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July 25, 2024

1734234 Ontario Ltd.
c/o Steve Kapolnas, P. Eng.
Project Manager
Stantec
100 – 300 Hagey Boulevard
Waterloo, ON N2L 0A4 *transmitted via email: steve.kapolnas@stantec.com*

Re: Karst Assessment, Stage 3A, Lockbridge Development Inc., Smithville, ON

Dear Mr. Kapolnas,

**1.0 Introduction and Background Information**

Lockbridge Development Inc. retained Terra-Dynamics Consulting Inc. (Terra-Dynamics) to assess karst conditions on a property (Block Plan 9 Area) located in southeastern Smithville, Ontario (Figure 1). The Lockbridge Development Inc. Block Plan 9 Area (the Site) is approximately 60.0 hectares in area and the Study Area comprised approximately 40.0 hectares (98.8 acres) in area which is located in the northern section of the Site. The property is referenced herein as the Study Area.

The Town of West Lincoln and the Regional Municipality of Niagara (Niagara Region) recently completed a Subwatershed Study (SWS) as part of the expansion of Smithville's urban boundary, and from that, Official Plan Amendment (OPA) No. 63 was developed. The SWS consisted of three (phased) reports as follows, prepared by Wood PLC (now WSP):

1. Wood PLC. 2021, January 29. Subwatershed Study Phase 1 Report: Characterization and Integration, Smithville Subwatershed Study and Stormwater Management Plan, Township of West Lincoln.

2. Wood PLC. 2022, March 29. Subwatershed Study – Phase 2: Impact Assessment. Smithville Subwatershed Study and Stormwater Management Plan, prepared for the Township of West Lincoln, 88 p and appendices.

3. Wood PLC. 2022, September 12. Subwatershed Study Phase 3: Management, Implementation, and Monitoring Plan (Draft), prepared for the Township of West Lincoln, 32 p and appendices.

The SWS identified four karst features in southeastern Smithville, SE 1, SE 2, SE 3 and SE 4 with SE 2 being in the Study Area.

Terra-Dynamics will be using different nomenclature than was used in the SWS. SE 2 as identified by the SWS (Phase 3) will be herein referred to as Sinkhole Southeast No. 1 (SH-SE-1).

For a time period of September 13, 2023, to April 25, 2024, Terra-Dynamics completed a karst assessment of SH-SE-1 in order to assist with understanding karst conditions of the Study Area and assess if any karst-based limitations or constraints to development pertain to the Study Area.

Karst hazards are identified as *"hazardous sites"*. The Provincial Policy Statement (PPS) (2020) defines *"hazardous sites"* in Section 6.0 as follows:

> *"Hazardous sites: means property or lands that could be unsafe for development or site alteration due to naturally occurring hazards. These may include unstable soils (sensitive marine clays [leda], organic soils) or unstable bedrock (karst topography)."*

The Niagara Peninsula Conservation Authority (NPCA) regulates karst within their watershed which includes West Lincoln and Smithville. The NPCA's Hazardous Sites Policy is presented herein in Appendix 1.

This is described in Section 7.0, Subsection 7.1.2 *Defining and Assessing Hazardous Site* of the 2022 NPCA Hazard Policy as follows:

*"Hazardous sites are considered to be part of the NPCA's regulated areas. The potential for catastrophic failures in some areas of unstable soil and unstable bedrock warrant site-specific studies to determine the extent of these hazardous sites, and therefore the appropriate limits of the hazard and regulation limits. The regulated area will be based on the conclusions and recommendations of such studies, to the satisfaction of the NPCA. Accordingly, the limits for hazardous lands, such as leda clays, organic soils and karst formations, shall be determined on a site-specific basis according to the Ministry of Natural Resources Technical Guide for Hazardous Sites (1996) and Understanding Natural Hazards (2001)."*

The *Hazardous Sites Technical Guide* (Ministry of Natural Resources and Forestry (MNRF), 1996) and Brunton (2013) provide specific methodology for identifying and evaluating hazardous sites. Within the Guide, the recommended methodology is summarized into five phases of investigation as follows:

1. Information Study;
2. Initial Study Area Inspection;
3. Reporting of Visual Inspection;
4. Subsurface Investigation; and
5. Analyses and Reporting.

This karst assessment of the Study Area addresses Phases 1 through 5 of the *Hazardous Sites Technical Guide* (MNRF, 1996), with Phase 4, the subsurface investigation, being addressed through a geotechnical investigation, prepared by Stantec Consulting Ltd. (Stantec), 2024 (draft). The information gathered from this study is described below with specific reference to the subject lands to address natural karst hazards per the definitions in the PPS and the policies of the NPCA (2022).

## 2.0 Methodology

Terra-Dynamics completed this karst-based investigation of the Study Area by completing the following tasks:

1. Performed a review of historic aerial photographs from 1934, 1954, 1965 and 2006;

2. Completed an initial field inspection on September 13, 2023, to identify and inspect karst features on and adjacent to the Study Area;
3. Installed water level dataloggers on the Study Area within the Sinkhole (SH-SE-1) and off-Study Area at the Rock Street Park Spring, a possible discharge location for the water sinking in SH-SE-1 (Figure 2) to continuously monitor water levels. A barometric datalogger was also installed on-site in order to compensate all water levels for barometric pressure. Multiple data downloads were completed over the monitoring period to prevent significant data gaps resulting from equipment failure or theft;
4. Performed numerous site visits during wet weather to inspect the Sinkhole on the Study Area for quantifying flow values into the Sinkhole and gather general flow-based observations;
5. Completed a rhodamine dye trace in the spring season of 2024 in order to determine the discharge location for water sinking at SH-SE-1;
6. Once the discharge location for SH-SE-1 was determined via dye trace, this location, South Rock Street Park Spring was installed with the datalogger previously instrumented within the Rock Street Park Spring in order to continuously record water levels (Figure 2);
7. Performed a review of a draft geotechnical investigation of the Study Area (Stantec, 2024); and
8. Completed a karst hazard risk assessment of existing karst conditions and conditions that could potentially be impacted by development.

## 3.0 Physical Setting, Geology and Historic Aerial Photograph Interpretation

### 3.1 Physical Setting

The Study Area in Southeast Smithville, Ontario is located in the centre of the Niagara Peninsula, above the Niagara Escarpment (Figure 1). The Study Area is situated south of Townline Road, east of Port Davidson Road and west of Shurie Road (Figures 1 and 2). The ground surface slopes generally down from east to west from approximately 191 mASL (metres above sea level) to 186 mASL.

Twenty Mile Creek is located north and east of the Study Area (Figure 2) and it flows in an easterly direction to Balls Falls and subsequently Lake Ontario. A tributary of Twenty Mile Creek is present on the northern portions of the Study Area (NPCA and OMAFRA, 2024) (Figures 1 and 2). After flowing north of the Study Area, this tributary passes under Townline Road and flows northwards through Rock Street Park (Figure 1 and 2).

### 3.2 Geology

The Study Area is located on the Haldimand Clay Plain which predominantly consists of poorly drained glaciolacustrine clay to silty clay overlying clay till (Chapman and Putnam, 1984 & Feenstra, 1975). The presence of the clay-based soils creates “flashy” conditions for stormwater flow and especially during the spring season freshet when the clay is saturated. The bedrock at the Site has been mapped as dolostone (Guelph Formation) (Oxtobee and Novakowski, 2002).

Vos (1969) shows the Study Area to be located in an area of variable drift thickness (or overburden thickness) with 12 to 18 feet thickness (3.7 to 5.5 metres) mapped along the northern boundaries of the Study Area and increasing drift thickness in a southward direction to greater than 7.6 m (25 feet) on the

southern portions of the Study Area. These drift thickness values are confirmed by nearby water well records reviewed online from the Ministry of the Environment, Conservation & Parks (MECP) website.

The overburden thickness of the Study Area discussed above is also supported by the geotechnical investigation completed by Stantec (Stantec, 2024). A depth to bedrock of 2.3 metres was recorded at MW-106-24, located in close proximity to the SH SE-1, approximately 15 metres north of SH-SE-1 (Figure 2) with depths to bedrock increasing in a southwards direction and then decreasing again at the very southernmost portions of the Study Area (Figure 4).

Buck et al. (2003) reported that there was no sinkhole or soil pipe development within the Eramosa Karst Conservation Area (an Earth Science Area of Natural Scientific Interest) in Stoney Creek/Hamilton at clay overburden depths greater than 2.8 metres. Conditions within the Study Area where less than 2.8 metres of clay overburden present are likely only in the vicinity of SH-SE-1, with the only geotechnical borehole or monitoring well overburden this shallow was MW-106-24 (Figure 4), immediately northwest of SH-SE-1, with an overburden thickness of 2.3 metres recorded (Stantec, 2024). The overburden thickness at SH-SE-1 was measured to be approximately 1.9 to 2.0 metres (Table 2). Table 1 below, summarizes the geotechnical borehole and monitoring well logs:

Table 1. Depth to Dolostone Bedrock (or thickness of overburden) from Geotechnical Boreholes and Monitoring Wells (Stantec, 2024).

| BH/MW ID | Depth to Bedrock (m) |
|---|---|
| BH101-24 | 5.6 |
| BH102-24 | 5.8 |
| BH103-24 | 3.2 |
| BH104-24 | 4.6 |
| BH105-24 | 6.4 |
| BH106-24 | 6.3 |
| BH117-24 | 8.4 |
| BH118-24 | 9.5 |
| BH119-24 | 7.3 |
| BH120-24 | 7.8 |
| BH121-24 | 5.0 |
| MW101-24 | 8.4 |
| MW102-24 | 7.8 |
| MW103-24 | 5.5 |
| MW104-24 | 5.8 |
| MW105-24 | 4.7 |
| **MW106-24** | **2.3** |
| MW107-24 | 7.3 |
| MW108-24 | 8.1 |
| MW109-24 | 6.3 |
| MW110-24 | 5.2 |
| MW111-24 | 6.3 |
| MW112-24 | 6.4 |

| | |
|---|---|
| AVERAGE | 6.3 |

*Notes: BHs not listed above, bedrock was not encountered therefore these BHs were not included in the average value. MW= Monitoring Well, BH= Borehole, m= metres, Bolded cells represent MW adjacent to SH-SE-1.*

### 3.3 Historic Aerial Photograph Interpretation

In reviewing aerial photographs from 1934, 1954, 1965 and 2006 (City of Hamilton, 2024), there have been no changes in land use, with agricultural land use dating back to 1934 (Figure 5). On all aerial photographs the northeast flowing watercourses are visible, however, SH-SE-1 can be difficult to identify.

## 4.0 Sinkhole Description, Flows and Continuous Water Level Monitoring Results

### 4.1 Sinkhole Southeast 1 (SH-SE-1)

SH-SE-1 is located on the northern portion of the Study Area, immediately northeast of a hedgerow (Figure 2). Flows enter the sinkhole from the southwest through a well-defined channel in the clay overburden that receives flows from the west and south. When flows into SH-SE-1 are at a greater rate than the infiltration capacity of the sinkhole, water ponds up in the depression of the sinkhole and if water levels become high enough, flows will continue past the sinkhole in an eastward and then northward direction, passing under Townline Rd. and entering Rock Street Park. The following table presents some general information for SH-SE-1:

Table 2. SH-SE-1 General Information

| Approximate Maximum Length (m)(NE/SW) | Approximate Maximum Width (m) (NW/SE) | Approximate Maximum Depth (m) | UTM Coordinates | Approximate Catchment Area (ha) |
|---|---|---|---|---|
| 5.1 | 4.3 | 1.9-2.0 | 618270 E, 4771862 N | 1.9 |

*Notes: NE: Northeast, SW: Southwest, NW: Northwest, SE: Southeast, E: Easting, N: Northing, m: Metres*

#### 4.1.1 SH-SE-1 Continuous Water Level and Flow Monitoring Results

On September 13, 2023, SH-SE-1 was instrumented with a Heron Instruments LT (level and temperature) water level datalogger, set to continuously record data at 15-minute intervals. The water level datalogger was installed within a stainless steel, perforated drive point in order to ensure a permanent and stable recording location. Water level data for SH-SE-1, along with daily precipitation data from the Grimsby Mountain Weather Station, ID 6133055 (Climate Data Online) from September, 2023 until April, 2024 is plotted and presented on Figure 8.

A barometric datalogger was also installed on a tree near SH-SE-1 in order to compensate the water level data for barometric pressure.

The table below outlines manual flow measurements taken at SH-SE-1 during the monitoring period. Flows were measured mainly volumetrically, with a malleable bucket or jug over time.

Table 3. Field Measurements of Flows at SH-SE-1 (2023/2024)

| Date | Flow (Litres/second) | Notes |
|---|---|---|
| December 18, 2023 | 0.4 | All flow sinking |
| January 10, 2024 (#1) | 1.8 | Sinkhole was inundated, flow measured upstream |
| January 10, 2024 (#2) | 1.5 | |
| January 10, 2024 (#3) | 1.6 | Water level in sinkhole notably decreasing |
| March 15, 2024 | 0.2 | All flow sinking |
| April 3, 2024 (#1) | 0.8 | All flow sinking |
| April 3, 2024 (#2) | 1.3 | Sinkhole beginning to inundate |
| April 3, 2024 (#3) | 3.8 | Sinkhole continuing to inundate |
| April 3, 2024 (#4) | 7.1 | Water level at top of DP |
| April 4, 2024 | 0.7 | All flow sinking |
| April 11, 2024 (#1) | 7.4 | Sinkhole inundated, 6.8 L/s flowing out of sinkhole |
| April 11, 2024 (#2) | 3.0 | Sinkhole inundated, 0.4 L/s flowing out of sinkhole, same flow measured an hour later, however sinkhole no longer outletting flow |

*Note: DP= Drive Point (steel perforated pipe containing water level datalogger)*

During flowing conditions resulting from precipitation and/or snow melt in the fall, winter, or early-spring seasons, SH-SE-1 becomes inundated as is apparent from both Table 3 and the datalogger water level plot presented on Figure 8. The measured flow rate of water sinking into SH-SE-1 was approximately 2.5 to 3.0 L/s. Therefore, on Figure 8, water level values of zero do not necessarily represent dry conditions but rather conditions where flows are less than the infiltration capacity of the sinkhole when the flow is not high enough to cause water to begin filling up the sinkhole. At a flow rate greater than 2.5 to 3.0 L/s, the sinkhole becomes inundated and overflows.

The water that does not infiltrate into SH-SE-1 during high flows will inundate SH-SE-1 and then flow in a northeast direction, through a culvert under Townline Road and then through Rock Street Park before discharging into Twenty Mile Creek (Figures 2 and 3).

**4.2 Rock Street Park Spring**

The Rock Street Park Spring is located in the northern portion of the Rock Street Park, west of Carter Drive and discharges into the watercourse that flows north/northeast through the park into Twenty Mile Creek.

This spring was initially instrumented with a water level datalogger on September 13, 2023, because it was deemed the most likely spring to discharge the water sinking into SH-SE-1. However, during the April 2024 dye trace of SH-SE-1, no dye was observed emerging from this spring. Therefore, there was less need to analyze flow values discharging from this spring and flows are not reported on herein. A water level plot is presented on Figure 9.

### 4.3 South Rock Street Park Spring

As is discussed below, in Section 5.0, interconnectivity between SH-SE-1 and a newly discovered spring, South Rock Street Park Spring, was determined during an April, 2024 dye trace. This newly discovered spring is located on the channel-bottom of the watercourse that runs north/northeast through the Rock Street Park, immediately north of Townline Road (Figure 2 and 3). Identifying this spring without completion of the dye trace and during initial site visits was not possible due to the fact that this spring discharges into an existing channel-bottom. Whenever South Rock Street Park Spring was flowing, the watercourse it discharges into was also flowing.

Following discovery of this spring, the water level datalogger continuously recording water levels at the Rock Street Park Spring was moved to the South Rock Street Park Spring. Given this spring was identified on April 4, 2024, and the monitoring associated with this report finished on April 25, 2024, there is not a large water level database for this spring, however, continuous water levels recorded at this spring, along with daily precipitation values from the Grimsby Mountain Environment Canada Weather Station (ID 6133055) are presented on Figure 10. It should be noted that these water level values represent both (i) water discharging directly from South Rock Street Park Spring and (ii) watercourse flows coming from south of Townline Road (Figure 2).

#### 4.3.1 South Rock Street Park Spring Continuous Water Level and Flow Monitoring Results

The continuous water level results from April 4 to April 25, 2024, at this location demonstrate that the watercourse at the spring location did not go dry during this time period with a minimum recorded depth of 0.18 metres. An April 9, 2024 site visit noted that there were ponded conditions with no outflow at the spring location. A maximum depth of 0.64 metres was recorded on April 12, 2024, following 26.8 mm of rainfall on April 11, 2024. Well defined responses to precipitation events are apparent as would be expected.

Given flows directly discharging from South Rock Street Park Spring are unable to be measured with discharge occurring from the channel-bottom of the watercourse, flow values measured in association with South Rock Street Park Spring were completed at the following locations:

a) The main stormwater culvert immediately north of Townline Road which discharges flows from the watercourse south of Townline Road and under high-flow conditions would include flows going downstream of the inundated SH-SE-1;
b) The Rock Street stormwater headwall, located approximately 5 metres northwest of the main stormwater culvert described above. This presumably discharges stormwater flows from along Rock Street; and
c) A downstream location from a) and b) above as well the South Rock Street Park Spring.

These monitoring locations of these are shown on Figure 3.

The flow values measured on April 4 and 11, 2024, at the above locations did not present any meaningful results with the highest percentage of flows being provided from the culvert running under Townline Road (as would be expected) and smaller percentages of flows being provided by the South Rock Street Park Spring and the Stormwater Headwall (from Rock Street).

Proposed stormwater management for the Study Area would include redirecting the flows currently sinking at SH-SE-1. The stormwater management facilities are proposed to discharge northwards into Rock Street Park (using the existing watercourse). Therefore, by redirecting the relatively small stormwater flows that presently sink into SH-SE-1 towards the stormwater management pond should not decrease flows in this minor tributary of Twenty Mile Creek.

**5.0 Dye Tracing Results**

In order to complete a thorough karst assessment, it is important to have an understanding of the discharge location of stormwater that sinks into karst features to assist in determining the significance of the flows conveyed by the karst system (e.g. does the sinking flow provide an ecological function of important habitat).

On April 4, 2024, ideal conditions to complete a dye trace were observed at SH-SE-1 (the flow entering the sinkhole was entirely sinking). 1 L/s of flow was measured at SH-SE-1. The study area was visited after 28.7 mm of rainfall was recorded over April 2 and 3, 2024 at the Environment Canada Grimsby Mountain Station (ID No. 6133055).

At 8:32 am, 200 mL or 40 grams of rhodamine WT fluorescent dye (20% stock solution) was injected into SH-SE-1 (Photograph 5, Appendix 2). The Ministry of the Environment, Conservation & Parks (MECP) Spills Hot Line was notified of the trace prior to dye injection and a Spill Number was obtained (#1-5DW1WW).

A YSI 600 OMS datalogger sonde was used to continuously monitor rhodamine dye concentrations during the dye trace, in combination with visual monitoring. The sonde was initially installed within the Rock Street Park Spring (Figure 2).

At 11:53 am, rhodamine was visually observed emerging from a spring in the southern portion of the Rock Street Park (Photograph 6, Appendix 2), at the bottom of the channel of the watercourse that flows in a northeastern direction across the park (Figure 2). Following the visual detection of the dye emerging from South Rock Street Park Spring, the rhodamine sonde was transferred to this location from the Rock Street Park Spring.

The following table summarizes details from the successful dye trace of SH-SE-1.

Table 4. SH-SE-1 Dye Trace Results

| Dye Emergence Location | Approximate Distance (m) | Time of Travel (hours) | Rate of Flow (m/hour) |
|---|---|---|---|
| South Rock Street Park Spring | 282 | ≤3.35 | ≥84.2 |

By 3:11 pm on April 4, 2024, the reddish/pinkish rhodamine dye was no longer visible at South Rock Street Park Spring or within the main channel of the watercourse so the rhodamine sonde was removed. A plot of rhodamine concentrations (in µg/L) during the April 4th dye trace is presented on Figure 7. Following the movement of the rhodamine sonde to the South Rock Street Park Spring, a peak rhodamine concentration of 1,184 µg/L was recorded at 12:11 pm, or 12 minutes following the installation of the rhodamine sonde. This peak rhodamine concentration was sustained for 30 minutes before the concentrations began decreasing. When the rhodamine sonde was installed in South Rock Street Park Spring, the rhodamine concentration was immediately recorded at 1,140 µg/L so much of the upslope of the rhodamine curve is absent from Figure 7.

Rhodamine dye was not observed at any other known spring or watercourse in the area on April 4 indicating that the entirety of the water sinking within SH-SE-1 discharges to South Rock Street Park Spring.

## 6.0 Assessment of Karst-based Risk

The purpose of this section is to evaluate and document the potential for risk and impact associated with the karst features identified within the proposed development within the subject lands.

### 6.1 Relevant Policies

The following policies pertain to the presence of the karst features on the subject property:

1. The Provincial Policy Statement (PPS) (MMAH, 2020);
2. The Niagara Peninsula Conservation Authority's (NPCA's) Policy Document (Hazardous Sites (Karst) (2022)); and
3. Township of West Lincoln's April 20, 2023 Official Plan Amendment 63.

#### 6.1.1 The Provincial Policy Statement (PPS)

Karst hazards are identified as "*hazardous sites*". The PPS (2020) defines "*hazardous sites*" in Section 6.0 as follows:

> *"Hazardous sites: means property or lands that could be unsafe for development and site alteration due to naturally occurring hazards. These may include unstable soils (sensitive marine clays [leda], organic soils) or unstable bedrock (karst topography)."*

The PPS requires that natural features and areas shall be protected for the long term if they are required for ecological function. Specifically Policy 2.1.8 of the PPS states that:

*"Development and site alteration shall not be permitted on adjacent lands to the natural heritage features. . . . unless the ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions."*

"Ecological function" is defined by the PPS as "*the natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes. These may include biological, physical and socio-economic interactions."*

### 6.1.2 The Niagara Peninsula Conservation Authority's (NPCA's) Policy Document (Hazardous Sites (Karst) (2022)) (Appendix 1 herein)

The relevant sections of the NPCA's Policy Document (Hazardous Sites (Karst) (2022)) pertaining to karst state the following (Sections 7.1.2 through 7.2.8):

***Defining and Assessing Hazardous Site***

*Hazardous sites are considered to be part of the NPCA's regulated areas. The potential for catastrophic failures in some areas of unstable soil and unstable bedrock warrant site-specific studies to determine the extent of these hazardous sites, and therefore the appropriate limits of the hazard and regulation limits. The regulated area will be based on the conclusions and recommendations of such studies, to the satisfaction of the NPCA. Accordingly, the limits for hazardous lands, such as leda clays, organic soils and karst formations, shall be determined on a site-specific basis according to the Ministry of Natural Resources Technical Guide for Hazardous Sites (1996) and Understanding Natural Hazards (2001).*

***Karst Formations***

*Karst is a landform that develops on or in limestone, dolomite, or gypsum by dissolution and is characterized by the presence of features such as sinkholes, underground (or internal) drainage through solution-enlarged fractures (joints) and caves. Karst formations can be significant geologic hazards. Sudden collapse of an underground opening of a sinkhole can cause surface subsidence that can severely damage overlying structures such as buildings, bridges or highways. Improperly backfilled sinkholes are prone to both gradual and sudden subsidence and similarly threaten overlying structures. Sewage, animal wastes and agriculture, industrial and ice control chemicals entering sinkholes as surface drainage are conducted directly and quickly into the groundwater/surface water systems.*

*There are at least five known locations within the watershed with Karst formations:*

*a) The Stoney Creek "Mountain" Area;*
*b) The Smithville Area;*
*c) The Gavora Drain and Balls Falls Area in Vineland;*
*d) The Brow of the Niagara Escarpment Area; and*
*e) The Onondaga Escarpment Area.*

*(Geologic Hazard Mapping Study, Karst Topography, Phase I, NPCA Watershed Area, Terra-Dynamics, 2006)*

***Policies for Planning and Regulating Hazardous Sites***

***Objectives***

*The objectives of the hazardous site policies are to:*

*a) Prevent the loss of life;*
*b) Minimize property damage;*
*c) Reduce the potential for incurring public cost associated with the impacts of hazardous sites; and*
*d) Manage existing risks and reduce the potential for future risks.*

***Development Regulation on Hazardous Lands***

1. *Development and site alteration on hazardous lands shall not be permitted except in accordance with the policies in this Chapter.*

2. *Development and site alteration may only be permitted on hazardous lands where the following criteria has been addressed:*

*a) A geotechnical study, completed by a qualified professional, demonstrates that all hazards associated with the site can be appropriately mitigated*
*b) Applicable provincial standards related to floodproofing, protection works and access can be met and implemented;*
*c) Vehicles and people have a way of safely entering and exiting the area during times of flooding, erosion and other emergencies;*
*d) Existing hazards are not aggravated;*
*e) New hazards are not created; and*
*f) There are no negative impacts on ecological features and functions. This may require the completion of an EIS in accordance with the NPCA Procedural Manual.*

3. *Infrastructure is permitted within hazardous lands subject to the policies of Chapter 10.*

***Development Within 50 metres of a Hazardous Site***

*Development and/or site alteration shall not be permitted within 50 metres of hazardous land unless it can be demonstrated that there are no adverse impacts to the hazard with respect to the control of flooding, erosion, dynamic beaches, pollution and conservation of land.*

***Additional Policies for Karst***

*In addition to the Policies in Section 7.2.2., the following Policies apply to hazardous lands that are karst features.*

1. *Development and site alteration on karst or within 50 metres of karst will only be considered where the following concerns are addressed:*

a) *Storm water drainage;*
b) *Utilities;*
c) *Groundwater contamination; and*
d) *Flooding.*

2. *Surface water run-off shall not directly enter a sinkhole or closed depression unless that is the natural drainage pattern. Drainage plans shall be designed to route surface water run-off through vegetated filters or other filtration measures before it enters such features.*

3. *No water wells shall be installed within 50 metres of a karst feature. The NPCA may require an assessment of the draw down impact of the well on the water table and may decline approval where the drawdown has the potential to destabilize karst topography.*

**6.1.3 Township of West Lincoln's April 20, 2023 Official Plan Amendment (OPA) 63**

Taking the information from the SWS, the Township of West Lincoln and incorporated the following in the April 20, 2023 Official Plan Amendment 63 pertaining to karst feature Sinkhole SE-1 (defined by the SWS as a low-constraint karst features) on the Study Area property (Wood Environment & Infrastructure Solutions, 2022): Policy 6.11.7.3.17 of OPA 63 pertains to high and medium-constraint karst features in northwest and southwest Smithville and as such, did not include Sinkhole SE-1. Therefore, alterations or remediation (close-out) of Sinkhole SE-1 defaults to the approval of the NPCA, in accordance with NPCA regulations and policies.

**6.2 Assessment of Karst-based Hazards**

The following is a simplification of assessing karst-based hazards:

<u>Hazard Potential</u>

1. Is the sinkhole or associated karst conduit expected to collapse or cause ground subsidence?
2. Is the water sinking into the sinkhole causing flooding issues or will it cause flooding issues in the future?
3. Are there karst conditions that are a risk to groundwater contamination?

In addition, the following is a simplification of assessing the natural heritage function of karst topography:

<u>Ecological and Natural Heritage Function</u>

Is the water that is flowing into the sinkhole and through the karst conduit serving the purpose to provide or supply water to an ecosystem that is reliant on the continued supply of that water, and can it

be demonstrated that there will be no negative impacts on the natural features or their ecological function(s)?

## 7.0 Evaluation of Karst-based Policies Pertinent to the Study Area

### 7.1 Evaluation of Potential Ecological Risks to the Discharge of Karst-based Groundwater to Twenty Mile Creek

Figure 2 shows the approximate catchment areas associated with Sinkhole SE-1. The catchment surface area for stormwater sinking into Sinkhole SE-1 is very small at 1.9 hectares. This volume of water is very small and would only occur during significant storm events when Twenty Mile Creek is inundated with flows in the spring season and after large precipitation events when flows are typically greater than 30,000 Litres/second (NPCA Flow Station 02HA020). Therefore, there should be no ecological risk to Twenty Mile Creek or the downstream drainage channel through Rock Street Park if Sinkhole SE-1 is subject to close-out or remediation.

### 7.2 Evaluation of Hazards

#### 7.2.1 Subsidence

As is referenced herein in Section 6.1.3, it is recommended that this low-constraint sinkhole, as referenced by Wood (2021), be subject to remediation or sinkhole close-out to remove any potential for subsidence in the clay overburden or the dolostone bedrock. A permit for a watercourse alteration from the NPCA will be required for the close-out of this Sinkhole SE-1.

#### 7.2.2 Flooding

As is referenced above in Section 7.1, the catchment area for water sinking into Sinkhole SE-1 is very small at 1.9 hectares and the results of the dye tracing showed a karst conduit that is only approximately 300 m long. The main flooding risk could occur if the karst conduit in the bedrock is intercepted during the placement of buried infrastructure in the beneath Townline Road. This potential risk can be alleviated by remediating or closing-out this sinkhole.

#### 7.2.3 Groundwater Contamination

In its present state as an open, small active sinkhole (Appendix 2, Photographs 1-3), there is potential for downgradient groundwater contamination if contamination enters the sinkhole when it receives storm water runoff, albeit at low volumes. There is also potential for downgradient groundwater contamination if liquid-based contaminants are poured into the sinkhole or there is a nearby fire and fire-extinguishing water enters the sinkhole. Remediating or closing-out Sinkhole SE-1 will eliminate the risk of contamination entering this sinkhole.

## 8.0 Conclusions

The following are conclusions based on the findings of this karst assessment:

1. A karst assessment was completed of the Study Area within Block Plan 9 Area. One sinkhole, Sinkhole SE-1, was identified.

2. Sinkhole SE-1 has a very small catchment area of 1.9 hectares and contributes an insignificant amount of water to aquatic habitat present in Twenty Mile Creek. The maximum inflow rate sinking into Sinkhole SE-1 was measured to be approximately 2.5 to 3.0 Litres/sec.

3. A rhodamine dye tracing test showed that water sinks into the bedrock for an approximate distance of 300 m and daylights at a previously unmapped spring immediately north of Townline Road in a drainage channel located in Rock Street Park. This spring was labeled the South Rock Street Park Spring as another previously mapped spring (Rock Street Park Spring) is located downstream of the South Rock Street Park Spring (Figure 2).

4. The results of the Karst Hazard Risk Assessment show the following based on the information obtained to-date for Sinkhole SE-1:

   (i) there is no ecological risk associated with future development to down-gradient habitat such as a cold water spring because of the very low sinking flow rates (maximum of 2.5 to 3.0 Litres/second) caused by the small upstream catchment area of approximately 1.9 hectares for stormwater flow. It is our understanding that the water from the proposed SWM pond northeast of Sinkhole SE-1 will discharge stormwater to this same drainage channel that will flow through Rock Street Park to Twenty Mile Creek;

   (ii) there is very low, to no, down-gradient flooding risk associated with future development of potentially intercepting the bedrock karst conduit(s) during deep bedrock excavations for buried services along Townline Road based on (a) the very small catchment area referenced above; and (b) minimal observed stormwater sinking flow rates of a maximum of 2.5 to 3.0 Litres per second of ephemeral flow after significant storm events or snow melt event. A karst contingency plan would be needed for the future bedrock excavations in the event higher karst-based flows are encountered.

   (iii) the risk of subsidence caused by unstable bedrock is likely very low owing to the small size of the karst conduit that transmits stormwater underground in the dolostone bedrock for a distance of approximately 300 m from Sinkhole SE-1 to the South Rock Street Park Spring. Remediating or closing-out Sinkhole SE-1 will further reduce the potential risk of subsidence in the bedrock;

   (iv) there is no significant risk of people or wildlife falling into deep bedrock crevices or surface voids because of the small size of Sinkhole SE-1; and

   (v) the risk of contamination is presently low owing to the small catchment area of this agricultural field. Remediation or close-out of Sinkhole SE-1 should eliminate all potential risks of subsurface contamination.

5. Based on a review of the Niagara Peninsula Conservation Area Karst Hazard Policy, there are no impediments to remediating or closing-out Sinkhole SE-1 to allow development of this area of the Study Area.

6. The Smithville Subwatershed Study classified Sinkhole SE-1 as a low constraint karst feature. The results of this karst monitoring program, dye tracing test and Karst Hazard Assessment confirms this classification.

**9.0 Recommendations**

The following recommendations are provided for your consideration:

1. Sinkhole SE-1 should be fenced-off with security or snow fencing to restrict entry into the area of this sinkhole;

2. This report should accompany a permit application to the NPCA to remediate or close-out Sinkhole SE-1. The application should be for "*Watercourse Alteration: Channels – Channel Work Less Than 500 m*";

3. Remediation should consist of the following tasks by a karst specialist and a geotechnical engineer:

   (i) redirecting stormwater that presently sinks into Sinkhole SE-1 to the downstream water course that flows beneath Townline Road in a culvert;
   (ii) excavating away the silty clay overburden around Sinkhole SE-1;
   (iii) hydro-vacaccing the bedrock inside the sinkhole and around its perimeter to extract all silty clay in the immediate vicinity of the sinkhole;
   (iv) filling the bottom of the throat of the sinkhole with clear stone (to allow any potential upgradient karstic flows to continue flowing through the bedrock);
   (v) caping the void in the bedrock above the clear stone with a layer of low slump concrete. The thickness of the concrete should be determined by a geotechnical engineer;
   (vi) regrading the area of excavation with native silty clay and recompacting the clay to the specifications decided by a geotechnical engineer;

4. Excavation into the bedrock should be avoided for the construction of the stormwater management pond (SWM Pond #1 – Figure 11) northeast of Sinkhole SE-1 and this stormwater management pond should be lined with recompacted native silty clay;

5. In the event that flowing karst conduits are intercepted during the installation of services along the northern portion of the Study Area near Townline Road (where there is a known presence of karstic flows), a karst contingency plan should be developed in order to address the possible flows in the bedrock.

6. Karst assessments should be completed on the other properties within the northwestern and eastern sections of the Block Plan 9 Area (Figure 1). These properties should be evaluated at the time of site-specific development.

**10.0 Limitations**

Karst assessments, by their nature, have inherent limitations and uncertainties primarily due to the presence of vegetation and the placement of fill material that may obscure surface expressions of karst features. It is believed that these uncertainties have been addressed through conservative interpretation

of historic and site-specific data at the places investigated. Conditions may vary in the subsurface at places not investigated. The assessment of karst, including the evaluation of risk, is valid only for the assumptions and conditions outlined in this report and the conditions as they were observed at the time of the investigation. Should knowledge of the site conditions change, the assessments of risks posed by the site may differ from that presented in this report.
This report was prepared by Terra-Dynamics Consulting Inc. for Stantec and Lockbridge Development Inc. The material in it reflects Terra-Dynamics' best judgment in light of the information available to Terra-Dynamics at the time of preparation. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. Terra-Dynamics accepts no responsibility for damages, if any, suffered by any third parties as a result of decisions made, or actions taken, based on this report.

We trust this information is sufficient for your present needs. If you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.


Kevin Slaine, B.Sc., P. Geo.
Senior Hydrogeologist

Attachments

Figure 1. Location of Block Plan 9 Area and Study Area
Figure 2. Base Map and Relevant Features with 2024 Dye Trace Results
Figure 3. South Rock Street Park Spring Location
Figure 4. Depth to Bedrock and Bedrock Elevations
Figure 5. Aerial Photograph 1934
Figure 6. Geologic Cross Section A-A'
Figure 7. April 4, 2024, SH-SE-1 Dye Trace: Rock St Park Spring and South Rock Street Park Spring
Figure 8. SH-SE-1 Water Level Elevation and Precipitation, September 13, 2023 to April 25, 2024
Figure 9. Spring Water Level Elevation and Precipitation, September 13, 2023 to April 25, 2024
Figure 10. South Rock Street Park Spring Water Level Elevation and Precipitation, April 4, 2024 to April 25, 2024
Figure 11. Location of Sinkhole SE-1 Relative to Proposed Site Plan

Appendix 1. NPCA Karst Policies
Appendix 2. Photographs

Appendix 3. Borehole and Monitoring Well Logs: Stantec, 2024

**11.0 References**

Buck, M., Worthington, S.R.H. and D.C. Ford. 2003. Evaluation of the Eramosa Karst in Stoney Creek, Ontario as a Candidate for an Earth Science Area of Natural Scientific Interest. Prepared for the Ontario Ministry of Natural Resources and the Region of Hamilton-Wentworth, 55 p.

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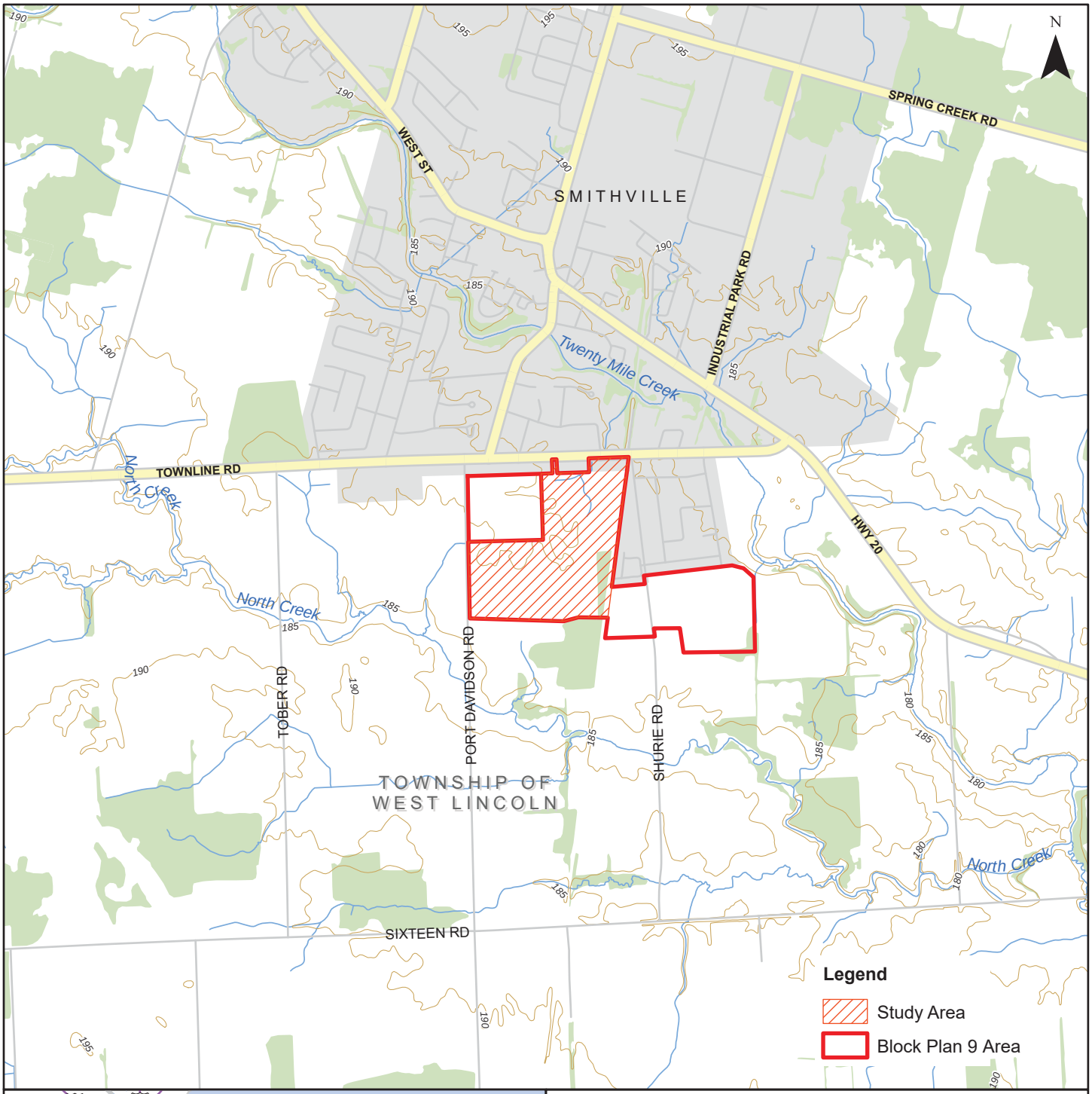




# Location of Block Plan 9 Area and Study Area

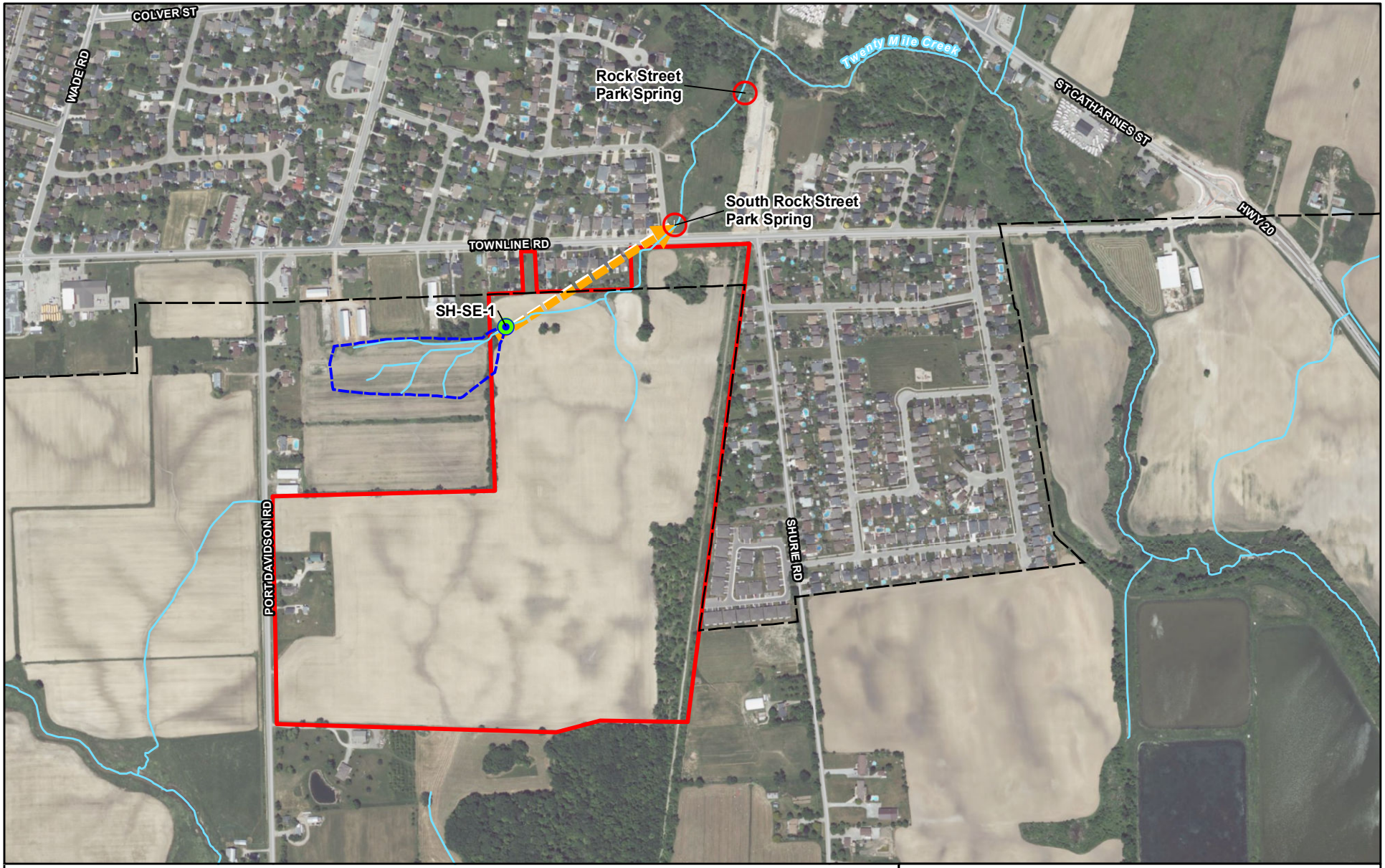
Karst Assessment
Southeast Smithville

Terra-Dynamics Consulting Inc.

0 500 Meters

**Figure 1**

Path: H:\TERRA_DYNAMICS\9716 - TD Smithville\gis\mxd\Figure 1 Location of Site and Study Area.mxd Revised: July 4, 2024




Study Area
Smithville
Sinkhole
Spring

SH-SE-1 Straight-Line Representation of Karst Conduit (2024 Dye Tracing Results)
Drainage Channel
Approximate Catchment of Inflow to Sinkhole SE-1

N

0 200 M
1:8,000

# Base Map and Relevant Features with 2024 Dye Trace Results

Karst Assessment Southeast Smithville

TDC Terra-Dynamics Consulting Inc.

**Figure 2**

Path: H:\TERRA_DYNAMICS\9716 - TD Smithville\gis\mxd\Figure 2 BaseMapRelevantFeatures2024DyeTrace.mxd Revised: July 9, 2024


Study Area
Smithville
Watercourse
Spring
Main Stormwater Culvert
Rock Street Stormwater Headwall
Downstream Flow Monitoring Location

N

0 50 M

1:1,500

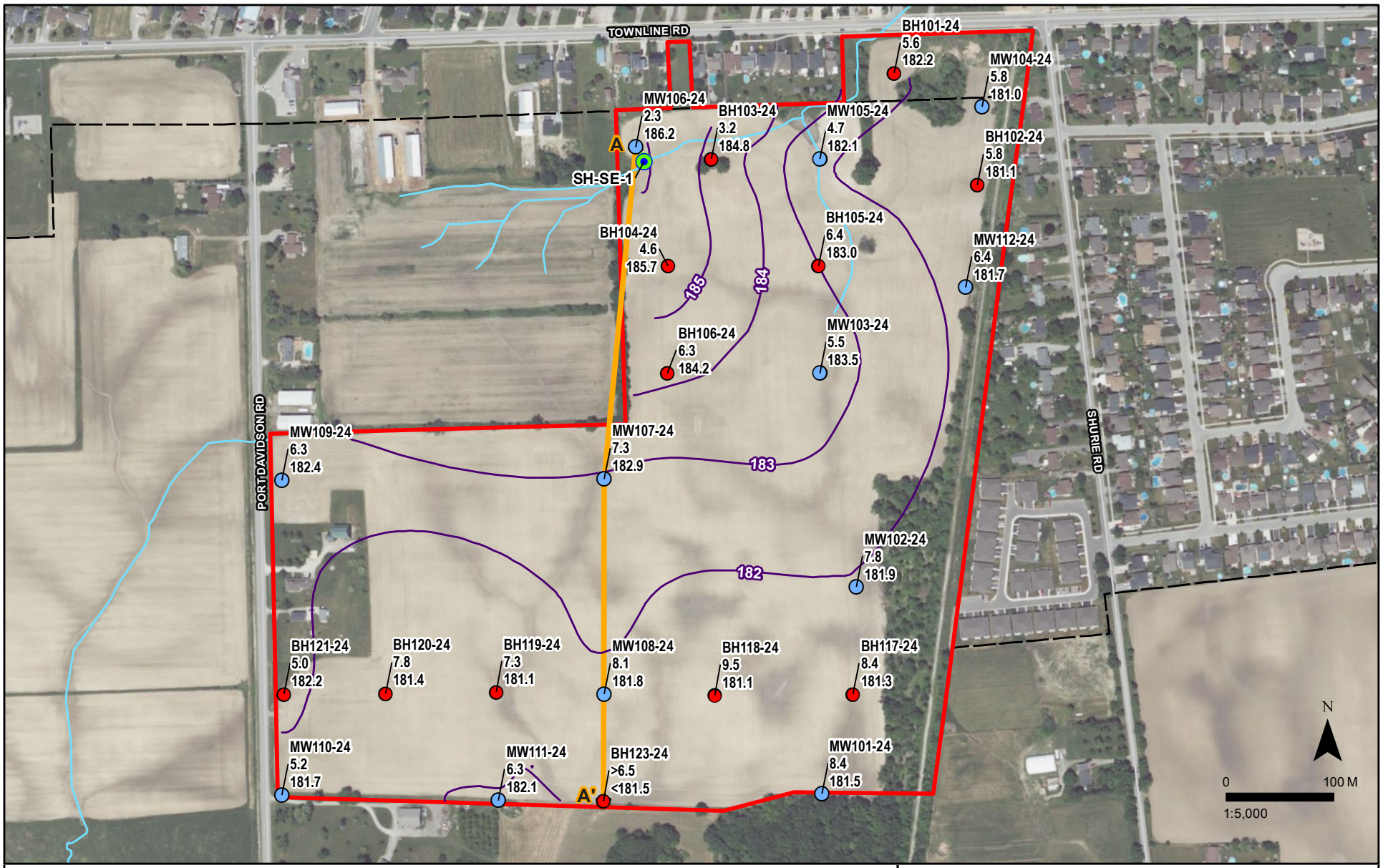
# South Rock Street Park Spring Location

Karst Assessment Southeast Smithville

TDC Terra-Dynamics Consulting Inc.

**Figure 3**

Path: H:\TERRA_DYNAMICS\9716 - TD Smithville\gis\mxd\Figure 3 South Rock Street Park Spring Location.mxd Revised: July 4, 2024




Study Area
Smithville
Geologic Cross-section
Sinkhole
Bedrock Surface Elevation (mASL)
Drainage Channel

BH103-24
3.2
184.8
Borehole ID
Depth to Bedrock (m)
Bedrock Elevation (mASL)

MW106-24
2.3
186.2
Monitoring Well ID
Depth to Bedrock (m)
Bedrock Elevation (mASL)

Source: Boreholes and monitoring wells; Stantec 2024.
Air Photo: Microsoft Virtual Earth.

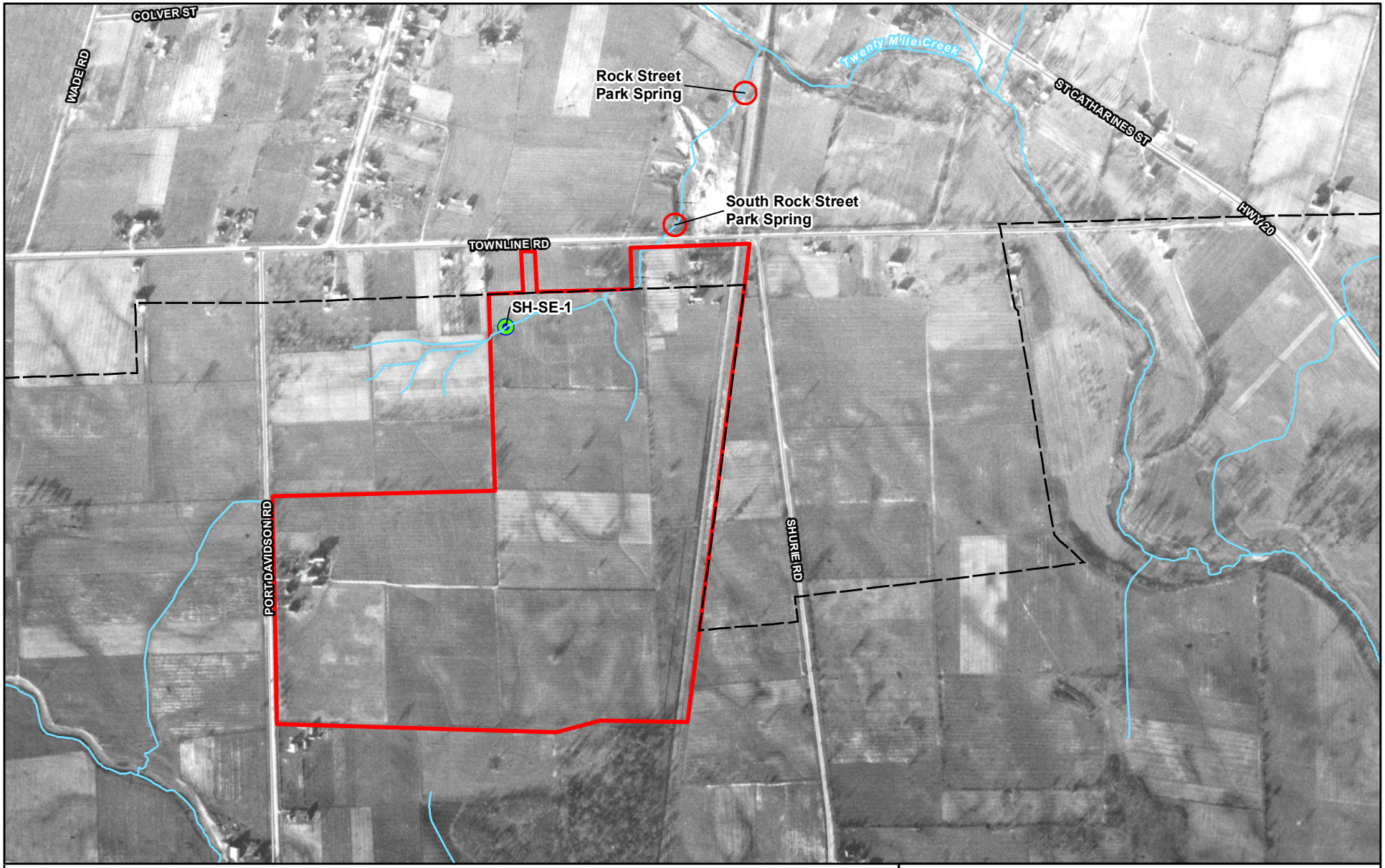
# Depth to Bedrock and Bedrock Elevations

Karst Assessment Southeast Smithville

TDC Terra-Dynamics Consulting Inc.

**Figure 4**

Path: H:\TERRA_DYNAMICS\9716 - TD Smithville\gis\mxd\Figure 4 Depth to Bedrock and Bedrock Elevations.mxd Revised: July 5, 2024




Study Area
Smithville
Sinkhole
Spring
Drainage Channel

N

0 200 M
1:8,000

Air photo:1934 Niagara Region Mosaic McMaster University.

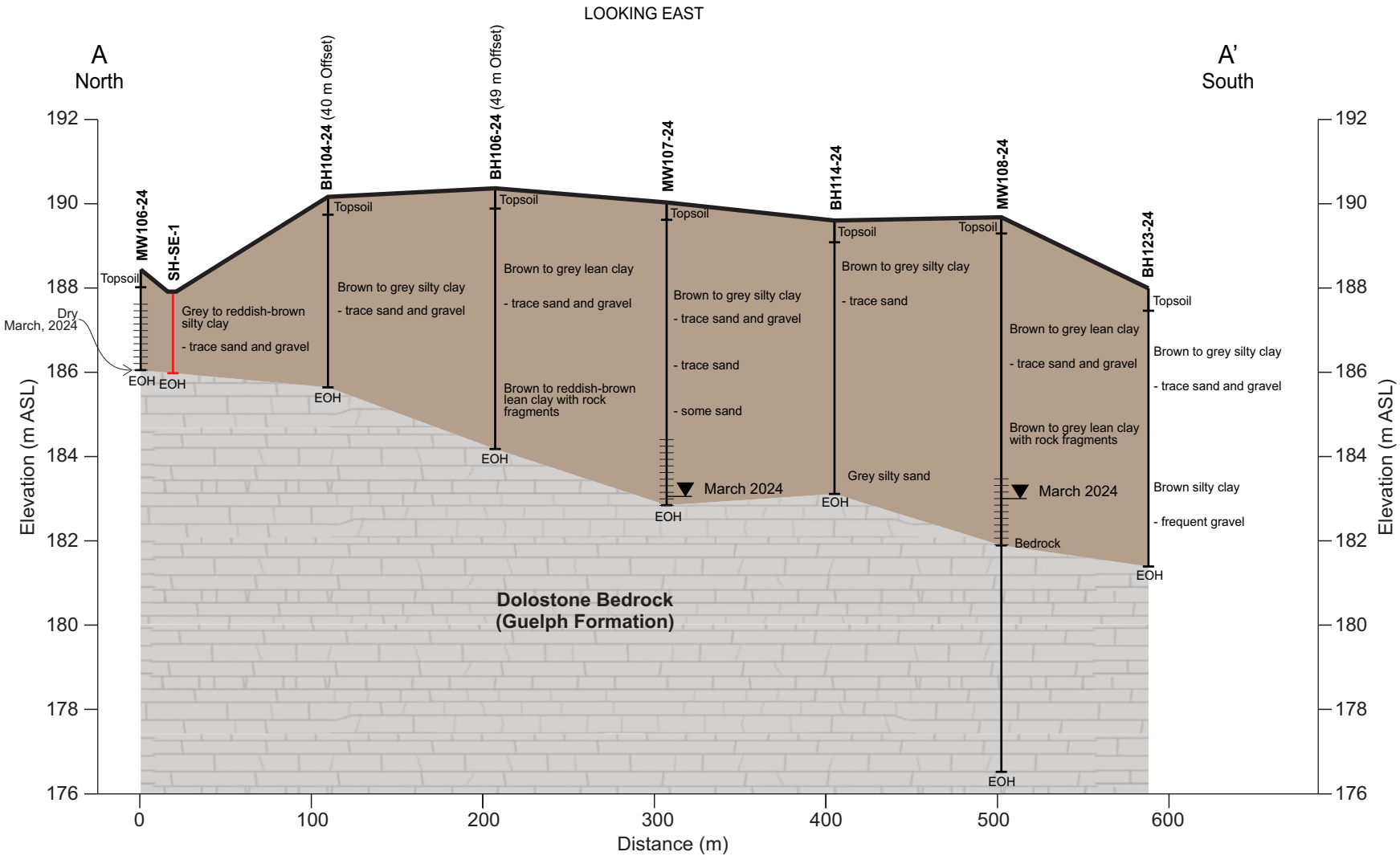
# Aerial Photograph 1934

Karst Assessment Southeast Smithville

TDC Terra-Dynamics Consulting Inc.

**Figure 5**

Path: H:\TERRA_DYNAMICS\9716 - TD Smithville\gis\mxd\Figure 5 1934 Aerial Photograph.mxd Revised: July 9, 2024




Screen

Groundwater Level and Date Measured

EOH End of Hole

Silty Clay

Dolostone Bedrock

Sinkhole (SH) SE-1

# Geologic Cross-section A-A'

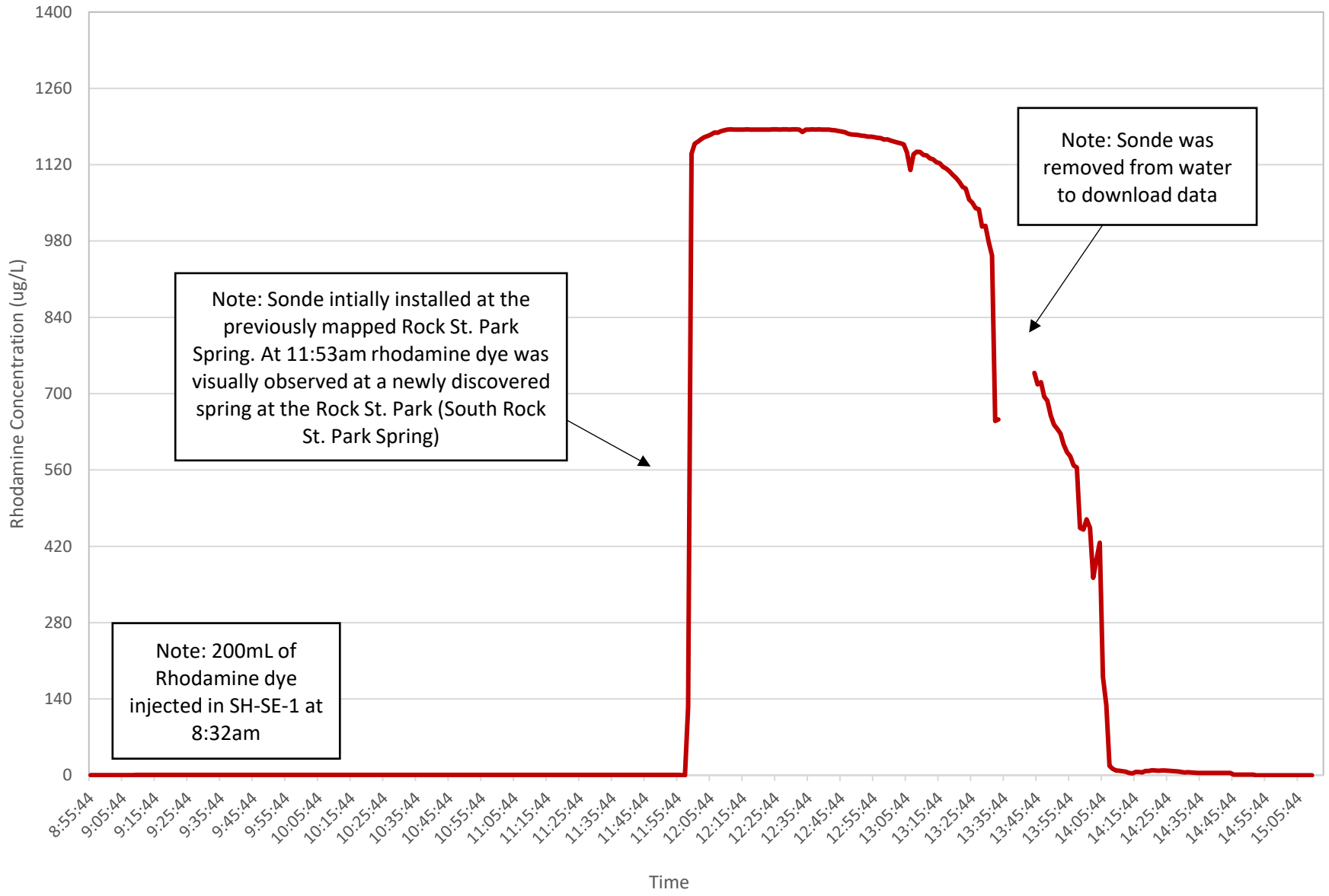
Karst Assessment
Southeast Smithville

Terra-Dynamics Consulting Inc.

**Figure 6**

H:\TERRA_DYNAMICS\9716 - TD Smithville\corel\Figure 6 Cross-section A-A'.cdr

Figure 7: April 4th, 2024 SH-SE-1 Dye Trace: Rock St Park Spring and South Rock Street Park Spring



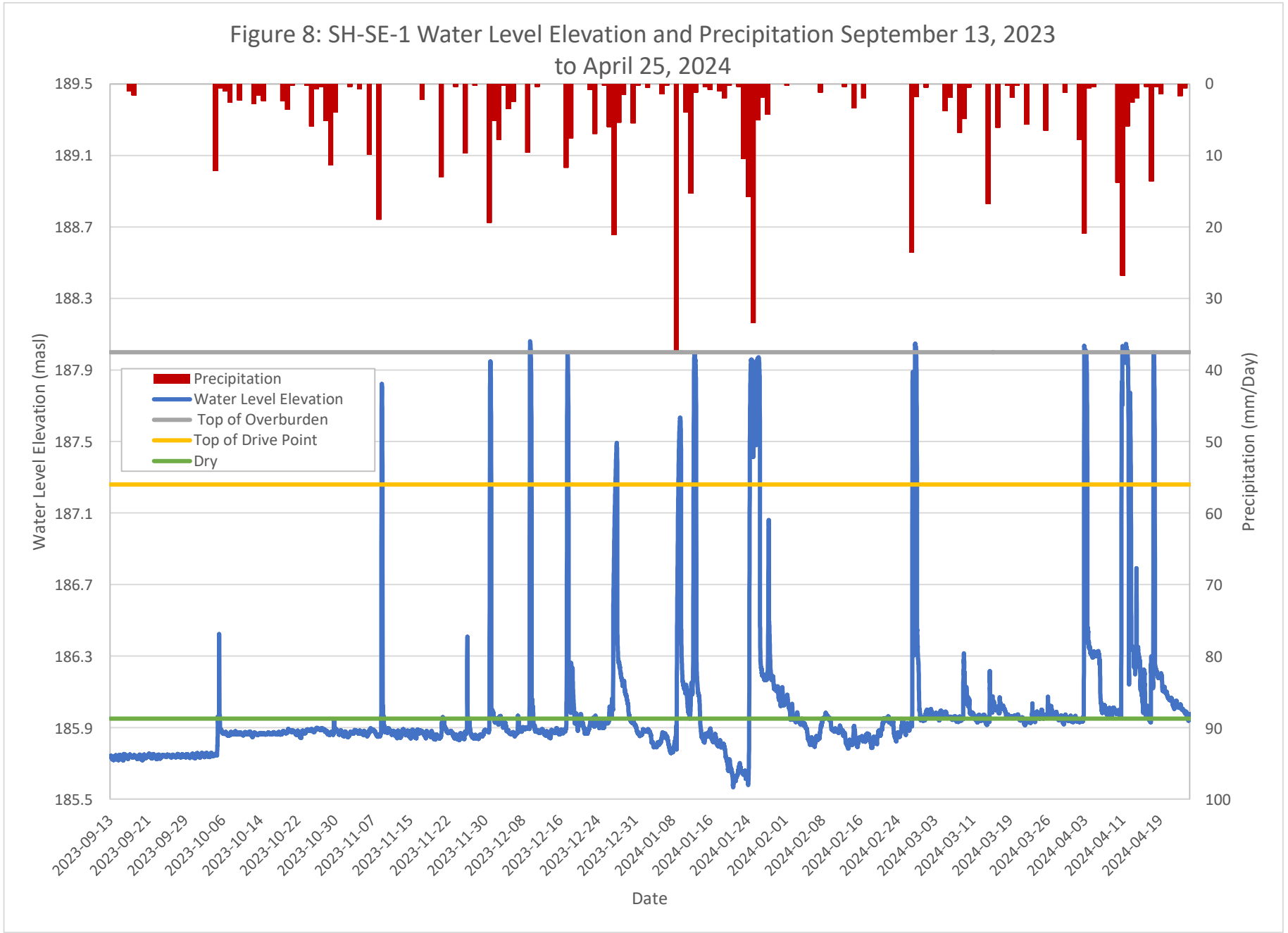


Figure 8: SH-SE-1 Water Level Elevation and Precipitation September 13, 2023 to April 25, 2024
Water Level Elevation (masl)
Precipitation (mm/Day)
Date
Precipitation
Water Level Elevation
Top of Overburden
Top of Drive Point
Dry
189.5
189.1
188.7
188.3
187.9
187.5
187.1
186.7
186.3
185.9
185.5
0
10
20
30
40
50
60
70
80
90
100
2023-09-13
2023-09-21
2023-09-29
2023-10-06
2023-10-14
2023-10-22
2023-10-30
2023-11-07
2023-11-15
2023-11-22
2023-11-30
2023-12-08
2023-12-16
2023-12-24
2023-12-31
2024-01-08
2024-01-16
2024-01-24
2024-02-01
2024-02-08
2024-02-16
2024-02-24
2024-03-03
2024-03-11
2024-03-19
2024-03-26
2024-04-03
2024-04-11
2024-04-19

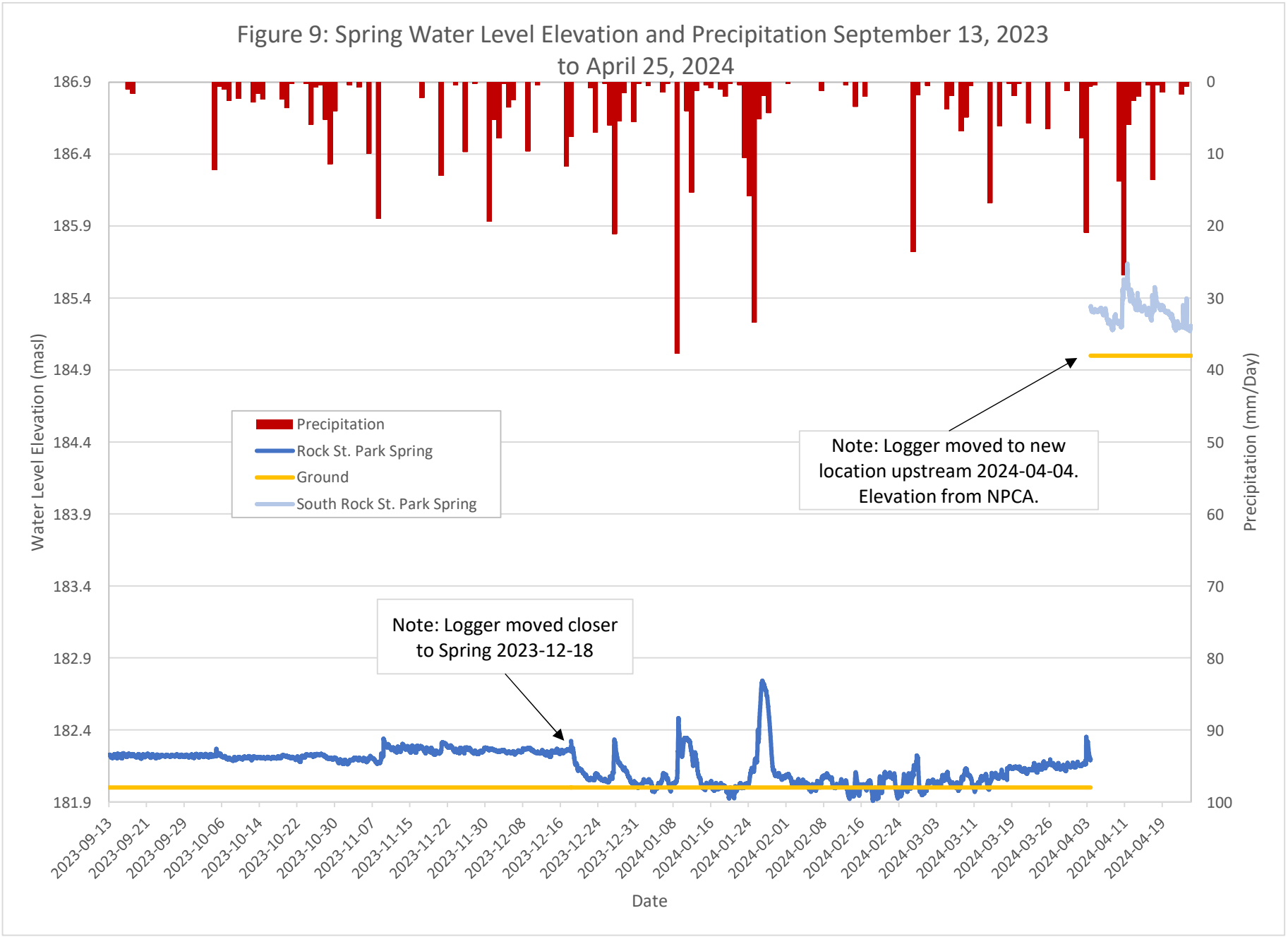
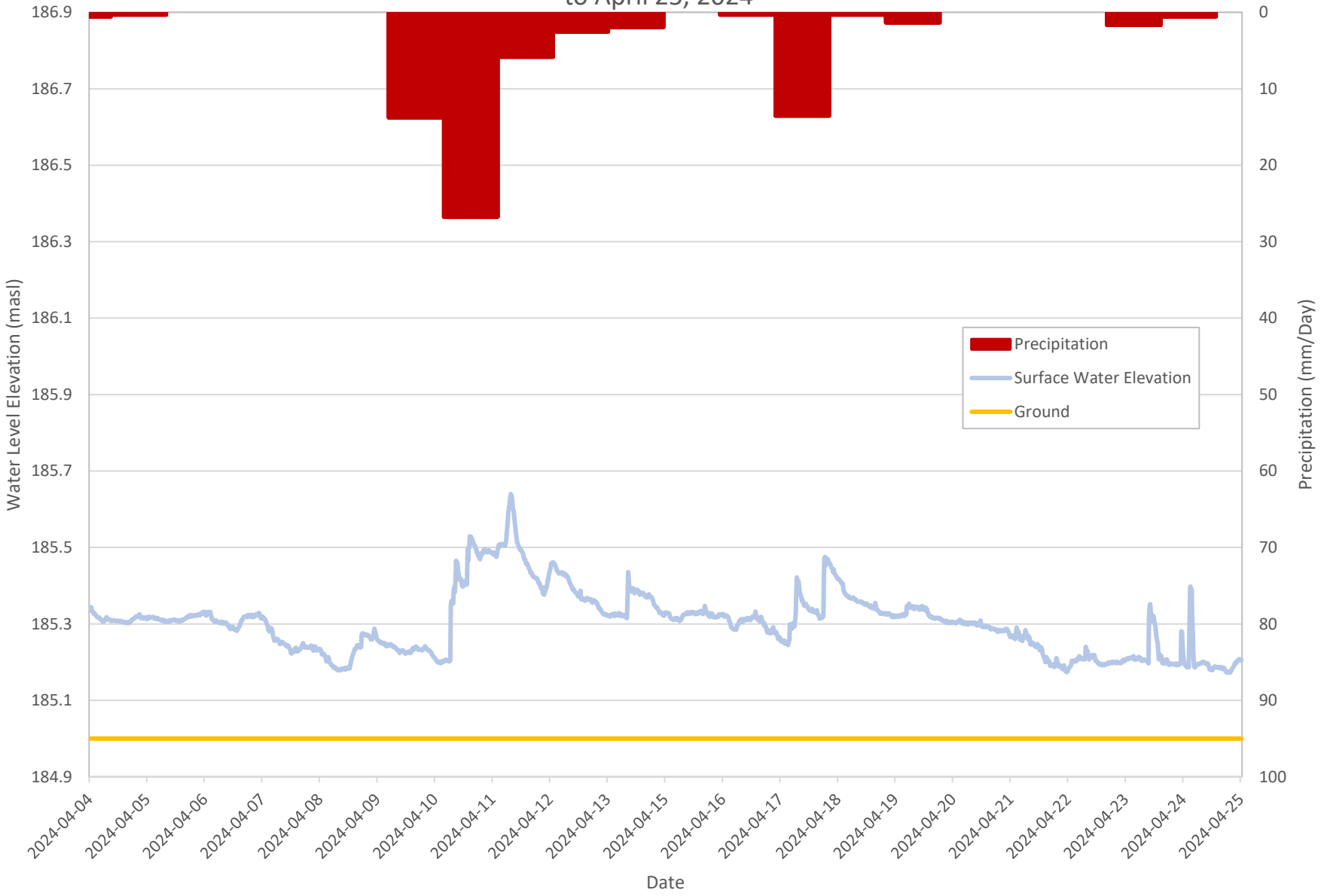
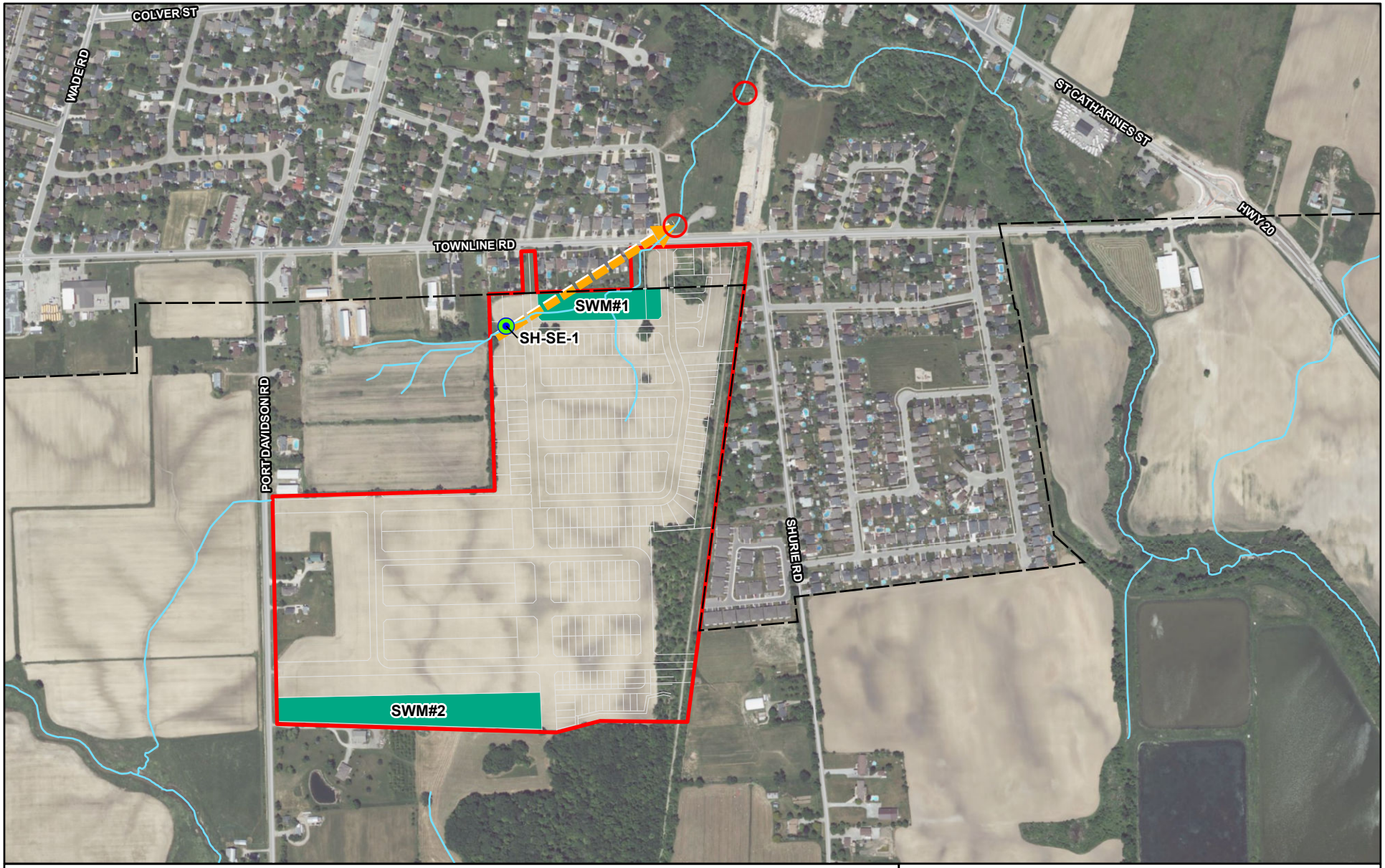


Figure 9: Spring Water Level Elevation and Precipitation September 13, 2023 to April 25, 2024
Water Level Elevation (masl)
Precipitation (mm/Day)
Date
Precipitation
Rock St. Park Spring
Ground
South Rock St. Park Spring
Note: Logger moved to new location upstream 2024-04-04. Elevation from NPCA.
Note: Logger moved closer to Spring 2023-12-18
186.9
186.4
185.9
185.4
184.9
184.4
183.9
183.4
182.9
182.4
181.9
0
10
20
30
40
50
60
70
80
90
100
2023-09-13
2023-09-21
2023-09-29
2023-10-06
2023-10-14
2023-10-22
2023-10-30
2023-11-07
2023-11-15
2023-11-22
2023-11-30
2023-12-08
2023-12-16
2023-12-24
2023-12-31
2024-01-08
2024-01-16
2024-01-24
2024-02-01
2024-02-08
2024-02-16
2024-02-24
2024-03-03
2024-03-11
2024-03-19
2024-03-26
2024-04-03
2024-04-11
2024-04-19

Figure 10: South Rock Street Park Spring Water Level Elevation and Precipitation April 4, 2024 to April 25, 2024






Study Area
Smithville
Sinkhole
Spring

SH-SE-1 Straight-Line Representation of Karst Conduit (2024 Dye Tracing Results)
Proposed SWM Pond
Drainage Channel

N

0 200 M

1:8,000

# Location of Sinkhole SE-1 Relative to Proposed Site Plan

Karst Assessment Southeast Smithville

TDC Terra-Dynamics Consulting Inc.

**Figure 11**

Path: H:\TERRA_DYNAMICS\9716 - TD Smithville\gis\mxd\Figure 11 Location of Sinkhole SE-1.mxd Revised: July 9, 2024

# Appendix 1

# NPCA Karst Policies

# NPCA POLICY DOCUMENT:

## Policies for Planning and Development in the Watersheds of the Niagara Peninsula Conservation Authority

**November 18, 2022 Consolidation**

Niagara Peninsula CONSERVATION

www.npca.ca

# 7.0 HAZARDOUS LANDS

## 7.1 WHAT ARE HAZARDOUS SITES?

### 7.1.1 Hazardous Sites and Hazardous Lands

The Provincial Policy Statement defines *hazardous sites* as lands that could be unsafe for *development* due to naturally occurring hazards. These may include unstable soils (*sensitive* marine clays [leda], organic soils) or unstable bedrock (karst topography). The *Conservation Authorities Act* uses a similar term, referring to *hazardous lands*, which are lands that are unsafe to *development* due to naturally occurring processes. Naturally occurring processes includes flooding, erosion, *dynamic beaches* and unstable soils. In the context of the *Conservation Authorities Act*, the term *hazardous lands* is used as a general term, referring to a full range of natural hazards (i.e. flooding, erosion, unstable soils). Earlier chapters in this document address *hazardous lands* associated with *dynamic beaches* (Chapter 4), erosion and *unstable slopes* (Chapter 5), and flooding (Chapter 6). The following chapter provides guidance for *hazardous lands* associated with unstable soils, such as *sensitive*

marine clays (leda clays), organic soils and unstable bedrock, such as karst formations (such as sinkholes and caves). The term hazardous site is used in this chapter to refer to naturally occurring hazards associated with unstable soils and unstable bedrock (similar in definition to the term *hazardous sites* which is used in the PPS to describe a similar feature). This chapter also provides guidance for unstable soils associated with back-dunes areas.

### 7.1.2 Defining and Assessing Hazardous Sites

*Hazardous sites* are considered to be part of the NPCA's regulated areas. The potential for catastrophic failures in some areas of unstable soil and unstable bedrock warrant site specific studies to determine the extent of these *hazardous sites*, and therefore the appropriate limits of the hazard and regulation limits. The regulated area will be based on the conclusions and recommendations of such studies, to the satisfaction of NPCA. Accordingly, the limits for *hazardous lands*, such as leda clays, organic soils and karst formations, shall be determined on a site-specific basis according to the Ministry of Natural Resources Technical Guide for Hazardous Sites (1996) and Understanding Natural Hazards (2001).

### 7.1.3 Karst Formations

Karst is a landform that develops on or in limestone, dolomite, or gypsum by dissolution and is characterized by the presence of features such as sinkholes, underground (or internal) drainage through solution-enlarged fractures (joints) and caves. Karst formations can be *significant* geologic hazards. Sudden collapse of an underground opening of a sinkhole can cause surface subsidence that can severely damage overlying *structures* such as *buildings,* bridges or highways. Improperly backfilled sinkholes are prone to both gradual and sudden subsidence and similarly threaten overlying *structures*. Sewage, animal wastes and agricultural, industrial and ice control chemicals entering sinkholes as surface drainage are conducted directly and quickly into the groundwater/*surface water* systems.

There are at least five known locations within the *watershed* with Karst formations:

a) The Stoney Creek "Mountain" Area;
b) The Smithville Area;
c) The Gavora Drain and Balls Falls Area in Vineland,
d) The Brow of the Niagara Escarpment Area; and
e) The Onondaga Escarpment Area.

(Geologic Hazard Mapping Study, Karst Topography, Phase I, NPCA Watershed Area, Terra Dynamics, 2006)

### 7.1.4 Back-Dune Areas

There are a number of back-dune areas located in-land from shorelines of Lake Erie. Back dune areas are considered to be a natural hazard, as these are locations which may be susceptible to slope failure and erosion, but may not be part of an *apparent valleyland* or part of the shoreline hazard area (as overtime they receded beyond the extent of the shoreline area). Back dunes form as a result of long-term changes of lake levels and a gradual recession of dune areas from the shoreline area. The NPCA will evaluate the potential risks associated with *development* on back-dunes on a case-by-case basis.

### 7.1.5 Hazard Slopes

There are instances through the *watershed* where steep slopes exist that are not part of a defined valley. These are considered hazard slopes and can be defined as having a vertical height greater than 3 metres and a slope steeper than 3:1 (horizonal to vertical).

# 7.2 POLICIES FOR PLANNING AND REGULATING HAZARDOUS LANDS

## 7.2.1 Objectives

The objectives of the *hazardous sites* policies are to:

a) Prevent the loss of life;
b) Minimize property damage;
c) Reduce the potential for incurring public cost associated with the impacts of *hazardous sites*; and,
d) Manage existing risks and reduce the potential for future risks.

## 7.2.2 Development Regulation on Hazardous Lands

1. *Development* and *site alteration* on *hazardous lands* shall not be permitted except in accordance with the policies of this Chapter.
2. *Development* and *site alteration* may only be permitted on *hazardous lands* where the following criteria has been addressed:

    a) A geotechnical study, completed by a qualified professional, demonstrates that all hazards associated with the site can be appropriately mitigated;
    b) Applicable provincial standards related to floodproofing, protection works and access can be met and are implemented;
    c) Vehicles and people have a way of safely entering and exiting the area during times of flooding, erosion and other emergencies;
    d) Existing hazards are not aggravated;
    e) New hazards are not created; and
    f) There are no *negative impacts* on ecological features or functions. This may require the completion of an EIS in accordance with the NPCA Procedural Manual.

3. *Infrastructure* is permitted within *hazardous lands* subject to the policies of Chapter 10.

## 7.2.3 Development within 50 metres of a Hazardous Site

*Development* and/or *site alteration* shall not be permitted within 50 metres of *hazardous land* unless it can be demonstrated that there are no adverse impacts to the hazard with respect to the control of flooding, erosion, *dynamic beaches*, *pollution* and *conservation of land*.

## 7.2.4 Additional Policies for Karst

In addition to the Policies in Section 7.2.2, the following Policies apply to *hazardous lands* that are karst features.

1) *Development* and *site alteration* on karst or within 50 metres of karst will only be considered where the following concerns are addressed:

    a) Storm water drainage;
    b) Utilities;
    c) Groundwater contamination; and
    d) Flooding.

2) *Surface water* run-off shall not directly enter a sinkhole or closed depression unless that is the natural drainage pattern. Drainage plans shall be designed to route *surface water* run-off through vegetative filters or other filtration measures before it enters such features.
3) No water wells shall be installed within 50 metres of a karst feature. The NPCA may require an assessment of the draw down impact of the well on the water table and may decline approval where the draw down has the potential to destabilize karst topography.

# Appendix 2

# Photographs

# Photographs

Photograph 1. Northward view of SH-SE-1 with Drive Point installed (contains water level datalogger) and flagged with orange tape (Photograph as taken on September 13, 2023).

Photograph 2. Southward view of SH-SE-1 when entirely inundated. The Drive Point is under water/not visible (Photograph was taken on January 10, 2024).

Photograph 3. Northward view of SH-SE-1 when nearly entirely inundated. The Drive Point is under water/not visible (Photograph was taken on January 10, 2024).

Photograph 4. Water level datalogger location within the Rock Street Park Spring (Photograph was taken on March 15, 2024).

Photograph 5. Southwest view of rhodamine dye injection at SH-SE-1. 200 mL of rhodamine dye was injected at 8:32 am (Photograph was taken on April 4, 2024).

Photograph 6. Southwest view at 12:00 pm of the rhodamine dye within the watercourse flowing through Rock Street Park. This photograph is northeast of the newly identified “South Rock Street Park Spring” which is located on the channel-bottom, immediately north of the culvert passing under Townline Road, at the intersection with Rock Street. Dye was first observed emerging from “South Rock Street Park Spring” at 11:53 am, and following this observation, the rhodamine sonde installed at “Rock Street Park Spring” was moved to this location (Photograph was taken on April 4, 2024).

# Appendix 3

# Borehole and Monitoring Well Logs: Santec, 2024

Stantec

# BOREHOLE RECORD

**BH101-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 5, 2024**

BH COORDINATES [NAD83] 618503.0N 4771944.0E
WATER LEVEL: **4.88**

PROJECT NO. : **161414473**
BH ELEVATION: **187.843m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 187.8 | Topsoil | | | | | | |
| | 187.4 | Brown, stiff, moist SILTY CLAY | | SS | 1 | 610 | 15 | |
| 1 | | Brown to grey, stiff to very stiff, moist, SILTY CLAY | | SS | 2 | 400 | 22 | |
| 2 | | | | SS | 3 | 375 | 21 | |
| | | | | SS | 4 | 610 | 18 | |
| 3 | | | | SS | 5 | 610 | 14 | |
| 4 | 183.3 | | | SS | 6 | 450 | 12 | |
| | | Reddish-brown, hard, moist, SANDY CLAY to SILTY SAND<br>- frequent gravel and rock fragments | | SS | 7 | 610 | 43 | |
| 5 | 182.2 | | | | | | | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 5.6 m<br>Water level encountered at 4.9 m upon completion of drilling | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 187, 186, 185, 184, 183, 182, 181, 180



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 5.61 m

Logged By:
Reviewed By:


Printed Apr 10 2024 11:51:0 STANTEC GEO 2016 161414473_SMITHVILLE_3A_NEW.GPJ GINT_1233_SOIL_2018_DATA_TEMP_REV2.GDT 4/10/24

# BOREHOLE RECORD

**BH102-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 5, 2024**

BH COORDINATES [NAD83] 618580.0N 4771841.0E
WATER LEVEL: **5.79**

PROJECT NO. : **161414473**
BH ELEVATION: **186.943m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 186.9 | Topsoil | | | | | | |
| | 186.5 | Brown, stiff, moist SILTY CLAY | | SS | 1 | 375 | 12 | |
| 1 | | Brown to grey, stiff to very stiff, moist, LEAN CLAY (CL)<br>- trace gravel | | SS | 2 | 325 | 17 | |
| 2 | | | | SS | 3 | 600 | 21 | |
| | | | | SS | 4 | 450 | 17 | Sieve/Hydro at 2.5 m<br>G 0% S 4% M 49% C 47% |
| 3 | | | | SS | 5 | 600 | 17 | |
| 4 | 182.4 | | | SS | 6 | 550 | 9 | |
| | 181.2 | Grey-brown, stiff, moist, LEAN CLAY (CL)<br>- with fine sand | | SS | 7 | | 10 | |
| 5 | | | | | | | | |
| 6 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 5.8 m<br>Water level encountered at 5.8 m upon completion of drilling | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 186 185 184 183 182 181 180 179



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 5.79 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH103-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **187.951m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618334.0N 4771865.0E | DATUM: **Geodetic**

DATE BORED: **March 5, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 188.0 | Topsoil | | | | | | |
| | 187.5 | Brown, very stiff, moist silty clay TOPSOIL with rootlets | | SS | 1 | 400 | 16 | |
| 1 | | Brown to grey, stiff to very stiff, moist, SILTY CLAY<br>- trace sand | | SS | 2 | 425 | 17 | |
| 2 | | | | SS | 3 | 400 | 16 | |
| | | | | SS | 4 | 375 | 15 | |
| 3 | 184.9 | | | | | | | |
| | 184.8 | Reddish-brown, very stiff, moist, SILTY CLAY<br>- frequent gravel and rock fragments | | SS | 5 | | | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 3.2 m | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

187 186 185 184 183 182 181 180



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: | Logged By:

Drilling Method: | Reviewed By:

Completion Depth: 3.2 m | Page 1 of 1

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# BOREHOLE RECORD

**BH104-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 5, 2024**

BH COORDINATES [NAD83] 618294.0N 4771766.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.271m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 190.3 | Topsoil | | | | | | |
| | | Brown, stiff, dry, silty clay TOPSOIL with rootlets | | SS | 1 | 400 | 11 | |
| | 189.8 | Brown to grey, stiff to very stiff, moist, SILTY CLAY<br>- trace sand, gravel and rootlets | | SS | 2 | 400 | 19 | |
| 1 | | | | SS | 3 | 425 | 25 | |
| 2 | | Greyish-brown | | SS | 4 | 450 | 21 | |
| 3 | | | | SS | 5 | 450 | 18 | |
| 4 | 185.7 | | | SS | 6 | 450 | 18 | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 4.6 m | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190 189 188 187 186 185 184 183



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 4.57 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH105-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 5, 2024**

BH COORDINATES [NAD83] 618433.0N 4771766.0E
WATER LEVEL: **5.79**

PROJECT NO. : **161414473**
BH ELEVATION: **189.429m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.4 | Topsoil | | | | | | |
| | 189.0 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 400 | 13 | |
| 1 | | Brown to grey, stiff to very stiff, moist, SILTY CLAY<br>- trace sand | | SS | 2 | 425 | 19 | |
| 2 | | | | SS | 3 | 425 | 23 | |
| 3 | | | | SS | 4 | 450 | 21 | |
| 4 | | | | SS | 5 | 450 | 15 | |
| 5 | | | | SS | 6 | 450 | 13 | |
| 6 | 183.3 | | | SS | 7 | 450 | 18 | |
| | 183.0 | Reddish-brown, hard, wet, SILTY CLAY<br>- frequent gravel and rock fragments | | SS | 8 | | | |
| 7 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 6.4 m<br>Water level encountered at 5.8 m upon completion of drilling | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182



BACKFILL SYMBOL
ASPHALT BENTONITE DRILL CUTTINGS GROUT SAND CONCRETE SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.4 m

Logged By:
Reviewed By:
Page 1 of 1

# BOREHOLE RECORD

**BH106-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 4, 2024**

BH COORDINATES [NAD83] 618293.0N 4771667.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.503m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 190.5 | Topsoil | | | | | | |
| | 190.0 | Brown, firm, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 325 | 8 | |
| 1 | | Brown, stiff to very stiff, moist, LEAN CLAY (CL) - trace gravel and sand | | SS | 2 | 375 | 24 | |
| 2 | | | | SS | 3 | 425 | 28 | Sieve/Hydro at 1.8 m G 2% S 6% M 25% C 67% |
| | | | | SS | 4 | 450 | 23 | |
| 3 | | Greyish-brown | | SS | 5 | 450 | 18 | |
| 4 | | | | SS | 6 | 450 | 11 | |
| 5 | | Brown | | SS | 7 | 450 | 12 | |
| 6 | 184.4 | | | | | | | |
| | 184.3 | Brown to reddish-brown, hard, moist, LEAN CLAY (CL) - frequent rock fragments | | SS | 8 | | 50 | |
| 7 | | End of Borehole Spoon and Auger Refusal due to inferred bedrock at 6.3 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190 189 188 187 186 185 184 183



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.25 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH107-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 4, 2024**

BH COORDINATES [NAD83] 618552.0N 4771652.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.175m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 190.2 | Topsoil | | | | | | |
| | 189.7 | Brown, firm, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 400 | 7 | |
| 1 | | Brown to brownish-grey, stiff to very stiff, moist, SILTY CLAY<br>- trace gravel and sand | | SS | 2 | 425 | 17 | |
| | | | | SS | 3 | 450 | 29 | |
| 2 | | | | SS | 4 | 450 | 21 | |
| 3 | | Greyish-brown | | SS | 5 | 450 | 20 | |
| 4 | | | | SS | 6 | 450 | 13 | |
| | 185.4 | | | SS | 7 | 450 | 13 | |
| 5 | | Brown to reddish-brown, stiff to very stiff, moist, SILTY CLAY<br>- frequent gravel and rock fragments | | | | | | |
| 6 | 183.6 | | | SS | 8 | | 29 | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190 189 188 187 186 185 184 183



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor: | Logged By:
Drilling Method: | Reviewed By:
Completion Depth: 6.55 m | Page 1 of 1

# BOREHOLE RECORD

**BH108-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 1, 2024**

BH COORDINATES [NAD83] 618531.0N 4771570.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **189.851m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.9 | Topsoil | | | | | | |
| | 189.4 | Brown, firm, wet, silty sand TOPSOIL with rootlets | | SS | 1 | 425 | 8 | |
| | | Brown to greyish-brown, stiff to hard, moist, SILTY CLAY<br>- trace gravel, sand and rootlets | | SS | 2 | 375 | 27 | |
| 1 | | | | SS | 3 | 450 | 31 | |
| 2 | | | | SS | 4 | 425 | 21 | |
| 3 | | | | SS | 5 | 450 | 21 | |
| | | Greyish-brown | | SS | 6 | 450 | 13 | |
| 4 | | | | SS | 7 | 450 | 15 | |
| 5 | | | | | | | | |
| 6 | 183.8 | | | | | | | |
| | 183.3 | Brown to reddish-brown, very stiff, moist, SILTY CLAY<br>- frequent gravel | | SS | 8 | 425 | 30 | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH109-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 1, 2024**

BH COORDINATES [NAD83] 618434.0N 4771567.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **189.553m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.6 | Topsoil | | | | | | |
| | 189.1 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 375 | 10 | |
| 1 | | Brown, stiff to very stiff, moist, SILTY CLAY - trace gravel and sand | | SS | 2 | 425 | 22 | |
| 2 | | | | SS | 3 | 425 | 27 | |
| | | | | SS | 4 | 450 | 18 | |
| 3 | | Greyish-brown | | SS | 5 | 375 | 20 | |
| 4 | | | | SS | 6 | 450 | 12 | |
| 5 | | | | SS | 7 | 450 | 10 | |
| 6 | 183.5 | | | | | | | |
| | 183.0 | Brownish-grey, stiff, moist, SILTY CLAY - trace sand | | SS | 8 | 450 | 12 | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH110-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **190.135m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618335.0N 4771568.0E | DATUM: **Geodetic**

DATE BORED: **March 4, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 190.1 | Topsoil | | | | | | |
| 0 | | Brown, stiff, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 400 | 9 | |
| | 189.7 | Brown to greyish-brown, very stiff to hard, dry to moist, SILTY CLAY - trace gravel and sand | | | | | | |
| 1 | | | | SS | 2 | 425 | 24 | |
| | | | | SS | 3 | 400 | 33 | |
| 2 | | | | SS | 4 | 425 | 23 | |
| | | Greyish-brown | | SS | 5 | 450 | 20 | |
| 3 | | | | | | | | |
| 4 | | | | SS | 6 | 450 | 17 | |
| | | | | SS | 7 | 450 | 15 | |
| 5 | | | | | | | | |
| 6 | | | | SS | 8 | | 10 | |
| | 183.7 | | | | | | | |
| | 183.6 | Grey, stiff, moist, SILTY CLAY - trace gravel | | | | | | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

190 189 188 187 186 185 184 183



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 6.55 m | Page 1 of 1 |

# BOREHOLE RECORD

**BH111-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 4, 2024**

BH COORDINATES [NAD83] 618135.0N 4771569.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.265m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 190.3 | Topsoil | | | | | | |
| | 189.8 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 375 | 10 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, moist to wet, SILTY CLAY<br>- trace gravel and sand | | SS | 2 | 425 | 21 | |
| 2 | | | | SS | 3 | 450 | 28 | |
| | | | | SS | 4 | 450 | 19 | |
| 3 | | Greyish-brown | | SS | 5 | 450 | 16 | |
| 4 | | | | SS | 6 | 450 | 12 | |
| 5 | | | | SS | 7 | 450 | 13 | |
| 6 | 184.2 | | | | | | | |
| | 183.7 | Greyish-brown, stiff, wet, SILTY CLAY<br>- frequent gravel, sand and rock fragments | | SS | 8 | | 20 | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190, 189, 188, 187, 186, 185, 184, 183



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:


Printed Apr 10 2024 11:51:16 STANTEC GEO 2016 161414473_SMITHVILLE_3A_NEW.GPJ GINT_1233_SOIL_2018_DATA_TEMP_REV2.GDT 4/10/24

# BOREHOLE RECORD

**BH112-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 4, 2024**

BH COORDINATES [NAD83] 618037.0N 4771568.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.586m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 190.6 | Topsoil | | | | | | |
| | 190.1 | Brown, firm, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 400 | 7 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, dry to moist, SILTY CLAY - trace sand | | SS | 2 | 375 | 20 | |
| 2 | | | | SS | 3 | 400 | 25 | |
| 3 | | | | SS | 4 | 400 | 20 | |
| 4 | | Greyish-brown | | SS | 5 | 450 | 15 | |
| | 186.0 | | | SS | 6 | 375 | 11 | |
| 5 | | Grey to reddish-brown, stiff, moist to wet, SILTY CLAY | | SS | 7 | 450 | 14 | |
| 6 | 184.1 | | | SS | 8 | | 8 | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190 189 188 187 186 185 184 183



BACKFILL SYMBOL
BENTONITE ASPHALT DRILL CUTTINGS GROUT SAND CONCRETE SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH113-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **190.008m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618335.0N 4771468.0E | DATUM: **Geodetic**

DATE BORED: **March 1, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 190.0 | Topsoil | | | | | | |
| 0 | | Brown, firm, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 400 | 7 | |
| | 189.5 | Brown to greyish-brown, stiff to very stiff, dry to moist, SILTY CLAY - trace sand | | | | | | |
| 1 | | | | SS | 2 | 375 | 21 | |
| | | | | SS | 3 | 450 | 19 | |
| 2 | | | | SS | 4 | 450 | 18 | |
| | | | | SS | 5 | 450 | 16 | |
| 3 | | | | | | | | |
| | | Greyish-brown | | SS | 6 | 450 | 12 | |
| 4 | | | | SS | 7 | 450 | 11 | |
| | | | | | | | | |
| 5 | | | | | | | | |
| | 183.9 | Grey, firm, moist, SILTY CLAY | | SS | 8 | 450 | 6 | |
| 6 | 183.2 | End of Borehole at 6.5 m | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

190 189 188 187 186 185 184 183



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 6.85 m | Page 1 of 1 |

# BOREHOLE RECORD

**BH114-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 1, 2024**

BH COORDINATES [NAD83] 618235.0N 4771469.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **189.707m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.7 | Topsoil | | | | | | |
| | 189.2 | Brown, firm, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 425 | 6 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, dry to moist, SILTY CLAY - trace sand | | SS | 2 | 450 | 15 | |
| 2 | | | | SS | 3 | 425 | 25 | |
| | | | | SS | 4 | 450 | 17 | |
| 3 | | Greyish-brown | | SS | 5 | 450 | 18 | |
| 4 | | | | SS | 6 | 450 | 18 | |
| 5 | | | | SS | 7 | 450 | 18 | |
| 6 | 183.6 | | | | | | | |
| | 183.2 | Grey, firm, moist, SILTY CLAY | | SS | 8 | 450 | 18 | |
| 7 | | End of Borehole at 6.5 m Borehole caved in at 5.8 m upon completion of drilling | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182



BACKFILL SYMBOL
BENTONITE ASPHALT DRILL CUTTINGS GROUT SAND CONCRETE SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH115-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 1, 2024**

BH COORDINATES [NAD83] 618135.0N 4771469.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **189.366m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 189.4 | Topsoil | | | | | | |
| 0 | | Brown, stiff, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 425 | 9 | |
| | 188.9 | Brown to greyish-brown, stiff to very stiff, dry to moist, SILTY CLAY - trace sand | | | | | | |
| 1 | | | | SS | 2 | 400 | 22 | |
| | | | | SS | 3 | 425 | 22 | |
| 2 | | | | SS | 4 | 450 | 12 | |
| 3 | | | | SS | 5 | 450 | 14 | |
| 4 | | | | SS | 6 | 450 | 11 | |
| | | Greyish-brown | | SS | 7 | 450 | 14 | |
| 5 | | | | | | | | |
| 6 | 183.3 | | | | | | | |
| | | Grey, stiff, moist, SILTY CLAY | | SS | 8 | | 10 | |
| | 182.8 | End of Borehole at 6.5 m | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH116-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 1, 2024**

BH COORDINATES [NAD83] 618036.0N 4771471.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **189.686m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.7 | Topsoil | | | | | | |
| | 189.2 | Brown, stiff, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 425 | 12 | |
| 1 | | Brown, stiff to very stiff, dry to moist, SILTY CLAY | | SS | 2 | 450 | 23 | |
| 2 | | | | SS | 3 | 425 | 24 | |
| | | | | SS | 4 | 450 | 16 | |
| 3 | | | | SS | 5 | 450 | 13 | |
| 4 | | | | SS | 6 | 425 | 12 | |
| 5 | | | | SS | 7 | 450 | 11 | |
| 6 | 183.6 | | | | | | | |
| | | Brownish-grey, firm, moist, SILTY CLAY<br>- Field vane max at 6.85 m | | SS | 8 | 450 | 7 | |
| | 182.8 | | | | | | | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.85 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH117-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 28, 2024**

BH COORDINATES [NAD83] 618465.0N 4771370.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **189.65m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.7 | Topsoil | | | | | | |
| | 189.2 | Brown, stiff, dry, silty sand TOPSOIL with rootlets<br>- some gravel | | SS | 1 | 457 | 15 | |
| 1 | | Brown to brownish-grey, very stiff to hard, dry to moist, SILTY CLAY<br>- trace sand | | SS | 2 | 457 | 31 | |
| 2 | | | | SS | 3 | 432 | 26 | |
| | | | | SS | 4 | 406 | 27 | |
| 3 | | | | SS | 5 | 457 | 15 | |
| | 185.8 | | | | | | | |
| 4 | | Grey, firm, moist to wet, SILTY CLAY<br>- trace gravel | | SS | 6 | 102 | 8 | |
| | | | | SS | 7 | 381 | 7 | |
| 5 | | | | | | | | |
| 6 | | | | SS | 8 | 457 | 5 | |
| 7 | | | | | | | | |
| | | | | SS | 9 | 457 | 7 | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)
189 188 187 186 185 184 183 182



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 8.38 m

Logged By:
Reviewed By:

Stantec

# BOREHOLE RECORD

**BH117-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.65m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618465.0N 4771370.0E | DATUM: **Geodetic**

DATE BORED: **February 28, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 8 | 181.6 | Grey, firm, moist to wet, SILTY CLAY - frequent rock fragments | | | | | | |
| | 181.3 | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 8.4 m | | SS | 10 | 0 | 50 | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m ●

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

181 180 179 178 177 176 175 174



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: | Logged By:

Drilling Method: | Reviewed By:

Completion Depth: 8.38 m | Page 2 of 2

# BOREHOLE RECORD

**BH118-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 28, 2024**

BH COORDINATES [NAD83] 618337.0N 4771369.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.57m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 190.6 | Topsoil | | | | | | |
| | 190.1 | Brown, stiff, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 457 | 13 | |
| 1 | | Brown to brownish-grey, very stiff, dry to moist, SILTY CLAY<br>- trace sand | | SS | 2 | 457 | 27 | |
| 2 | | | | SS | 3 | 432 | 27 | |
| 3 | | | | SS | 4 | 457 | 21 | |
| 4 | | | | SS | 5 | 457 | 19 | |
| 5 | 185.6 | Brownish-grey | | SS | 6 | 457 | 17 | |
| 6 | | Grey, stiff to very stiff, moist to wet, SILTY CLAY<br>- frequent gravel and rock fragments below 7.6 m | | SS | 7 | 406 | 15 | |
| 7 | | | | SS | 8 | 381 | 11 | |
| 8 | | | | SS | 9 | 381 | 21 | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190 189 188 187 186 185 184 183

BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 9.45 m

Logged By:
Reviewed By:
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# BOREHOLE RECORD

**BH118-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 28, 2024**

BH COORDINATES [NAD83] 618337.0N 4771369.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **190.57m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 8 | | | | | | | | |
| 9 | 181.1 | | | SS | 10 | 152 | 50 | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 9.5 m | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 182 181 180 179 178 177 176 175



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 9.45 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH119-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **188.393m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618135.0N 4771372.0E | DATUM: **Geodetic**

DATE BORED: **February 27, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 188.4 | Topsoil | | | | | | |
| 0 | 187.9 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 381 | 10 | |
| 1 | | Brown, stiff to very stiff, moist, SILTY CLAY<br>- trace sand | | SS | 2 | 356 | 17 | |
| 2 | | | | SS | 3 | 432 | 22 | |
| 3 | | | | SS | 4 | 457 | 16 | |
| | 184.6 | | | SS | 5 | 457 | 14 | |
| 4 | 184.2 | Brown, stiff, moist, SILTY CLAY | | SS | 6 | 457 | 13 | |
| | | Grey to brownish-grey, firm to stiff, moist, SILTY CLAY | | SS | 7 | 457 | 10 | |
| 5 | | | | | | | | |
| 6 | | | | SS | 8 | 457 | 7 | |
| 7 | 181.1 | | | SS | 9 | 0 | 50 | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 7.3 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

188 187 186 185 184 183 182 181



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 7.32 m | Page 1 of 1 |

# BOREHOLE RECORD

**BH120-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.233m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618033.0N 4771371.0E | DATUM: **Geodetic**

DATE BORED: **February 27, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 189.2 | Topsoil | | | | | | |
| 0 | 188.8 | Brown, very stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 381 | 18 | |
| 1 | | Brown to grey, stiff to very stiff, dry to moist, SILTY CLAY<br>- trace sand | | SS | 2 | 406 | 22 | |
| 2 | | | | SS | 3 | 432 | 24 | |
| 3 | | | | SS | 4 | 457 | 22 | |
| 4 | | | | SS | 5 | 356 | 17 | |
| 5 | | | | SS | 6 | 457 | 12 | |
| 6 | 183.1 | | | SS | 7 | 432 | 19 | |
| 7 | | Brownish-grey, stiff, moist, SILTY CLAY | | SS | 8 | 457 | 10 | |
| 8 | 181.5 | | | SS | 9 | 152 | 50 | |
| | | End of Borehole | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

189 188 187 186 185 184 183 182



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: | Logged By:

Drilling Method: | Reviewed By:

Completion Depth: 7.77 m | Page 1 of 2

Stantec

# BOREHOLE RECORD

**BH120-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.233m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618033.0N 4771371.0E | DATUM: **Geodetic**

DATE BORED: **February 27, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES: TYPE | SAMPLES: NUMBER | SAMPLES: RECOVERY (mm) or TCR % | SAMPLES: N-VALUE or RQD % | OTHER TESTS / REMARKS | BACKFILL/ MONITOR WELL/ PIEZOMETER | ELEVATION (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | | Spoon and Auger Refusal due to inferred bedrock at 7.8 m | | | | | | | | 181 |
| 9 | | | | | | | | | | 180 |
| 10 | | | | | | | | | | 179 |
| 11 | | | | | | | | | | 178 |
| 12 | | | | | | | | | | 177 |
| 13 | | | | | | | | | | 176 |
| 14 | | | | | | | | | | 175 |
| 15 | | | | | | | | | | 174 |
| 16 | | | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m ●

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: | Logged By:

Drilling Method: | Reviewed By:

Completion Depth: 7.77 m | Page 2 of 2

# BOREHOLE RECORD

**BH121-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 27, 2024**

BH COORDINATES [NAD83] 617939.0N 4771370.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **187.21m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 187.2 | Topsoil | | | | | | |
| | 186.8 | Brown, stiff, dry, silty sand TOPSOIL with rootlets<br>- some gravel | | SS | 1 | 356 | 13 | |
| 1 | | Brown to grey, stiff to very stiff, dry to moist, SILTY CLAY<br>- trace sand | | SS | 2 | 356 | 20 | |
| | | | | SS | 3 | 381 | 11 | |
| 2 | | | | SS | 4 | 457 | 14 | |
| 3 | | | | SS | 5 | 457 | 14 | |
| | 183.4 | | | | | | | |
| 4 | | Brown to grey, firm, moist, SILTY CLAY | | SS | 6 | 432 | 7 | |
| | 182.6 | | | | | | | |
| | 182.2 | Brown to grey, firm, moist, SILTY CLAY<br>- frequent rock fragments | | SS | 7 | 381 | 29 | |
| 5 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 5.0 m | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 187, 186, 185, 184, 183, 182, 181, 180



BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 5 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**BH122-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.005m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618333.0N 4771273.0E | DATUM: **Geodetic**

DATE BORED: **February 28, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.0 | Topsoil | | | | | | |
| | 188.5 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 400 | 8 | |
| 1 | | Brown, stiff to very stiff, dry to moist, SILTY CLAY<br>- trace sand, gravel and rootlets | | SS | 2 | 425 | 18 | |
| 2 | | | | SS | 3 | 450 | 18 | |
| | | | | SS | 4 | 450 | 16 | |
| 3 | | | | SS | 5 | 450 | 14 | |
| 4 | | | | SS | 6 | 450 | 15 | |
| 5 | | | | SS | 7 | 375 | 14 | |
| 6 | | | | SS | 8 | 450 | 28 | |
| | 182.5 | End of Borehole at 6.5 m | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

189 188 187 186 185 184 183 182



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 6.55 m | Page 1 of 1 |

# BOREHOLE RECORD

**BH123-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **187.983m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618234.0N 4771271.0E | DATUM: **Geodetic**

DATE BORED: **February 29, 2024** | WATER LEVEL: **N/A**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 188.0 | Topsoil | | | | | | |
| 0 | 187.5 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 450 | 8 | |
| 1 | | Brown to greyish-brown, stiff to hard, dry to moist, SILTY CLAY<br>- trace sand and gravel | | SS | 2 | 450 | 22 | |
| | | | | SS | 3 | 450 | 22 | |
| 2 | | | | SS | 4 | 450 | 16 | |
| 3 | | | | SS | 5 | 450 | 15 | |
| 4 | 183.4 | Greyish-brown | | SS | 6 | 450 | 12 | |
| 5 | | Brown, stiff to hard, dry to moist, SILTY CLAY (POSSIBLE TILL)<br>- frequent gravel | | SS | 7 | 450 | 14 | |
| 6 | 181.5 | | | SS | 8 | 375 | 55 | |
| 7 | | End of Borehole at 6.5 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

187 186 185 184 183 182 181 180



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 6.55 m | Page 1 of 1 |

# BOREHOLE RECORD

**BH124-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 29, 2024**

BH COORDINATES [NAD83] 618037.0N 4771273.0E
WATER LEVEL: **N/A**

PROJECT NO. : **161414473**
BH ELEVATION: **188.768m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 188.8 | Topsoil | | | | | | |
| | 188.3 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 450 | 9 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, dry to moist, SILTY CLAY<br>- trace sand | | SS | 2 | 400 | 19 | |
| 2 | | | | SS | 3 | 450 | 23 | |
| 3 | | | | SS | 4 | 425 | 18 | |
| 4 | | | | SS | 5 | 450 | 17 | |
| 5 | | Greyish-brown | | SS | 6 | 450 | 18 | |
| 6 | | | | SS | 7 | 450 | 12 | |
| 7 | 182.2 | Brown, stiff, wet, SILTY CLAY<br>- frequent gravel | | SS | 8 | 400 | 15 | |
| 8 | | End of Borehole at 6.5 m<br>Borehole caved in at 5.5 m upon completion of drilling | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 188, 187, 186, 185, 184, 183, 182, 181

BACKFILL SYMBOL
ASPHALT GROUT CONCRETE
BENTONITE DRILL CUTTINGS SAND SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.55 m

Logged By:
Reviewed By:
Page 1 of 1

# BOREHOLE RECORD

**MW101-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 29, 2024**

BH COORDINATES [NAD83] 618436.0N 4771278.0E
WATER LEVEL: **7.3 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **189.876m**
DATUM: **Geodetic**

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 189.9 | Topsoil | | | | | | |
| | 189.4 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 375 | 9 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, dry to moist, LEAN CLAY (CL)<br>- trace sand | | SS | 2 | 400 | 22 | |
| | | Greyish-brown | | SS | 3 | 400 | 23 | Sieve/Hydro at 1.8 m<br>G 0% S 1% M 31% C 68% |
| 2 | | | | SS | 4 | 450 | 19 | |
| 3 | | | | SS | 5 | 300 | 17 | |
| 4 | | | | SS | 6 | 375 | 12 | |
| | | | | SS | 7 | 450 | 12 | |
| 5 | 184.8 | Brown to grey, stiff to hard, moist, SILTY CLAY<br>- frequent gravel and rock fragments | | | | | | |
| 6 | | | | SS | 8 | 450 | 8 | |
| 7 | | | | | | | | |
| | | | | SS | 9 | 450 | 31 | |
| 8 | | | | | | | | |

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182

▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 11.4 m

Logged By:
Reviewed By:
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Stantec

# BOREHOLE RECORD

**MW101-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.876m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618436.0N 4771278.0E | DATUM: **Geodetic**

DATE BORED: **February 29, 2024** | WATER LEVEL: **7.3 m on March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 8 | 181.5 | Spoon and Auger Refusal due to inferred bedrock at 9.6 m | | | | | | |
| 9 | | Very poor to good quality grey DOLOSTONE BEDROCK<br>- highly to moderately weathered, flat to vertical orientation, rough irregular undulating to smooth undulating<br><br>UCS = 131.4 MPa at 10.1 m | | HQ | 1 | 57% | 0% | |
| 10 | | | | HQ | 2 | 100% | 18% | |
| 11 | 178.5 | | | HQ | 3 | 100% | 85% | |
| 12 | | End of Borehole at 11.4 m<br>Water level encountered at 9.3 m upon completion of drilling | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m ●

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

181 180 179 178 177 176 175 174



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 11.4 m | Page 2 of 2 |

Stantec

# BOREHOLE RECORD

**MW102-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 1, 2024**

BH COORDINATES [NAD83] 618468.0N 4771469.0E
WATER LEVEL: **2.7 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **189.646m**
DATUM: **Geodetic**

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS | BACKFILL/ MONITOR WELL/ PIEZOMETER | ELEVATION (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 189.6 | Topsoil | | | | | | | | |
| 0 | 189.2 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 425 | 10 | | | |
| 1 | | Brown to greyish-brown, stiff to very stiff, dry to moist, SILTY CLAY<br>- trace sand | | SS | 2 | 400 | 21 | | | 189 |
| | | | | SS | 3 | 450 | 21 | | | 188 |
| 2 | | | | SS | 4 | 450 | 17 | | | |
| | | | | | | | | | | 187 |
| 3 | | Greyish-brown | | SS | 5 | 450 | 14 | | | |
| 4 | | | | SS | 6 | 225 | 13 | | | 186 |
| | | | | SS | 7 | 400 | 13 | | | 185 |
| 5 | | | | | | | | | | |
| | | | | | | | | | | 184 |
| 6 | | | | SS | 8 | 425 | 9 | | | |
| | | | | | | | | | | 183 |
| 7 | 182.0 | | | | | | | | | |
| | 181.9 | Grey, firm, wet, SILTY CLAY<br>- frequent gravel and rock fragments | | | | | | | | 182 |
| 8 | | | | | | | | | | |



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 7.77 m

Logged By:
Reviewed By:

Stantec

# BOREHOLE RECORD

**MW102-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.646m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618468.0N 4771469.0E | DATUM: **Geodetic**

DATE BORED: **March 1, 2024** | WATER LEVEL: **2.7 m on March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES: TYPE | SAMPLES: NUMBER | SAMPLES: RECOVERY (mm) or TCR % | SAMPLES: N-VALUE or RQD % | OTHER TESTS / REMARKS | BACKFILL/ MONITOR WELL/ PIEZOMETER | ELEVATION (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 7.8 m | | | | | | | | 181 |
| 9 | | | | | | | | | | 180 |
| 10 | | | | | | | | | | 179 |
| 11 | | | | | | | | | | 178 |
| 12 | | | | | | | | | | 177 |
| 13 | | | | | | | | | | 176 |
| 14 | | | | | | | | | | 175 |
| 15 | | | | | | | | | | 174 |
| 16 | | | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m ●

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: | Logged By:

Drilling Method: | Reviewed By:

Completion Depth: 7.77 m | 

# BOREHOLE RECORD

**MW103-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 4, 2024**

BH COORDINATES [NAD83] 618434.0N 4771667.0E
WATER LEVEL: **5.5 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **188.976m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 189.0 | Topsoil | | | | | | |
| 0 | 188.5 | Brown, stiff, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 400 | 8 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, moist, SILTY CLAY<br>- trace sand<br>- some gravel below 4.6 m | | SS | 2 | 425 | 17 | |
| 2 | | | | SS | 3 | 425 | 19 | |
| 3 | | | | SS | 4 | 450 | 15 | |
| 4 | | Greyish-brown | | SS | 5 | 450 | 17 | |
| 5 | 183.5 | | | SS | 6 | 450 | 14 | |
| 6 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 5.5 m | | SS | 7 | 450 | 16 | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 188, 187, 186, 185, 184, 183, 182, 181

▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 5.49 m

Logged By:
Reviewed By:
Page 1 of 1

# BOREHOLE RECORD

**MW104-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **186.81m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618584.0N 4771913.0E | DATUM: **Geodetic**

DATE BORED: **March 5, 2024** | WATER LEVEL: **5.2 m on March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 186.8 | Topsoil | | | | | | |
| 0 | 186.4 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 600 | 12 | |
| 1 | | Brown to reddish-brown, stiff to very stiff, moist, SILTY CLAY<br>- trace sand, gravel and rootlets<br>- frequent gravel and rock fragments below 4.6 m | | SS | 2 | 500 | 17 | |
| 2 | | | | SS | 3 | 600 | 19 | |
| 3 | | | | SS | 4 | 400 | 16 | |
| 4 | | | | SS | 5 | 600 | 15 | |
| 5 | 181.0 | Reddish-brown | | SS | 6 | 600 | 13 | |
| 6 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 5.8 m<br>Water level encountered at 5.5 m upon completion of drilling | | SS | 7 | 375 | 16 | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

186 185 184 183 182 181 180 179



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 5.79 m | Page 1 of 1 |

# BOREHOLE RECORD

**MW105-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **186.732m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618434.0N 4771865.0E | DATUM: **Geodetic**

DATE BORED: **March 5, 2024** | WATER LEVEL: **0.5 m on March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 186.7 | Topsoil | | | | | | |
| 0 | 186.3 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 400 | 9 | |
| 1 | | Brown grey, stiff, moist, SILTY CLAY - trace sand, gravel and rootlets | | SS | 2 | 450 | 11 | |
| 2 | | | | SS | 3 | 450 | 11 | |
| | | | | SS | 4 | 400 | 9 | |
| 3 | 183.7 | Brown grey, stiff, moist, SILTY CLAY - frequent gravel and rock fragments | | SS | 5 | 275 | | |
| 4 | 182.6 | | | SS | 6 | 375 | | |
| | 182.1 | Spoon and Auger Refusal due to inferred bedrock at 4.2 m | | | | | | |
| 5 | | Fair to excellent grey DOLOSTONE BEDROCK - highly weathered, flat orientation, very wide spacing, smooth undulating<br>UCS = 88.2 MPa at 5.6 m | | HQ | 1 | 100% | 71% | |
| 6 | | | | | | | | |
| 7 | 179.3 | | | HQ | 2 | 100% | 93% | |
| | | End of Borehole at 7.4 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m ●

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

186 185 184 183 182 181 180 179

▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 7.44 m | Page 1 of 1 |

Stantec

# BOREHOLE RECORD

**MW106-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **188.523m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618264.0N 4771876.0E | DATUM: **Geodetic**

DATE BORED: **March 5, 2024** | WATER LEVEL: **March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 188.5 | Topsoil | | | | | | |
| 0 | 188.1 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 375 | 27 | |
| 1 | | Grey to reddish-brown, stiff, dry to moist, SILTY CLAY<br>- trace sand and gravel | | SS | 2 | 450 | 19 | |
| 2 | 186.2 | | | SS | 3 | 450 | 21 | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 2.3 m | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m ●

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

188 187 186 185 184 183 182 181



BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 2.26 m | Page 1 of 1 |

# BOREHOLE RECORD

**MW107-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 4, 2024**

BH COORDINATES [NAD83] 618235.0N 4771569.0E
WATER LEVEL: **7.0 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **190.142m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 190.1 | Topsoil | | | | | | |
| 0 | 189.7 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 400 | 8 | |
| 1 | | Brown to greyish-brown, very stiff, moist, SILTY CLAY<br>- trace sand, gravel and rootlets | | SS | 2 | 375 | 23 | |
| 2 | | Greyish-brown | | SS | 3 | 425 | 28 | |
| | | | | SS | 4 | 450 | 29 | |
| 3 | 187.1 | Brownish-grey, stiff, moist, SILTY CLAY<br>- trace sand | | SS | 5 | 450 | 15 | |
| 4 | | | | SS | 6 | 450 | 12 | |
| | 185.6 | Brown to brownish-grey, very stiff, moist, SILTY CLAY<br>- some sand | | SS | 7 | 450 | 18 | |
| 5 | | | | | | | | |
| 6 | | Brownish-grey | | SS | 8 | 450 | 15 | |
| | 182.8 | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 7.3 m | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 190 189 188 187 186 185 184 183

▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 7.32 m | Page 1 of 1 |

Stantec

# BOREHOLE RECORD

**MW108-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **189.848m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 618235.0N 4771370.0E | DATUM: **Geodetic**

DATE BORED: **February 28, 2024** | WATER LEVEL: **6.8 m on March 14, 2024**

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa
WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| | 189.8 | Topsoil | | | | | | |
| 0 | 189.4 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 356 | 12 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, moist, LEAN CLAY (CL)<br>- trace sand, gravel and rootlets | | SS | 2 | 330 | 23 | |
| 2 | | | | SS | 3 | 356 | 29 | |
| | | | | SS | 4 | 381 | 19 | |
| 3 | | | | SS | 5 | 381 | 12 | |
| 4 | | | | SS | 6 | 406 | 13 | Sieve/Hydro at 4.0 m<br>G 1% S 3% M 46% C 50% |
| 5 | | | | SS | 7 | 457 | 14 | |
| 6 | 183.8 | | | | | | | |
| | | Brown to greyish-brown, stiff, moist, LEAN CLAY (CL)<br>- frequent rock fragments below 7.6 m | | SS | 8 | 457 | 8 | Sieve/Hydro at 6.3 m<br>G 3% S 1% M 50% C 46% |
| 7 | | | | | | | | |
| | 181.9 | | | SS | 9 | 330 | 50 | |
| 8 | | | | | | | | |

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 189, 188, 187, 186, 185, 184, 183, 182

▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor: | Logged By:

Drilling Method: | Reviewed By:

Completion Depth: 7.92 m | Page 1 of 2

# BOREHOLE RECORD

**MW108-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 28, 2024**

BH COORDINATES [NAD83] 618235.0N 4771370.0E
WATER LEVEL: **6.8 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **189.848m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 8 | 181.8 | Spoon and Auger Refusal due to inferred bedrock at 7.9 m | | | | | | |
| | | Very poor to good quality grey DOLOSTONE BEDROCK<br>- highly to moderately weathered, flat to vertical orientation, very close to close spacing, rough irregular undulating to smooth undulating | | HQ | 1 | 100% | 47% | |
| 9 | | UCS = 108.6 MPa at 8.2 m | | HQ | 2 | 100% | 85% | |
| | | UCS = 81.9 MPa at 12.9 m | | HQ | 3 | 88% | 0% | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | HQ | 4 | 100% | 25% | |
| 13 | 176.5 | End of Borehole at 13.3 m | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m ●
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 181, 180, 179, 178, 177, 176, 175, 174



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 7.92 m

Logged By:
Reviewed By:

# BOREHOLE RECORD

**MW109-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **188.67m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 617937.0N 4771568.0E | DATUM: **Geodetic**

DATE BORED: **March 4, 2024** | WATER LEVEL: **0.8 m on March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 188.7 | Topsoil | | | | | | |
| | 188.2 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 350 | 11 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, dry to wet, LEAN CLAY (CL)<br>- trace sand, gravel and rootlets<br>- frequent rock fragments below 6.0 m | | SS | 2 | 400 | 17 | |
| 2 | | | | SS | 3 | 450 | 20 | |
| | | | | SS | 4 | 450 | 15 | Sieve/Hydro at 2.5 m<br>G S M C<br>0% 1% 43% 56% |
| 3 | | | | SS | 5 | 450 | 23 | |
| 4 | | Greyish-brown | | SS | 6 | 450 | 10 | |
| 5 | | | | SS | 7 | 450 | 17 | |
| 6 | 182.4 | | | SS | 8 | | | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 6.3 m | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

188 187 186 185 184 183 182 181



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 6.25 m | Page 1 of 1 |

# BOREHOLE RECORD

**MW110-24**

CLIENT: **Lockbridge Development Inc** | BH COORDINATES | PROJECT NO. : **161414473**

PROJECT: **Smithville 3A Block 9** | [NAD83] | BH ELEVATION: **186.902m**

LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON** | 617937.0N 4771277.0E | DATUM: **Geodetic**

DATE BORED: **February 28, 2024** | WATER LEVEL: **1.1 m on March 14, 2024**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 186.9 | Topsoil | | | | | | |
| | 186.4 | Brown, stiff, moist, silty clay TOPSOIL with rootlets | | SS | 1 | 457 | 10 | |
| 1 | | Brown to reddish-brown, stiff to hard, dry to moist, Sandy SILTY CLAY (CL-ML)<br>- trace sand, gravel and rootlets<br>- frequent rock fragments below 4.6 m | | SS | 2 | 457 | 22 | |
| | | | | SS | 3 | 457 | 17 | |
| 2 | | | | SS | 4 | 406 | 18 | |
| 3 | | | | SS | 5 | 279 | 16 | |
| 4 | | | | SS | 6 | 457 | 32 | Sieve/Hydro at 4.0 m<br>G 9% S 30% M 35% C 26% |
| | | | | SS | 7 | 229 | 23 | |
| 5 | 181.7 | | | SS | 8 | 178 | 50 | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 5.2 m<br>Water level encountered at 3.7 m upon completion of drilling | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)

LABORATORY TEST ▲ FIELD VANE TEST ◆

POCKET PEN. ★ POCKET SHEAR VANE ◘

50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

SPT (N-value) BLOWS/0.3m

Water Content (%) and Blow Count

10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)

186 185 184 183 182 181 180 179



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

| | |
|---|---|
| Drilling Contractor: | Logged By: |
| Drilling Method: | Reviewed By: |
| Completion Depth: 5.18 m | Page 1 of 1 |

# BOREHOLE RECORD

**MW111-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **February 29, 2024**

BH COORDINATES [NAD83] 618137.0N 4771272.0E
WATER LEVEL: **1.7 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **188.444m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 188.4 | Topsoil | | | | | | |
| | 188.0 | Brown, stiff, dry, silty sand TOPSOIL with rootlets | | SS | 1 | 425 | 10 | |
| 1 | | Brown to greyish-brown, stiff to very stiff, moist, SILTY CLAY<br>- trace sand, gravel and rootlets<br>- frequent gravel below 6.1 m | | SS | 2 | 425 | 19 | |
| | | Greyish-brown | | SS | 3 | 450 | 19 | |
| 2 | | | | SS | 4 | 450 | 13 | |
| 3 | | | | SS | 5 | 450 | 15 | |
| 4 | | | | SS | 6 | 450 | 9 | |
| | | Brown | | SS | 7 | 450 | 15 | |
| 5 | | | | | | | | |
| 6 | 182.2 | | | SS | 8 | | | |
| | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 6.3 m | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m)
188 187 186 185 184 183 182 181



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL
BENTONITE DRILL CUTTINGS SAND SLOUGH ASPHALT GROUT CONCRETE

Drilling Contractor:
Drilling Method:
Completion Depth: 6.25 m

Logged By:
Reviewed By:
Page 1 of 1

# BOREHOLE RECORD

**MW112-24**

CLIENT: **Lockbridge Development Inc**
PROJECT: **Smithville 3A Block 9**
LOCATION: **Smithville 3A / Block Plan 9, Smithville, ON**
DATE BORED: **March 5, 2024**

BH COORDINATES [NAD83] 618569.0N 4771746.0E
WATER LEVEL: **4.7 m on March 14, 2024**

PROJECT NO. : **161414473**
BH ELEVATION: **188.143m**
DATUM: **Geodetic**

| DEPTH (m) | ELEVATION (m) | SOIL DESCRIPTION (USCS) | STRATA PLOT | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY (mm) or TCR % | SAMPLES N-VALUE or RQD % | OTHER TESTS / REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0 | 188.1 | Topsoil | | | | | | |
| | 187.7 | Brown, stiff, moist, silty sand TOPSOIL with rootlets | | SS | 1 | 375 | 7 | |
| 1 | | Brown to reddish-brown, stiff to very stiff, moist to wet, SILTY CLAY<br>- trace sand, gravel and rootlets<br>- frequent gravel below 6.1 m | | SS | 2 | 400 | 15 | |
| 2 | | | | SS | 3 | 425 | 22 | |
| 3 | | | | SS | 4 | 450 | 20 | |
| 4 | | | | SS | 5 | 450 | 20 | |
| 5 | | | | SS | 6 | 450 | 11 | |
| 6 | | | | SS | 7 | 425 | 14 | |
| 7 | 181.7 | | | SS | 8 | | | |
| 8 | | End of Borehole<br>Spoon and Auger Refusal due to inferred bedrock at 6.4 m | | | | | | |

UNDRAINED SHEAR STRENGTH, Cu (kPa)
LABORATORY TEST ▲ FIELD VANE TEST ◆
POCKET PEN. ★ POCKET SHEAR VANE ◘
50 kPa 100 kPa 150 kPa 200 kPa

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$
SPT (N-value) BLOWS/0.3m
Water Content (%) and Blow Count
10 20 30 40 50 60 70 80

BACKFILL/ MONITOR WELL/ PIEZOMETER

ELEVATION (m): 188, 187, 186, 185, 184, 183, 182, 181



▼ Water Level Measured On Date Indicated

BACKFILL SYMBOL: ASPHALT, GROUT, CONCRETE, BENTONITE, DRILL CUTTINGS, SAND, SLOUGH

Drilling Contractor:
Drilling Method:
Completion Depth: 6.4 m

Logged By:
Reviewed By: