-22 **Analyst** Z S<br>**Method** SM 5210B | | | |
| BOD5 | <1 mg/L | 76 | 75-125 |
| **Run No** 417330 **Analysis/Extraction Date** 2022-02-18 **Analyst** SKH<br>**Method** EPA 365.1 | | | |
| Total P | <0.020 mg/L | 97 | 80-120 |
| **Run No** 417377 **Analysis/Extraction Date** 2022-02-18 **Analyst** SKH<br>**Method** EPA 351.2 | | | |
| Total Kjeldahl Nitrogen | <0.100 mg/L | 983 | 70-130 |
| **Run No** 417466 **Analysis/Extraction Date** 2022-02-23 **Analyst** SD<br>**Method** EPA 200.8 | | | |
| Silver | <0.01 mg/L | 110 | 70-130 |
| Aluminum | <0.1 mg/L | 101 | 70-130 |
| Aqua-Regia Digest | | | |
| Arsenic | <0.02 mg/L | 96 | 70-130 |
| Cadmium | <0.008 mg/L | 105 | 70-130 |
| Cobalt | <0.01 mg/L | 105 | 70-130 |
| Chromium Total | <0.05 mg/L | 106 | 70-130 |
| Copper | <0.01 mg/L | 116 | 70-130 |

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MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering

Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Manganese | <0.01 mg/L | 105 | 70-130 |
| Molybdenum | <0.01 mg/L | 92 | 70-130 |
| Nickel | <0.01 mg/L | 110 | 70-130 |
| Lead | <0.01 mg/L | 98 | 70-130 |
| Antimony | <0.01 mg/L | 98 | 70-130 |
| Selenium | <0.02 mg/L | 114 | 70-130 |
| Sn | <0.1 mg/L | 75 | 70-130 |
| Zinc | <0.04 mg/L | 98 | 70-130 |
| **Run No** 417472 **Analysis/Extraction Date** 2022-02-23 **Analyst** SKH **Method** C SM2540 | | | |
| Total Suspended Solids | <2 mg/L | 98 | 90-110 |
| **Run No** 417473 **Analysis/Extraction Date** 2022-02-17 **Analyst** C M **Method** P 8270 | | | |
| Methlynaphthalene, 1- | <0.1 ug/L | 80 | 50-140 |
| Methlynaphthalene, 2- | <0.1 ug/L | 80 | 50-140 |
| 7H-Dibenzo(c,g)carbazole | <0.2 ug/L | 60 | |
| Anthracene | <0.1 ug/L | 78 | 50-140 |
| Benz[a]anthracene | <0.1 ug/L | 82 | 50-140 |

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Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
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Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Benzo[a]pyrene | <0.01 ug/L | 79 | 50-140 |
| Benzo(b+j+k)fluoranthene | <0.1 ug/L | 127 | |
| Benzo(e)pyrene | <0.2 ug/L | 84 | |
| Benzo[ghi]perylene | <0.1 ug/L | 78 | 50-140 |
| Chrysene | <0.05 ug/L | 83 | 50-140 |
| Dibenz(a,j)acridine | <0.2 ug/L | 28 | |
| Dibenz[a h]anthracene | <0.1 ug/L | 74 | 50-140 |
| Dibenzo(a,i)pyrene | <0.1 ug/L | 52 | |
| Fluoranthene | <0.1 ug/L | 80 | 50-140 |
| Fluorene | <0.1 ug/L | 80 | 50-140 |
| Indeno[1 2 3-cd]pyrene | <0.1 ug/L | 78 | 50-140 |
| Naphthalene | <0.1 ug/L | 78 | 50-140 |
| Perylene | <0.1 ug/L | 68 | |
| Phenanthrene | <0.1 ug/L | 82 | 50-140 |
| Pyrene | <0.1 ug/L | 80 | 50-140 |
| **Run No** 417476 **Analysis/Extraction Date** 2022-02-17 **Analyst** C M<br>**Method** B 625/P 8270 | | | |
| Dichlorobenzidine, 3,3'- | <0.5 ug/L | 60 | 20-140 |

**Guideline = Storm Sewer - Toronto** *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

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Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering

Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Bis(2-ethylhexyl)phthalate | <0.4 ug/L | 90 | 20-140 |
| Di-n-butylphthalate | <1.3 ug/L | 84 | 20-140 |
| **Run No** 417481 **Analysis/Extraction Date** 2022-02-17 **Analyst** C M<br>**Method** B 625/P 8270 | | | |
| Pentachlorophenol | <1.0 ug/L | 90 | 20-150 |
| **Run No** 417487 **Analysis/Extraction Date** 2022-02-20 **Analyst** YH<br>**Method** EPA 8260 | | | |
| Tetrachloroethane, 1,1,2,2- | <0.5 ug/L | 100 | 60-130 |
| Dichlorobenzene, 1,2- | <0.4 ug/L | 82 | 60-130 |
| Dichlorobenzene, 1,4- | <0.4 ug/L | 85 | 60-130 |
| Benzene | <0.5 ug/L | 88 | 60-130 |
| Dichloroethylene, 1,2-cis- | <0.4 ug/L | 87 | 60-130 |
| Chloroform | <0.5 ug/L | 90 | 60-130 |
| Methylene Chloride | <4.0 ug/L | 117 | 60-130 |
| Ethylbenzene | <0.5 ug/L | 82 | 60-130 |
| m/p-xylene | <0.4 ug/L | 84 | 60-130 |
| o-xylene | <0.4 ug/L | 91 | 60-130 |
| Dichloropropene,1,3-trans- | <0.2 ug/L | 84 | 60-130 |

**Guideline = Storm Sewer - Toronto** *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

# Certificate of Analysis

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering

Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Tetrachloroethylene | <0.3 ug/L | 81 | 60-130 |
| Toluene | <0.4 ug/L | 88 | 60-130 |
| Trichloroethylene | <0.3 ug/L | 88 | 60-130 |
| **Run No** 417489 **Analysis/Extraction Date** 2022-02-23 **Analyst** YH<br>**Method** EPA 8260 | | | |
| Xylene Mixture | | | |
| **Run No** 417526 **Analysis/Extraction Date** 2022-02-23 **Analyst** R G<br>**Method** SM 5520B/F | | | |
| Oil & Grease - Mineral | <1 mg/L | 90 | 60-120 |
| Oil & Grease - Non-mineral | <1 mg/L | | 60-120 |
| Oil & Grease - Total | <1 mg/L | 100 | 60-120 |
| **Run No** 417558 **Analysis/Extraction Date** 2022-02-24 **Analyst** C M<br>**Method** P 8270 | | | |
| PAH (Total) | | | |
| **Run No** 417592 **Analysis/Extraction Date** 2022-02-24 **Analyst** QL<br>**Method** EPA 8081B | | | |
| Polychlorinated Biphenyls | <0.1 ug/L | 88 | 60-140 |
| **Run No** 417630 **Analysis/Extraction Date** 2022-02-24 **Analyst** AET<br>**Method** SUBCONTRACT-A | | | |

**Guideline = Storm Sewer - Toronto** *** = Guideline Exceedence**

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Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

# Certificate of Analysis

Client: Orbit Engineering
1900 Clark Blvd
Brampton, ON
L6T 0E9
Attention: Mr Mohammed Razeen
PO#:
Invoice to: Orbit Engineering

Report Number: 1971874
Date Submitted: 2022-02-16
Date Reported: 2022-02-28
Project: OE211312AG
COC #: 215628

## *QC Summary*

| Analyte | Blank | QC % Rec | QC Limits |
|---|---|---|---|
| Nonylphenol Ethoxalate (Total) | | | |
| Nonylphenols (Total) | <1.0 ug/L | 92 | |
| **Run No** 417800 **Analysis/Extraction Date** 2028-20-22 **Analyst** R S<br>**Method** SUBCONTRACT P-INORG | | | |
| Cyanide (total) | <0.01 mg/L | 94 | |

**Guideline = Storm Sewer - Toronto** *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

eurofins 215628

# STANDARD CHAIN-OF-CUSTODY

146 Colonnade Road, Unit #8, Ottawa, ON, K2E 7Y1 - Phone: 613-727-5692, Fax: 613-727-5222

Eurofins Workorder #: 1971874

## CLIENT INFORMATION

Company: ORBIT ENGINEERING
Contact: HAFIZ AHMED
Address: 9-1900 Clark Blvd, BRAMPTON
Telephone: 905-494-0074 Cell:
Email: #1: hafizahmed@orbitengineering-ca
Email: #2: mohammed.razeen@orbitengineering.ca
Project: OE211312AG Quote #:

## INVOICE INFORMATION (SAME AS CLIENT INFORMATION: YES ☑ NO ☐)

Company: Fax:
Contact: Email: #1:
Address: Email: #2:
Telephone: PO #:

## TURN-AROUND TIME (Business Days)

☐ 1 Day* (100%) ☐ 2 Day** (50%) ☐ 3-5 Days (25%) ☑ 5-7 Days (Standard)

Please contact Lab in advance to determine rush availability.
*For results reported after rush due date, surcharges will apply: before 12:00 - 100%, after 12:00 - 50%.
**For results reported after rush due date, surcharges will apply: before 12:00 - 50%, after 12:00 - 25%.

## REGULATION/GUIDELINE REQUIRED

☒ Sanitary Sewer, City: Toronto
☒ Storm Sewer, City: Toronto
☐ ODWSOG (Use DW CoC if analyzing drinking water)
☐ PWQO
☐ O.Reg 347
☐ Other:

☐ O. Reg 153 Table # ____, Coarse / Fine, Surface / subsurface
The sample results from this submission will form part of a formal Record of Site Condition (RSC) under O.Reg. 153/04 ☐ Yes ☐ No
Type: Com-Ind / Res-Park / Agri / GW / All Other / Sediment

☐ O. Reg 406 Excess Soils
Table # _____ Full depth/Strat/Ceiling/mSPLP Leachate
Type: Com-Ind /Res-Park /Agri/All Other
Category: Surface /Subsurface

The optimal temperature conditions during transport should be less than 10°C. Sample(s) cannot be frozen, unless otherwise indicated or agreed upon with the Laboratory. Note that this COC is not to be used for drinking water samples. The COC must be complete upon submission of the samples, there will be a $25 surcharge if required information is missing (required fields are shaded in grey).

| Sample Details | | | Sample Analysis Required | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Field Filtered --> | | | | | | | | | | | | | | | | | | | RN# (Lab Use Only) |
| | | | O.Reg.153 parameters | | | | | | | | | | | | | | | | |
| Sample ID | Date/Time Collected | Sample Matrix | # of Containers | PHC F1 - F4 | BTEX | VOCs | PAHs | PCBs | Metals + Inorganics | Metals only | Fluoride TOC, COD | Cyanide, CrVI | Micro 300 | Routine | Nutrients | MS, BCA, DIR | Organics | | |
| BH/MW-4 | 15-2-22 | GW | | | | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | 1610728 |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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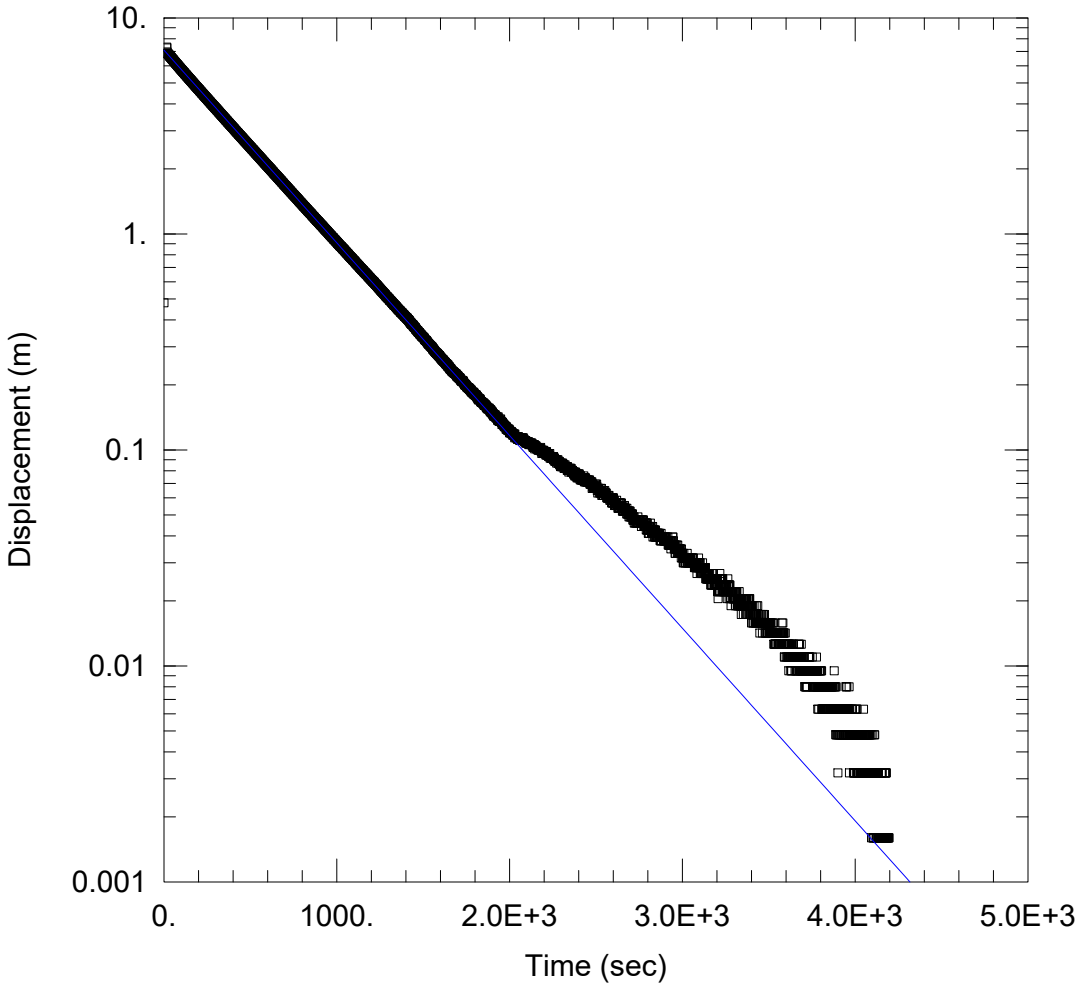
| | PRINT | SIGN | DATE/TIME | TEMP (°C) |
|---|---|---|---|---|
| Sampled By: | Zubair & Faizan | | | |
| Relinquished By: | | | | |
| Received By: | Victor Gallant | V.G. | 02/16/22 9:52 a.m. | 10.7°C |

COMMENTS:

CUSTODY SEAL: ☐ YES ☐ NO Ice packs submit ☑ Yes ☐ No

# Appendix C

## In-Situ Hydraulic Conductivity Testing Results




## HYDROGEOLOGICAL INVESTIGATION

Data Set: C:\...\BH2MW.aqt
Date: 03/23/22 Time: 16:15:51

## PROJECT INFORMATION

Company: Orbit Engineering Limited
Client: Nivas Development Ltd
Project: OE211312AG
Location: 101 Main Street East, Markdale
Test Well: BH/MW2
Test Date: Feb 15, 2022

## AQUIFER DATA

Saturated Thickness: 5. m Anisotropy Ratio (Kz/Kr): 1.

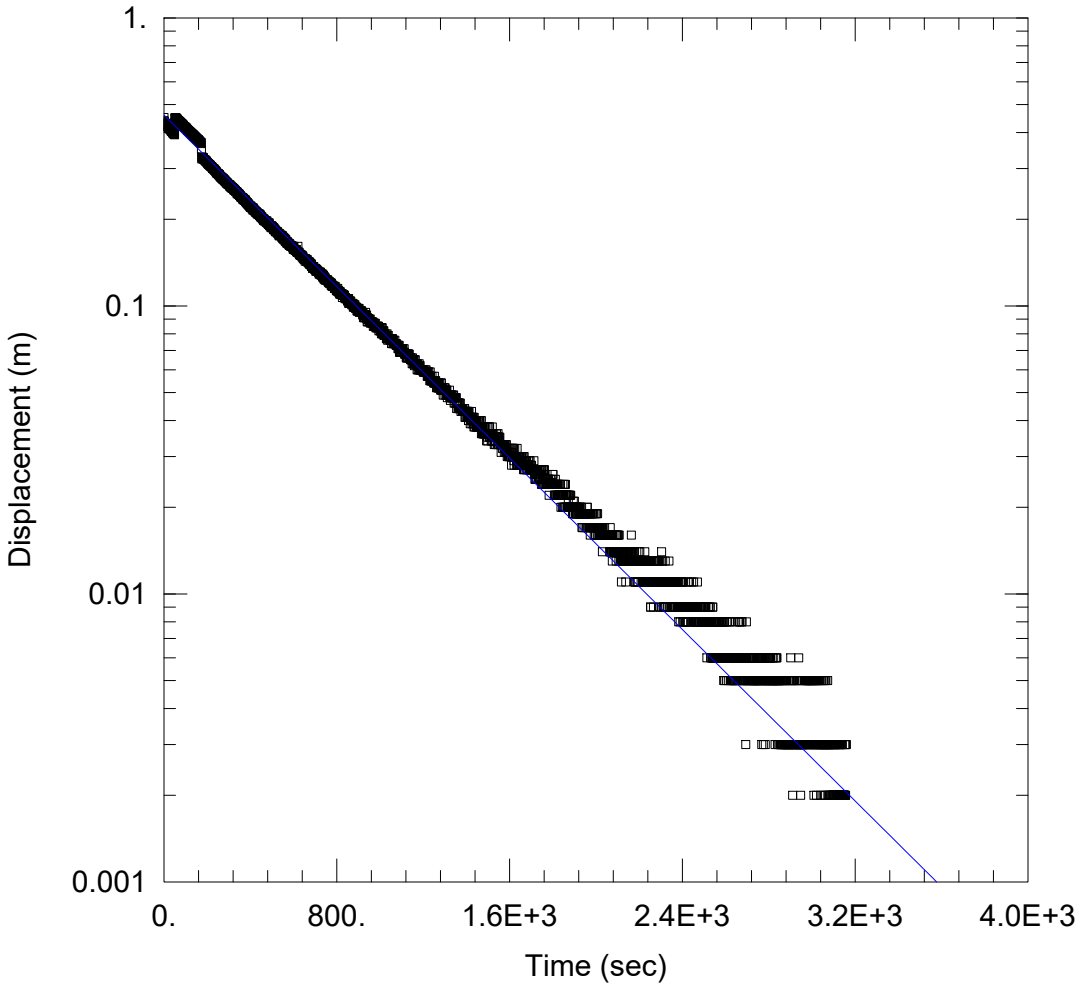
## WELL DATA (BH/MW2)

Initial Displacement: 0.48 m
Total Well Penetration Depth: 4.4 m
Casing Radius: 0.025 m
Static Water Column Height: 3. m
Screen Length: 1.52 m
Well Radius: 0.1 m

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0001227 cm/sec
y0 = 7.089 m




## HYDROGEOLOGICAL INVESTIGATION

Data Set: C:\...\BHMW4.aqt
Date: 03/23/22 Time: 16:25:04

## PROJECT INFORMATION

Company: Orbit Engineering Limited
Client: Nivas Development Ltd.
Project: OE211312AG
Location: 101 Main Street, Markdale, ON
Test Well: BH/MW4
Test Date: 15 February 2022

## AQUIFER DATA

Saturated Thickness: 5. m Anisotropy Ratio (Kz/Kr): 1.

## WELL DATA (BH/MW4)

Initial Displacement: 0.451 m
Total Well Penetration Depth: 3.52 m
Casing Radius: 0.025 m
Static Water Column Height: 3. m
Screen Length: 1.52 m
Well Radius: 0.1 m

## SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.051E-6 m/sec y0 = 0.4603 m

# Appendix D

## Information on Water Well Records Acquired from MECP

| Well ID | Well Record Information | Well Tag # (since 2003) | Audit # | Contractor Lic# | Well Depth (m) | Date of Completion (MM/DD/YYYY) |
|---|---|---|---|---|---|---|
| 2514981 | PDF \| HTML | N/A | 241173 | 6634 | 12.8 | 04/23/2002 |
| 7150514 | PDF \| HTML | A066634 | Z104066 | 7190 | 12.2 | 05/28/2010 |
| 7301412 | PDF \| HTML | A235868 | Z271523 | 7190 | 4.6 | 11/20/2017 |
| 7301413 | PDF \| HTML | A189006 | Z271524 | 7190 | 4.6 | 11/20/2017 |

# Appendix E

## Drawings Provided by the Client

MAIN STREET

LAWLER DRIVE

GREY COUNTY ROAD 12

BH7

BH5

BH3

BH1

SEWAGE PUMPING STATION & GENERATOR SITE
MUNICIPALITY OF GREY HIGHLANDS 694.17 m²

COMMERCIAL DEVELOPMENT WITH 18 DWELLING UNITS
8,495 m²

RESIDENTIAL DEVELOPMENT WITH 48 DWELLING UNITS (APARTMENTS)
4,954 m²

SWMM, ENVIRO & PARK LAND
14,715 m² (1.47 ha, 3.64 ac)

BH6- MW

BH4- MW

BH2 - MW

HAZARD LAND BOUNDARY (10.00 m OFFSET)

PATEL DRIVE

BRADLEY STREET

BH8

THAPLIYAL DRIVE

BH9

MISHRA DRIVE

THAPLIYAL DRIVE

BH10

DEVONLEIGH HOMES SERVICES EASMENT

PARK LAND
324 m²

SITE STATISTICS:

TOTAL AREA INCLUDING SWM & ENVIRONMENTALLY PROTECTED AREA 8.913 ha

ZONING RM.

TOWNHOUSE LOT AREA 200 m² min. FRONT WIDTH 6.00 m min.
SEMIDETACHED LOT AREA 300 m² min. FRONT WIDTH 9 m min.

| TOTAL DWELLING UNITS | 235 |
|---|---|
| SEMIDETACHED | 14 |
| TOWNHOUSES | 155 |
| DWELLINGS ABOVE COMMERCIAL | 18 |
| APARTMENTS | 48 |

RESIDENTIAL/COMMERCIAL LOTS NET AREA (EXCLUDING RIGHT OF WAYS, PARK, SWMM & ENVIRO LANDS) = 54,769 m²

RESIDENTIAL DENSITY PROPOSED: 235/5.477 ha = 42.91 UNITS/HECTAR

APARTMENT BUILDING: 48 DWELLING UNITS
SITE AREA 4,954 m²(0.495ha, 1.224 ac)

COMMERCIAL SITE AREA: 8,495 m²(0.850 ha, 2.10 ac)
PROPOSED ZONING C3

SOSCIA
PROFESSIONAL ENGINEERS INC.

10376 Yonge Street, Suite 307
Richmond Hill, ON. L4C 3B8
WWW.ssosciaeng.ca
ph 905 237 5410
fax 905 237 5413

DELBROOK GROUP

# DRAFT PLAN SKETCH. OPTION 2

JOB # 21-044
MARKDALE DEVELOPMENT. MUNICIPALITY OF GREY HIGHLANDS
DATE: AUGUST 20, 2021
SCALE: 1:1250

# Appendix F

## Dewatering Calculation Sheet and Equations

**Radius of Influence ($R_o$) and Groundwater Inflow Rate (Q) Calculation - Unconfined**

**Aquifer - Square or Rectangular Excavation**

**Project:** Geotechnical and Hydrogeological Investigation Residential Development

**OE Project Number:** OE211312AG

**Client :** Nivas Development Ltd C/O Delbrook Triumphant Builders Inc.

**Station/Dwelling:** Apartment (48 Dwelling Units)


**Orbit Engineering Limited**

1900 Clark Boulevard, Unit 9

Brampton, ON, L6T 0E9

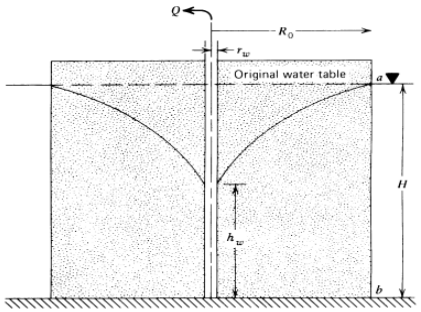
Tel: +1 905 494 0074

Fax: +1 855 666 3355

www.orbitengineering.ca, info@orbitengineering.ca


**Excavation is evaluated using the following numerical solution for square or rectangular excavations (x/a < 1.5) in an unconfined aquifer (Powers, 2007):**

$$Q = [(\pi K(H^2 - h^2))/ln(Ro/rs)]$$



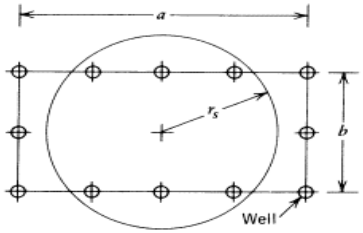




**Figure 6.3** Equilibrium radial flow to a frictionless well in a water table aquifer.

| Parameter | | Units |
|---|---|---|
| K | 0.000105 | cm/sec |
| K | 0.091 | m/d |
| H | 3 | m |
| h | 1.9 | m |
| $R_o$ | 36.7 | m |
| a | 37.0 | m |
| x | 94 | m |
| $r_s$ | 33.3 | m |
| C | 3000.0 | |
| Ln $R_o/r_s$ | 0.097 | |
| π = | 3.1416 | |

**Legend:**

| | |
|---|---|
| | Fill in |
| | Leave alone calculated number |
| | Copy numbers to the table |

| | | |
|---|---|---|
| Q | 15.88 | $m^3/d$ |
| | **15,879** | L/d |

| | |
|---|---|
| **31,758** L/d | **Expected Pumping Rate with contingency** |

Where:
- Q = groundwater inflow ($m^3$/sec)
- K = hydraulic conductivity (m/sec)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- x = length of excavation (m)
- a = width of excavation (m)
- L = line source distance (m)
- $R_o$ = radius of influence (m)
- $r_s$ = equivalent well radius (m)

100.0% Contingency for the variability in hydraulic conductivity that could be experienced and to provide flexibility to address additional drainage needed as a result of precipitation events.

$$r_s = \sqrt{ax/\pi}$$

Where:
- $r_s$ = equivalent well radius (m)
- a = excavation width (m)
- x = excavation length (m)

$$R_o = r_s + C(H - h)\sqrt{K}$$

Where:
- $R_o$ = radius of influence (m)
- C = is a constant (unitless; 3,000 for radial flow to pumped wells and between 1,500 and 2,000 for line flow to trenches or to a line of wellpoints)
- $r_s$ = equivalent well radius (m)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- K = hydraulic conductivity (m/sec)

**REFERENCES:**


Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc.

## Radius of Influence ($R_o$) and Groundwater Inflow Rate (Q) Calculation - Unconfined

## Aquifer - Square or Rectangular Excavation

**Project:** Geotechnical and Hydrogeological Investigation Residential Development
**OE Project Number:** OE211312AG
**Client :** Nivas Development Ltd C/O Delbrook Triumphant Builders Inc.
**Station/Dwelling:** Townhouses (58-72)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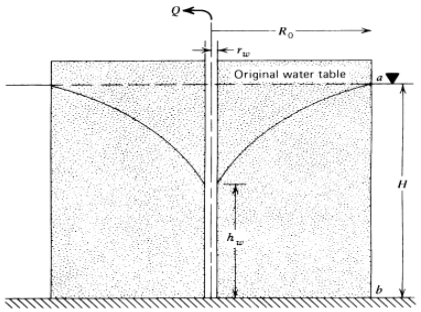
**Excavation is evaluated using the following numerical solution for square or rectangular excavations (x/a < 1.5) in an unconfined aquifer (Powers, 2007):**

$$Q = [(\pi K(H^2 - h^2))/ln(Ro/rs)]$$



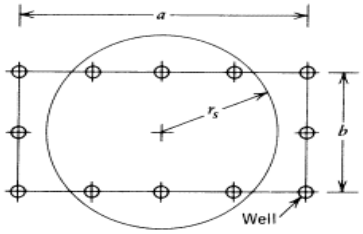




**Figure 6.3** Equilibrium radial flow to a frictionless well in a water table aquifer.

| Parameter | | Units |
|---|---|---|
| K | 0.000112 | cm/sec |
| K | 0.096 | m/d |
| H | 2.8 | m |
| h | 2.3 | m |
| $R_o$ | 34.8 | m |
| a | 36.0 | m |
| x | 96 | m |
| $r_s$ | 33.2 | m |
| C | 3000.0 | |
| Ln $R_o/r_s$ | 0.047 | |
| π = | 3.1416 | |

**Legend:**

| | |
|---|---|
| | Fill in |
| | Leave alone calculated number |
| | Copy numbers to the table |

| | | |
|---|---|---|
| Q | 16.55 | $m^3/d$ |
| | **16,551** | L/d |

**33,102** L/d **Expected Pumping Rate with contingency**

Where:
- Q = groundwater inflow ($m^3$/sec)
- K = hydraulic conductivity (m/sec)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- x = length of excavation (m)
- a = width of excavation (m)
- L = line source distance (m)
- $R_o$ = radius of influence (m)
- $r_s$ = equivalent well radius (m)

100.0% Contingency for the variability in hydraulic conductivity that could be experienced and to provide flexibility to address additional drainage needed as a result of precipitation events.

$$r_s = \sqrt{ax/\pi}$$

Where:
- $r_s$ = equivalent well radius (m)
- a = excavation width (m)
- x = excavation length (m)

$$R_o = r_s + C(H - h)\sqrt{K}$$

Where:
- $R_o$ = radius of influence (m)
- C = is a constant (unitless; 3,000 for radial flow to pumped wells and between 1,500 and 2,000 for line flow to trenches or to a line of wellpoints)
- $r_s$ = equivalent well radius (m)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- K = hydraulic conductivity (m/sec)

**REFERENCES:**


Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc.

**Radius of Influence ($R_o$) and Groundwater Inflow Rate (Q) Calculation - Unconfined**

**Aquifer - Square or Rectangular Excavation**

**Project:** Geotechnical and Hydrogeological Investigation Residential Development

**OE Project Number:** OE211312AG

**Client :** Nivas Development Ltd C/O Delbrook Triumphant Builders Inc.

**Station/Dwelling:** Townhouses (73-86)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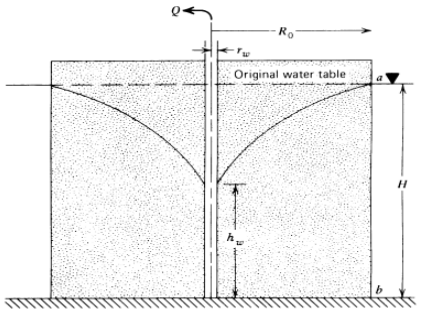
**Excavation is evaluated using the following numerical solution for square or rectangular excavations (x/a < 1.5) in an unconfined aquifer (Powers, 2007):**

$$Q = [(\pi K(H^2 - h^2))/ln(Ro/rs)]$$



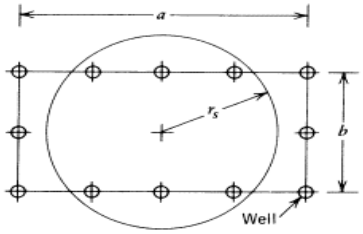




**Figure 6.3** Equilibrium radial flow to a frictionless well in a water table aquifer.

| Parameter | | Units |
|---|---|---|
| K | 0.000112 | cm/sec |
| K | 0.096 | m/d |
| H | 2.8 | m |
| h | 2.3 | m |
| $R_o$ | 34.1 | m |
| a | 48.0 | m |
| x | 69 | m |
| $r_s$ | 32.5 | m |
| C | 3000.0 | |
| Ln $R_o/r_s$ | 0.048 | |
| π = | 3.1416 | |

**Legend:**

| | |
|---|---|
| | Fill in |
| | Leave alone calculated number |
| | Copy numbers to the table |

| | | |
|---|---|---|
| Q | 16.21 | $m^3/d$ |
| | **16,211** | L/d |

| | | |
|---|---|---|
| **32,421** | L/d | **Expected Pumping Rate with contingency** |

Where:
- Q = groundwater inflow ($m^3$/sec)
- K = hydraulic conductivity (m/sec)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- x = length of excavation (m)
- a = width of excavation (m)
- L = line source distance (m)
- $R_o$ = radius of influence (m)
- $r_s$ = equivalent well radius (m)

100.0% Contingency for the variability in hydraulic conductivity that could be experienced and to provide flexibility to address additional drainage needed as a result of precipitation events.

$$r_s = \sqrt{ax/\pi}$$

Where:
- $r_s$ = equivalent well radius (m)
- a = excavation width (m)
- x = excavation length (m)

$$R_o = r_s + C(H - h)\sqrt{K}$$

Where:
- $R_o$ = radius of influence (m)
- C = is a constant (unitless; 3,000 for radial flow to pumped wells and between 1,500 and 2,000 for line flow to trenches or to a line of wellpoints)
- $r_s$ = equivalent well radius (m)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- K = hydraulic conductivity (m/sec)

**REFERENCES:**


Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc.

## Radius of Influence ($R_o$) and Groundwater Inflow Rate (Q) Calculation - Unconfined

## Aquifer - Square or Rectangular Excavation

**Project:** Geotechnical and Hydrogeological Investigation Residential Development
**OE Project Number:** OE211312AG
**Client :** Nivas Development Ltd C/O Delbrook Triumphant Builders Inc.
**Station/Dwelling:** Townhouses (87-93)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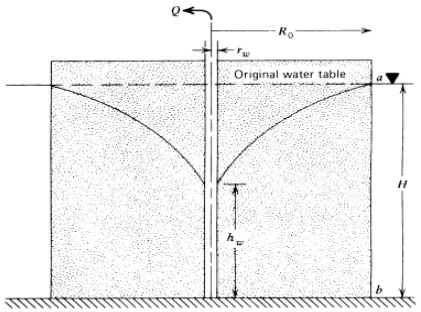
**Excavation is evaluated using the following numerical solution for square or rectangular excavations (x/a < 1.5) in an unconfined aquifer (Powers, 2007):**

$$Q = [(\pi K(H^2 - h^2))/ln(Ro/rs)]$$



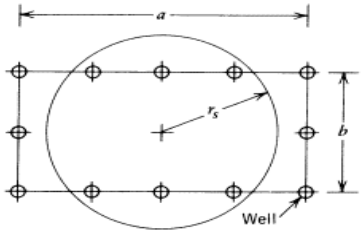




**Figure 6.3** Equilibrium radial flow to a frictionless well in a water table aquifer.

| Parameter | | Units |
|---|---|---|
| K | 0.000112 | cm/sec |
| K | 0.096 | m/d |
| H | 2.8 | m |
| h | 1.8 | m |
| $R_o$ | 26.6 | m |
| a | 36.0 | m |
| x | 48 | m |
| $r_s$ | 23.5 | m |
| C | 3000.0 | |
| Ln $R_o/r_s$ | 0.127 | |
| π = | 3.1416 | |

**Legend:**

| | |
|---|---|
| | Fill in |
| | Leave alone calculated number |
| | Copy numbers to the table |

| | | |
|---|---|---|
| Q | 10.99 | $m^3/d$ |
| | **10,994** | L/d |

**21,987** L/d **Expected Pumping Rate with contingency**

Where:
- Q = groundwater inflow ($m^3$/sec)
- K = hydraulic conductivity (m/sec)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- x = length of excavation (m)
- a = width of excavation (m)
- L = line source distance (m)
- $R_o$ = radius of influence (m)
- $r_s$ = equivalent well radius (m)

100.0% Contingency for the variability in hydraulic conductivity that could be experienced and to provide flexibility to address additional drainage needed as a result of precipitation events.

$$r_s = \sqrt{ax/\pi}$$

Where:
- $r_s$ = equivalent well radius (m)
- a = excavation width (m)
- x = excavation length (m)

$$R_o = r_s + C(H - h)\sqrt{K}$$

Where:
- $R_o$ = radius of influence (m)
- C = is a constant (unitless; 3,000 for radial flow to pumped wells and between 1,500 and 2,000 for line flow to trenches or to a line of wellpoints)
- $r_s$ = equivalent well radius (m)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- K = hydraulic conductivity (m/sec)

**REFERENCES:**


Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc.

## Radius of Influence ($R_o$) and Groundwater Inflow Rate (Q) Calculation - Unconfined Aquifer - Square or Rectangular Excavation

**Project:** Geotechnical and Hydrogeological Investigation Residential Development
**OE Project Number:** OE211312AG
**Client :** Nivas Development Ltd C/O Delbrook Triumphant Builders Inc.
**Station/Dwelling:** SWM Pond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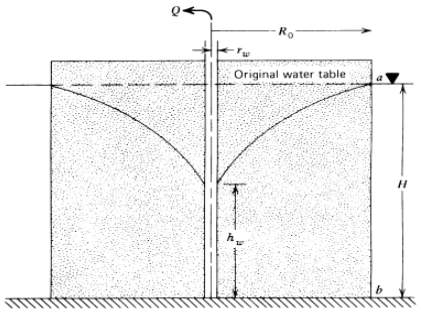
**Excavation is evaluated using the following numerical solution for square or rectangular excavations (x/a < 1.5) in an unconfined aquifer (Powers, 2007):**

$$Q = [(\pi K(H^2 - h^2))/ln(Ro/rs)]$$



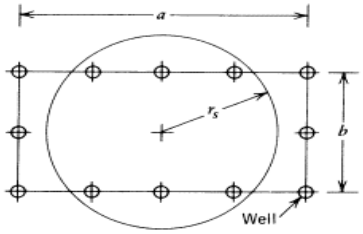




**Figure 6.3** Equilibrium radial flow to a frictionless well in a water table aquifer.

| Parameter | | Units |
|---|---|---|
| K | 0.000112 | cm/sec |
| K | 0.096 | m/d |
| H | 2.8 | m |
| h | 1.8 | m |
| $R_o$ | 52.0 | m |
| a | 50.0 | m |
| x | 150 | m |
| $r_s$ | 48.9 | m |
| C | 3000.0 | |
| Ln $R_o/r_s$ | 0.063 | |
| π = | 3.1416 | |

**Legend:**

| | |
|---|---|
| | Fill in |
| | Leave alone calculated number |
| | Copy numbers to the table |

| | | |
|---|---|---|
| Q | 22.17 | $m^3/d$ |
| | **22,172** | L/d |

**44,344** L/d **Expected Pumping Rate with contingency**

Where:
- Q = groundwater inflow ($m^3$/sec)
- K = hydraulic conductivity (m/sec)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- x = length of excavation (m)
- a = width of excavation (m)
- L = line source distance (m)
- $R_o$ = radius of influence (m)
- $r_s$ = equivalent well radius (m)

100.0% Contingency for the variability in hydraulic conductivity that could be experienced and to provide flexibility to address additional drainage needed as a result of precipitation events.

$$r_s = \sqrt{ax/\pi}$$

Where:
- $r_s$ = equivalent well radius (m)
- a = excavation width (m)
- x = excavation length (m)

$$R_o = r_s + C(H - h)\sqrt{K}$$

Where:
- $R_o$ = radius of influence (m)
- C = is a constant (unitless; 3,000 for radial flow to pumped wells and between 1,500 and 2,000 for line flow to trenches or to a line of wellpoints)
- $r_s$ = equivalent well radius (m)
- H = saturated thickness of the aquifer before pumping (m)
- h = saturated thickness of the aquifer after pumping (m)
- K = hydraulic conductivity (m/sec)

**REFERENCES:**


Powers, J.P, Corwin, A.B., Schmall, P.C., Kaeck, W.E., and Herridge, C.J., 2007. Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Ed. John Wiley and Sons Inc.