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WINDSOR
ONTARIO, CANADA

Sandwich South Master Servicing Plan Municipal Servicing Functional Design Report

SANDWICH SOUTH
MASTER SERVICING
PLAN

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1.0 Introduction

1.1 Background and Purpose of Report

The City of Windsor has been undertaking various studies that support their ongoing efforts to establish a framework for the development of the Sandwich South Secondary Plan Area. The City has retained Dillon Consulting Limited (Dillon) to complete a Sandwich South Master Servicing Plan (SSMSP) in 2019. To supplement the Master Plan, a detailed reviewed of the municipal servicing has been completed and detailed in this Municipal Servicing Functional Design Report.

This report is expected to serve as a guideline for the City, regulatory agencies, land owners and developers to facilitate the orderly servicing of this area. The SSMSP is a Master Plan Types 1 and 2, which is following the Municipal Class Environmental Assessment (MCEA) process, and is intended to satisfy Schedule B requirements for identified projects. Refer to the main SSMSP document for more information regarding the evaluation of alternatives and determination of preferred servicing strategies.

This report outlines the functional design for the following municipal infrastructure required to service the development within the SSMSP Area:

- Trunk sanitary sewers including the assessment of available treatment plant capacity;
- Trunk storm sewers;
- Stormwater management (SWM) facilities including consideration for the Little River floodplain;
- Stormwater pumping stations;
- Overland drainage, minimum development elevations and site grading;
- Watermain Distribution Network; and
- Internal Collector Road Network.

The design criteria and functional design details developed for the preferred solutions are included herein including budgetary project cost estimates and implementation recommendations. This report is intended as an appendix to the SSMSP and shall be reviewed in conjunction with the following reports:

- Stormwater Management Technical Report (Appendix D)
- Transportation Analysis (Appendix E)
- Natural Environment Report (Appendix B); and
- Sandwich South Master Servicing Plan (Covering Report)

1.2 Study Area

The study area is approximately 2,540 hectares (ha) in area and generally lies south of the EC Row Expressway, extending southerly to the City's boundary just south of Highway 401, westerly to Walker Road and extending easterly to the City's boundary. **Figure 1.0** illustrates the overview map of the study area including the proposed land use within the study area.

The functional design will focus on the two secondary plan areas identified in **Figure 1.0.** The areas are identified as the East Pelton Secondary Plan Area and the County Road 42 (CR42) Secondary Plan Area, which are 400 ha and 200 ha in area, respectively. These two areas have associated secondary plans that establish the land use and development density that can be accommodated in those areas. This report will highlight how that information is used to design municipal infrastructure for these two areas.

In addition to the two secondary plan areas, additional assessment was completed for the area in the vicinity of the proposed Lauzon Parkway and CR42 intersection. The improvements required at this intersection is the first phase of the greater plan for the widening and realignment of Lauzon Parkway and CR42 which were recommended through the Lauzon Parkway Environmental Assessment completed in 2014.

In 2022, it was announced that an automotive battery manufacturing facility would be constructed within the Employment designed lands located south of E.C Row, west of Banwell Road and north of the Canadian Pacific Railway (CPR) right of way. This functional design report does not provide recommendations for the development of this site, however as development proceeds with that property, the developer shall confirm that development meets the requirements of the City of Windsor and that due diligence studies be complete to confirm that the development does not have a negative impact to downstream areas. In addition, road network, sanitary sewer system and drainage improvements required to support this development should be identified and implemented.

1.3 Reference Reports

The design criteria and assumptions outlined herein have been developed through a review of City of Windsor and regional/provincial design guidelines along with completed and ongoing studies and secondary plans for the Sandwich South project area. Documents reviewed and referenced include the following:

- City of Windsor Development Manual (2015);
- Upper Little River Watershed Master Drainage and Stormwater Management Plan (Stantec Consulting Limited) (Stantec, Draft 2017, ongoing);
- Secondary Plans:
    - East Pelton Planning Area (2013);
    - County Road 42 Planning Area (2018);
- Growth Management Study (Hemson Consulting Ltd., ongoing);
- WUC Water System Master Plan 2019 Update (2020);
- Windsor Sewer and Coastal Flood Protection Master Plan (Dillon, 2020);
- Design Guidelines for Sewage Works (MECP, 2008);
- Draft Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval (MECP, 2019);
- Windsor/Essex Region Stormwater Management Standards Manual (ERCA, 2018);
- Sanitary Sewer Servicing Study for Lands Annexed from the Town of Tecumseh Schedule “B” Class Environmental Assessment (Stantec, 2006) and Addendum (Stantec, 2014) (SSSEA);
- Little River Regulatory Floodplain Mapping (Dillon, Draft 2022);
- Little River Watershed Flood Line Mapping Hydraulic Report (Dillon, Draft 2022);
- Little River Watershed Flood Line Mapping Hydrologic Report (Dillon, Draft 2022);
- Sandwich South Master Servicing Plan Transportation Network Analysis (Dillon, Ongoing);
- Walk Wheel Windsor Active Transportation Plan; and
- 7th Concession Drain Realignment, Drainage Report (Dillon, Ongoing).

2.0 Existing Conditions

The following sections summarize the existing conditions and infrastructure within the Study Area that were considered as part of the identification and evaluation of alternatives (refer to **Figure 2-0).**

2.1 Existing Site Conditions

2.1.1 Land Use

Lands within the study area are primarily agricultural lands with small areas developed for residential and commercial uses. The Windsor Airport Land is located at the north-west of the study area and includes a solar power energy farm along the northeast quadrant.

Figure 2-0 Sandwich South Area Existing Conditions

Various natural environment areas existing which are further defined in the Natural Heritage Characterization Report included in Appendix B of the SSMSP.

2.1.1 Topography

In general, the topography is relatively flat within the Little River Watershed. The topography within the Study Area is relatively higher than downstream areas in the watershed, which was confirmed by analyzing existing digital elevation models, LiDAR survey completed in 2017, and spot elevations from the City Sewer Atlas. Supplementary survey of the existing drains was completed and used to develop the topographic surface. A topographical map showing the existing conditions is shown in **Figure 2-1.**

2.1.2 Soil Condition

General soils information for the City was determined by reviewing the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) soil distributions map and the geotechnical report that was completed for the project: Preliminary Geotechnical Assessment, Sandwich South Lands (Golder, 2020) (**Appendix F-1**). The existing soil conditions within the study area consists of fill or organic surficial soils overlying an extensive deposit of silty clay/clayey silt. In areas of previous development and construction activity, the soils consist of a fill of varying composition (silt, sand, clay, organics, deleterious materials, etc.) placed over topsoil in some areas, and of variable depth.

Based on the available historical and existing site information, the report details the recommendations for roadway, sewer, and stormwater management facility installations. These recommendations should be reviewed as part of the detailed design process to refine the functional design solutions.

The information and recommendations provided were sufficient to complete the functional design but are not recommended to be used for detailed design. A site-specific detailed geotechnical investigation and testing should be completed for all recommended solutions during detailed design phase to confirm the findings from the Preliminary Geotechnical Assessment.

2.2 Existing Servicing

2.2.1 Drainage and Storm Sewers

The study area is serviced via municipal and roadside drains that provide overland drainage for agricultural lands including connection for field drainage tiles.

All drains generally drain east and north along the existing topography and discharge to the Little River Drain. Greater detail on the existing drainage conditions are referenced within this Master Plan's Stormwater Management Technical Report (Draft 2022) (**Appendix D**) and the Little River Regulatory Flood Line Hydrological and Hydraulic Reports (Dillon, Draft 2022).

There are currently no existing trunk storm sewers servicing the study area, however there are culverts for the enclosed ditches along Joy Road and Baseline Road within the study area.

A summary of changes to the existing drains proposed to facilitate the first phases of development area detailed in **Section 5.1.3** below.

2.2.2 Sanitary Sewers

The sanitary sewer system conveys domestic sewage via local service connections from residential, commercial, industrial, institutional and other land uses to a wastewater treatment plant where it is filtered, treated and discharged. Sewage from this area is directed to the Little River Pollution Control Plant (LRPCP) and the Lou Romano Water Reclamation Plant (LRWRP).

The southwest area of the study (68 ha) area is serviced via a 450 mm dia. sanitary sewer which directs sanitary flow to the City's sewer system at Walker Road. This sewer provides outlet for Southwest Detention Centre and surrounding areas. There is an existing 300mm and 450mm diameter sewer running west of 8th Concession Road and connecting to sewers along Walker Road. This area is part of the LRWRP drainage area.

The remaining 1,933 ha is part of the LRPCP sewage contribution area. A detailed sanitary sewage plan (SSSEA, Stantec, 2006, Addendum 2014) referenced in Section 1.3 above, was prepared by Stantec Consulting Ltd. This study provides the framework for the sanitary servicing of the Lands Annexed from the Town of Tecumseh which primarily consists of the Sandwich South study area. The study provides recommendations for the implementation of trunk sanitary sewers that will provide an outlet for the developable area within Sandwich South as well as the southern portion of the Town of Tecumseh (Oldcastle).

Portions of the SSSEA trunk sanitary storm system have been constructed including:

- 900mm dia. and 975mm dia. trunk sewers on 8th Concession Road from CR42 to Highway 401;
- 1200mm and 1350mm dia. trunk sewers on CR42, from 8th Concession Road to Lauzon Parkway;
- 1650mm dia. trunk sewers on Lauzon Parkway;
- 1650mm dia. trunk sewer running east along the Canadian Pacific Rail (CPR) track; and
- 1650mm and 2100mm diameter trunk sewer running north on Banwell Road.

Eventually effluent discharges to the LRPCP. Details on the existing LRPCP treatment capacity and annual average daily flow can be found in **Section 4.1.5** below and **Appendix F- 2.**

The existing sanitary trunk infrastructure is detailed on **Figure 4-0.**

2.2.3 Water Distribution & Servicing

The City's potable water supply system is serviced by the ENWIN Water (formerly Windsor Utilities Commission (WUC)). There are existing watermains along the major roads within the study area including 8th, 9th and 10th Concession Roads that range in size from 150 mm dia. to 200 mm dia. that connect to an existing trunk watermain located along CR 42 which connects to the Provincial Road waterman. Refer to the Water Distribution Network (Figure 7-0) detailing the existing and proposed watermain infrastructure.

2.2.4 Road Network

Table 1 describes the existing City of Windsor roads in the study area.

Table 1 Summary of Existing Roads

Road Name	Class	Posted Speed (km/hr)	Lanes	Active Transportation
EC Row Expressway (CR22)	Expressway	100	4	Not Applicable
Lauzon Parkway	Class 1 Arterial	70	2	None
Walker Road	Class 2 Arterial	60	5	Sidewalks both sides
Provincial Road	Class 2 Arterial	60	2/4*	None
County Road 42	Class 2 Arterial	50	2	None
Baseline Road	Class 2 Arterial	50	2	None
9th Concession	Class 2 Arterial	60	2	None
10th Concession/ County Road 17	Class 2 Arterial	60	2	None
Banwell Road	Class 2 Arterial	60	2	None
7th Concession	Class 1 Collector	50	2	None
8th Concession	Class 1 Collector	60/40**	2	None
Joy Road	Local	40	2	None
Ray Road	Local	40	2	None
Service Road B	Local	40	2	None

* 2 lanes west of Walker Road; 4 lanes between Walker Road and Highway 401

**60 km/hr between CR42-Baseline Road; 40km/hr south of Baseline Road

3.0 Proposed Conditions

The Sandwich South area is expected to be required to service future growth of the City of Windsor. Planning details related to the proposed development land uses and other development guidelines are included in the Secondary Plans associated for this area. For areas outside of the two established secondary plans, land use boundaries were based on previous draft Sandwich South area studies as well as the City's Official Plan. Proposed population densities used to estimate servicing demands were based on a combination of recommendations of the Secondary Plan studies.

As development proposals are submitted for this area, developers shall demonstrate that the proposed built form, land use and population will not exceed the sanitary system capacity allocation. Sewage generation allocation is based on the proposed land use and population densities provided in **Table F3.1** in **Appendix F-3**. This report notes where additional flexibility in changes to the proposed development and conversely where infrastructure could be constrained should these guidelines not be adhered to.

Sections 4.0 to 7.0 below will further describe assumptions and criteria used to develop the municipal servicing plan for each type of infrastructure as well as how previously completed studies were used.

The findings noted below assume an ultimate scenario in which all development areas are fully build out. Notes regarding staging will be included below.

4.0 Sanitary Servicing

4.1 Design Criteria

The following is intended to provide recommendations for trunk sanitary sewer design criteria to be included within the SSMSP. For the purpose of the SSMSP, trunk sanitary sewers are defined as those that are 375 mm in diameter or greater. The functional design and associated costs estimates for this study will be provided for trunk sanitary sewers only. The sanitary trunk system sewer design sheet can be found in **Appendix F-3** along with a plan showing the sanitary drainage areas **(Figure F-3-1)** and associated sanitary population projection estimates (**Table F3-1**). Comparisons and assumptions on the design criteria is provided in the Servicing Criteria and Assumptions Memo, appended to this report in **Appendix F-5**.

4.1.1 Sanitary Sewer Generation Rate

A sewage generation of 363 L/Cap/day was used for sanitary sewage design within the Sandwich South Project area; this rate aligns with the current City of Windsor Development Manual (2015) standard of 0.0042 L/Cap/s, it also aligns with the rate used in the SSSEA design (2014).

4.1.2 Peaking Factor

The Harmon Formula was used for the peaking factor within the Sandwich South project area due to the estimated design population of 82,000 (both LRPCP and LRWRP drainage areas) and the potential impacts a higher design flow could have on the existing Sandwich South trunk sanitary sewers.

4.1.3 Sanitary Design Population Densities

Sanitary design population densities outlined within the City's Development Manual (2015) were compared with the East Pelton and CR42 Secondary Plans. The secondary plans generally propose increased residential density for both medium and low-density land uses, when compared with the 50 persons per hectare outlined within the current Development Manual. The secondary plans were used to create specific design densities based on the land use and allowable densities found within the respective secondary plans. Hemson, on behalf of the City of Windsor, completed a Development Charge

Background Study, dated November 5, 2020 that outlines the proposed population growth within the Sandwich South Area. The population growth criteria were used to estimate the total population and corresponding sewage generation rates.

Table 4-1 below outlines the proposed residential population densities for the Sandwich South area. The assumptions used to determine these densities are as follows:

- Single Family Dwelling: 3.83 Persons Per Unit (PPU)
- Row Housing/Semi-Detached Dwellings: 2.33 PPU
- Apartments: 1.66 PPU

The blended density of 50 ppl/ha is proposed for the areas outside of the two Secondary Plan Areas, as planning studies supporting the framework for development of those areas have not been completed. The City shall confirm the most appropriate density that is expected for these areas after the future planning studies have been completed.

Table 4-1: Proposed Residential Population Densities

Land Use	East Pelton	County Road 42	Other
Low Density Residential	36ppl/ha	75ppl/ha	--
Medium Density Residential	80ppl/ha	106ppl/ha	--
Mixed Use	92ppl/ha	112ppl/ha	--
Future Urban	--	--	50ppl/ha

Table 4-2 outlines the proposed Commercial and Industrial population densities. The densities are based on the current City Development Manual.

Table 4-2: Proposed Commercial/Industrial Population Densities

Land Use	East Pelton	County Road 42	Other
Commercial	74 ppl/ha	74 ppl/ha	--
Business Park Type I	--	68 ppl/ha	--
Business Park Type II	--	74 ppl/ha	--
Future Employment	--	--	68 ppl/ha

Institutional/other population densities were developed using MECP guidelines and the City of Windsor Development Manual. Equivalent population densities for Major Institutional and Private Recreation land uses are based on per bed or per site sewage generation rates outlined within the MECP Sewer Design Guidelines (2008) and the total site area. Minor Institutional density has been taken from the City's Development Manual. A summary of Institutional/Other population densities is outlined within **Table 4-3 below.**

Table 4-3: Proposed Institutional/Other Population Densities

Land Use	East Pelton	County Road 42
Major Institutional	Correctional Facility **30 ppl/ha** (equivalent)	Hospital **76 ppl/ha** (equivalent)
Minor Institutional	Church **22 ppl/ha**	--
Private Recreation	Windsor Campground **78 ppl/ha**	--

Assumptions used to generate equivalent institutional/other population densities are listed below:

- Major Institutional (South West Detention Centre)
    - 315 beds
    - 12.17 ha site
    - 363 L/bed/day
- Major Institutional (Hospital)
    - 669 beds (full buildout)- Windsor Regional Hospital Stage 1 Proposal Submission Part B, June 2015
    - 24.25 ha site
    - 1000 L/bed/day (MECP)
- Private Recreation (Windsor Campground)
    - 208 sites (184 serviced)
    - 5.4 ha site
    - 735 L/site/day (MECP composite rate)

Based on these population densities the total population estimated within each drainage areas are listed in Table F3-1 Sanitary Population Estimates Summary.

4.1.4 Extraneous Flow Allowances

Extraneous flow allowances represent the dry weather ground water infiltration rate that could be expected over the life cycle of the proposed sanitary sewer. The extraneous flow rate for newly constructed systems should be minimized and shall not exceed the acceptable range recommended in the MECP guidelines.

Based on a review of the infiltration rates, it is recommended that the extraneous flow allowance of 0.156 L/s/ha be used for sanitary design within the SSMSP area. This recommended value is within the new MECP guidelines range, however is greater than that assumed in the SSSEA.

The sanitary sewer system design was completed based on a dry weather population generation rate and does not consider design under wet weather conditions. Proposed sewers constructed within the study area shall not result in exceedances to the extraneous flow.

For the Windsor Sewer and Coastal Flood Protection Master Plan (2020) (WSMP), a wet weather flow allowance from the Sandwich South development area of 1.0 L/s/Ha was allocated under ultimate conditions. The development of that value is outlined in the WSMP, Technical Volume 2 Report (2020). That value is not intended to be the basis for sewer design as an extraneous flow allowance, but was used to represent a wet weather inflow and infiltration allowance to evaluate flood risk areas downstream within existing developed areas within the City. The sanitary sewer design is based on a 'dry weather' condition whereby extraneous flow allowances were accounted of 0.156 L/s/ha is allocated, building upon the SSSEA (2014).

Management of wet weather inflow and infiltration shall be managed for all new systems. Proposed sewers constructed within the study area shall not result in exceedances to the extraneous flow allowances listed above and the City shall implement construction inspection, (both during construction of municipal infrastructure and construction of private systems), compliance enforcement, flow monitoring, and maintenance throughout the lifecycle of the system. See **Section 4.1.6** for recommendations regarding monitoring and enforcing sanitary infiltration management allowances.

4.1.5 Design Flow

The peak design flow was reviewed for both the Little River Pollution Control Plant (LRPCP) and the Lou Romano Water Reclamation Plant (LRWRP) drainage areas based on the design criteria and assumptions listed previously. A summary of the Sandwich South design sanitary flow is outlined below. The total populations were determined using the population densities provided above along with the following parameters:

Little River Pollution Control Plant

The information below was generated by this sanitary sewer analysis, which is included in more detail in Appendix F-3.

- Total Sanitary Design Population: **79,312**
- Sanitary Drainage Area: **1,998 ha**
- SSMSP Peak Design Flow: **2,313 L/s**
- Flows assumed from the Town of Tecumseh Inlets:
  - 325 L/s Oldcastle (Tecumseh) (8th Concession trunk sewer)
  - 983 L/s Tecumseh Hamlet (CR22/Banwell trunk sewer)
- Annexed Lands Sanitary EA (SSSEA) Peak Design Flow: **2,441 L/s**
- Capacity of Downstream Sewer (ID 269393): **2,629 L/s**

Lou Romano Water Reclamation Plant

- Total Sanitary Design Population: **3,081**
- Sanitary Drainage Area: **68 ha**
- Peak Design Flow: **57 L/s**

Based on the above, the downstream sanitary trunk sewer facilities will have capacity to accommodate the full build out of the study area based on the established land use plan and listed population densities.

In review of the sewer capacity of the existing downstream 1650 mm dia. trunk sanitary sewer system, under ultimate full build out conditions, the sewer capacity ranges from 79% to 88% pipe capacity based on this sewer design. It is recommended that as the City approaches full build out of the study area, the flows contributing to this sewer are monitored to confirm that dry weather sanitary sewer generation is consistent with the estimated findings of this assessment.

4.1.6 Additional Sanitary Servicing Recommendations

The following additional recommendations have been proposed for inclusion within the SSMSP:

- All new manholes shall be watertight and wrapped in waterproof membrane if installed below the seasonally high groundwater table (proposed MECP design criteria).
- Sanitary flows for all new development should be monitored pre (if applicable) and post construction.
    - The City shall stipulate maximum extraneous flow allowances in development agreements to ensure sewers do not exceed infiltration allowances during a minimum 2-year maintenance period after construction.
    - A maximum allowable infiltration rate of 0.008 L/s/Ha after the end of this maintenance period (5% of the 0.156 L/s/Ha noted in Section 4.1.4).
- Sampling manholes for all larger developments (including residential areas) and manholes at the downstream end of all new development shall be installed and sized to accommodate monitoring equipment.
- Sewage Ejectors to be required for all new homes or buildings with basements.
- Building Management:
    - Home management practices- prohibit window wells and roof drain connections, enforce proper lot grading; and
    - Inspection/testing of private drain connection (through permitting process).

4.2 Sanitary Sewer Functional Design Solutions

The functional design of the SSMSP trunk sanitary sewer system is illustrated in **Figure 4-0**. The proposed sanitary sewer drainage areas are illustrated **in Appendix F-3,** along with the detailed sanitary sewer functional design sheets.

The proposed sanitary sewers range in size from 375 mm dia. to 825 mm dia. Sewer invert elevations and gradients were designed to ensure proper drainage of the entire SSMSP. The profile of the proposed sanitary sewer system is dictated by the available sanitary sewer outlet elevations, conflicts with other municipal infrastructure, and the proposed site grading. It should be noted that while conflicts between the sanitary and storm sewers were assessed, a re-evaluation of these conflicts should be performed for any proposed changes to the sewer alignments and/or invert elevations.

Critical sanitary trunk sewer inverts required to mitigate conflicts with other infrastructure is included. Two areas where the elevation of the proposed sanitary sewer is critical to provide a functional connection includes the following:

- CR42 – The proposed trunk storm sewers along CR42 have been set to a depth necessary to provide gravity connections to properties within the associated drainage area. The storm sewer system has been designed to avoid conflict with the existing sanitary trunk sewers, however any sanitary sewer or private drain connection crossings over the CR42 trunk storm sewers must consider the depth of the storm trunk sewer and sewer conflicts shall be avoided.
- Southwestern Ontario South West Detention Centre (8th Concession Road) - Currently the existing sanitary connection for the facility is serviced through the rear (west side of the property). To accommodate the trunk storm sewer required to service the extension of Road C and discharge to Pond P2 the sanitary sewer may need to be re-constructed to avoid conflict. Details are included in Figure 4-0 and Appendix F-3.

4.3 Little River Pollution Control Plant Treatment Capacity

A high-level review of the available treatment capacity at the LRPCP was performed to determine whether the existing plant can accommodate the full development of the study area. Through the assessment, it was determined that the LRPCP does not have sufficient available capacity to accommodate all planned future development within the Sandwich South area, in addition to existing flows and commitments to the Town of Tecumseh. The total plant expansion capacity will be confirmed during a future Schedule C LRPCP Expansion project. The approximate population that could be accommodated within the system is estimated to be equivalent to 57% of the total estimated population within the East Pelton Secondary Plan Area and 15% of the total estimated population CR 42 Secondary Plan Area.

The assessment was based solely on population generated sewage rates and averaged daily flows measured at the LRPCP. The assessment does not include considerations for the management of peak flow rates or wet weather (extraneous flow) conditions.

Considerations for influent quality was also not included but should be evaluated as part of future studies.

It is recommended that as part of the future LRPCP plant expansion Schedule C Environmental Assessment, that the total capacity of the treatment plant consider measure to manage wet weather inflows.

Detailed information on the capacity assessment of the LRPCP including methodology and assumptions is provided in **Appendix F-2**.

5.0 Stormwater Servicing

Stormwater collection and management systems generally consist of a network of open drains, storm sewers, pumping stations, overland flood routes and stormwater management (SWM) facilities. The proposed storm trunk sewer drainage, drains and SWM facilities have been incorporated as part of this Functional Servicing Report, and described in further detail below. The SWM facilities proposed for the two secondary plan areas as shown in **Figure 5.0** and the layout of the proposed storm trunk sewers can be found in **Figures 5.1, 5.2 and 5.3** for the East Pelton, CR42 and Lauzon Parkway/Airport areas.

It should be noted that the functional design of the storm sewer network was based on the rational method and as development proceeds into the detailed design stage the City will require a dual drainage model be developed to verify the proposed storm sewer trunks and overland flow rated are adequate per the level of service criteria included herein.

5.1 Trunk Storm Sewer

To convey stormwater to the proposed SWM ponds a network of trunk storm sewers has been functionally designed. This study has focused on the design of the trunk sewer infrastructure required to service the established drainage areas. The following sections describe the criteria and assumptions used to functionally design the trunk sewers.

5.1.1 Design Criteria

The City of Windsor has adopted the 2018 Windsor/Essex Region Stormwater Management Standards Manual (WERSWM) as the governing stormwater design guidelines for both major and minor system stormwater design. As such, the design criteria outlined in the WERSWM will be adopted as the basis for the design and implementation of the SSMSP. Level of service for the trunk sewer storm system shall be assessed based on a depth of the minor system Hydraulic Grade Line (HGL) as it relates to the proposed finished ground elevation. The HGL shall be lower than 0.30 m below the finished ground elevation. The HGL is a function of the sewer inflows from the developable lands with consideration of tailwater conditions acting against the system from the proposed SWM ponds. Under a free flow outlet design, storm trunk sewers are to be designed to convey all flows through the designed pipe based on the proposed level of service event. Additionally, velocities and cover requirements have been specified which are consistent within the City of Windsor Development Manual (2015). The design criteria for trunk storm sewer infrastructure is summarized within **Table 5-1** below.

Per the design criteria in the City's Development Manual, a 1:5 year return period is used to size the proposed storm sewers. Through public consultation, including feedback obtained by the project's Stakeholder Advisory Committee, local surface flooding has been a noted issue in existing areas of the City due to local topography, sewer capacity constraints and frequency of major storm events. Considering these factors, there is opportunity to implement a more resilient drainage system which is imperative to mitigate future risks associated with Climate Change and provide an enhanced level of service. A cost comparison was completed by comparing the trunk sewer costs under a 1:5 year level of service versus a 1:10 year level of service, to evaluate the increased costs associated the higher level of service. The overall cost difference between the return periods was approximately a $2M increase (15%) for the 1:10 year return period for all proposed trunk storm sewers required to service the CR42 and East Pelton SPAs. The project team also compared the storm sewer design criteria used in other Ontario Municipalities which showed that, as of 2021, both the City of Brampton and City of Mississauga require a 1:10 level of service for local storm sewers.

Based on this comparison, the incremental increase in total project costs would be warranted based on the additional system resilience; therefore, the trunk storm sewer design will be based on a 1:10 year return period level of service. Local storm sewers required upstream of the identified trunks are proposed to be designed to a 1:5 year return period.

Table 5-1: Proposed Storm Trunk Sewer Design Criteria

Parameter	Design Criteria
Trunk Sewers - Return Period	1:10 Year
Local Sewers - Return Period	1:5 Year
Storm Sewer Design	Rational Method
Hydraulic Storm Sewer Sizing	Manning's Equation

Parameter	Design Criteria
Manning’s Roughness Coefficient ‘n’	0.013
IDF Rainfall Data	Windsor Airport (Station No 6139525)
Initial Time of Inlet (T_j)	20 Minutes[2]
Minimum Velocity	0.76 m/s
Maximum Velocity	3.0 m/s
Minimum Pipe Cover	1.0 m
Trunk Sewer Diameter[1]	1050 mm or Greater

Note 1: For the purposes of this SSMSP, functional design and cost estimates will be provided for trunk infrastructure only. This includes storm sewers 1050 mm in diameter or greater.

Note 2: Inlet time was based on Table 3.2.2.6 of the WERSWM, where the average proposed impervious values, greenfield nature of this area, and the scale of this design was considered in selecting a 20 min Inlet Time.

In order to quantify stormwater flows using the rational method, proposed runoff coefficients for the various land uses within the Sandwich South project area were established (**Table 5-2**). These coefficients align with those found within the WERSWM. Weighted runoff coefficients were determined based on the established land use plan (Hemson, 2018).

Table 5-2: Proposed Runoff Coefficients and Impervious Values

Proposed Land Use	Runoff Coefficient*	Impervious (%)*
Open Space, Stormwater Corridors, Natural Environment Areas	0.20	0
Residential – Single Family	0.60	60
Residential – Single Family (lot size 500 m^2 or less)	0.70	70
Residential – Semi-Detached	0.70	70
Residential – Townhouse/Row Housing	0.80	80
Industrial/Commercial	0.90	90

*Values from Windsor/Essex Region Stormwater Management Standards Manual (2018)

Upon detailed design, developers shall confirm that based on the proposed building and road layout that percent runoff is similar to those included in **Table 5-2**.

5.1.2 Storm Sewer

The proposed storm sewers for the SSMSP were designed based on the current City and Provincial standards described in **Table 5-1 and Table 5-2**, along with generally accepted engineering principles. The SSMSP storm sewer design sheets as well as more detailed storm trunk sewer layouts, drainage area information and pipe junction naming are included in **Appendix F-4** for reference. Storm sewer designs were completed using the rational method based the criteria listed above and the static 1:10 year return period HGL data for each SWM pond. The development of the pond design and associated HGL information is further expanded on in Section 5.2.

The proposed SSMSP storm sewer systems for the East Pelton and CR42 SPAs are shown in **Figures 5-1 to 5-3.** The trunk storm sewer alignment was developed based on the proposed roadway network at the time of this Study. The storm sewer invert elevations are based on the proposed site grading, as well as the design normal water level of the proposed SWM ponds. Both the road network and the storm sewer alignment may be subject to change during the detail design if an updated roadway layout is proposed and approved by the City or if conflicts arise during the detail design with other services in which the storm trunk sewer design needs to be modified. During the 1:10 year storm, the HGL elevation is greater than 0.30 m below the finished ground elevations, therefore no ponding is expected. For storms greater than 1:10 years, the roadways will be used to store and convey overland flows to appropriate drainage outlets.

The road network will be designed to encourage storage of stormwater on roadway pavements for storm frequencies greater than 1:5 year. The maximum allowable roadway ponding depth permitted will be 0.30 m for a 1:100 year return period. Provisions for a minimum of one dry lane shall be provided for all arterial and collector roadways shall be accommodated, wherever possible. Maximum road ponding and dry lane access requirements shall be confirmed at the detailed design stage.

All stored flows will be conveyed by the storm sewer system to the stormwater facility which has been designed to receive these flows. Flows resulting from storm events greater than the 1:100 year and unable to be stored within the municipal right-of-way will be directed to the overland flow routes to the downstream SWM ponds. **Section 6.0** provides more details on overland flow routes and flood level protection. As part of the detailed design and site-specific SWM studies, developers will be required to provide grading plans and surface storage calculations that support these requirements.

5.2 New and Improved Drains

The SWM analysis, detailed in **Appendix D – Stormwater Management Technical Report,** evaluated the capacity of the municipal drains under existing, initial build-out, and ultimate build out scenarios. The sections below detail the findings and recommendations of drainage improvements to implement this comprehensive plan.

It should be noted that the findings of the SWM Study have incorporated the allowable release rates identified for each pond and associated storm pumping stations.

As development proceeds, developers must consider existing drainage patterns and farm tile system locations. Where required, tiles shall be capped and/or intercepted with a header pipe and directed to the appropriate outlet. This should be done as part of each expansion to development.

As drainage improvements are implemented, considerations for providing flood proofing along the drains edges to mitigate flood risks shall be considered based on the regulatory flood levels. Flood proofing shall be comprised of raised earth berms that exceed regulatory flood mapping elevations and also prevent overland flows from the proposed development areas and roadways from entering the drains.

It should be noted that drainage improvements described in **Section 10** below, are recommended to accommodate the initial and ultimate condition stages of build out. As development occurs within the SSMSP area, an evaluation of the drainage system conditions will need to be undertaken to confirm that the proposed improvements will not have impacts to upstream or downstream areas. As SWM ponds are implemented and new pumped outlets to the municipal drain system are put in place, incremental reductions in drain flows should be realized due to the added control of runoff from those areas as recommended in the ULRMP. To accommodate road improvements and subdivision construction, there will be a need to implement the recommendations listed herein such as the 7th Concession Drain Realignment (East-West Arterial Drain). The timing of this improvement will be largely depending on the level of development. Upon implementing drain improvements, the size and location of those drains shall be confirmed using the area wide model. Drainage improvements recommend below note the estimated timeframe for which these improvements will be implemented.

5.2.1 6th Concession Drain

Relocation and enhancement of the 6th Concession Drain, directly south of Baseline Road, from 7th Concession Road to the Little River Drain, is recommended under initial buildout conditions. These improvements are aimed to improve safety due to current steep side slopes and the drains in close proximity to the roadway and private property. The Municipal Drain is proposed to be re-established to a flat bottom ditch and realigned further south within the East Pelton and CR42 SPA initial buildout area SWM corridor. The following design details for the drain are therefore recommended through the 6th Concession Drain from 7th Concession Road to the Little River Drain outlet:

- Flat bottom ditch with a bottom width of 0.30 m;
- 5:1 side slopes; and
- Longitudinal slope to be brought back to the original design of 0.16% *(Consulting Engineers 1969 Survey Engineers Report*).

Based on the findings of the **Appendix D – Stormwater Management Technical Report**, under existing conditions, the governing 1:100 year water levels in the drain are shown to exceed existing bank elevations at the following locations:

- 0.10 m to 0.20 m from 7th Concession Road to the existing confluence with the 7th Concession Drain;
- 0.20 m to 0.30 m from the existing confluence with the 7th Concession Drain to 8th Concession Road; and
- 0.10 m from 8th Concession Road to 9th Concession Road.

During detail design of the realignment, it is recommended that the future enhancements to the drain consider minimum drain bank elevations to above the 1:100 year levels.

The design of the 6th Concession Drain, including the necessary bank improvements are sized to accommodate existing, initial buildout and ultimate buildout conditions without posing any adverse flooding on existing adjacent properties or downstream areas. The bank improvements are expected to also act as a flood barrier for adjacent future development.

Through consultation with property owners along Baseline Road between 7th and 8th Concession Road, localized low areas experience ponding during major wet weather events. During future road reconstruction, the local storm sewer servicing the existing residential areas shall be evaluated to mitigate local flooding issues.

Cross sections of the re-alignment of the 6th Concession Drain is illustrated in **Figures 5-4-1A and B, Figures 5-4-3 A, B and C.**

5.2.2 7th Concession Re-Alignment - East-West Arterial Road Drain

A future East-West (E-W) Arterial Road is to be constructed, connecting Walker Road, along the western boundary of the SSMSP, with the future Lauzon Parkway extension and extending further east to connect with 10th Concession Road/County Road 17 at the SSMSP eastern city limits. This E-W Arterial Road alignment was established as part of the Lauzon Parkway Improvements Class EA ESR *(MRC, 2014)* which consisted of a 2-lane cross section with provisions for an ultimate 4-lane cross section.

To accommodate future development within the SSMSP area and redirect existing drainage outside of the initial buildout areas, a new E-W Arterial Municipal Drain is proposed. This drain is also necessary to provide a storm outlet for all areas south of the E-W Arterial Roadway, including the E-W Arterial Roadway. Drainage will be controlled via SWM facilities south of the E-W Arterial Roadway. These ponds will have pumped outlets directly to the E-W Arterial Drain.

The drain is proposed to be constructed as follows:

- **West Alignment** along the north side of the E-W Arterial Road from the 7th Concession Drain to the Little River Drain; and
- **East Alignment** along the south side of the E-W Arterial Road from the Little 10th Concession Drain to the Little River Drain.

In the future, after the implementation of the E-W Arterial Drain, to limit servicing conflicts and municipal drain structure crossings under the E-W Arterial Road, either of the following is recommended prior to the construction of roadway construction:

- **Scenario 1:** Construction of the SWM Pond proposed along the south of the E-W Arterial Drain within the designated SWM corridor to convey upstream municipal drain flows from the Hayes Drain and 9th Concession Drain. This pond would be constructed in advance of the roadway to capture the roadway drainage and to intercept the municipal drains (8th, 9th and Hayes Drain); or
- **Scenario 2:** Capture of the Hayes Drain within the E-W Arterial Road storm trunk sewer and construct the Hurley Relief Drain realignment directly north of the Highway 401, to redirect municipal drain flows south of the Highway 401 into the Little River Drain from the existing Hurley Drain and 9th Concession Drain.

These two scenarios are recommended to be further assessed prior to detailed design of the E-W Arterial Road and a preferred drainage solution determined. This includes the feasibility of allowing the E-W Arterial Road to convey uncontrolled into the Little River Drain until such time where the Regional Wet Pond within the E-W Arterial SWM corridor is ready to be implemented.

This drain would redirect flows from the upstream drainage areas (7th Concession Drain, 8th Concession Drain, Hayes Drain and 9th Concession Drain) to the upper reaches of the Little River at the proposed confluence point with the E-W Arterial Drain. To mitigate flood risk that could result from the redirection of this flow, it is imperative that the drain improvements occur after the implementation of SWM ponds and attenuated pumping station outlets for the East Pelton, CR42 SPAs. Prior to the implementation of the E-W Arterial Drain, the size and location of the drain shall be confirmed with the objective to mitigate impacts to the downstream and upstream areas including Little River.

5.2.3 Hurley Relief Drain

The Hurley Relief drain is located within the south portion of the SSMPS area. The drain currently intercepts drainage from Town of Tecumseh, Oldcastle area, crosses the Hwy 401 and 9th Concession Drain, eventually discharging to Little River, approximately 420 m north of Hwy 401. Through recommendations from the ULRMP, the Hurley Relief Drain is recommended to be realigned to an alignment north of the Highway 401 right-of-way. The realignment is expected to redirect runoff from Hurley Relief Drain and 9th Concession Drain sub-watersheds to accommodate Future Employment development area between the E-W Arterial Road and Hwy 401.

As this 1,300 m realignment is outside the initial build out areas, the previously completed ULRMP study proposed drain design was generally maintained however the longitudinal slope has been established to accommodate the conveyance of upstream Municipal Drains (Hurley Relief Drain, 9th Concession Drain). The Hurley Relief Drain realignment is expected to have the following design properties:

- Flat bottom ditch with a bottom width of 3.0 m;
- 3:1 side slopes; and
- Longitudinal slope of 0.15 %.

The conceptual design of the realignment is shown to maintain flows within the banks of the Municipal Drain realignment. Further analysis is expected to be required during detail design of the realignment to confirm that the design is adequate to existing conditions at that time.

5.2.4 Little 10th Concession Drain Realignment

Through recommendations from the ULRMP, the Little 10th Concession Drain is recommended to be realigned to a similar length south of CR42, along the outer eastern boundary of the SSMSP to accommodate ultimate buildout development.

The latest Municipal Drainage report *(Dillon, 2013)* shows that the current drain design is adequate to maintain existing levels and therefore the design details are proposed to be maintained through the realignment under ultimate buildout conditions. This design is expected to be further reviewed as development requires the realignment.

5.2.5 Lachance Drain Realignment

To accommodate an automotive battery manufacturing facility that is currently being constructed, south of the EC Row Expressway and west of Banwell Road, the Lachance Drain was realigned around the industrial development from directly downstream of the existing Banwell Road crossing to its existing drain alignment north of the CN Railway right-of-way.

For further details on the Lachance Drain Realignment, please refer to the Drainage Report for the New Drain Alignment of a Portion of the Lachance Drain. Dated March 25th, 2022.

5.2.6 Little River Drain

Based on the existing condition analysis completed for the Little River watershed, flood inundation beyond the banks of the drain are shown to occur during the Chicago 1:100 year 24 hour event. This flooding occurs in the areas immediately upstream of the CR42. This is expected as Municipal Drains are traditionally not sized for these major system events, with in-drain structures being designed to a lower level of service, thus causing a restriction through the watercourse.

Initial Build-Out Condition

The following 1:100 year HGL elevation results are identified within the Little River Drain, under initial buildout conditions, based on the incorporation of the E-W Arterial Drain and necessary drain redirections:

- Little River Drain water surface elevations exceed existing conditions from the existing confluence with the Hurley Relief Drain to the Lauzon Parkway Crossing under the Scenario 1 E-W Arterial Drain Condition;
- Little River Drain water surface elevations exceed existing conditions from Highway 401 to the Lauzon Parkway Crossing under the Scenario 2 E-W Arterial Drain Condition; and
- Initial and Ultimate condition water elevations are lower than existing conditions downstream of Lauzon Parkway.

Further details of the bank height requirements are provided in Section 9.3 and Table 9- 1 of **Appendix D** – Stormwater Management Technical Report.

Under interim conditions, prior to the implementation of the full SWM strategy which will attenuate runoff flows entering the municipal drainage system, measures to mitigate negative impacts will need to be determined. The extent and sizing of measures will need to be based on the phasing and location of development. These solutions shall balance runoff flows such that redirection of flows to the E-W Arterial Drain do not pose flood risk to the portions of Little River immediately downstream of the new confluence of those drains. Solutions may include the maintenance of existing drains and introducing interconnections. For example as portions of the E-W Arterial Drain is implemented, interconnections between that drain and the northern portion of the 8th, Hayes or 9th Concession Drains may be warranted.

Ultimate Build-Out Condition

Based on ultimate buildout conditions which reflects full built out of the SSMSP area, a number of contributing Municipal Drains are to be abandoned/redirected south of the E-W Arterial Drain. Drainage will be captured via the proposed storm sewer network and directed to the proposed SWM Ponds which will attenuate outlet flows contributing to the Little River.

Based on the improvements proposed to the banks of the Little River Drain discussed in **Section 9.3.1**, under ultimate buildout conditions, the Little River Drain has ample capacity to convey the proposed development runoff.

5.2.7 Road Crossings

Where drains crossing existing or proposed roadways, culverts shall be sized to mitigate capacity constraints and bottlenecks with the system. Refer to **Appendix D** for drainage flows within the proposed drains. Road crossings required to provide conveyance of proposed municipal drains shall consider providing linkages of the natural environment systems.

5.2.8 Waterfowl Mitigation

Municipal drains are anticipated to be primarily dry in between rain events and not constitute suitable habitat for waterfowl. The proposed 5:1 side slopes will provide some flat areas that could be attractive to waterfowl therefore all drains must be planted with appropriate long grass seed mix to mitigate those habitat areas and regular mowing of drain banks shall not be permitted. Refer to the Supplementary Waterfowl Adaptive Mitigation Plan for Stormwater Management Facilities included as **Appendix F-9** of this report.

5.3 Stormwater Management Facilities

Stormwater management analysis and functional design completed for this area has determined that to support the Initial Build Out areas, a total of eight (8) regional SWM facilities are required. These ponds will provide service for the East Pelton and CR42 SPAs.

These 8 ponds represent more than six (6) kilometers of linear ponds that have a width of 70-90 m and depths between 3.9 m to 5.6 m from top of bank to the permanent pool surface or pond bottom. To support full development of the SSMSP area, additional ponds will be required beyond the 8 ponds listed above, however those ponds are expected to be implemented in the future phases of development. The SSMSP details the assessment of various SWM facility configurations based on the evaluation of criteria and recommendations that have been developed through the ULRMP (2023). An overall study area plan showing the location of SWM ponds is shown in **Figure 5-0**.

Through the functional design process, pond stage-storage tables were developed and incorporated into the PCSWMM technical model for each Regional Pond. Functional maximum pond water surface elevations were then determined for all synthetic storm events. Stage-storage tables have been included in Appendix F-10.

All technical design details of the SWM requirements for the initial buildout area ponds are provided in Section 7 and Section 8 of **Appendix D** – Stormwater Management Technical Report.

5.3.1 Design Criteria

Regional Stormwater Management (SWM) Facilities, throughout the Sandwich South area, are sized for water quantity and quality control, in conjunction with the requirements set out within the WERSWM and the MECP Stormwater Management Planning and Design Manual (SWMPDM). The SWM Facilities are sized based on the Stormwater Management Analysis completed using PCSWMM and detailed in the SWM Technical Report (Appendix D of the SSMSP). Based on proposed contributing service areas and future development densities, estimated storage volumes required for each pond under various storm events where determined. The impervious values that were used for the various land uses within the Sandwich South project area align with those found within the WERSWM.

The SWM Design requirements through the Sandwich South area adhere to the following:

Stormwater Management Pond Requirements

- Ponds to be located within the SWM corridors (established per the Upper Little River Watershed Master Drainage and Stormwater Management Plan (ULRMP));

- Corridors will include natural linkages, maintenance access and public multi-use pathways to provide framework for the required Natural Heritage System and active transportation network;
- Water Quantity Control: Provide sufficient active storage volume within the SWM Facility to control post development peak flows to the municipal drain capacity:
  - Maximum post-development 2-year allowable release rate of 3 L/s/ha;
  - Maximum post-development 5-year allowable release rate of 4 L/s/ha;
  - Maximum post-development 100-year and UST allowable release rate of 6 L/s/ha;
  - Provide the 1:100 year storage requirements with a minimum 0.30 m freeboard from pond water surface elevation to proposed top of bank; and
  - Provide the Urban Stress Test (UST) storage requirements such that the water surface elevation of the pond does not exceed the proposed top of bank.
- Water Quality: Provide a Normal Level of Protection of 70% long-term Total Suspended Solids (TSS) Removal) for water quality treatment as follows:
  - Wet Ponds: Sizing of the permanent pool within the SWM Facility to meet the requirements set out within Table 3.2 and Table 4.6 of the SWMPDM;
  - Dry Ponds: Where dry ponds are proposed, quality control measures will need to be accommodated separately from the proposed stormwater ponds, see below for more information; and
  - Sizing of the inlet forebay to meet the minimum design criteria, settling distances and dispersion lengths as per Table 4.6 and Section 4.6.2 of the SWMPDM.
- Pond drawdown time shall be less than 48 hours for the 1:100 year storm event.
- Pond inlet pipes shall be unsubmerged during dry weather.
- Side Slopes of 5:1 within the active storage area and 1.5:1 within the permanent pool area;
- Permanent pool shall be approximately 1.5 m - 2.0 m deep;
- Active Storage depths range between 2.5 m and 3.5;
- The total pond depth and footprint is dependent on the minimum cover required on the corresponding storm sewer system and the recommended pumping station

requirements. A minimum 0.3 m freeboard is required however in most instances these values is exceeded due to the depth of the storm trunk sewer system;

- The top of bank of the pond shall be set such that overland flow from the upstream drainage area will have the ability to drain over the banks into the pond to account for events greater than the 1:100 year storm. The top of banks shall also mitigate risk of inflow from adjacent municipal drains. The top of bank elevations shall be greater that the recently developed Flood Line mapping flood elevations which are further described in **Section 5.3.2.**
- Ponds shall be heavy planted with geese deterrent grasses, woody vegetation and shade barring trees. The plantings and other landscape features shall provide screening along the top of banks such as trees, and rocks. A detailed description of design, construction and implementation requirements to mitigation waterfowl mitigation is detailed in the Waterfowl Adaptive Mitigation Plan for Stormwater Management Facilities in **Appendix F-9. Pumping Stations Requirements**

Quality Control Measures - Dry Pond Drainage Areas

To provide quality control to meet a Normal Level of Protection 70% long-term TSS removal criteria for dry pond facilities, measures upstream of the SWM ponds will be required. As part of the detailed design process, measures to address quality shall be proposed for review by the City through the draft plan of subdivision process. Based on the total inlet flow volumes for each drainage area it is anticipated that underground chambers that provide suspended solid and pollutant removal. Underground facilities shall be accompanied within the proposed SWM corridors. The use of goss gully traps in catchbasin and other methods of quality treatment may also be considered.

Drainage areas that will be serviced via dry ponds, the use of upstream water quality measures will be required and will require further assessment during detailed design. During detailed design for private sites, at-source water quality control may be considered acceptable in lieu of contributing to a regional water quality control strategy. This is to be confirmed with the City at the pre-consultation stage.

Waterfowl Mitigation

It was identified through the ULRMP and Windsor International Airport Master Plan (2010) that the use of SWM ponds poses safety risks associated with the airport. In order to address the potential for waterfowl safety risks, a comprehensive mitigation plan to design and implement the proposed ponds has been developed as part of the SSMSP. This draft memo entitled “Supplementary Waterfowl Adaptive Mitigation Plan and Stormwater Management Facilities – Sandwich South Master Servicing Plan” dated May 2023 and is attached for reference.

This plan has been developed to follow guidelines provided in the 2018 Template for the Development of an Airport Wildlife Management Plan by Transport Canada. The recommended mitigation measures consider four principals of wildlife management:

1. **Habitat modification (landscaping, engineering designs);**
2. Wildlife exclusion (netting, fencing);
3. Behaviour modification (decoys, falcons/dogs, flags); and
4. Physical removal (capture and release).

It is recommended that the SWM pond wildlife management will be achieved by habitat modification, through the use of linear, meandering and heavily vegetated ponds. Beyond the design and mitigation plans that are identified for each pond during detailed design, monitoring and maintenance of those elements must be done regularly and throughout the lifetime of these facilities. Over time, as monitoring is completed, modifications to the ponds, landscape and/or implementation of additional mitigations measures listed above will need to be introduced as needed. The provided Adaptive Mitigation Plan is meant to be a framework for the continued operations and maintenance of these facilities.

Pumping Stations Requirements

Ponds shall outlet to existing/future municipal drains via storm pumping stations:

- The stormwater drainage area layout has been developed to consolidate the number of regional pumping stations to minimize overall long term operation and maintenance costs;

A functional design of the pumping station has been developed and described in **Section 5.3** and shall follow the below criteria:

- Pumping stations are required to have backup power generation.

- Pumping stations shall also have capabilities to drain the permanent pools for each respective pond for maintenance. This may require the inclusion of an additional subdrain at the downstream end of the pond to the pumping station wet well including provisions to override the pump-on elevations when maintenance is required. There are two ponds that have multiple permanent pool cells which are

5.3.2 Little River Watershed Flood Line Mapping

Results from the Little River Flood Line Study (Dillon, 2022) identified the recommendation of a two-zone floodplain throughout the SSMSP area. This two-zone concept is an approach to flood plain management where the flood plain is separated in two-parts; the floodway and the flood fringe. Determination of the floodway and flood fringe extents and respective levels used different modelling analysis methodologies, which is further discussed within the Little River Flood Line Study Hydrologic and Hydraulic Technical Reports (Dillon, 2022). The floodway and flood fringe are defined as follows:

Floodway Area

Inner portion of the flood plain where the majority of the flow is conveyed and represents the area required for safe passage of flood flow and/or that area where flood depth and/or velocities are considered to be such that they pose a potential threat to life and/or property damage. This area is traditionally where development and site alterations would cause a danger to public health and safety or property damage.

New development within the floodway will be prohibited or restricted. Should development be permitted, flood compensation measures are required to be further investigated. Generally acceptable permitted uses within the floodway include flood and/or erosion control works and minor additions or passive, non-structural uses that do not affect flood flows.

Flood Fringe Area

The Flood fridge area is defined as the outer portion of the flood plain where it could be potentially safe to develop with no adverse impacts. The flood fringe area is determined historically through a review of critical flood depths and/or velocities that could create significant hazards for developments and the magnitude of flooding. Magnitude of flooding considers both the 1:100 year regulatory event verses historical events such as the Hurricane Hazel or Timmins Flood. Development within the flood fringe is permitted however the proposed development shall be built above the flood fringe elevations.

Development Floodproofing

It is expected that the governing 1:100 year flood fringe water levels summarized within the report and new floodplain maps will dictate new development floodproofing standards within the SSMSP. The required floodproofing standards for the SSMSP area will include:

- Minimum road grade to be 0.30 m below the identified 1:100 year flood fringe level; and
- Minimum building opening to be 0.30 m above the higher of either:
    - The 1:100 year flood fringe level of the watershed; or
    - The dynamic 1:100 year local road ponding level.

The development floodproofing requirements above are to be based on the 2022 updated flood line mapping, unless otherwise indicated by ERCA. Any future updates to the Little River floodplain beyond the 2022 study may govern at the time of design. All development within the SSMSP are expected to consult with ERCA during the early stages of design process to confirm these requirements and floodproofing levels.

Under both initial and ultimate build out conditions, drainage from the watershed is expected to be attenuated within the developments SWM corridor Wet Ponds to the maximum allowable release rate of 6 L/s per hectare of contributing drainage area, under a 1:100 Year return period. It is anticipated that as development proceeds and the associated SWM ponds and pumping stations are implemented that the flood elevations of the Little River will decrease incrementally and the flood plain extents will be reduced.

The proposed overland flow grades have been set above the minimum existing condition flood elevations to mitigate flood risks for existing development areas.

5.3.3 Stormwater Management Facilities Design Solutions

The proposed SWM facility was designed to address both the quality and quantity of stormwater runoff from the SSMSP. The proposed SWM facility for the initial build out consists of eight (8) ponds and eight (8) stormwater pumping stations outletting to their respective downstream drains. The SWM facilities are illustrated in **Figure 5-0** with a more detailed layouts shown on **Figures 5-1, 5-2 and 5-3**. The required water quality and quantity control volumes were determined through the completion of the stormwater modelling and the pond layouts were designed to accommodate those volumes. **Table 5.3** below has a summary of the volumes required under criteria storm return periods along with the approximate volume provided based on the functional design layouts. Future detailed design of each pond shall confirm that the minimum storage/treatment volumes are met.

Table 5-3: SSMSP Initial Buildout Area Functional SWMF Design Details

Pond ID	Ultimate Service Area (ha)	Weighted Impervious Value (%)	Water Quality Design							Water Quantity Design				
			[1]Required Permanent Pool Volume (m^3)	[1]Provided Permanent Pool Volume (m^3)	[1]Provided Permanent Pool Depth (m)	[2]Design NWL(s) or Dry Pond Bottom (m)	32 mm Water Quality Inflow (m^3/s)	[1]32 mm Water Quality WSEL (m)	[1]32 mm Water Quality Volume (m^3)	Maximum Release Rate (m^3/s)	Maximum 1:100 Year WSEL (m)	Maximum 1:100 Year Active Storage Volume (m^3)	Maximum UST WSEL (m)	Maximum UST Active Storage Volume (m^3)
P1	***124.10***	***74***	***16,754***	***23,841***	***2.0***	***183.00***/*183.20/183.50*	***7.15***	***183.94***	***19,970***	***0.745***	***185.71***	***86,850***	***186.32***	***117,800***
P2	51.97	90	8,159	8,645	2.0	183.90	3.84	184.98	10,230	0.312	186.77	39,750	187.36	52,900
P3	***224.15***	***73***	***30,260***	***40,770***	***2.0***	***180.20***/*180.70/181.20*	***12.47***	***181.52***	***33,330***	***1.345***	***183.59***	***153,300***	***184.25***	***206,100***
P4	99.51 & 91.9*	83	14,628	18,036	2.0	179.00	3.24	179.85	14,990	0.597	181.92	81,200	182.61	111,800
P5	60.82	85	9,123	10,249	2.0	178.00	4.84	179.04	11,700	0.365	180.83	45,900	181.41	61,100
P6	***63.24***	***83***	***9,290***	***10,800***	***2.0***	***179.30***	***5.34***	***180.56***	***11,870***	***0.379***	***182.66***	***47,250***	***183.31***	***62,400***
P7	7.73	23	603	2,727	2.0	179.10	0.34	179.53	860	0.046	180.76	4,700	181.16	6,500
P8	117.8 & 91.9**	87	24,895	32,076	2.0	178.00	8.90	179.26	34,100	1.258	181.47	141,200	182.21	190,400

Bolded Pond ID: Dry Pond preferred where Pond Bottom to be the lowest elevation shown

1 Required Water Quality Permanent Pool Design if a Wet Pond is confirmed acceptable during detail design.

2 Design NWL if Wet Pond is preferred. Pond Bottom if Dry Pond is preferred.

** Major System Only to Pond from 91.9 ha Catchment.*

*** Minor System Only to Pond from 91.9 ha Catchment.*

The geometry of the final ponds will be determined during the detailed design stage. Flexibility to construct the ponds in stages should also be confirmed and reviewed with the City during the detailed design based on phasing and construction timing of the proposed development. Pond placement has considered safety by providing appropriate setbacks from the roads and developed lands adjacent to the ponds. Cross sections of each pond identifying the dimensions of the SWM corridor, SWM facilities and distance to the proposed developments and naturalized corridors have been included in **Figures 5-4-1 to 5-4-8.**

As noted above, pond depth has been established based on the depth of the upstream storm sewer. Inlet storm sewers shall be unsubmerged during dry weather conditions therefore the permanent pool (normal water level (NWL)) was set at or around the lowest storm sewer invert elevation. From there, the water levels at each incremental storm design event was determined through the stormwater modelling based on the functional design storage volumes. **Table 5-4** provides a summary of the various water levels at each design event. Upon detailed design the following water level elevations shall be maintained.

- Permanent Pool (NWL) or Pond Bottom: Shall correspond to the elevations found in **Table 5-4** and shall not exceed the invert of the inlet storm sewers. Deviations from these criteria shall be reviewed and confirmed with ERCA prior to proceeding.
- 1:10 year Water Level: The storm trunk sewer level of service is based on a 1:10 year return period. Through the storm sewer design, it has been confirmed that during these events that the HGL does not exceed 0.3 m below ground level.
- 1:100 year Water Level: It should be confirmed that during this return period that the associated HGL does not exceed 0.3 m above the finished ground surface.
- UST Water Level: It should be confirmed that during this return period that the storage volume required does not exceed the banks of the pond.

Each storm trunk sewer inlets to the SWM ponds via a gravity inlet. Where storm sewers inlet at the most upstream end of the linear pond, the inlets shall be configured to outlet to the inline sediment forebay. Where the storm sewer inlets mid-stream, offline sediment forebays are proposed and incorporated into the footprint of each pond. Per the SWMPDM, the City shall monitor each pond on an annual basis (see **Section 6.2** of the SWMPDM) as sediment accumulation at each forebay will require removal and disposal offsite on a periodic basis, refer to **Section 5.2.3.3** for more details. Each inlet shall be designed with scour protection such as rip rap. The bottom and side slopes of each pond shall be stabilized to avoid riling and slumping.

Table 5-4: Stormwater Pond Critical Design Elevations Summary

Design Event	**Design Water Level (m)**							
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
	E-Pelton North	**E-Pelton South**	**CR42 SPA SW**	**CR42 SPA NW**	**CR42 SPA NE**	**CR42 SPA SE**	**LAUZON INTERSECTION**	**CR42SPA N, CR42-LAUZON ROW, AIRPORT**
Minimum Pond NWL	183.00 (Bottom)	183.90	180.20 (Bottom)	179.00	178.00	179.30	179.10	178.00
32mm Quality Event	183.94	184.98	181.52	179.85	179.04	180.56	179.53	179.26
1:2 YR	184.11	185.18	181.74	180.02	179.23	180.81	179.66	179.53
1:5 YR	184.49	185.6	182.21	180.39	179.64	181.3	179.93	180.07
1:10YR	184.73	185.83	182.49	180.62	179.88	181.58	180.09	180.38
1:100YR	**185.71**	**186.77**	**183.59**	**181.92**	**180.83**	**182.66**	**180.76**	**181.47**
Urban Stress Test	186.32	187.36	184.25	182.61	181.41	183.31	181.16	182.21
Max Pond Level and Active Storage	187.50	189.30	184.50	183.50	183.00	184.50	182.60	183.00
Freeboard from Top of Bank (1:100	*1.79*	*2.53*	*0.91*	*1.58*	*2.17*	*1.84*	*1.84*	*1.53*
Freeboard from UST WSEL	*1.18*	*1.94*	*0.25*	*0.89*	*1.59*	*1.19*	*1.44*	*0.79*

5.3.4 Constructability and Maintenance

5.3.4.1 Pond Excavation Volumes

Eight (8) stormwater management (SWM) ponds have been proposed to service the proposed East Pelton SPA, CR42 SPA and Windsor International Airport lands, with active storage volume of ponds ranging from 15,000 m^3 (P7) to 250,000 m^3 (P8) (excluding volume of the permanent pool area). The total excavated volume of soil of the eight (8) ponds including the active and permanent storage is approximately 891,400 cubic meters (m^3) as shown in **Table 5-5.**

Table 5-5: Pond Excavation Volumes

Pond Number	Maximum UST Active Storage Volume (m^3)	Pond Status	Permanent Pool Volume (m^3)	Total Excavated Volume (m^3)
1	117,800	Dry	0	117,800
2	52,900	Wet	8,600	61,500
3	206,100	Dry	0	206,100
4	111,800	Wet	18,000	111,800
5	61,100	Wet	10,200	71,300
6	62,400	Wet	10,800	73,200
7	6,500	Wet	2,700	9,200
8	190,400	Wet	32,100	222,500
TOTALS	809,000		82,400	**891,400**

This is a significant volume that will need to be removed from the SWM corridor. During detailed design, methods to reuse the material onsite shall be developed. Fill of the site around the top of bank of the pond's is limited as it is imperative to maintain overland flow routes to the ponds

5.3.4.2 Excess Soil

To meet requirements O. Reg. 406/19: On-Site and Excess Soil Management which will require the City and developers to:

- Complete an Assessment of Past Uses (APU) of the project area to determine if there have been any activities that could have impacted soil quality (i.e., gas station, spills, etc.);

- Determine the quality of excess soil expected to be removed from the project site by completing required analysis;
- Compare the soil results to applicable MECP excess soil quality standards to determine how they can be reused or if they need to be disposed at a landfill;
- Preparation of technical reports including, but not limited to, APU, SAP, SCR, and ESDAR to provide to owners, contractors;
- Review of sites that are proposed to receive the soil
- Be responsible for the movement and tracking of soils; and
- Preparation and submittal of notification to online registry, if required

A Qualified Person (Engineer/Geoscientist) must lead the excess soils process to ensure all requirements, as outlined in O. Reg 406/19, are completed. In addition, all City specifications related to excess soils shall be followed. It is anticipated that due to the historical land use of that area that much of the material will be deemed acceptable for reuse.

Of special note, construction of drains under the Municipal Drainage Act are exempt from the requirements of O. Reg. 406/19.

5.3.4.3 Pond Sediment Removal

A sediment forebay is proposed at each storm sewer inlet which has been sized based on the MECP requirements. The City shall monitor the sediment loading from each of these outlets and include the proposed ponds as part of the regular maintenance and operation of the City's SWM faculties. Need for sediment storage and drying areas shall be considered per the SWMPDM, inclusion of these areas has not been consider in the layout of the SWM corridors or the boundary of the SWM corridors at this stage however through detailed design it is recommended that the surplus areas be considered for this purpose. Prior to the assumption of the SWM Ponds by the City, sediment removal shall be completed.

The pumping stations shall be designed to provide opportunity for the City to fully drain the ponds as part of the future maintenance of the SWM facilities. A lower invert maintenance outlet from the pond to the pumping station is recommended.

5.3.4.4 Road Crossings

Where linear ponds cross existing or proposed collector or arterial roadways, bridge segments will be required to maintain the necessary flow conveyance and equalization from upstream pond cells to downstream cells.

5.3.4.5 Natural Environment Considerations

Mitigation measures to reduce impacts on terrestrial and aquatic species along the municipal drain and natural environmental corridors shall be considered in the construction methods and scheduling of works around or in the adjacent municipal drains.

5.4 Pumping Station Design and Analysis

In order to direct water from the wet ponds to the existing and proposed drains, a stormwater pumping station (PS) is required for each pond. The proposed location of the stormwater PS will be within the SWM corridor in close proximity to the proposed ponds. **Table 5.5** below detail the pumping station designs that were completed as part of this project. The discharge rate for each PS is dependent on the maximum allowable release rates noted in Section 5.3.1 and the outlet elevation has been reviewed to ensure that the sewer can discharge to the drain while still maintaining minimum cover requirements.

Table 5.5 - Storm Pumping Station Design Summary

Pumping Station (PS)	Description (Wet Well Size)	PS Required Capacity m3/s	Permanent Pool or Pond Bottom (Elevation m)	Pond Bottom (Elevation m)	Finished Grade (Elevation m)	PS Depth m	Discharge Invert	Total Dynamic Head	Pump Configuration	Discharge Pipe Diameter mm	Outlet Pipe Size mm	Pump motors kW each
P1	6.0 x 10.0 m	0.745	183.00	181.50	187.48	6.78	184.73	3.63	2 duty + 1 standby	450	750	35
P2	5.0 x 3.5 m	0.312	183.90	182.40	189.28	8.18	185.20	3.20	1 duty + 1 standby	450	500	30
P3	9.0 x 15.0 m	1.345	180.20	178.20	184.50	6.6	181.38	3.08	2 duty + 1 standby	925	1500	75
P4	8.0 x 15.0 m	0.597	178.40	176.40	183.50	8.80	179.90	2.80	2 duty + 1 standby	600	900	35
P5	5.0 x 3.5 m	0.365	178.00	176.00	182.91	8.21	179.67	3.57	1 duty + 1 standby	450	500	30
P6	5.0 x 3.5 m	0.397	179.30	177.30	185.00	9.00	180.70	3.30	1 duty + 1 standby	450	500	30
P7	3.6 m DIA	0.044	179.10	177.10	182.94	7.14	179.22	2.02	1 duty + 1 standby	100	200	3
P8	9.0 x 15.0 m	1.258	178.00	176.00	183.00	8.30	179.22	3.12	2 duty + 1 standby	925	1500	75

5.4.1 Pumping Station Site Layout

Figures 5-6-0 and Figure 5-6-1 illustrates a typical pumping station site layout plans for two pumping station capacity ranges. For pumping stations with a firm capacity lower than 0.4 cms, a standard cylindrical wet well structure will be sufficient to accommodate the required pumps. Pumping stations with a firm capacity greater than 0.4 m cms capacity will require the implementation of a cast-in-place structure. Sizes of each pumping station wet well has been included in the pumping station design summary Table F4.2 in Appendix F4. Wet wells shall accommodate 2 duty axial flow pumps with 1 standby pump. The dimensions and configuration of the pumping station were determined by the ANSI Standard Pump Intake Design developed by the Hydraulic Institute.

Pumping station site layout show the size and potential location of the proposed wet well, standby power generator, and the proposed control/equipment building. A site area of approximately 30 m by 30 m will be required to accommodate the larger pumping stations, including space for regular maintenance access. The drain/pond maintenance corridors should provide linkages to the pumping station sites from the municipal right-of-way for vehicles needing access.

In addition to the typical pumping station controls and power supply, it is recommended that monitoring equipment be implemented to record outflow data as well as a power generator to provide emergency backup capabilities.

Each pumping station shall be equipped with an outlet forcemain to discharge to the adjacent municipal drain. The forcemeain outlet elevations have been based on the existing drain depths however upon detail design, the designer shall confirm an acceptable forcemain depth. Permanent sediment and erosion control shall also be implemented at the each forcemain outlet.

6.0 Proposed Site Grading for Overland Flow Route

Developers will be required to establish the proposed road grades, as shown in **Figures 6-0 and 6-1**, in order to ensure that overland flow is routed along roads or designated corridors to appropriate outlets. Proposed overland flow routes have been directed towards the proposed SWM ponds where overland flow will be directed through spillways into the ponds.

Overland flow will be provided through road grading towards the proposed pond. The overland flow will “cascade” over the “saw-tooth” road grading to the pond. There will be temporary ponding of runoff on the road surfaces until it can be captured by the catchbasins and/or conveyed to the ponds. The roadway ponding depth shall not exceed 0.30 m during a 1:100 year event scenario.

Each Developer will have to assess their developable lands and provide detailed roadway grading that conforms to the designated overland flow patterns outlined herein. Based on the staging of development, Developers must provide temporary flow routes and address temporary drainage of any adjacent vacant lands to ensure runoff is directed towards appropriate stormwater outlets. Sediment and erosion control must also be implemented during construction and for any temporary SWM measures.

Developers will also be required to mitigate any possible flooding in adjacent undeveloped properties. The proposed ground elevations should be developed to allow for sufficient cover on the proposed sanitary and storm sewers, while also adhering to the minimum flood-proofing elevations, as described in **Section 5.2.2** above. All required costs associated with maintaining the overland flow routes and modifying the site grades will be the direct responsibility of the Developer, as required.

7.0 Water Distribution & Servicing

7.1 Design Criteria

The water distribution and servicing requirements and upgrades within the Sandwich South project area were evaluated as part of the WUC Water System Master Plan 2019 (WUCMP) Update. The WUCMP used existing infrastructure and future growth projections to model the performance of the water treatment and distribution system and provide recommendations on water infrastructure improvements required to meet future demand, including within Sandwich South.

Some of the key assumptions used in the report include the following:

- Water system demand criteria based on 2017 ENWIN Treated Water Pumpage Report
    - Residential/non-residential (ICI) split (52%/48%)
    - Maximum day demand factor of 1.47
    - Peak hour demand factor of 2.28
- Water demand rates:
    - Future residential water demand: **227 L/cap/d**
    - Future non-residential water demand: **210 L/cap/d**

This study included recommendations for proposed trunk watermain to service the SSMSP area where trunk watermains are defined as 400 mm diameter or greater. Local distribution mains will be required to provide services to new development however design of those facilities is outside the scope of this project.

A new elevated storage tank is proposed in the area of the Provincial Road and Walker Road intersection. The elevated tank will be similar in specifications to the existing Hanna Elevated Tank and will be required to provide adequate capacity and pressure in the proposed development area. It should be noted that the Town of Tecumseh's Water and Wastewater Master Plan (2008) also recommends a water tower in this area therefore future coordination between the two municipalities is required to develop a coordinated approach.

The recommendations related to the Sandwich South study area found within the WUCMP (watermain sizes, costs, etc.) are proposed to be included (referenced) within the SSMSP. It is assumed that no further water servicing assessment is required. Required alignments for these watermains shall be accommodated in the functional design of the SSMSP.

7.2 Watermain Distribution Design

The watermain distribution system and servicing design solutions will be in compliance with the WUCMP which can be obtained through the ENWIN Water Website (WUC) under Drinking Water Reports. The WUCMP recommended trunk watermain distribution infrastructure is illustrated in the WUCMP.

8.0 Utilities

In addition to the municipal servicing and road network infrastructure, utilities, including power, natural gas and telecommunications, are required to support development. Utilities have been involved throughout the course of the study to ensure that the scope of development and demand associated with the first stages of development are communicated. Currently Hydro One, MNSi, ENWIN, Cogeco, Enbridge, and Bell have existing infrastructure along existing municipal right of ways throughout the study area. Each of these utilities have been involved in project discussion were provided with the proposed land use and projected populations within the two secondary plan areas. To support the growth proposed within the SSMSP area extension of utility services will be required including routing of necessary trunk/feeder infrastructure to distribute utilities to service increase demand.

As development proceeds and existing road right of ways are redeveloped it is recommended that utilities be placed underground. Refer to the typical road cross sections **Figures 9-2 to 9-8** for the proposed joint use utility corridor location within the proposed road.

The meeting minutes for all utility meetings are provided in **Appendix F-6**. The following sections highlight notes from the meeting held on February 2, 2022 with all the utilities.

8.1 Hydro One

Hydro One has immediate plans to extend aerial hydro service along the south side of County Road 42. Alignment to be provided to the City for approval as it relates to the CR42 EA and proposed roadway cross section.

It is expected that relocations to the existing underground services using joint use trenches would be required during the reconstruction of existing roadways, as there are currently existing overhead lines within the study area. Coordination will be required during the detailed design to address the potential relocations.

8.2 Enbridge

During the meeting, it was confirmed that there will be no overlap with the ongoing construction project for the installation of a plant on CR42, east of Lauzon Parkway.

Enbridge was made aware of the City’s goal to develop a Sustainable Neighbourhood Action Plan (SNAP) within the study area. Developers would need to meet some of the strategies to achieve a net-zero neighbourhood. District energy for heating and cooling is being considered to assist in achieving this goal. Section 8.4 discusses this in detail.

8.3 Other Utilities

Bell, Cogeco and MNSi did not foresee any potential concerns. All utilities were tasked to provide preliminary servicing strategies and potential constraints in order to assist with coordination on the future developments.

To facilitate the first phases of municipal drainage works, roadworks and SWM ponds, lowering and/or relocation of these drains will be required. Prior to the design of each project, the existing utilities shall be identified

8.4 District Energy

The City's Energy Management Plan (July 2017) provides framework for how Sandwich South is planned to be a 'Net-Zero' Neighbourhood, where "A net zero energy district is a place where no more energy is consumed than is supplied by non-fossil fuel sources to approach zero emissions". Those targets are being considered in the development of the SSMSP, please refer to the Council Report S 116/2020 Dated September 1, 2020.

To meet these objectives, the inclusion of a corridor for a district energy system is proposed by which hot and cold water pipes will be routed within the City’s right-of-way to provide heating and cooling of buildings. At this time, the source and layout of this system has not been established however to ensure that this system can be constructed as development occurs, a corridor within the proposed right-of-way has been assigned. **Refer to Figures 9-2 to 9-8** which illustrates the proposed alignment of this infrastructure.

The City of Windsor has recently retained RWDI in Partnership with Urban Strategies Inc. to complete a Sustainable Neighbourhood Action Plan for Sandwich South. Net Zero Community Strategies will further define measures recommended to implement this plan. As required, this municipal servicing strategy shall be refined to accommodate those strategies.

9.0 Transportation

A Transportation Study (SSMSP, Appendix E) has been prepared by Dillon to identify the internal road network to support the development of the study area. The estimated traffic demand is based on the estimated population growth within the study area. This study has identified the network under ultimate conditions where all areas have been fully built out. Based on the findings of the Transportation analysis, various road network configuration alternatives have been evaluated and based on the recommended solutions identified, conceptual design of the road network and right-of-way configuration was completed. Collector and arterial road network conceptual design within the study area is discussed in this section.

9.1 Traffic Demand Assumptions

The planned road network design is based on the assumptions of the Lauzon Parkway EA (2014), the East Pelton Secondary Plan, the CR 42 Secondary Plan, and the Draft Sandwich South Secondary Plan. Hemson provided the forecasts of the number of housing units and employees in the study area by zone as shown in Table 9-1 and **Figure 9-1.**

Table 9-1: Future Development by Zone

Land Use	A1 CR 42 Secondary Plan Area (North)	A2 CR 42 Secondary Plan Area (South)	A3 East Pelton Secondary Plan Area	A4 Other Areas (North)	A5 Other Areas (South)	Total
Single Detached House (units)	1726	0	554	1356	1099	**4735**
Semi/Duplex/ Townhouse (units)	0	899	221	679	550	**2349**
Apartment (units)	0	657	362	611	451	**2081**
Retail (employees)	0	805	1336	0	435	**2576**
Employment Land (employees)	0	3470	0	16,316	501	**20,287**
Hospital (employees)	0	3000	0	0	0	**3000**
Total	**1726 units**	**1556 units, 7275 emp**	**1137 units, 1336 emp**	**2646 units, 16,316 emp**	**2100 units, 936 emp**	**9165 units, 25,863 emp**

9.2 Road Improvements and Expansion

In general, existing road widening and construction of new roadways is triggered by the vehicular volume demand during the peak hour, in the peak direction, reaching a maximum 700 vehicles per hour (vph). The need for road expansion, urbanization or implementation of new roadways will generally be driven by development.

This study has identified the collector road improvements and new corridors that would be required to support development of the study area. The designs are conceptual in nature and represent the required spacing and extent of each roadway. The final alignment, intersection spacing, lane configuration, active transportation, transit and parking design elements will need to be detailed through the completion of a Schedule C Environmental Assessment.

9.2.1 Arterial Road Network Improvements

To support the first stages of development the improvements proposed to the arterial road network in the Lauzon Parkway EA (2014) will need to commence. The City has identified the completion of the Lauzon Parkway and CR42 intersection to be one of the first phases of construction required to support growth in in this Sandwich South Area. This also is required to support the scheduled widening of CR42 within the County of Essex between Manning Road and the City/Town municipal boundary.

9.2.2 East Pelton Secondary Plan Area

Major roads within this study area are currently two-lane rural cross-sections without active transportation facilities, with the exception of Walker Road, which has a five-lane urban cross-section with sidewalks on both sides of the roadway.

To accommodate the development, the following new road construction, and existing road improvements are expected:

- Upgrading 7th Concession Road to meet municipal design standards including curb and gutter, lighting and local drainage sewers;
- Right-of-Way widening of 8th Concession Road from County Road 42 to East-West Arterial. It is recommended that as development proceeds along adjacent lands, that the roadway be improved from two (2) lane rural cross section to a two (2) lane urban cross sections that provides accessible active transportation facilities.

In additional to travel lanes, additional lanes for parking or turning lanes may be required;

- Traffic calming on Baseline Road from 7th Concession Road to 8th Concession Road to lower the amount of traffic travelling on this corridor, while still allowing access for emergency vehicles and local traffic. Traffic calming measures shall be consistent with the City's requirements and future Complete Streets Design Guidelines; and
- Construction of internal road network of collector roadways.

9.2.3 County Road 42 Secondary Plan Area

Currently, major roads in the County Road 42 Secondary Plan area are two-lane rural cross sections without active transportation facilities.

To accommodate the growth, below are the full built-out major roadway network:

- Upgrading 8th, 9th and 10th Concession Roads to meet municipal design standards including curb and gutter, lighting and local drainage sewers;
- Right-of-way widening of the 9th Concession from County Road 42 to East-West Arterial. It is recommended that as development proceeds along adjacent lands, that the roadway be improved from two (2) lane rural cross section to a two (2) lane urban cross sections that provides accessible active transportation facilities. In additional to travel lanes, additional lanes for parking or turning lanes may be required;
- Construction of internal road network of collector roadways.

9.2.4 Other Lands within Study Area

In response to provided development and growth within the City of Windsor, increased traffic demands requiring road widening within the lands outside the two secondary areas is required. The Lauzon Parkway EA (2014) estimates that these improvements will be required by the year 2034.

- Expanding Lauzon Parkway from 2 to 4 lanes from the CPR tracks to County Road 42, including extension from CR 42 to Highway 401 with eventual widening to 6 lanes;

- Widening Banwell Road to a four-lane cross-section from Tecumseh Road East to the CPR tracks;
- Protecting Banwell Road right of way for six lanes; and
- A skeleton collector road network to support future development outside the two noted secondary plan areas.

Please refer to **Figure 9-1** for ultimate road network.

9.3 Active Transportation

Active transportation facilities for all new arterial and collector roadways in the study area have been included in the conceptual design. Facilities will need to be developed to achieve an All Ages and Abilities (AAA) network within this new development area. Beyond the City's Development Manual (2015), minimum requirements and recommendations to achieve AAA principles are being developed by the City of Windsor and will be detailed within a separate Complete Street Guideline. This guideline is expected to be completed after the completion of this functional design study. Developers moving forward shall consult with the City's Planning and Transportation groups on the appropriate cycling and pedestrian facilities that will be suitable based on the traffic demands and other right of way features.

Based on the transportation network study, the estimated traffic volumes and road type, a recommended bike facility types has been noted in the SSMSP's **Appendix E** Transportation Study. These selections are preliminary only and have been included in the conceptual cross sections

9.4 Transit System

A draft transit system plan has also been developed to achieve the multi-modal targets identified for this area. Refer to the Transportation Study in Appendix E of the SSMSP main report. Facilities including auxiliary lanes and sidewalk bus stop shelters required to support the transit system shall be implemented within the proposed right of ways. The locations and need for these types of facilities shall be identified during the draft plan of subdivision and Schedule C EAs.

9.5 Cross-Sections

Urban Collector Roadway Cross-Sections have been developed based on recommendations within the Ontario Traffic Manual, the City's current Development Manual (2015), which also meet the requirements of Walk Wheel Windsor Active Transportation Plan.

All collector roadways are proposed to have a 26.0 m right of way which is consistent with the City's Official Plan. The 8th and 9th Concession cross-sections include four travel lanes, two southbound and two northbound to reflect the ultimate need to widen those corridors to accommodate two through travel lanes and potential for additional turning or parking lanes. The Baseline Road, 7th and 10th Concession Road, and Class II Urban Collectors are all designed as 26.0m R.O.W with two travel lanes.

Please refer to **Figures 9-2 to 9-8** for typical cross-sections.

Table 9.2 Right-of-Way Cross Section Design Criteria

Cross Section Element	Criteria	Source/Reference
Collector Road R.O.W Width	26.0 m Class II Urban Collector	City of Windsor Official Plan
Number of Lanes	See Transportation Study, SSMSP, Appendix E.	
Lane Width	3.5 m	Lauzon Parkway EA (2014)
Grades	Minimum 0.3 m below the Regulatory Floodplain Levels	Little River Regulatory Floodplain Mapping (2022 Draft)
Sidewalk	1.8 m wide sidewalks on both sides of the road	City of Windsor Development Manual
Bike Facility	Protected Bike Lanes or Cycle Track	Ontario Traffic Manual, Complete Streets Guideline
Landscape Zones	1.8 m minimum	
Parking Lanes or Transit Lanes	To be determined through future Schedule C EAs or Draft Plan of Subdivision Process.	

10.0 Implementation Plan

In order to assist the City with the prioritization of the projects, a phasing plan was developed, in conjunction with the existing Secondary Plans and Lauzon Parkway Improvements Environmental Assessment (2014). The project implementation plan priorities are based primarily on the necessary infrastructure to be constructed in order to support development of the areas based on the phases laid out East Pelton and CR42 Secondary Plan Area.

The current identified list of priority projects may be influenced by future infrastructure, socio-economic or political demands. The project prioritization identified below should be reviewed frequently and in conjunction with any other planned City infrastructure works. When completing the detailed design of the proposed infrastructure, consideration should be given to the timing and coordination with adjacent private and public projects. There may be opportunities to coordinate adjacent projects to provide a more economical solution and eliminate potential reconstruction in the future.

After the completion of this SSMSP, development is assumed to occur simultaneously within the East Pelton and CR42 Secondary Plans. The remainder of lands within the SSMSP study area, outside of these areas, will be developed in future. Those areas may only be developed should the required planning studies be implemented to support development.

Beyond the phasing identified in the secondary plans, consideration has been given to developments that have active development applications. This includes the new proposed Regional Hospital, south of County Road 42, east of 9th Concession Road and the Riverbend residential development within the north portion of East Pelton. Projects that support the initial development of the two secondary plan areas have been identified as immediate. It is recommended that the City proceed with the development of policies, procedures and obtain the resources necessary to implement these identified projects. These projects are assumed to be implemented within the next 5-year horizon. The implementation plan has been broken down into the following summaries which are included in **Appendix F-7.**

- Table F-9-1 – 5 Year Horizon;

- Table F-9-2 – Phase 1 County Road 42;
- Table F-9-3 – Phase 1 East Pelton;
- Table F-9-4 – Phase 2 County Road 42; and
- Table F-9-5 – Phase 2 East Pelton.

Table 10-1: 5-year Horizon Project Implementation Recommendations

Project Title	Project Description
Schedule C Roadway Environmental Assessment	
Collector Road Right-of-Way Widening Environmental Assessment - Schedule C	8th Concession Corridor from CR 42 to the EW Arterial Road.
	9th Concession Corridor from CR 42 to the EW Arterial Road.
Transportation	
Lauzon Parkway/CR42 Intersection Improvements	Realignment of Lauzon Parkway between Service Road B and CR42.
CR42 Intersection Improvements	CR42 reconstruction, Lauzon Parkway to the City Boundary.
9th Concession Road	Improvements to 9th Concession Corridor - From County Road 42 to Baseline Road. (0.9 km)
7th Concession Road	Improvements to 7th Concession Corridor - From County Road 42 to the Future E-W Arterial Road. (1.2 km)
Sanitary	
9th Concession Sanitary Trunk Sewer	Construct sanitary trunk sewer along 9th Concession Road from County Road 42 to Baseline Road (0.9 km). Required to serve the Regional Hospital Facility.
Stormwater Management Servicing- Lauzon Parkway and CR 42 Intersection	
P7 Drainage Area - East of Lauzon Parkway, north of CR42	
P7 SWM Pond	Construct receiving pond.
P7 Pump Station	Construct storm pump station.
P7 Trunk Storm Sewer on CR42 and Lauzon Parkway	Construct trunk storm sewers servicing the local roadway and discharging to P7 pond.
P8 Drainage Area - West of Lauzon Parkway, north of CR42	
P8 SWM Pond	Construct receiving pond. Pond construction may be phased to serve the initial Lauzon Parkway reconstruction. The remainder of the airport development lands are not anticipated to develop immediately.
P8 Pump Station	Construct storm pump station. Pump station configuration may be staged based on the phased implementation of the pond storage capacity.
P8 Trunk Storm Sewer - Lauzon Parkway	Construct trunk storm sewers along the Lauzon Parkway from Service Road B to P8.
P8 Trunk Storm Sewer - CR42	Construct trunk storm sewers along the CR42, between 9th Concession and Outlet to P8.

Project Title	Project Description
Municipal Drains	
6th Concession Drain Realignment	Relocate 6th Concession Drain from 7th Concession Road to 8th Concession Road. (1.4 km) to be incorporated recommended through a Drainage Report being prepared by Baird AE.
6th Concession Drain Improvements	Repairs to the existing 6th Concession Drain (2.0 km) being recommended through a Drainage Report being prepared by Baird AE.

The project implementation list is meant to provide guidance to the City to develop a long-term infrastructure plan. It is recommended that the City continuously review and re-evaluate the prioritization list and how it overlaps with other road projects or maintenance programs. The City will need to make modifications to the City's operations and maintenance and asset management programs to include these new infrastructure as they are constructed.

Factors affecting the servicing of these lands include:

- Market conditions and servicing costs;
- Ability of land owners and developers to assemble lands of appropriate size to finance the needed infrastructure and enter into land owner agreements;
- Appropriate storm sewer outlets, including the presence of the necessary SWM ponds and pumping stations required;
- Available sanitary sewer outlets to the existing trunk sanitary sewer network.
- LRPCP and LRWRP Treatment Plant Capacity;
- Adequate water supply and power from the City's existing distribution systems;
- Completion of site-specific due diligence assessments required to meet City, Essex Region Conservation Authority (ERCA) and Agency draft plan of subdivisions submissions such as Environmental Assessments, Stormwater Management Reports, and Traffic Impact Assessments. Refer to **Appendix F-8** that details a detailed list of development specific requirements; and
- Identify need for arterial and/or collector road improvements to support traffic demands posed by developments.

10.1 Staging Considerations

The recommended infrastructure noted in this study will need to be implemented in a staged approach to follow the rate of development.

10.1.1 Sanitary

Trunk sanitary sewers have been sized to provide service for ultimate build out conditions. It is expected that in the short term, the level of development and resulting flows may not provide sufficient self-cleansing velocities with the sewers. Interim measures to mitigate maintenance and operation issues due to material build up or infiltration within trunk sanitary sewers shall be implemented as needed. This may include flushing of the trunk sewer regularly to reduce sediment build up. The trunk sewer shall be incorporated into the City's regular sewer monitoring plan to confirm flow are consistent with expected sewage generation rates and that new sources of inflow or infiltration are not present.

The capacity assessment completed for the LRPCP (**Appendix F-2**), it was noted that equivalent population growth could be accommodated prior to the need for increased treatment capacity at the plant. The City shall continually monitor the effluent inflow and characteristics to proactively plan for the necessary Environmental Studies and internal plant improvements required to accommodate development. Based on these findings, it was confirmed that expansion of the overall LRPCP rated capacity will be required to accommodate full development. Based on this assessment, it is recommended that the City move forward with the Schedule C Environmental Assessment and pre-engineering required to expand the LRPCP treatment plant. The City shall commence monitoring population growth and track how the estimated flows will affect the inflow capacity of the treatment plant. Beyond considerations for population growth, risks associated with wet weather storm events and inflow and infiltration management shall also continue to be top priority.

10.1.2 Municipal Drains

Below summarizes the recommended drainage improvements in order of implementation.

Table 10-1 Summary of Drainage Improvement Staging

Drain	Improvement	Trigger
Initial Buildout (East Pelton and CR 42 SPA)		
7th Concession Drain Realignment	Construction of a drain from 7th Concession Drain to Little River to intercept all N/S Drains.	Initial stages of development within the East Pelton and CR SPA Areas.

Drain	Improvement	Trigger
6th Concession Drain Improvements – 7th Concession Road to 8th Concession Road	Shift drain outside of private property areas into the SWM Corridor and revise cross section.	Initial stages of development within the East Pelton area.
6th Concession Drain Improvements –8th Concession Road to 9th Concession Road	Shift drain outside of the Baseline Road right of way and into the SWM Corridor and revise cross section.	Development within CR42 SPA will trigger the urbanization of Baseline Road to support higher traffic demand.
Watson Drain (10th Concession Rd to Little River)	Maintain the Watson Drain crossing at CR42 as part of the CR42 reconstruction.	Improvements to CR42, between the City Limits and Lauzon Parkway.
Ultimate Buildout		
Watson Drain (E-W Arterial Drain to Little River)	Abandon the Watson Drain as part of the urbanization of 10th Concession Road. Drainage to be intercepted by SWM ponds.	Construction of the SWM Ponds in the areas currently served by this drain.
Hurley Relief Drain	Realign to directly north of the Highway 401, intercept all N/S Drains.	Construction of the E-W Arterial Road and development within the areas south of the E-W Arterial Road.
Little 10th Concession Drain Realignment		Development within the areas in the vicinity of 10th Concession Road, south CR42.
Lachance Drain Realignment	Realignment to the drain into the proposed SWM Corridor	This work was completed as part of the development of the proposed Automotive Battery Plant.

10.1.3 Stormwater Management

Each phase has a proposed SWM facility with a pumped outlet, associated storm and sanitary trunk infrastructure and road improvements.

The City will not permit interim SWM solutions that require offline or private SWM solutions. Developers must contribute to the development of the ultimate SWM facilities in the allocated SWM facilities. Partial construction of the pump stations and ponds is permitted; however the developer must confirm that the necessary quality and quantity design criteria are met.

10.1.4 Water Distribution

This plan does not provide details regarding the expansion of the water distribution network as water network demands will need to be assessed by ENWIN Water to determine when the trunk watermain infrastructure upgrades are triggered.

10.1.5 Utilities

Similar to water distribution, power, gas and telecommunications needs are not formalized at this time. Utilities have been notified of the proposed development and estimated growth yields as noted in Section 8.0 above. It is recommended that developers engage utilities early in the development process to ensure that services are available and/or what works need to be done to support development needs.

10.2 Approvals

During detailed design, relevant agency and municipal approvals will be required including, but not limited to, the MECP, Transport Canada, ERCA permits and approvals, Windsor International Airport, and ENWIN approvals.

The SSMSP Natural Environment Assessments dated 2022 and Stage 1 Archaeological Assessment Dated 2021 have been completed as part of this project and should be referenced to determine any additional studies or approvals that may be required for Schedule B projects. These reports are in Appendix B and C of the Master Plan report. Discussion with the City will be required during detailed design if any additional approvals are required to construct the recommended infrastructures.

10.3 Development Charges

The information used in this study will be used to complete an Area- specific development charge schedule which outlines cost sharing for trunk infrastructure required. Infrastructure recommendations and cost estimates from this study will be used as the basis for that study. Changes to the expected population growth in response to Bill 23 shall be considered in the completion of this analysis.

11.0 Cost Estimates

In order to provide the City with a more detailed summary of the proposed works, estimated construction costs have been developed. The capital construction costs for the various recommended solutions are based on the year 2022 construction prices. During detailed design, detailed cost estimates should be completed to more accurately estimate the construction costs for the proposed improvements. This section includes a summary of the high-level costs related to the proposed roadways, sanitary and storm trunk sewers, pumping stations and ponds.

A summary of the cost estimate assumptions is included below in **Section 11.1**

11.1 Costing Assumptions and Methodology

The cost assumptions for all recommended improvements for each of the service areas include, but are not limited to, the following:

- Construction cost estimates, including labour, are based on 2022 unit prices and the accuracy of each estimate is +/- 30% and dependent on the timing of implementation;
- 30% contingency added for Capital Construction Cost;
- Future engineering costs calculated as 20% of capital construction costs; and
- Due to material supply issues, global increase in fuel costs and local market fluctuations an additional inflation allowance of 20% has been applied to all infrastructure costs.

A more detailed summary of key assumptions used to develop project cost estimates can be found in **Appendix F-7** in the document entitled Budgetary Cost Estimate Assumptions.

It should be noted that land acquisition costs required to construct recommended solutions on private property are not included in the cost estimates. Land acquisition requirements and the associated costs shall be confirmed during detailed design.

Transportation

The roadway construction cost estimates for full road construction, including earth excavation, granular road base, pavement, curbs and gutters, sidewalks, bike lanes, restoration, street lighting, traffic signals and other typical surface works.

Storm and Sanitary Infrastructure

Storm and sanitary construction cost estimates for works within the municipal right-of-way included the pipes, backfill, maintenance holes, private drain connections, and restoration. Sewer cost do not include road restoration costs and assume that road work will be included in the provided transportation network costs.

Stormwater Management Facilities

The stormwater management facilities cost estimates include the installation of the facilities, including excavation of material, export of materials, landscaping, erosion control, restoration, and recreational trails. For the purposes of this study it was assumed that most of the pond excavation volume will be moved off site

Storm Pumping Stations

The cost estimate for the recommended pumping stations include the cost to construct the pumping station, provide generators and outlet pipes to the municipal drains.

11.2 Unit Prices

Approximate unit prices were developed based on 2022 average construction costs for similar projects. The unit prices were utilized to determine the total construction costs for the recommended solutions within the study area. To simplify the costs for the proposed works, majority of the unit prices were developed on a per metre basis, with a few others developed on a per item basis.

Appendix F-7 details the functional design costs, unit costs and a summary of total costs for the projects identified for the two secondary plan areas. This table should be read in conjunction with the cost estimate assumptions identified in **Appendix F-7.**

11.3 Implementation Variances

Due to the scale of the proposed works and the implementation schedule, actual construction costs may vary significantly depending on the year of implementation. Priority projects recommended for implementation in the near future will have a higher degree of cost accuracy than works to be completed many years in the future.

The implementation plan detailed in **Section 10.0** of this report identifies projects to be completed in the next 5-year timeframe. Timing of other projects should vary in implementation timing as they are driven by development. Consideration for inflation, material supply and market factor shall be considered in budgeting and planning proposed infrastructure.

11.4 Operation and Maintenance Costs

The costs to operate and maintain the various infrastructure improvements that have been recommended were not included in the cost estimate. Due to the implementation time horizon, operation and maintenance costs could vary significantly. The City will need to include the recommended solution to its operations and maintenance programs once they are constructed. As the improvements are constructed, the City should update their asset inventories and corresponding operational budgets that will be necessary to maintain the new infrastructure.

On-going monitoring and maintenance will need to take place to ensure that the infrastructure is not altered in any way that could make the system vulnerable to failure. The costs for maintenance may vary significantly from year to year, so it is important to be conservative when estimating the City’s operation maintenance costs.

11.5 Cost Estimate Summary

All construction estimates have been broken down into projects to provide a more accurate representation of what the costs are, to complete the construction of the proposed infrastructure within the two (2) secondary plan areas in the study area. The construction costs for the new proposed collector roads, sanitary and storm infrastructure, SWM facilities, and pumping stations are separated based on the projects in the phasing plan.

Total costs for all projects are detailed in **Appendix F-7**. Below summarizes the total cost for each infrastructure based on the phases.

Table 11-1: Summary of Total Infrastructure Costs

Phases	Schedule C Environmental Assessments	Transportation Network	Stormwater Management Facilities and Storm Trunk Sewers	Municipal Drainage Improvements	Sanitary Trunk Infrastructure	Total
5 Year Horizon	$1.34M	$10.50M	$18.70M	$6.95M	N/A	$37.49M
Phase 1 – East Pelton	$0.30M/EA	$36.52M	$62.18M	$10.03M	N/A	$108.73M
Phase 2 – East Pelton	$0.30M/EA	$21.10M	$28.50M	N/A	N/A	$49.60M
Phase 1 – CR42 SPA	$0.30M/EA	$108.23M	$125.75M	$7.86M	$1.26M	$243.10M
Phase 2 – CR42 SPA	$0.30M/EA	$100.67M	$178.27M	$8.04M	$9.87M	$296.85M

12.0 Summary of Functional Servicing

The Municipal Servicing Functional Design Report outlines the design criteria and recommended infrastructure required to serve proposed development within the SSMSP to follow the requirements of the Municipal Class Environmental Assessment (Class EA 2023) - Approach No. 2 and the requirements of Phases 1 and 2 of the Class EA, including requirements for any Schedule B projects.

This study has provided guidance for the design, construction and implementation of the following:

- Trunk sanitary sewers including the assessment of available treatment plant capacity;
- Trunk storm sewers;
- SWM facilities including consideration for the Little River floodplain;
- Stormwater pumping stations;
- Overland drainage, minimum development elevations and site grading;
- Watermain Distribution Network; and
- Internal Collector Road Network.

Sanitary Sewers and Treatment Plant Capacity

Recommendation of the SSSEA shall continue to be implemented sanitary servicing needs increase within the study area. The trunk sanitary sewers design has been evaluated based on the established lands uses and population densities and the depth and size of the sewer were confirmed. The study recommends that the sanitary sewer along the 9th Concession Road and 10th Concession Road be implemented with focus on the first segment of sewer on 9th Concession Road, extending from CR42 to Baseline Road to service the Regional Hospital and surrounding lands.

Based on the assessment of average daily flows to the LRPCP, it was determined that approximately 57% of development with the East Pelton SPA and 15% of development CR42 SPA can be accommodated prior to the City needing to proceed with a Schedule C Environmental Assessment for the expansion of the treatment capacity of the plant.

Storm Sewer Servicing

Storm trunk sewers have been recommended to provide stormwater conveyance from the proposed developable lands downstream to designated SWM facility. Trunk storm sewers are designed to provide a 1:10 year level of service based on land use based imperviousness values. The sewers range in size from 975 mm dia. to 3000 mm dia. and have been located along arterial and collector roadways throughout the study area.

Stormwater Management

A regional SWM strategy has been developed for the initial buildout areas which include the East Pelton and CR42 SPAs and the Areas adjacent to the first phase of the Lauzon Parkway improvements. The areas have been broken down into eight (8) drainage areas each with a corresponding SWM pond and pumping station. Ponds are designed to provide quantity and quality control of stormwater runoff to meet municipal and provincial minimum guidelines and to provide consideration climate change through the evaluation of the prescribed Urban Stress Test.

The functional design of the SWM ponds has been completed and used to determine the necessary SWM corridor configuration and confirm minimum corridor widths. SWM pond designs will need to include considerations for waterfowl mitigation including additional landscape and active features to deter waterfowl habitat and reduce safety risks due to the proximity to the Windsor International Airport (WIA).

Transportation

The proposed transportation network is comprised of 3 arterial roads that provide access to and from the project service areas. The size and extent of the arterial roads, Lauzon Parkway, County Road 42 and the proposed East-West Arterial Road, have been developed via the Lauzon Parkway Environmental Assessment (2014). Internally there are a number of collector roads that support internal land use changes and population growth. Existing concession roads will be urbanized and those corridors will be used to accommodate trunk sewer servicing and utility services. Proposed cross section upgrades and typical collector road cross sections have been included which shall be used to guide the transformation of these corridors to service new developments.

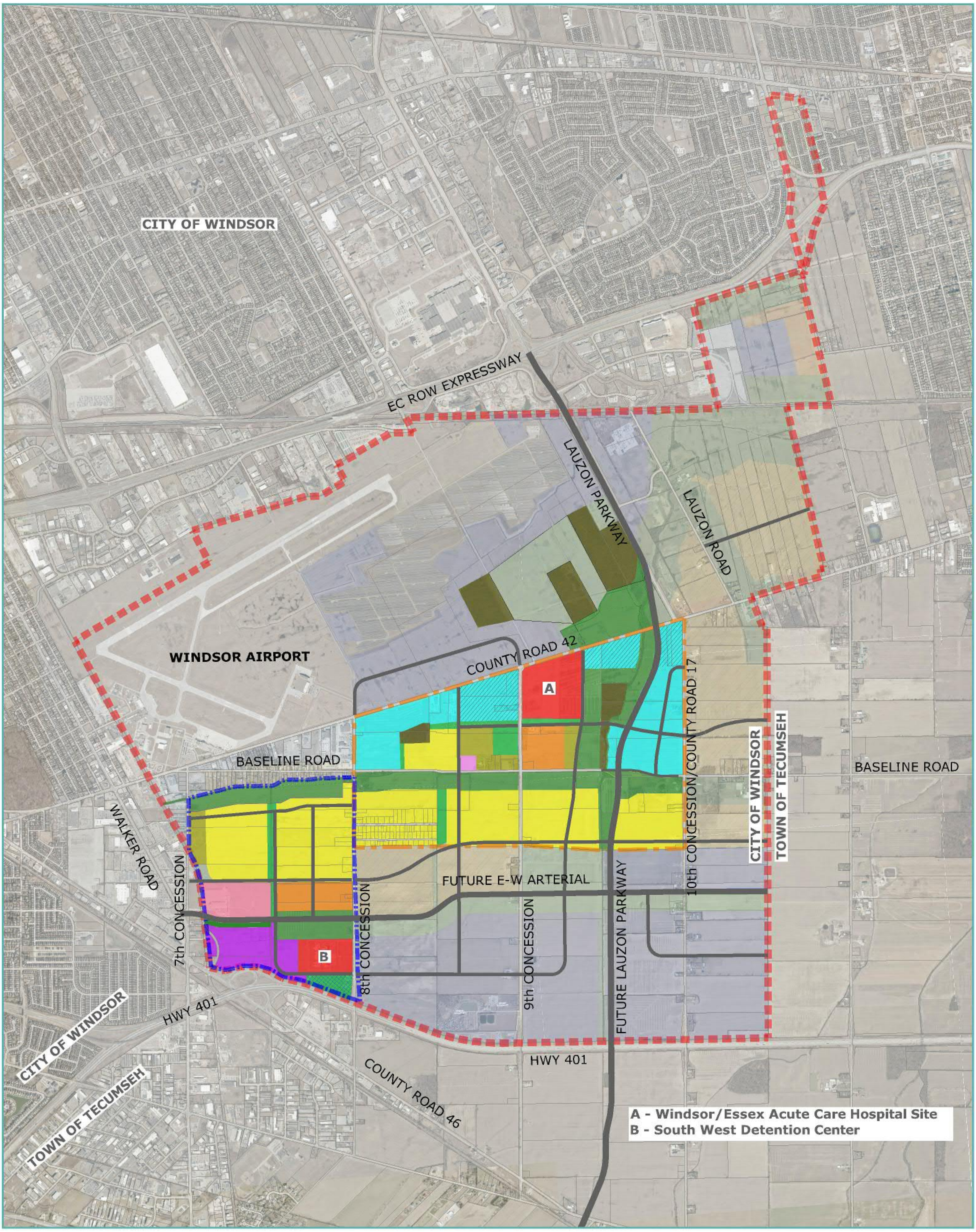
Watermain Servicing

Watermain distribution needs have been identified in the Water System Master Plan 2019 Update (2020). A number of watermain trunk improvements have been identified to service the development in Sandwich South. As development needs are identified, ENWIN shall be made aware of water servicing requirements to assist with determining if watermain improvements will be trigger to meet minimum servicing demands. Upon construction of proposed road improvements, watermain improvement needs shall be identified and incorporated in these projects.

Utility servicing

Each utility company has been provided a plan of population growth and land uses proposed for the initial buildout areas. Necessary power distribution and telecommunications will need to be routed to the initial build out areas. Developers shall commence discussions with utilities early in the development application process to determine the extent of utility improvements required to provide sufficient servicing. Utilities shall consider providing services that will also serve the greater development in an organized efficient way.

Figures



A - Windsor/Essex Acute Care Hospital Site
B - South West Detention Center

SANDWICH SOUTH
MASTER SERVICING PLAN

LEGEND

- Sandwich South Project Boundary
- County Road 42 Secondary Plan Area
- East Pelton Secondary Plan Area
- 🟨 Low Density Residential
- Medium Density Residential
- Business Park Type I
- ▨ Business Park Type II
- 🟥 Major Institutional
- Existing Employment
- Existing Residential
- ▨ Private Recreation
- Minor Institutional
- 🟧 Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- 🟩 Open Space/Park
- 🟪 Commercial Centre
- 🟩 SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban
- Proposed Collector/ Arterial Roads

STUDY AREA MAP
PROPOSED LAND USE

FIGURE 1-0

MAP DRAWING INFORMATION:
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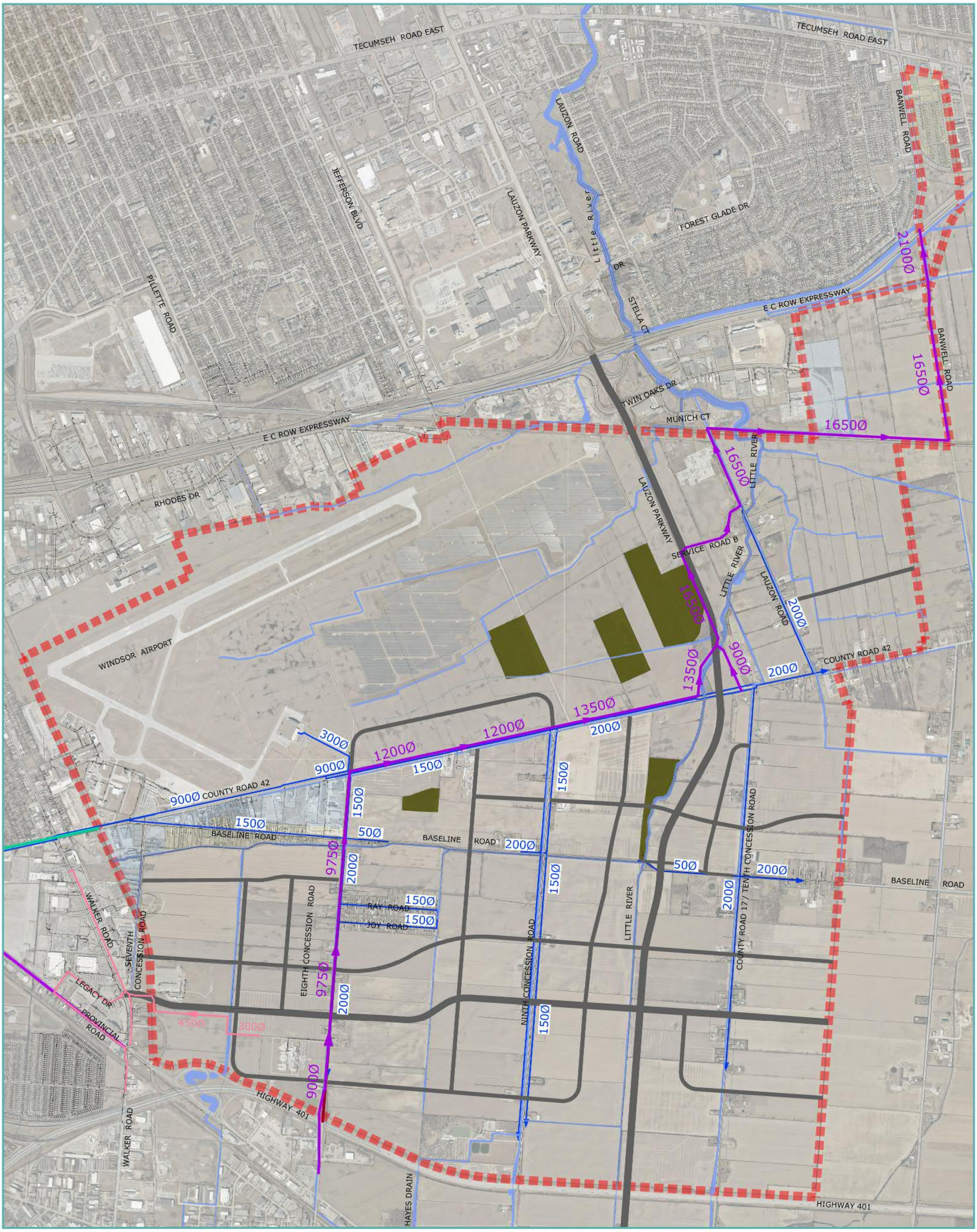

🟥 STUDY AREA
EXISTING SANITARY TRUNK SEWERS
EXISTING SANITARY TRUNK SEWERS (LOU ROMANO)
EXISTING WATERMAIN
EXISTING MUNICIPAL DRAINS
▨ NATURAL HERITAGE AREA

SANDWICH SOUTH MASTER SERVICING PLAN

EXISTING CONDITIONS FIGURES

FIGURE 2-0

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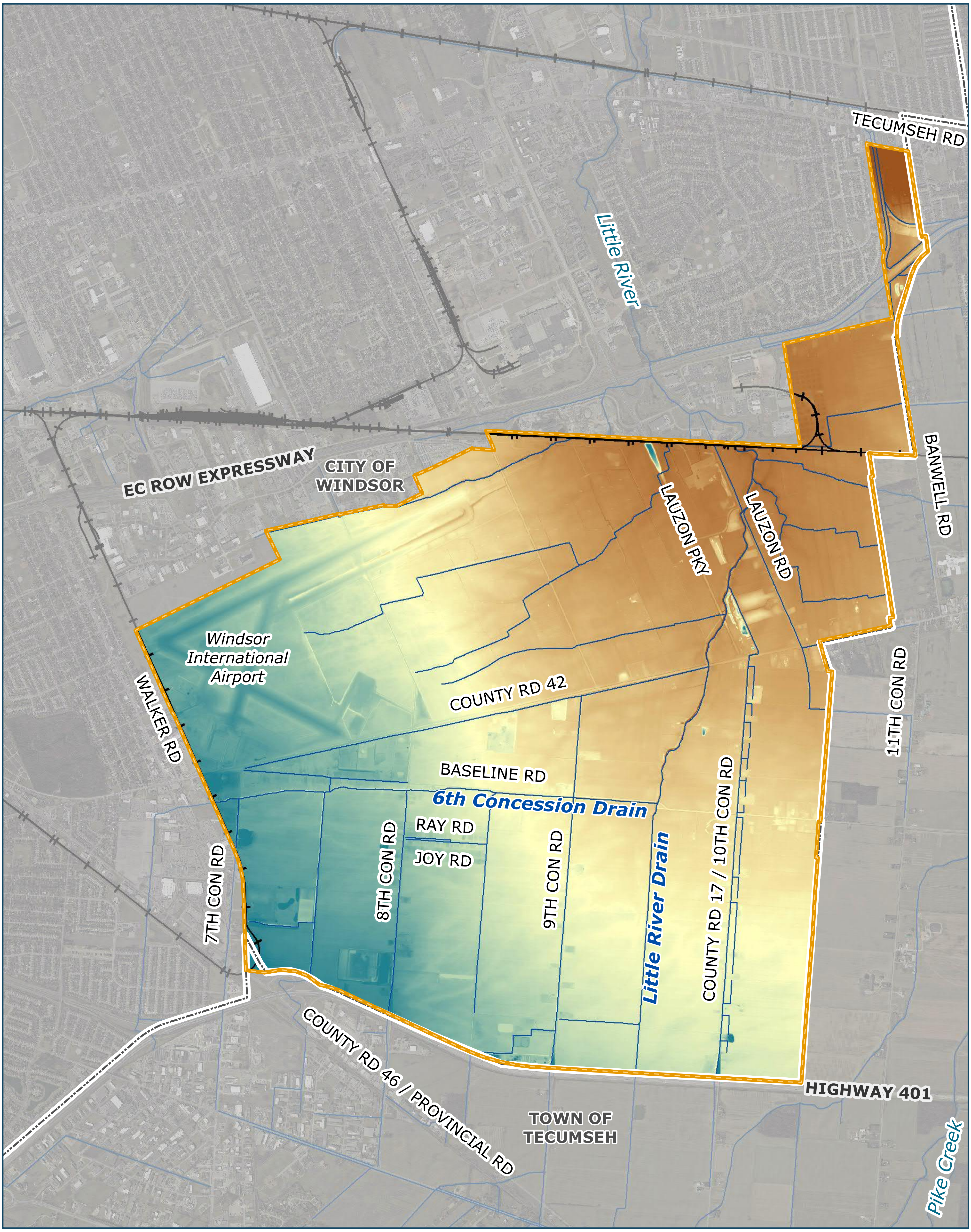

SANDWICH SOUTH MASTER SERVICING PLAN

▭ Sandwich South Master Planning Area
+ Railway
— Municipal Drain / Watercourse
▭ Municipal Boundary

DEM Value (masl)
High : 199
Mid: 188
Low : 176

SANDWICH SOUTH MASTER PLANNING AREA TOPOGRAPHIC MAP

FIGURE 2-1

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

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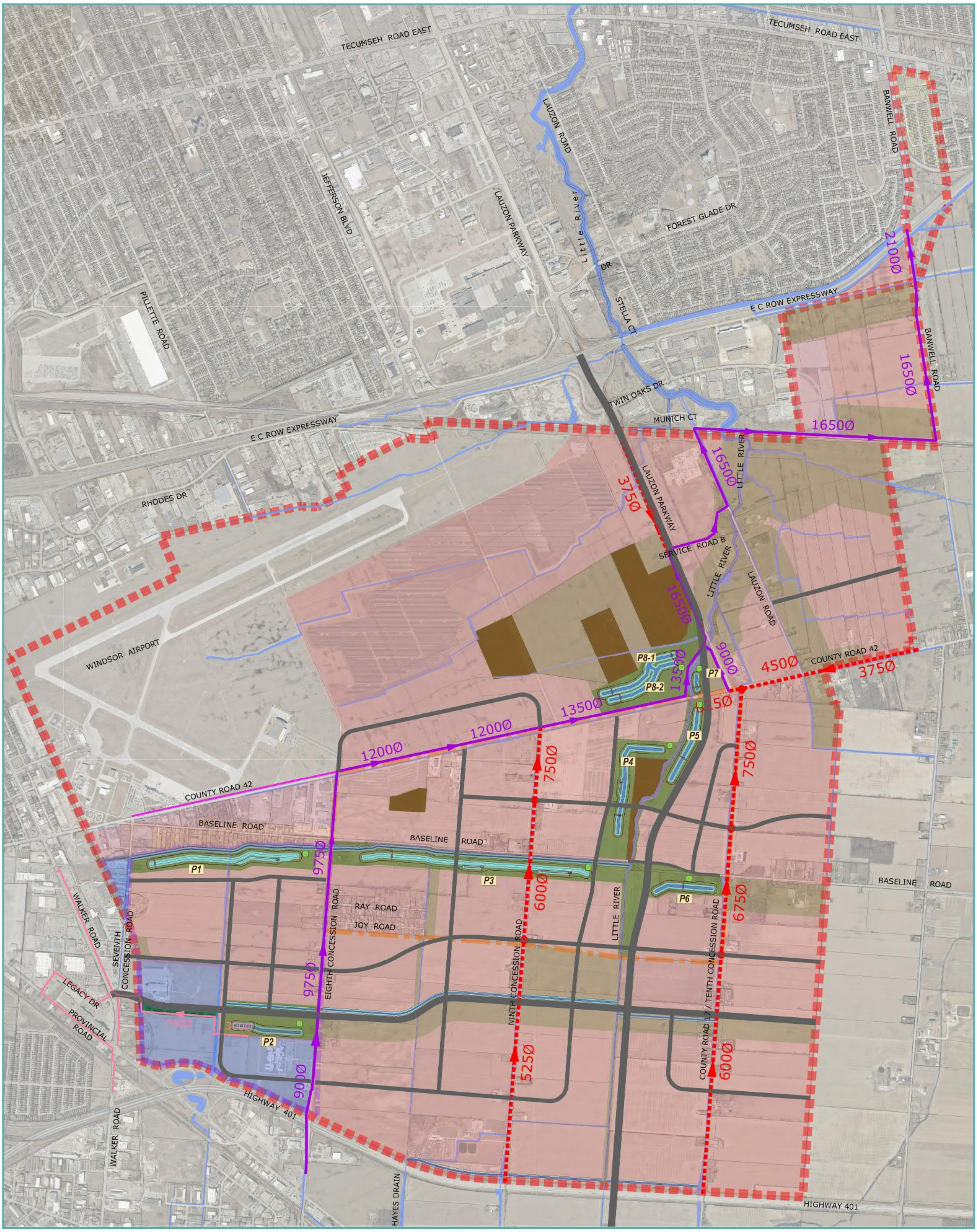

SANDWICH SOUTH MASTER SERVICING PLAN

- ▬ STUDY AREA
- ▬ EAST PELTON SPA
- ▬ CR42 SPA
- ➜ TRUNK STORM SEWER
- ▬ 1:100 YEAR FLOODWAY EXTENTS
- ▬ FUTURE COLLECTOR AND ARTERIAL ROADS
- ■ NATURAL HERITAGE AREA
- P1 TYPICAL POND NAME
- 🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
- ⇦ PROPOSED STORM SEWER DRAINAGE
- ■ STORMWATER PUMP STATION
- 🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL
- ■ STORMWATER MANAGEMENT POND - ACTIVE STORAGE
- ▬ MUNICIPAL DRAIN RELOCATION OR NEW DRAIN
- ■ LITTLE RIVER POLLUTION CONTROL PLANT DRAINAGE AREA
- ■ LOU ROMANO WATER RECLAMATION PLANT DRAINAGE AREA
- ▬ PROPOSED SANITARY DRAINAGE AREA
- ➜ EXISTING SANITARY TRUNK SEWERS (LOU ROMANO)
- ➜ EXISTING SANITARY TRUNK SEWERS
- ➜ PROPOSED SANITARY TRUNK SEWERS

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PROPOSED SANITARY SEWER LAYOUT

FIGURE 4-0

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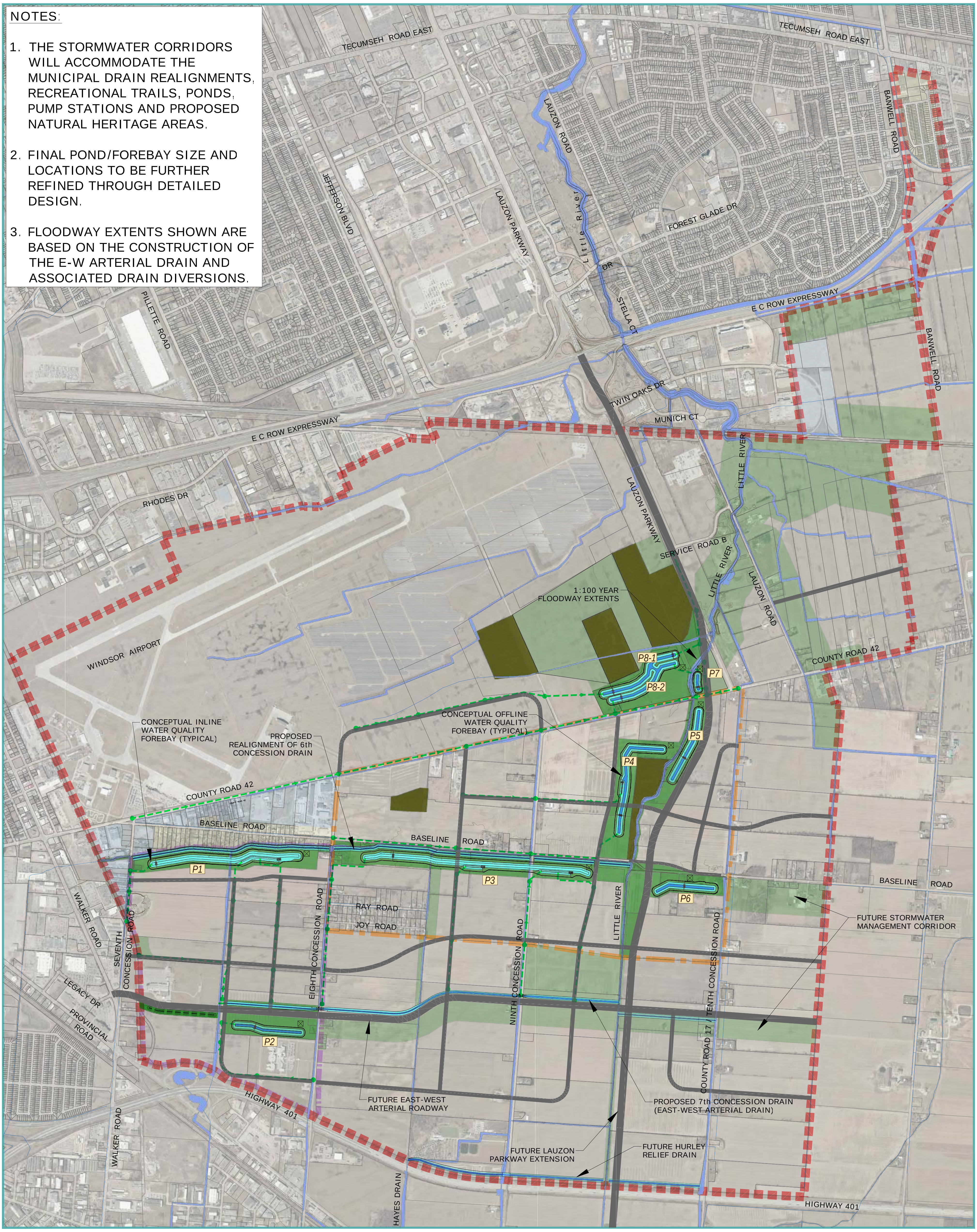

NOTES:

1. THE STORMWATER CORRIDORS WILL ACCOMMODATE THE MUNICIPAL DRAIN REALIGNMENTS, RECREATIONAL TRAILS, PONDS, PUMP STATIONS AND PROPOSED NATURAL HERITAGE AREAS.
2. FINAL POND/FOREBAY SIZE AND LOCATIONS TO BE FURTHER REFINED THROUGH DETAILED DESIGN.
3. FLOODWAY EXTENTS SHOWN ARE BASED ON THE CONSTRUCTION OF THE E-W ARTERIAL DRAIN AND ASSOCIATED DRAIN DIVERSIONS.

SANDWICH SOUTH MASTER SERVICING PLAN

🟥	STUDY AREA	🟩	OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
▬	EAST PELTON SPA	⇦	PROPOSED STORM SEWER DRAINAGE
▬	CR42 SPA	☒	STORMWATER PUMP STATION
▶	TRUNK STORM SEWER	🟦	STORMWATER MANAGEMENT POND- PERMANENT POOL
▬	1:100 YEAR FLOODWAY EXTENTS	▭	STORMWATER MANAGEMENT POND - ACTIVE STORAGE
▬	FUTURE COLLECTOR AND ARTERIAL ROADS	▬	MUNICIPAL DRAIN RELOCATION OR NEW DRAIN
▨	NATURAL HERITAGE AREA		
P1	TYPICAL POND NAME		

STORMWATER MANAGEMENT STRATEGY

FIGURE 5-0

MAP DRAWING INFORMATION:
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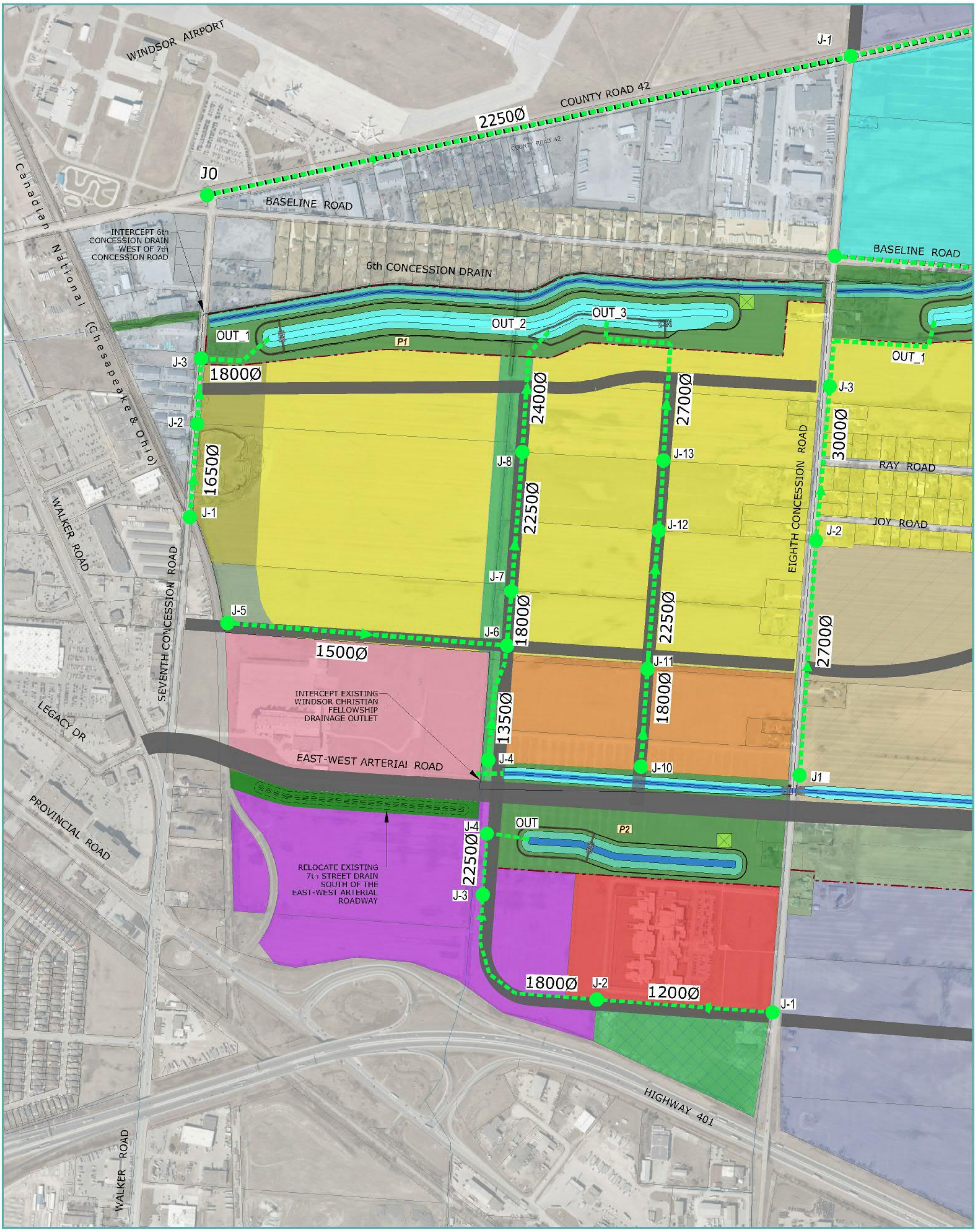

SANDWICH SOUTH MASTER SERVICING PLAN

- - -▸- - TRUNK STORM SEWER

- - - - - PROPERTY ACQUISITION BOUNDARY

▬ FUTURE COLLECTOR AND ARTERIAL ROADS

🟫 NATURAL HERITAGE

― EXISITING DRAINS

2400Ø STORM SEWER SIZE

🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR (FUTURE)

⇦ PROPOSED STORM SEWER DRAINAGE

☒ STORMWATER PUMP STATION

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

▭ STORMWATER MANAGEMENT POND - ACTIVE STORAGE

═ MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND

🟨 Low Density Residential
▨ Medium Density Residential
▨ Business Park Type I
▨ Business Park Type II
🟥 Major Institutional
▨ Existing Employment
▨ Existing Residential
▨ Private Recreation
▨ Minor Institutional
🟧 Mixed Use
▨ Natural Heritage
▨ Neighbourhood Commercial
▨ Open Space/Park
▨ Commercial Centre
🟩 SWM Corridor
▨ Airport Solar Farm
▨ Future Employment
▨ Future Urban

STORMWATER MANAGEMENT STRATEGY

EAST PELTON SPA

FIGURE 5-1

THE CITY OF WINDSOR ONTARIO, CANADA

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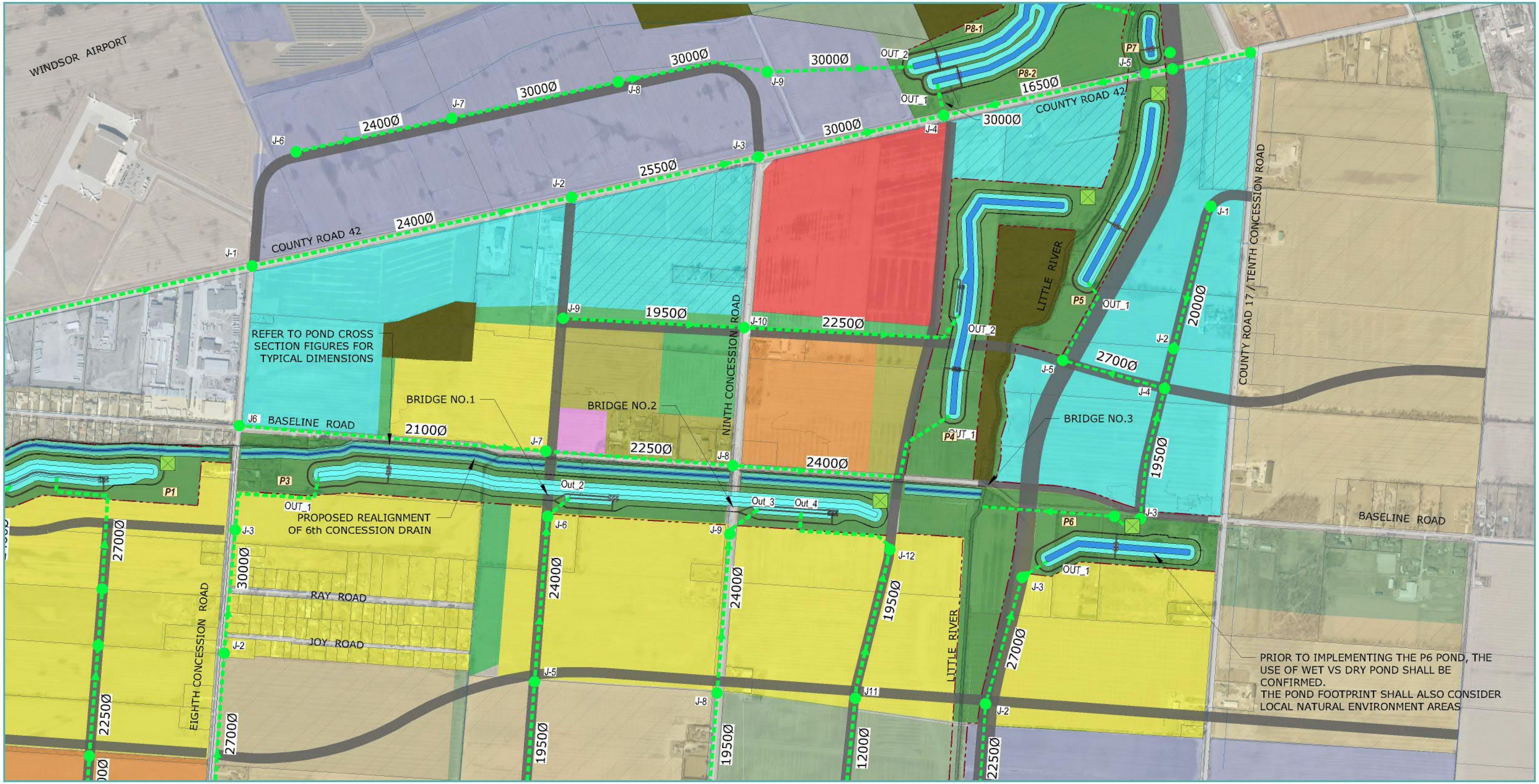

SANDWICH SOUTH MASTER SERVICING PLAN

- - -▶ TRUNK STORM SEWER
― EXISTING DRAINS
- - - PROPERTY ACQUISITION BOUNDARY
2400Ø STORM SEWER SIZE
▬ FUTURE COLLECTOR AND ARTERIAL ROADS
▨ NATURAL HERITAGE
🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
← PROPOSED STORM SEWER DRAINAGE ARROW
☒ STORMWATER PUMP STATION
🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL
▭ STORMWATER MANAGEMENT POND - ACTIVE STORAGE
═ MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND

🟨	Low Density Residential	🟥	Major Institutional	🟩	Open Space/Park
▨	Medium Density Residential	▨	Existing Employment	⬛	Commercial Centre
⬛	Business Park Type I	▨	Existing Residential	🟩	SWM Corridor
▨	Business Park Type II	▨	Private Recreation	▨	Airport Solar Farm
		▨	Minor Institutional	▨	Future Employment
		🟧	Mixed Use	▨	Future Urban
		▨	Natural Heritage		
		▨	Neighbourhood Commercial		

STORMWATER MANAGEMENT STRATEGY
CR42 SPA

FIGURE 5-2

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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STATUS: FINAL SCALE: 1:5000 PROJECT: 19-9817 DATE: April 27, 2023

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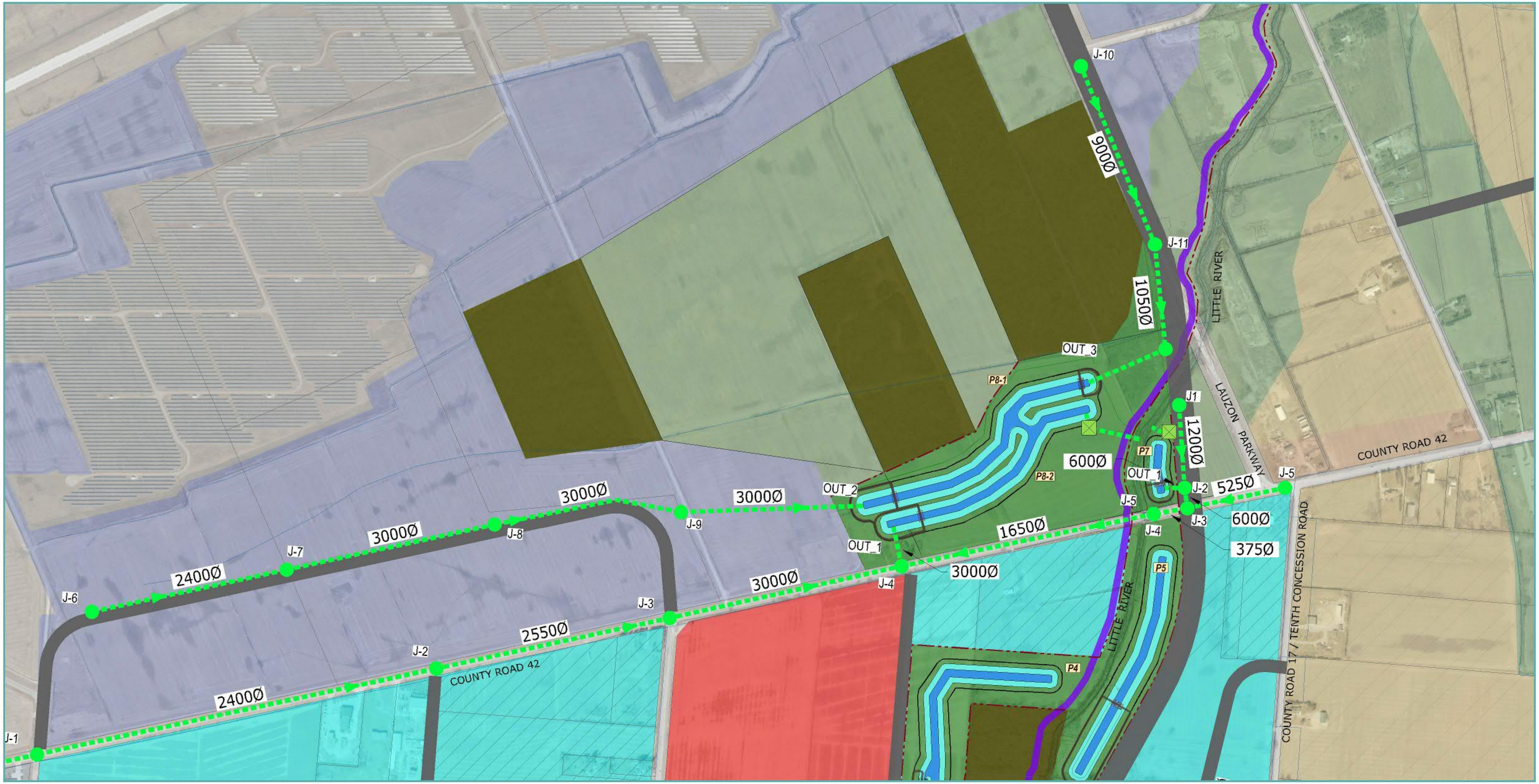

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT STRATEGY

LAUZON PARKWAY AND CR42 INTERSECTION

FIGURE 5-3

TRUNK STORM SEWER
EXISTING DRAINS
PROPERTY ACQUISITION BOUNDARY
STORM SEWER SIZE
FUTURE COLLECTOR AND ARTERIAL ROADS
NATURAL HERITAGE
OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
PROPOSED STORM SEWER DRAINAGE ARROW
☒ STORMWATER PUMP STATION
STORMWATER MANAGEMENT POND- PERMANENT POOL
STORMWATER MANAGEMENT POND - ACTIVE STORAGE
MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND
- Low Density Residential
- Medium Density Residential
- Business Park Type I
- Business Park Type II
- Major Institutional
- Existing Employment
- Existing Residential
- Private Recreation
- Minor Institutional
- Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- Open Space/Park
- Commercial Centre
- SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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STATUS: FINAL
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PROJECT: 19-9817
DATE: April 26, 2023

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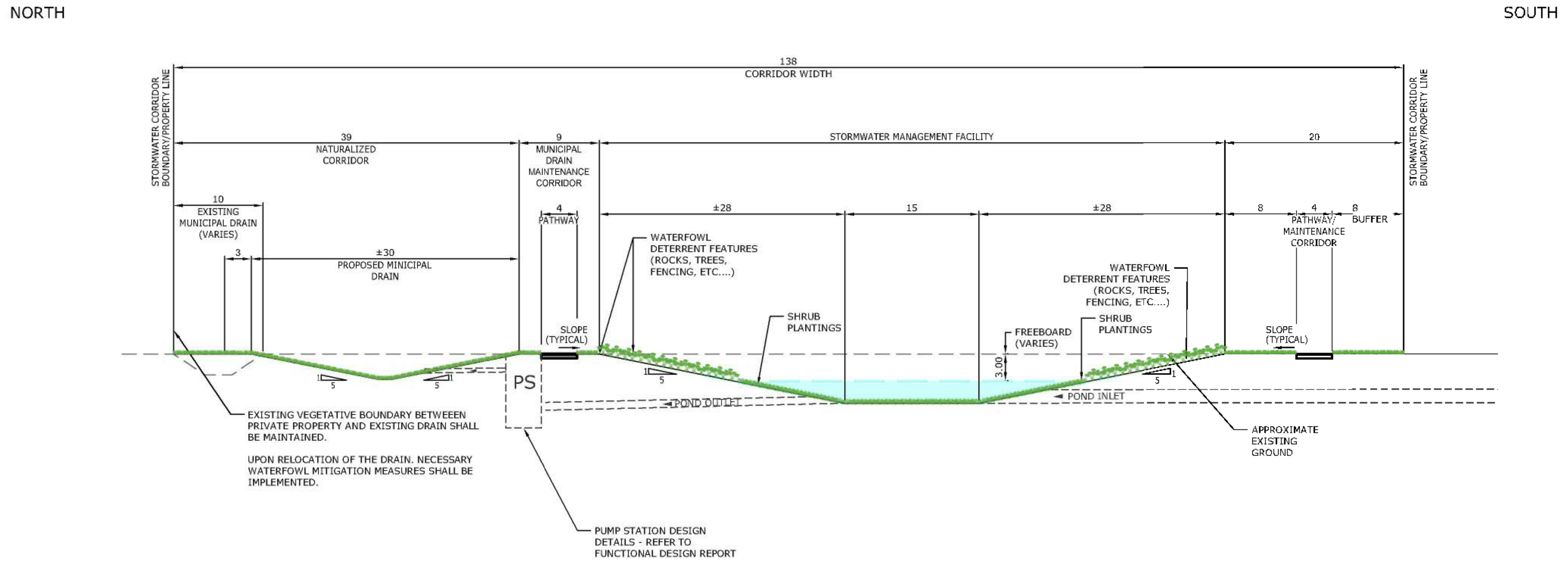

EAST PELTON NORTH (P1)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

P1-STORMWATER MANAGEMENT
CORRIDOR (DRY POND)
FIGURE 5-4-1A

THE CITY OF WINDSOR
ONTARIO, CANADA

DILLON
CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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STATUS: FINAL
PROJECT: 19-9817
DATE: March 28, 2023

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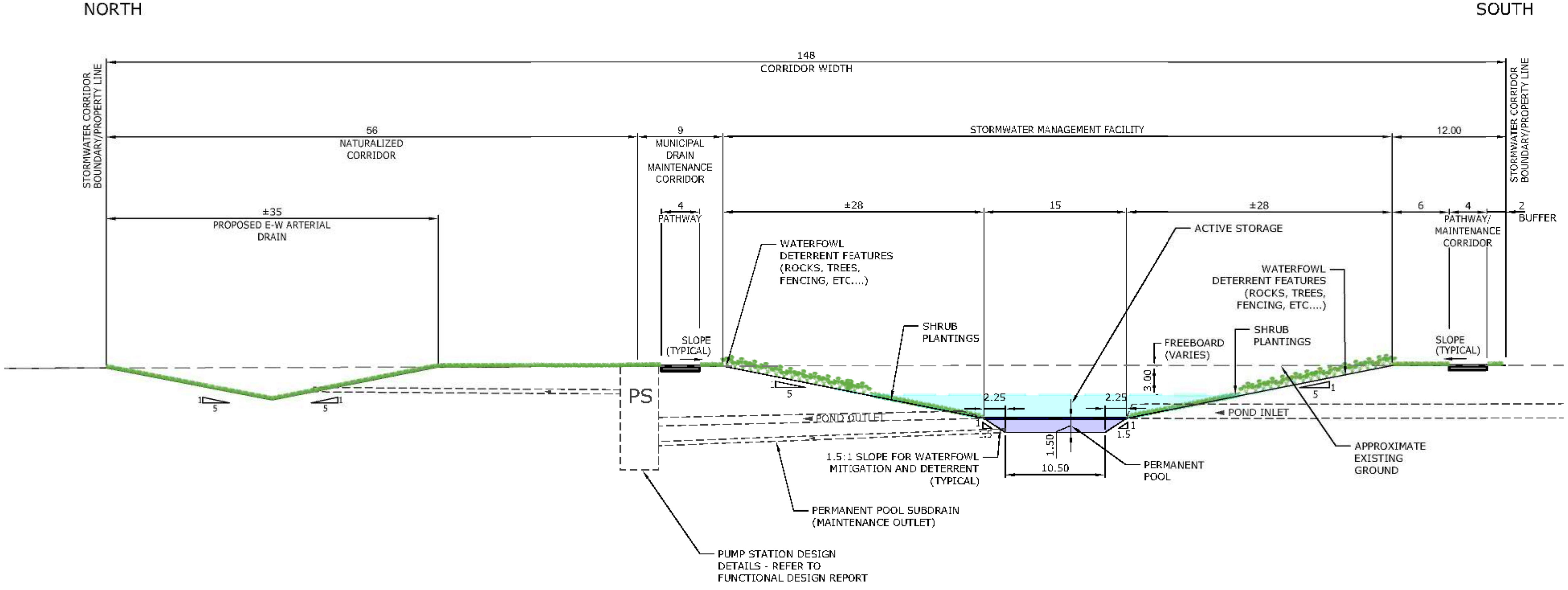

EAST PELTON SOUTH (P2)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT
CORRIDOR WITH OFFLINE FOREBAY
FIGURE 5-4-2

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2015, TOWN OF TECUMSEH 2015, *ESSEX REGION CONSERVATION AUTHORITY 2015, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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SCALE
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STATUS: FINAL PROJECT: 19-9817 DATE: March 27, 2023

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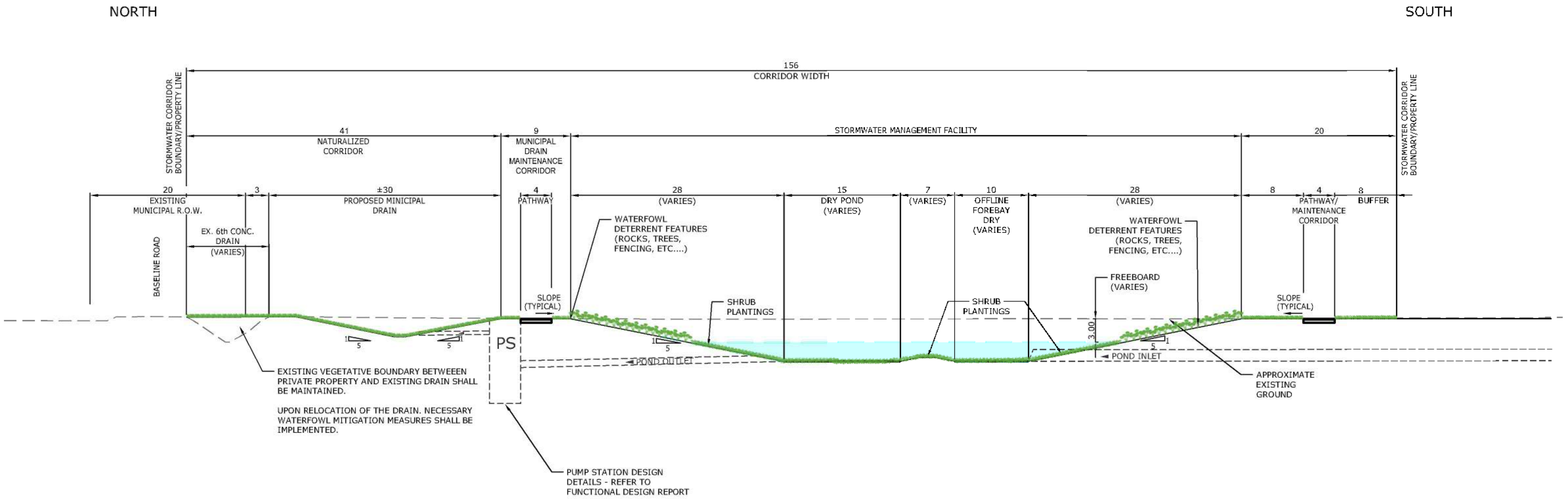

CR42SPA SOUTH EAST (P3)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT CORRIDOR
WITH OFFLINE FOREBAY (DRY POND)
FIGURE 5-4-3A

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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SCALE
0 2 10 25m

STATUS: FINAL
PROJECT: 19-9817
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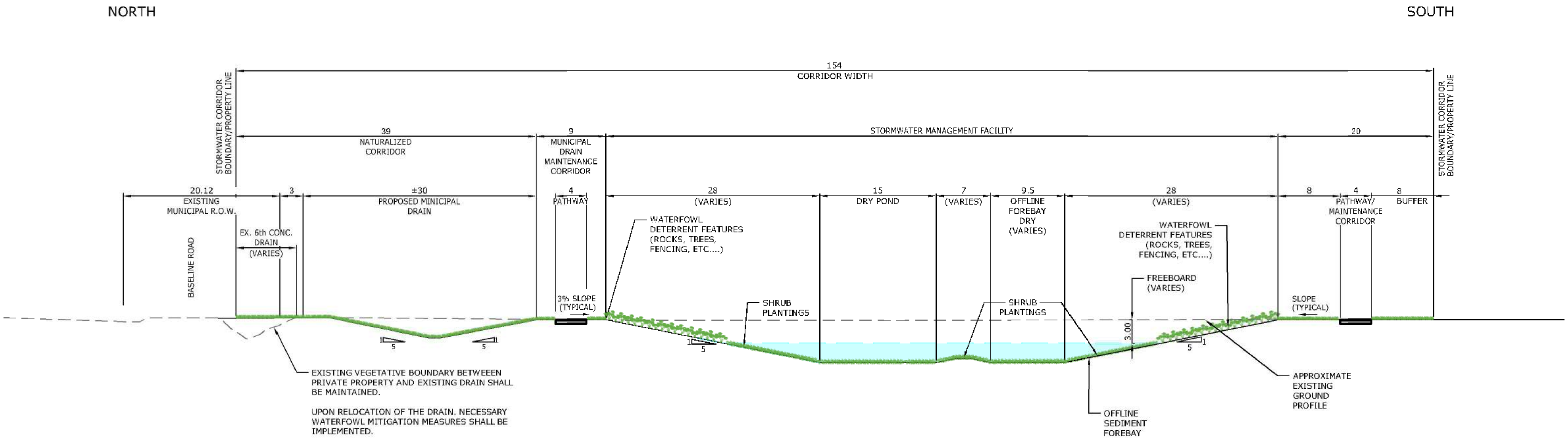

CR42SPA SOUTH CENTRAL (P3 CENTRAL)

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT CORRIDOR
WITH OFFLINE FOREBAY (DRY POND)
FIGURE 5-4-3B

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2015, TOWN OF TECUMSEH 2015, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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SCALE
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DATE: March 28, 2023

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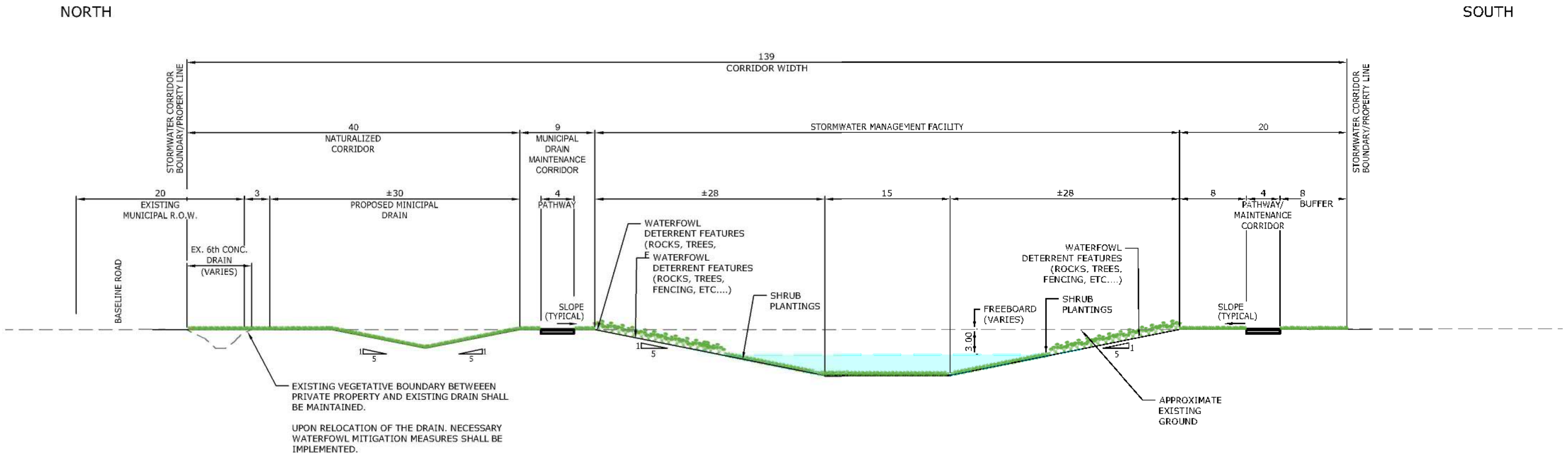

CR42SPA SOUTH WEST (P3)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT CORRIDOR
WITH OFFLINE FOREBAY (DRY POND)
FIGURE 5-4-3C

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

SCALE
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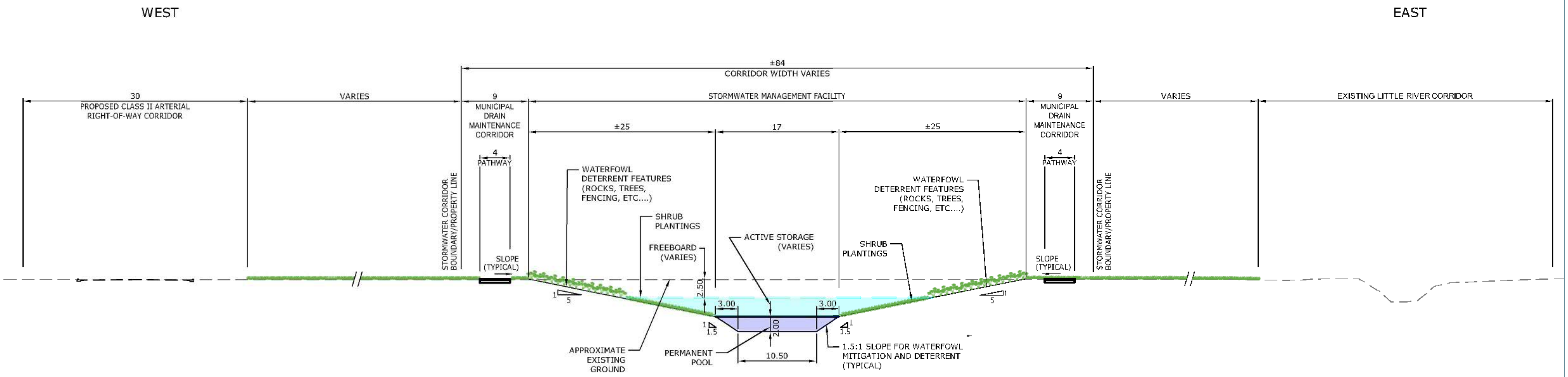
STATUS: FINAL PROJECT: 19-9817 DATE: March 28, 2023



CR42SPA NW (P4)

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT CORRIDOR
WITH OFFLINE FOREBAY
FIGURE 5-4-4

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

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MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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STATUS: FINAL PROJECT: 19-9817 DATE: March 27, 2023

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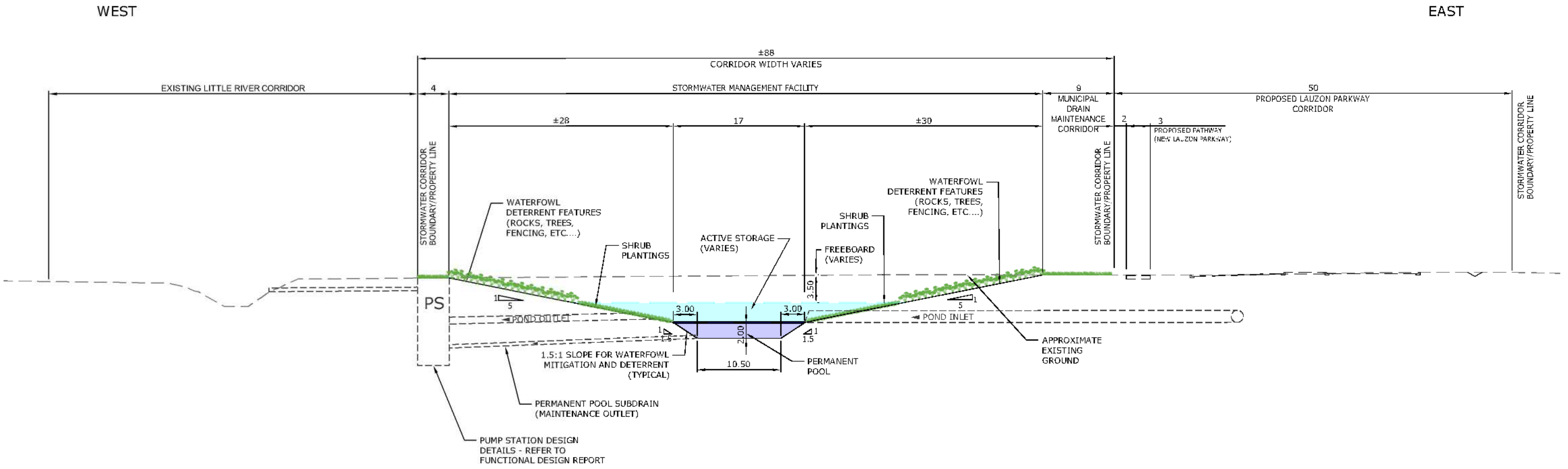

CR42SPA EAST (P5)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT
CORRIDOR WITH OFFLINE FOREBAY
FIGURE 5-4-5

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2015, TOWN OF TECUMSEH 2015, *ESSEX REGION CONSERVATION AUTHORITY 2015, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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PROJECT: 19-9817
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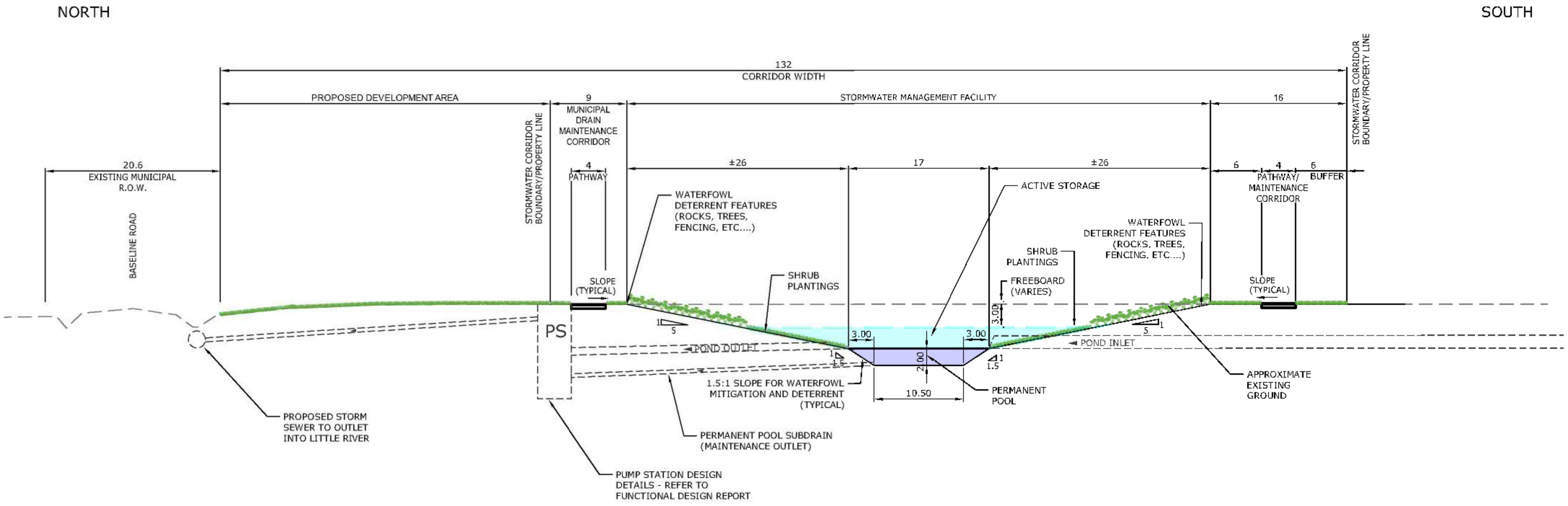

CR42SPA SOUTHEAST (P6)

NOTE:
USE OF A DRY VERSUS WET POND SHALL BE EVALUATED UPON DETAILED DESIGN. ALSO THE CROSS SECTION SHALL BE REFINED BASED ON THE EXTENT OF EXISTING NATURAL ENVIRONMENT AREAS.

SANDWICH SOUTH MASTER SERVICING PLAN

🟪 STORMWATER MANAGEMENT POND- PERMANENT POOL

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT
CORRIDOR WITH OFFLINE FOREBAY
FIGURE 5-4-6

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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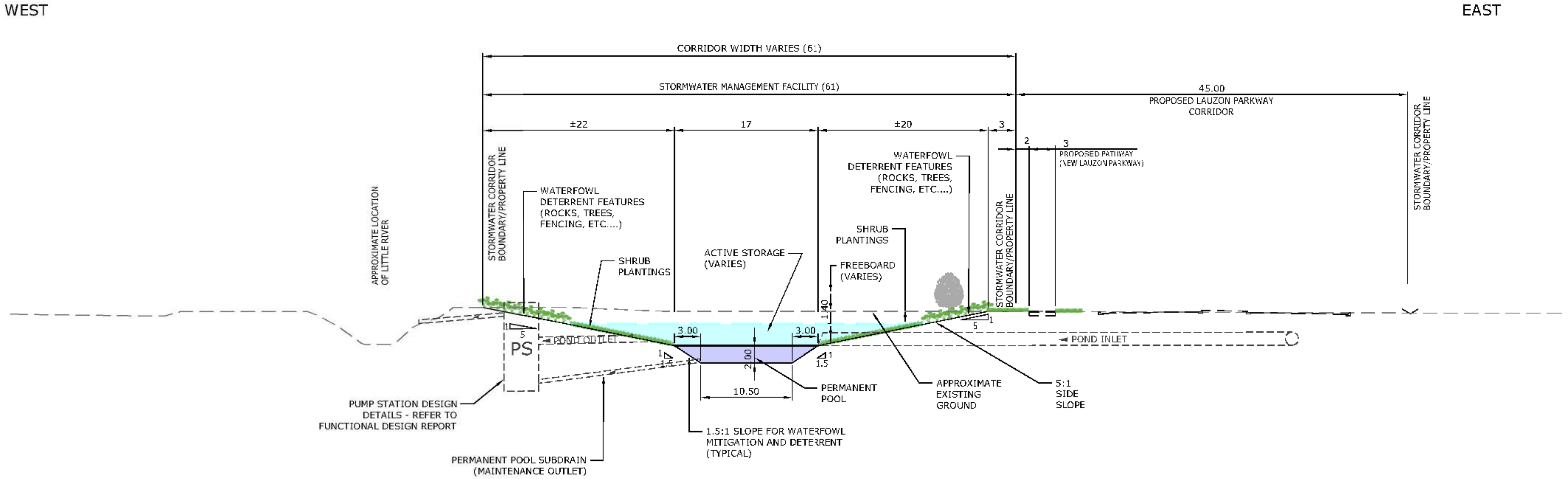
STATUS: FINAL
PROJECT: 19-9817
DATE: March 27, 2023



LAUZON PARKWAY AND CR42 INTERSECTION (EAST) (P7)

SANDWICH SOUTH MASTER SERVICING PLAN

🟪 STORMWATER MANAGEMENT POND- PERMANENT POOL

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT
CORRIDOR WITH OFFLINE FOREBAY
FIGURE 5-4-7

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2015, TOWN OF TECUMSEH 2015, *ESSEX REGION CONSERVATION AUTHORITY 2015, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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SCALE
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STATUS: FINAL
PROJECT: 19-9817
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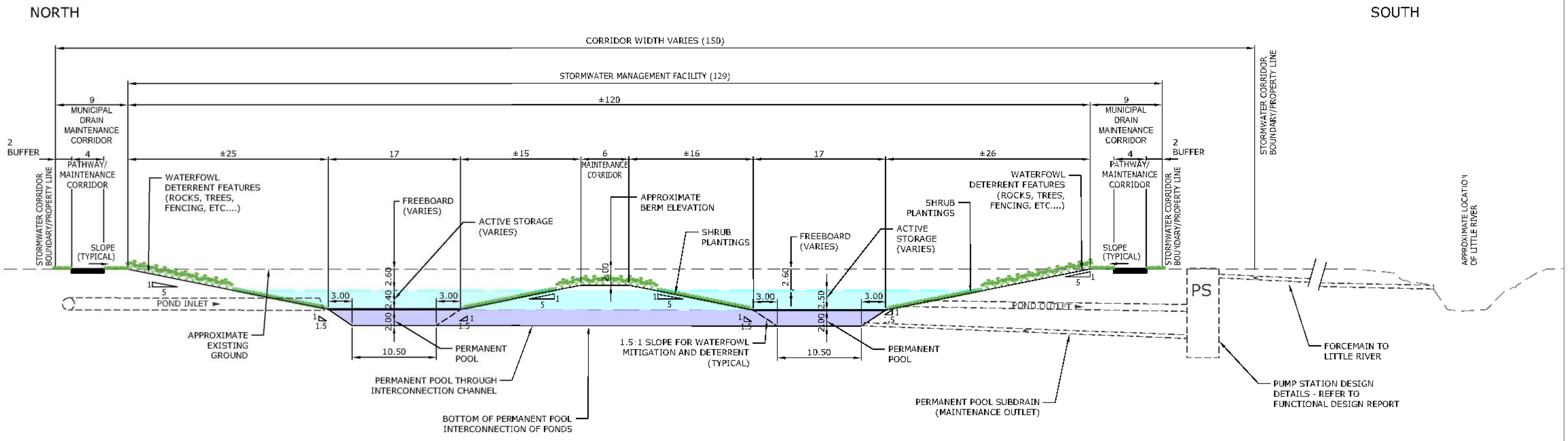

LAUZON PARKWAY AND CR42 INTERSECTION (WEST) (P8)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

▨ STORMWATER MANAGEMENT POND - ACTIVE STORAGE

STORMWATER MANAGEMENT
CORRIDOR WITH OFFLINE FOREBAY
FIGURE 5-4-8

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2015, TOWN OF TECUMSEH 2015, *ESSEX REGION CONSERVATION AUTHORITY 2015, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO.
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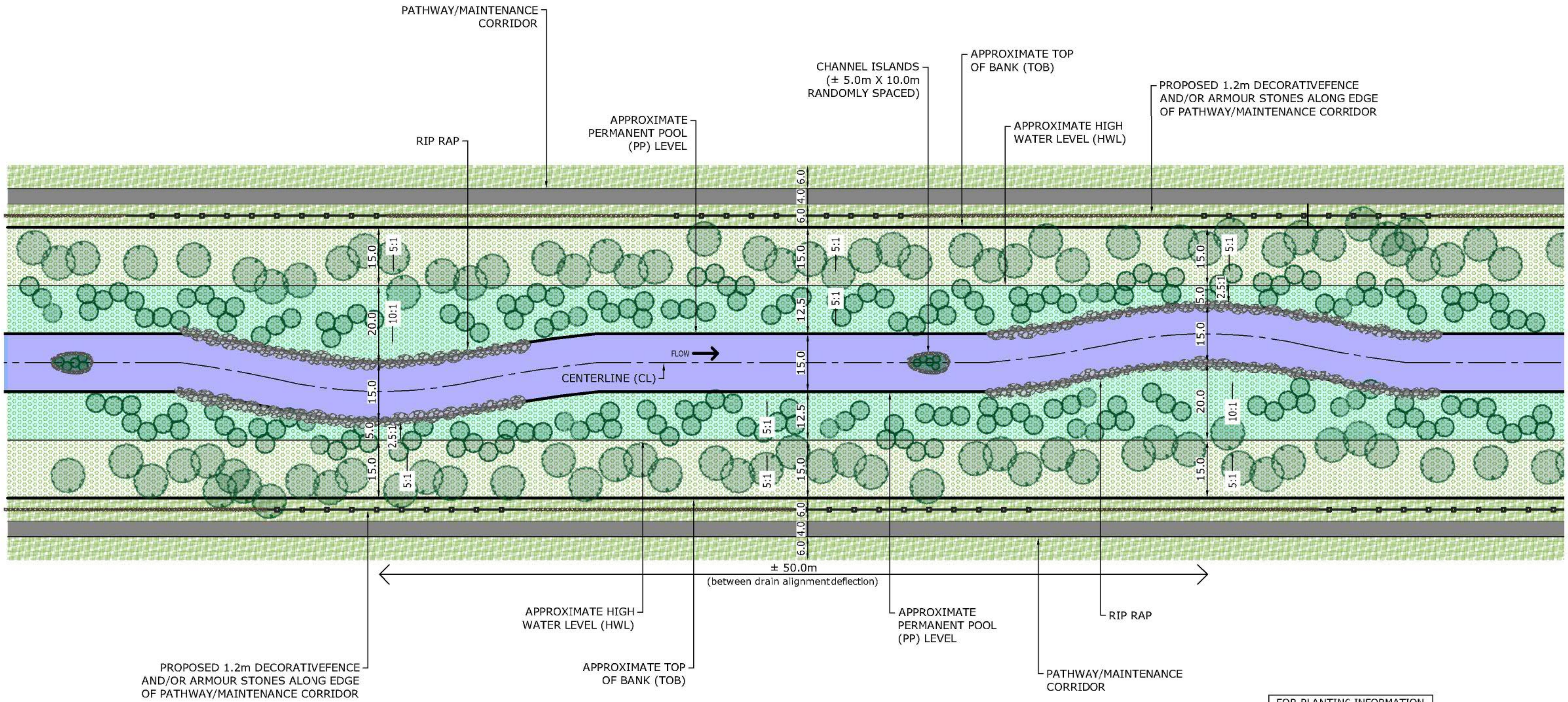
STATUS: FINAL PROJECT: 19-9817 DATE: March 27, 2023



FOR PLANTING INFORMATION
SEE LANDSCAPE FIGURES

WATERFOWL MITIGATION
TYPICAL POND SEGMENT

SANDWICH SOUTH MASTER SERVICING PLAN

🟪 PERMANENT POOL (PP)	▨ WATERFOWL DETERRENT GRASSES	●—●— PROPOSED FENCE	● PROPOSED DECIDUOUS TREES
🟩 FLOOD FRINGE AQUATIC PLANTINGS (HIGH WATER LEVEL (HWL) SIDE SLOPE)	■ ASPHALT PATHWAY, MAINTENANCE CORRIDOR	●●●● PROPOSED ARMOUR STONES	
▨ SHRUB/PERENNIAL BED (FREEBOARD SIDE SLOPE)	▨ RIP RAP	● PROPOSED MULTI-STEM TREE	

CONCEPTUAL FOWL MITIGATION POND
SEGMENT PLAN
FIGURE 5-5

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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STATUS: FINAL
PROJECT: 19-9817
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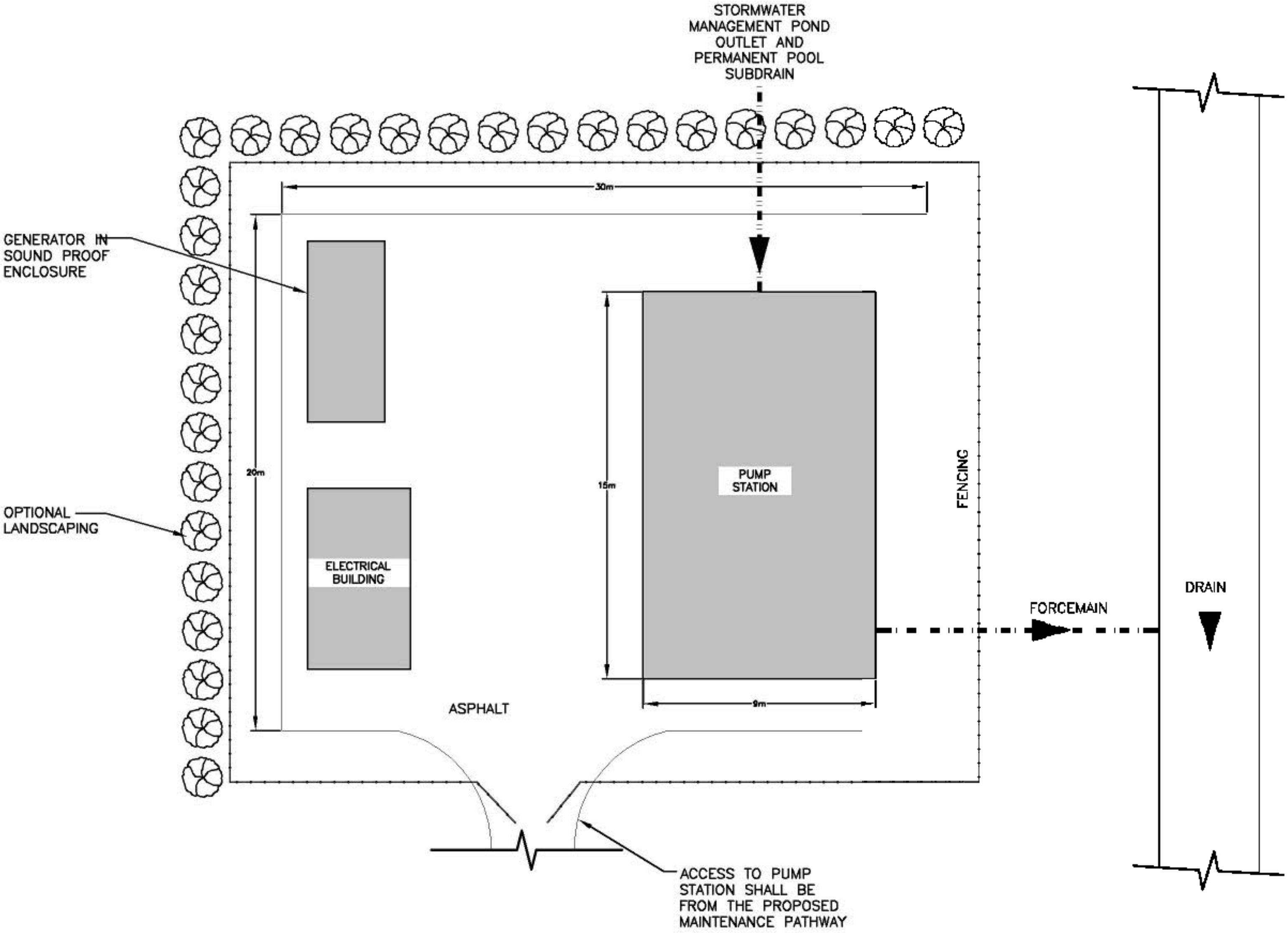
NOTES:

1. PUMP STATION ACCESS, PANEL EQUIPMENT AND GENERATOR SHALL BE PLACED AN ELEVATIONS 0.3 M GREATER THAN THE MINIMUM ERCA FLOOD PROOFING ELEVATIONS.
2. PUMP STATION FORCEMAIN INLET TO THE MUNICIPAL DRAINS SHALL CONSIDER EROSION CONTROL AND SCOUR PROTECTION.
3. THE PUMP STATION FOOTPRINT IS DEPENDENT ON THE CAPACITY OF THE PUMP STATION. REFER TO THE FUNCTIONAL DESIGN REPORT FOR SITE SPECIFIC WET WELL DIMENSIONS.
4. THE PERMANENT POOL SUBDRAIN WILL ONLY BE REQUIRED FOR INLETS FOR WET STORMWATER MANAGEMENT PONDS.



SANDWICH SOUTH MASTER SERVICING PLAN

TYPICAL PUMP STATION SITE PLAN (GREATER THAN 0.4 CMS CAPACITY)

FIGURE 5-6-0

MAP CREATED BY: SMZ
MAP CHECKED BY: TC

STATUS: FINAL

1.5 0 1.5
SCALE METRES

PROJECT: 19 9517

DATE: March 27, 2023

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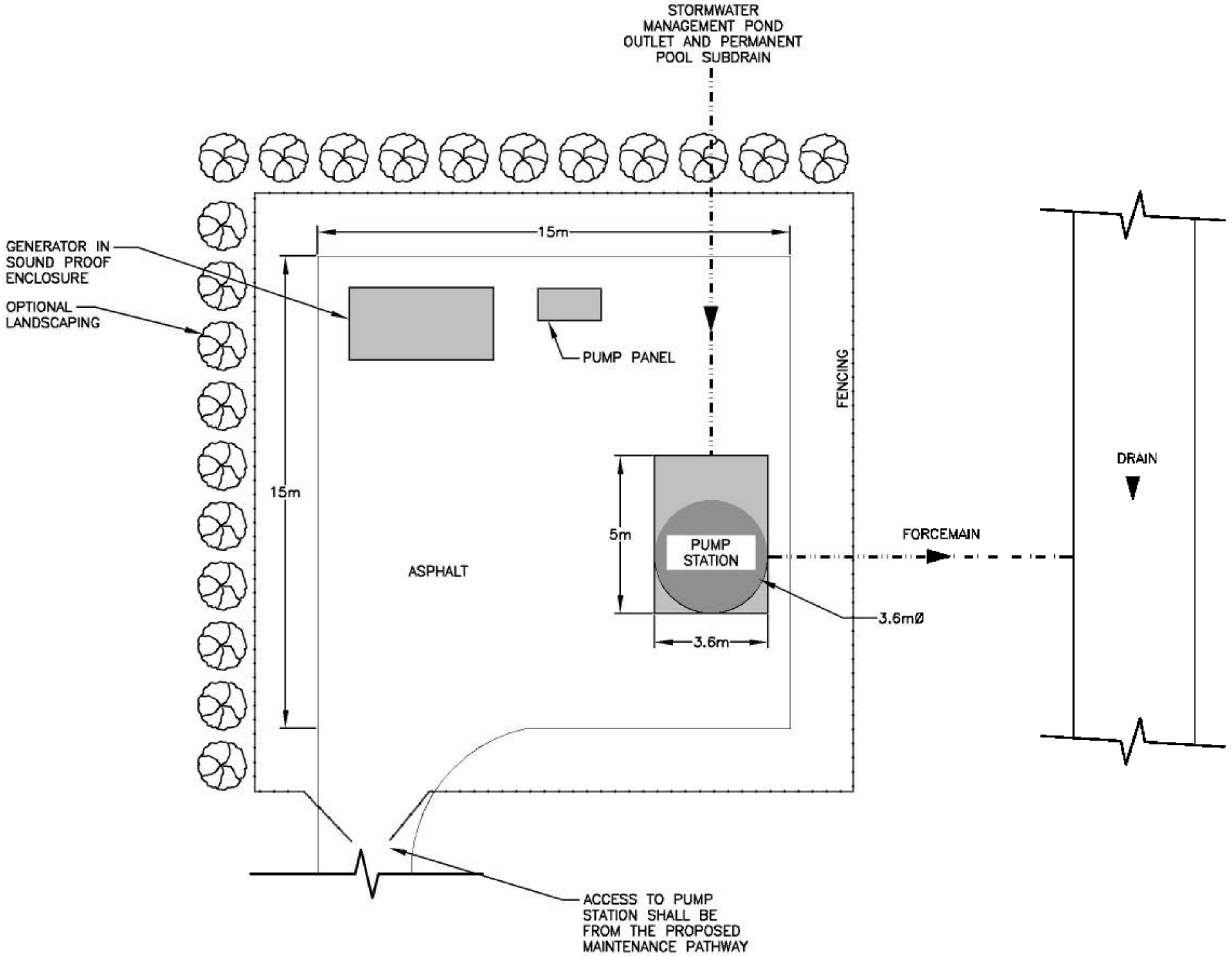
File Location: c:\pw working directory\projects 2019\10smz\dms20713\199517-10-ps site-con.dwg March 27, 2023 11:35 AM

NOTES:

1. PUMP STATION ACCESS, PANEL EQUIPMENT AND GENERATOR SHALL BE PLACED AN ELEVATIONS 0.3 M GREATER THAN THE MINIMUM ERCA FLOOD PROOFING ELEVATIONS.
2. PUMP STATION FORCEMAIN INLET TO THE MUNICIPAL DRAINS SHALL CONSIDER EROSION CONTROL AND SCOUR PROTECTION.
3. THE PUMP STATION FOOTPRINT IS DEPENDENT ON THE CAPACITY OF THE PUMP STATION. REFER TO THE FUNCTIONAL DESIGN REPORT FOR SITE SPECIFIC WET WELL DIMENSIONS.
4. THE PERMANENT POOL SUBDRAIN WILL ONLY BE REQUIRED FOR INLETS FOR WET STORMWATER MANAGEMENT PONDS.



SANDWICH SOUTH MASTER SERVICING PLAN

TYPICAL PUMP STATION SITE PLAN (LESS THAN 0.4 CMS CAPACITY)

FIGURE 5-6-1

MAP CREATED BY: SMZ
MAP CHECKED BY: TC

STATUS: DRAFT

SCALE 1.5 0 1.5 METRES

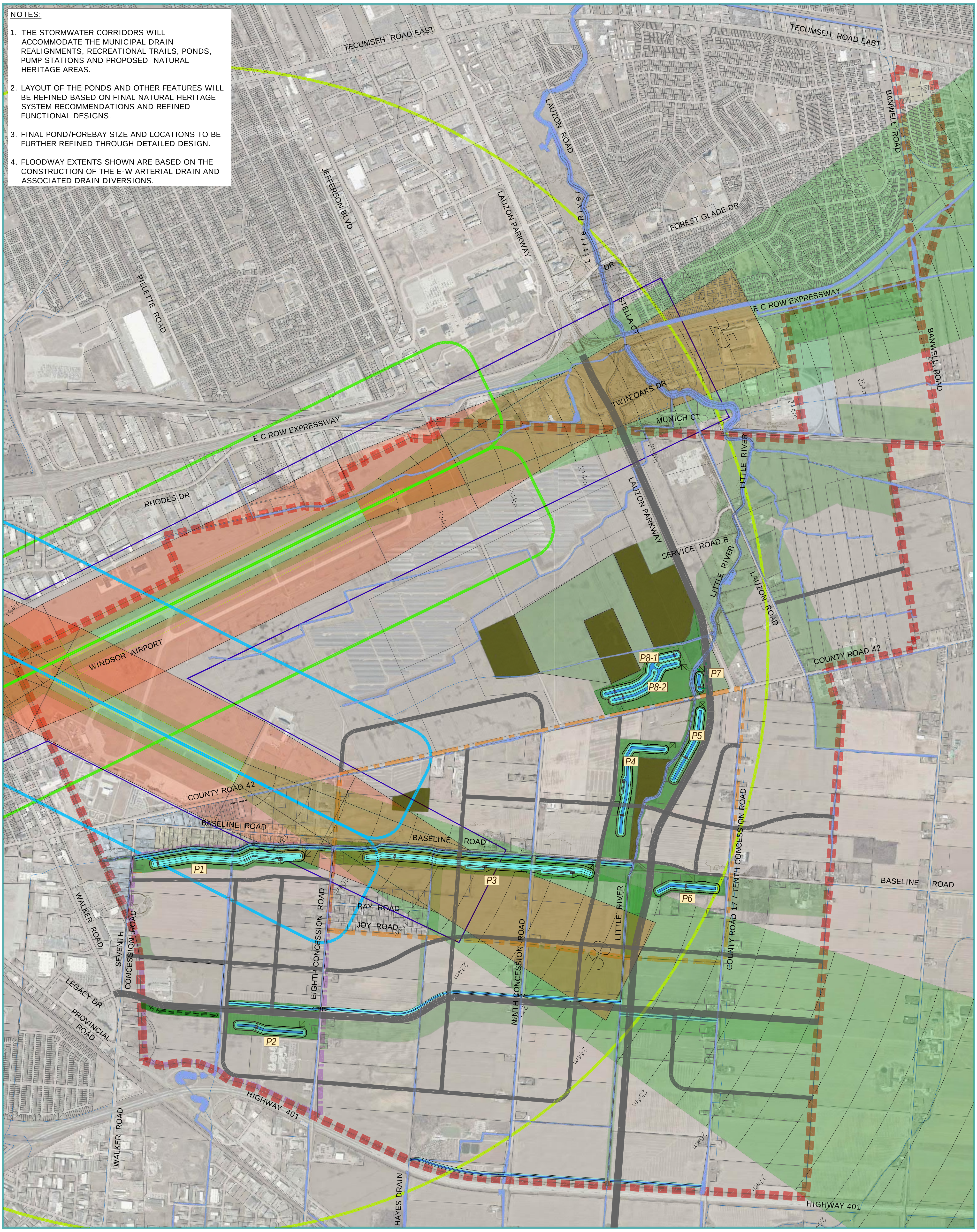
PROJECT: 19 9517

DATE: March 27, 2023

File Location: c:\pw working directory\projects 2019\10smz\dms20713\199817-10-ps site-con.dwg March 27, 2023 11:35 AM

NOTES:

1. THE STORMWATER CORRIDORS WILL ACCOMMODATE THE MUNICIPAL DRAIN REALIGNMENTS, RECREATIONAL TRAILS, PONDS, PUMP STATIONS AND PROPOSED NATURAL HERITAGE AREAS.
2. LAYOUT OF THE PONDS AND OTHER FEATURES WILL BE REFINED BASED ON FINAL NATURAL HERITAGE SYSTEM RECOMMENDATIONS AND REFINED FUNCTIONAL DESIGNS.
3. FINAL POND/FOREBAY SIZE AND LOCATIONS TO BE FURTHER REFINED THROUGH DETAILED DESIGN.
4. FLOODWAY EXTENTS SHOWN ARE BASED ON THE CONSTRUCTION OF THE E-W ARTERIAL DRAIN AND ASSOCIATED DRAIN DIVERSIONS.



🟥	STUDY AREA
🟪	EAST PELTON SPA
🟧	CR42 SPA
🟩	TRUNK STORM SEWER
🟦	1:100 YEAR FLOODWAY EXTENTS
⬛	FUTURE COLLECTOR AND ARTERIAL ROADS
▨	NATURAL HERITAGE AREA
P1	TYPICAL POND NAME
🟩	OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
⇦	PROPOSED STORM SEWER DRAINAGE
☒	STORMWATER PUMP STATION
🟦	STORMWATER MANAGEMENT POND- PERMANENT POOL
▢	STORMWATER MANAGEMENT POND - ACTIVE STORAGE
▬	MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

AIRPORT ZONES LEGEND

○	4 KM DIAMETER FROM AIRFIELD CENTRE (WILDLIFE CONTROL ZONE)
▢	TYPICAL TRAFFIC PATTERN (East-West)
▢	TYPICAL TRAFFIC PATTERN (North-South)
▢	OBSTACLE LIMITATION SURFACES (OLS)

SANDWICH SOUTH MASTER SERVICING PLAN

AIRPORT ZONE OVERLAY

FIGURE 5-7

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE: 1:12500
STATUS: FINAL
PROJECT: 19-9817

DATE: April 18, 2023

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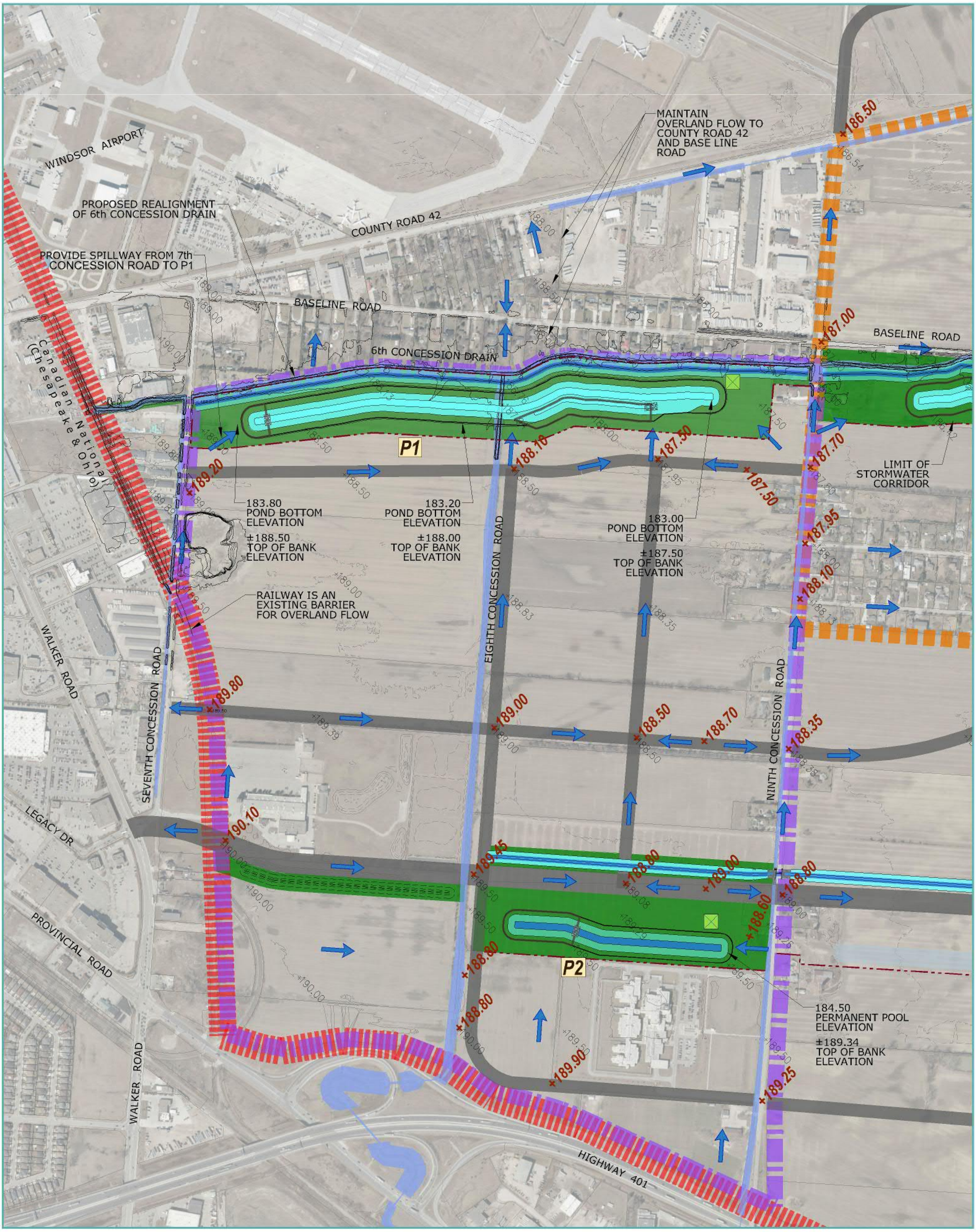

SANDWICH SOUTH MASTER SERVICING PLAN

SUGGESTED SITE GRADING FOR OVERLAND FLOOD ROUTE

EAST PELTON SPA

FIGURE 6-0

🟥	STUDY AREA
🟪	EAST PELTON SPA
🟧	CR42 SPA
+189.50	PROPOSED MINIMUM ROAD GRADE
× 190.00	EXISTING ROAD GRADE
→	OVERLAND FLOW DIRECTION
▬	FUTURE COLLECTOR AND ARTERIAL ROADS
☒	STORMWATER PUMP STATION
🟦	STORMWATER MANAGEMENT POND- PERMANENT POOL
▭	STORMWATER MANAGEMENT POND - ACTIVE STORAGE
▬	MUNICIPAL DRAIN RELOCATION OR NEW DRAIN
▬	1:100 YEAR FLOODWAY EXTENTS (EXISTING CONDITION)
P1	TYPICAL POND NAME

NOTE:
PROPOSED GRADES SHALL EXCEED MINIMUM REGULATORY FLOOD ELEVATION WHICH MAY BE REFERENCED FROM ERCA REGULATORY MAPPING

OVERLAND FLOW FOR PRIVATE PROPERTY AREAS SHALL BE DIRECTED TO THE MUNICIPAL RIGHT OF WAY ACCORDING TO THEIR ASSIGNED STORM WATER DRAINAGE AREA (REFER TO FIGURES F4-1, F4-2, AND F4-3).

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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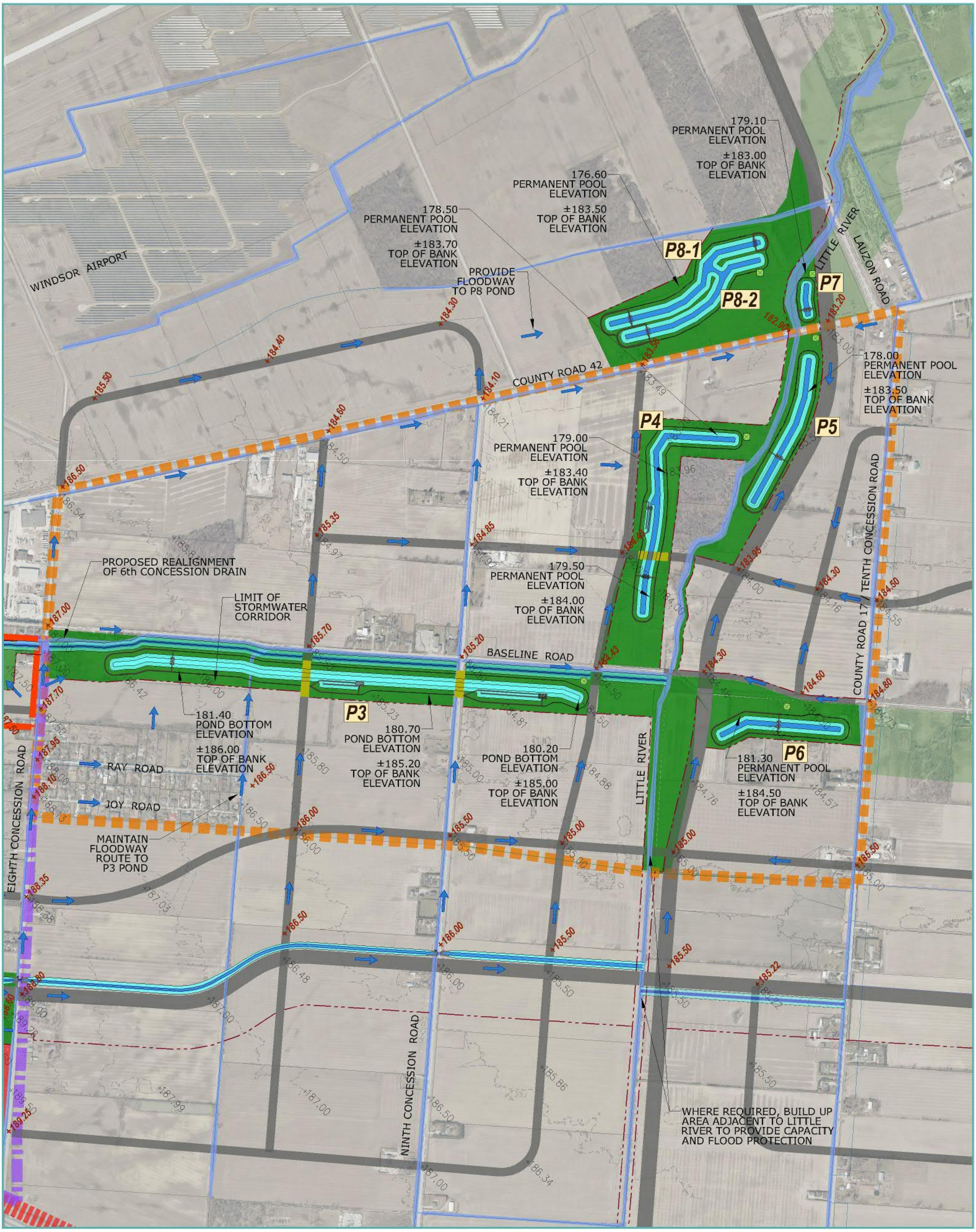
SCALE: 1:4000
STATUS: FINAL
PROJECT: 19-9817

DATE: April 28, 2023



🟥	STUDY AREA
🟪	EAST PELTON SPA
🟧	CR42 SPA
+189.50	PROPOSED MINIMUM ROAD GRADE
× 190.00	EXISTING ROAD GRADE
→	OVERLAND FLOW DIRECTION
▬	FUTURE COLLECTOR AND ARTERIAL ROADS
☒	STORMWATER PUMP STATION
🟦	STORMWATER MANAGEMENT POND- PERMANENT POOL
▭	STORMWATER MANAGEMENT POND - ACTIVE STORAGE
═	MUNICIPAL DRAIN RELOCATION OR NEW DRAIN
═	1:100 YEAR FLOODWAY EXTENTS (EXISTING CONDITION)
P1	TYPICAL POND NAME

NOTE:
PROPOSED GRADES SHALL EXCEED MINIMUM REGULATORY FLOOD ELEVATION WHICH MAY BE REFERENCED FROM ERCA REGULATORY MAPPING

OVERLAND FLOW FOR PRIVATE PROPERTY AREAS SHALL BE DIRECTED TO THE MUNICIPAL RIGHT OF WAY ACCORDING TO THEIR ASSIGNED STORM WATER DRAINAGE AREA (REFER TO FIGURES F4-1, F4-2, AND F4-3).

SANDWICH SOUTH MASTER SERVICING PLAN

SUGGESTED SITE GRADING FOR OVERLAND FLOOD ROUTE

CR42 SPA

FIGURE 6-1

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE: 1:6000
STATUS: FINAL
PROJECT: 19-9817

DATE: May 24, 2023

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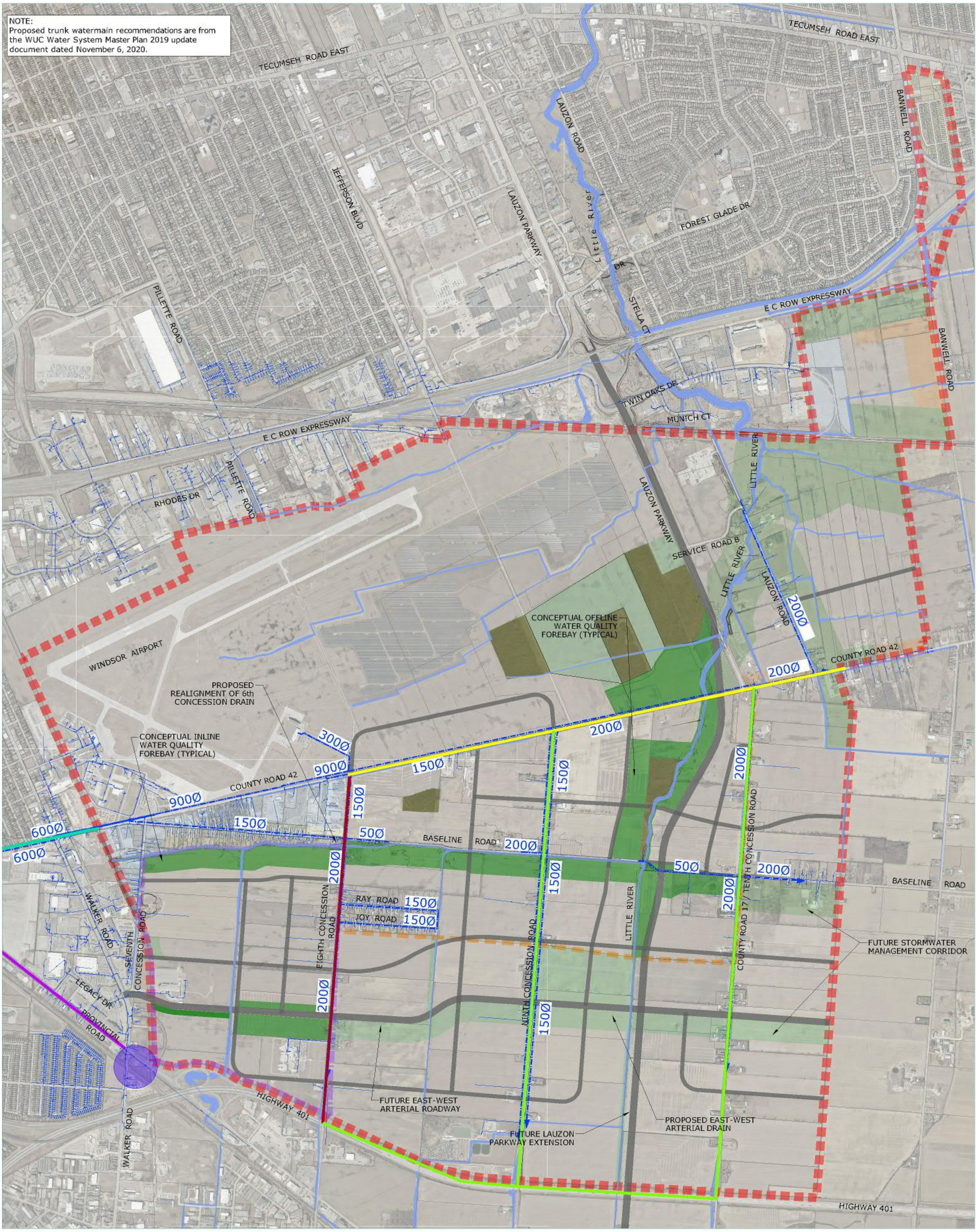

NOTE:
Proposed trunk watermain recommendations are from the WUC Water System Master Plan 2019 update document dated November 6, 2020.

SANDWICH SOUTH MASTER SERVICING PLAN

🟥 STUDY AREA
▬ EAST PELTON SPA
▬ CR42 SPA
🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
▬ FUTURE COLLECTOR AND ARTERIAL ROADS
▨ NATURAL HERITAGE AREA
▬ 1:100 YEAR FLOODWAY EXTENTS

— EXISTING WATERMAIN
● PROPOSED WATER TOWER
▬ WM 11 (PROVINCIAL ROAD), 600mm (2023)
▬ WM1b (COOK TO SYS), 900mm (2025)
▬ WM 5 (COUNTY ROAD 42), 600mm (2029)
▬ WM SANDWICH, 400mm (2039)
▬ WM SANDWICH 8TH, 600mm (2039)

EXISTING AND PROPOSED TRUNK WATERMAIN

FIGURE 7-0

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COO ROADINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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SCALE: 1:12500
STATUS: FINAL
PROJECT: 19-9817

DATE: May 24, 2023

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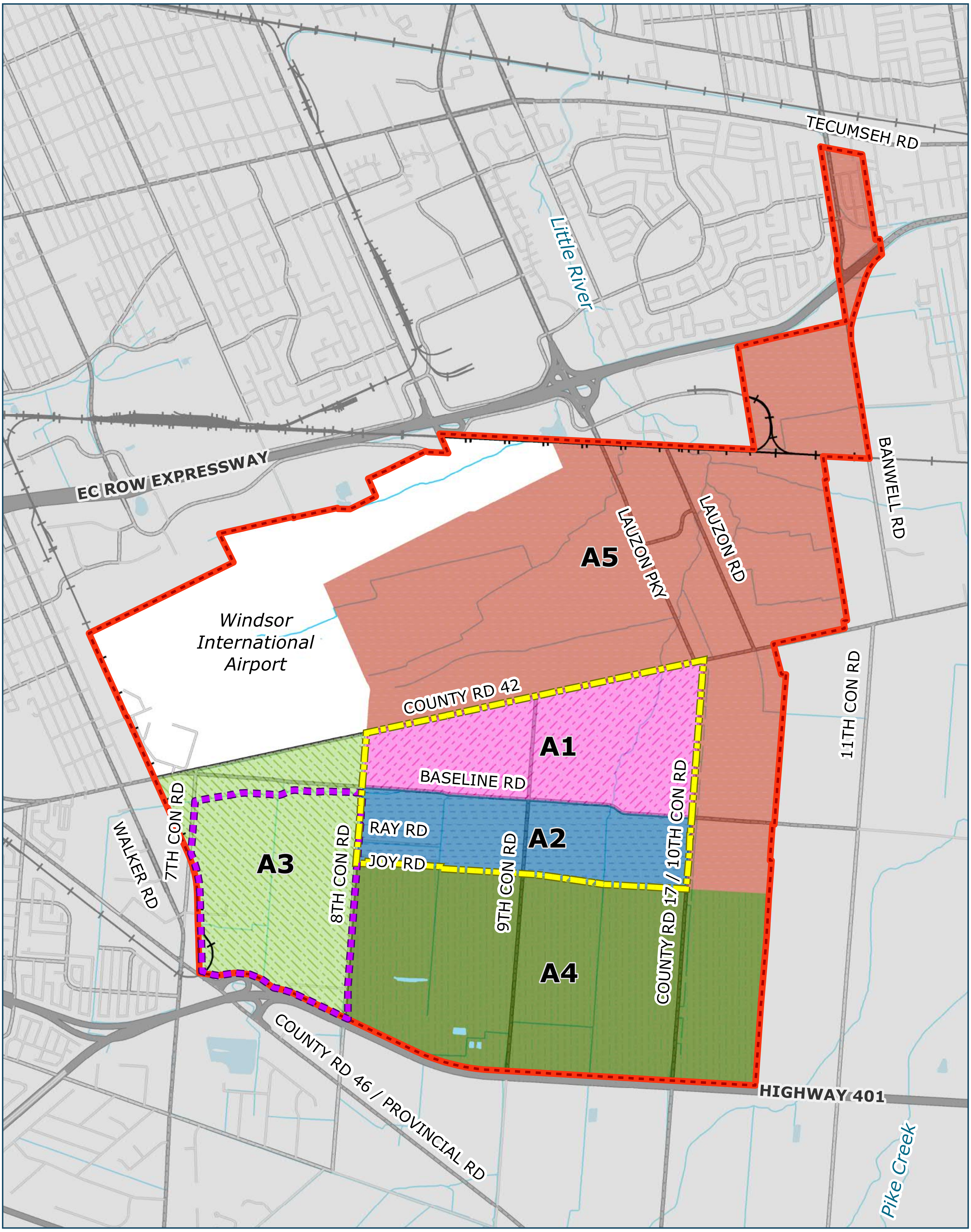

SANDWICH SOUTH
MASTER SERVICING PLAN

TRAFFIC ZONES

FIGURE 9-0

- 🟥 Sandwich South Study Area
- 🟨 County Road 42 Secondary Plan Area
- 🟪 East Pelton Secondary Plan Area
- ┼ Railway
- ─ Municipal Drain / Watercourse
- 🟦 Waterbody

Traffic Zone

- ▨ A1
- ▨ A2
- ▨ A3
- 🟩 A4
- 🟥 A5

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK
MAP CHECKED BY: SM
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR – DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO

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0 250 500 1,000 m

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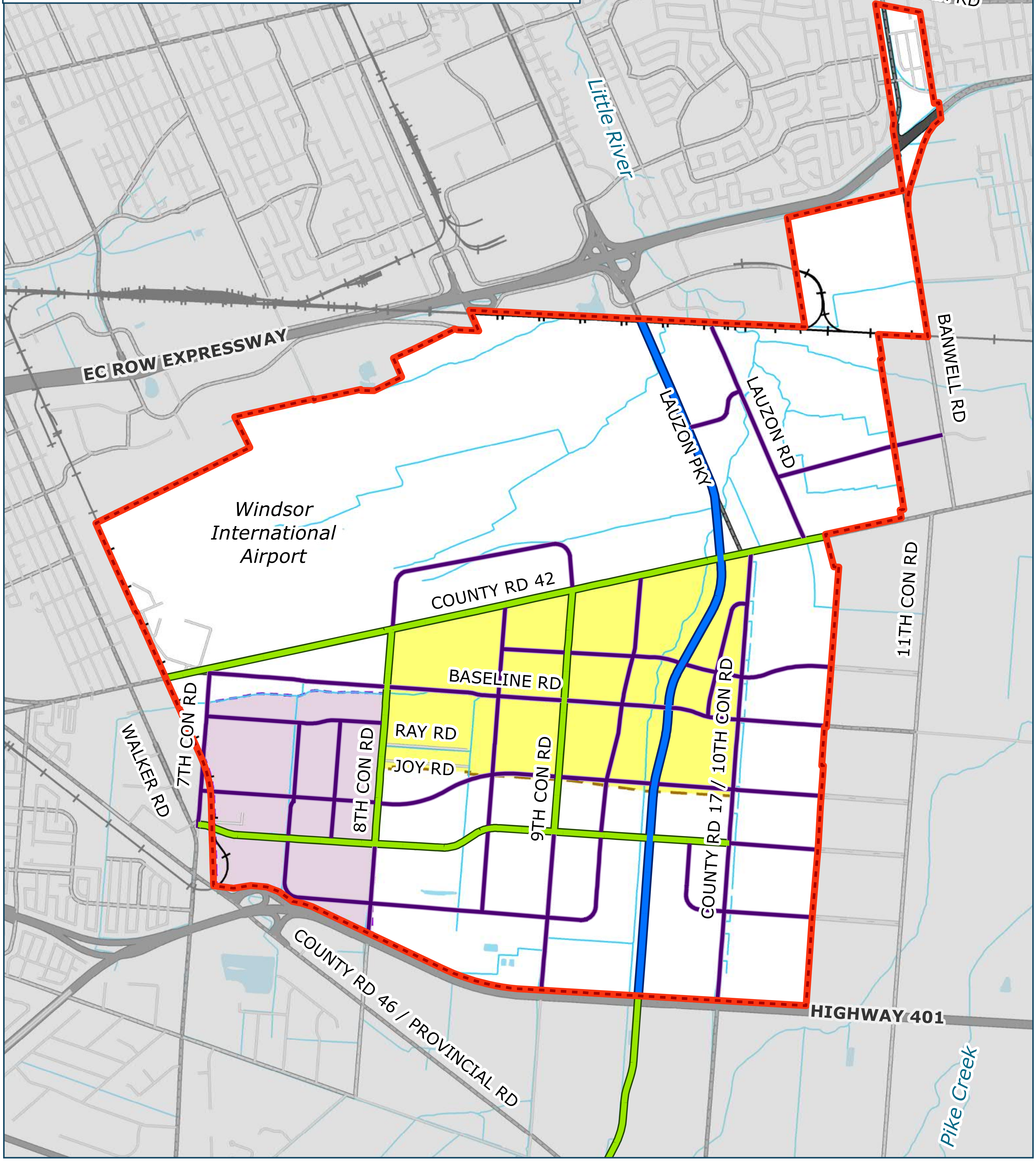
STATUS: FINAL
PROJECT: 19-9817
DATE: 2022-05-12

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\FINAL_REPORT\Transportation\FigX_Traffic_Zones.mxd

Note:
Additional future road connections to Banwell Road are proposed, refer to the Banwell Road Environmental Assessment (2016) and County Road 43/Banwell Road Class Environmental Assessment Study (2009).



🟥 Sandwich South Study Area
🟨 County Road 42 Secondary Plan Area
🟪 East Pelton Secondary Plan Area
🟦 Six-Lane Urban Roadway
🟩 Four-Lane Urban Roadway
━ Two-Lane Urban Roadway
┼ Railway
━ Municipal Drain / Watercourse
🟦 Waterbody

SANDWICH SOUTH
MASTER SERVICING PLAN

ULTIMATE ROAD NETWORK

FIGURE 9-1

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK
MAP CHECKED BY: SM
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR – DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO

**2019 IMAGERY - THE DIGITAL MAP LAYERS HAVE BEEN USED WITH THE EXPRESS PERMISSION OF THE CORPORATION OF THE COUNTY OF ESSEX

0 250 500 1,000 m

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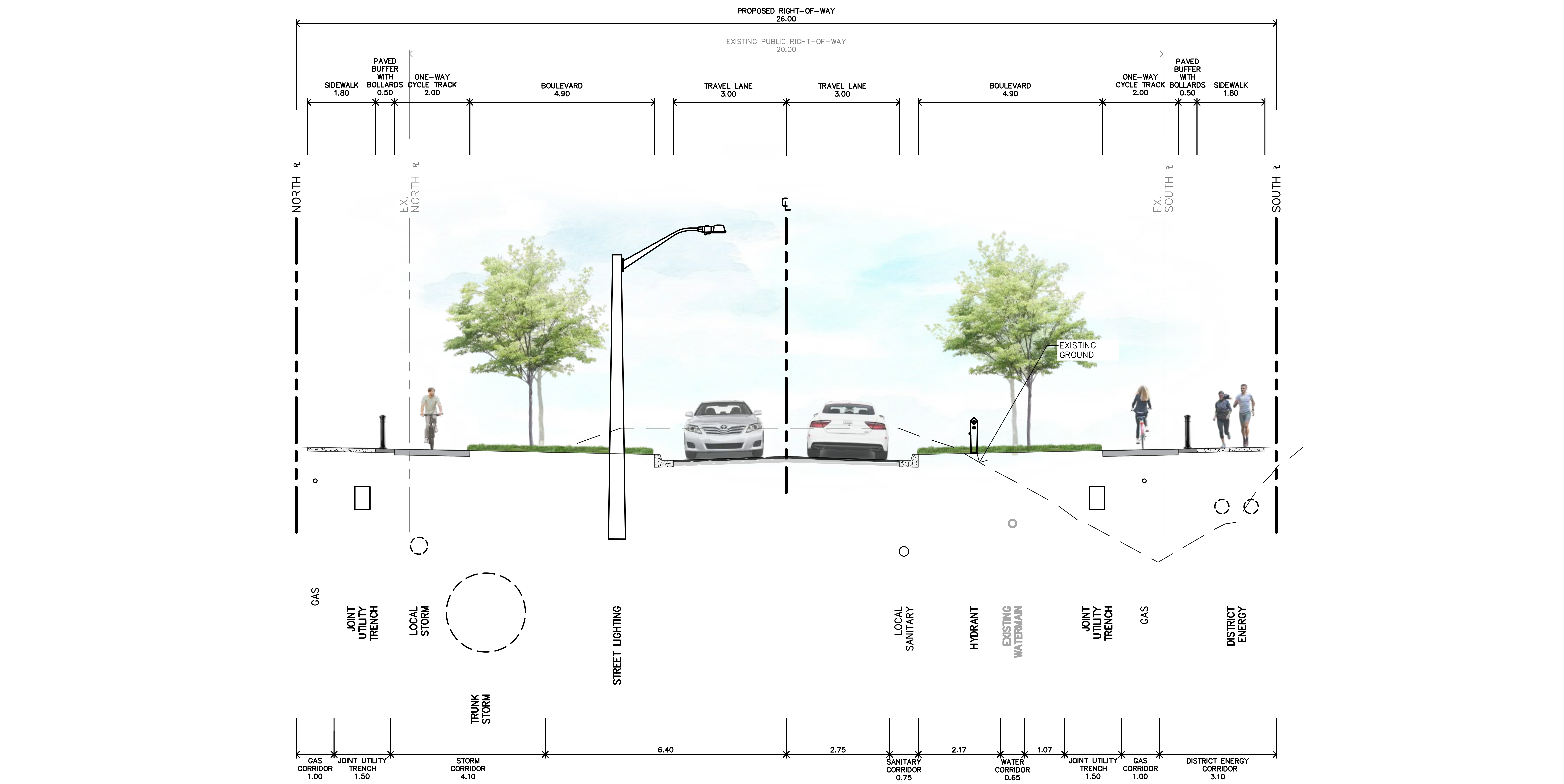
STATUS: FINAL
PROJECT: 19-9817
DATE: 2022-05-12

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\FINAL_REPORT\Transportation\FigX_Ultimate_Road_Network.mxd



SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION
BASELINE ROAD

EIGHTH CONCESSION ROAD TO LAUZON PARKWAY
(CYCLE TRACKS & SIDEWALKS)

FIGURE 9-2

THE CITY OF WINDSOR ONTARIO, CANADA

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MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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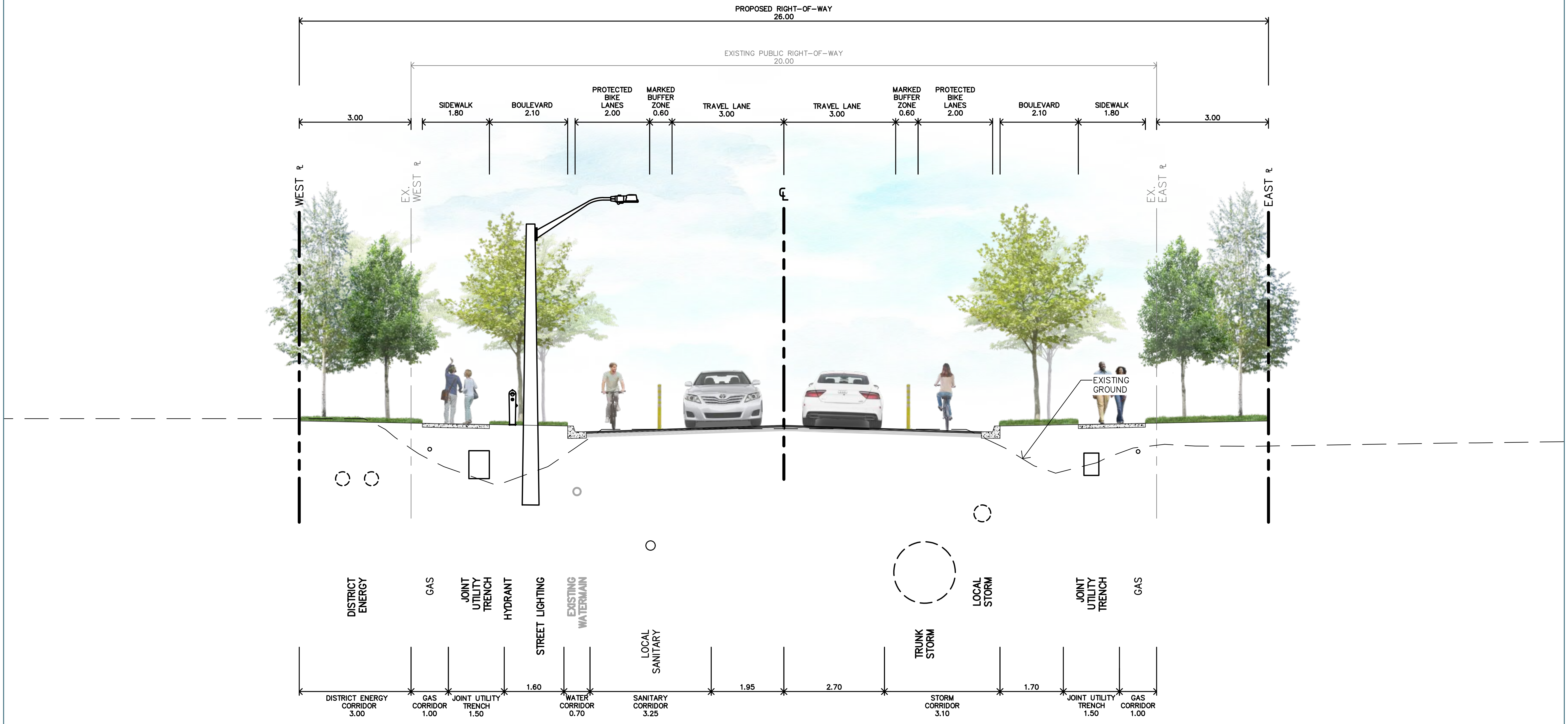
STATUS: FINAL
PROJECT: 19-9817
DATE: April 06, 2023

File Location: c:\pw working directory\projects 2019\31aab\dms70974\199817-02-pic-sections.dwg April, 06, 2023 3:02 PM



SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION
7th CONCESSION ROAD
(WITH PROTECTED BIKE LANES & SIDEWALKS)

FIGURE 9-3

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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STATUS: FINAL
PROJECT: 19-9817
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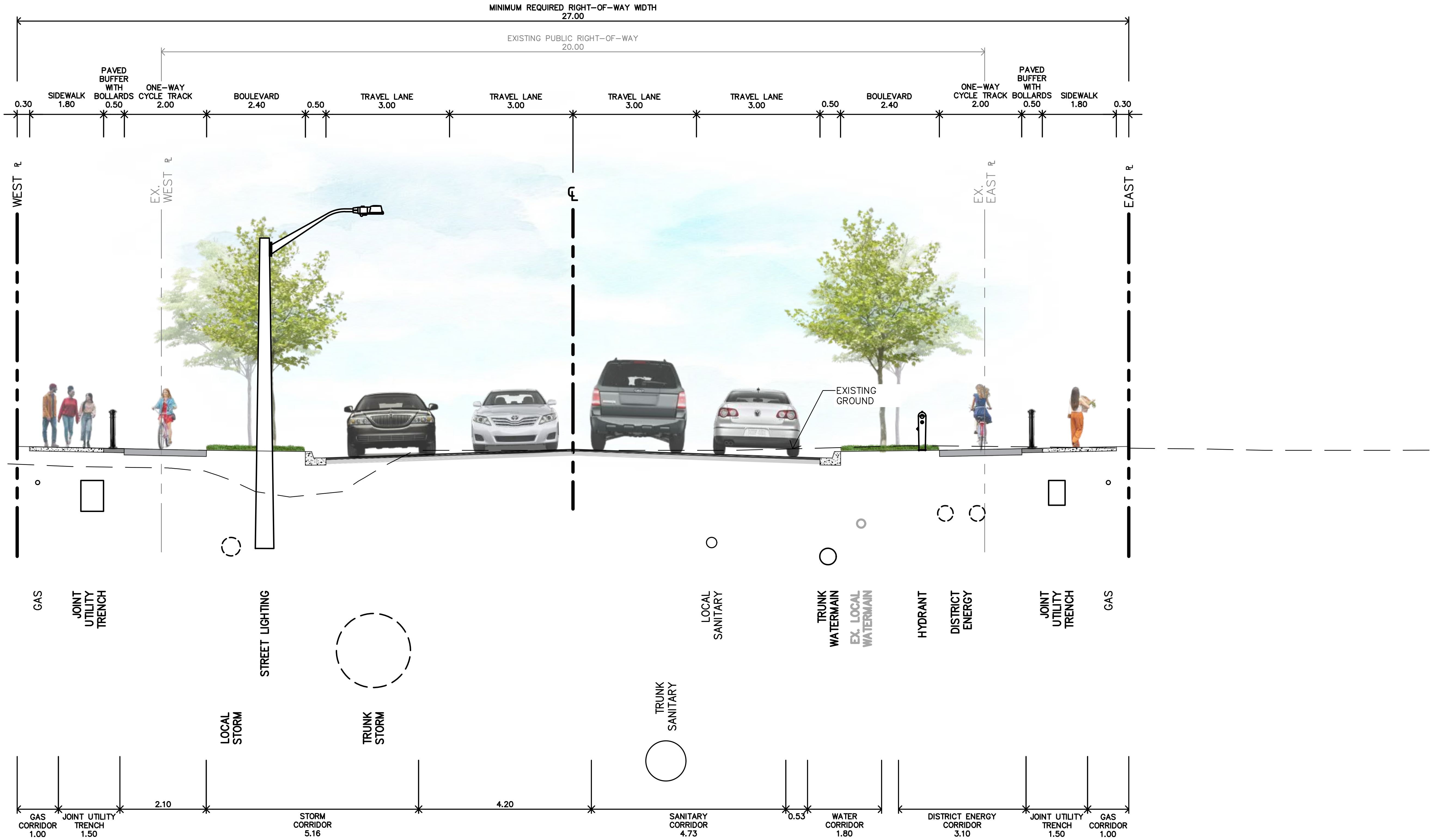

NOTE:
THE SSMSP TRANSPORTATION ANALYSIS (2023) NOTES THAT A TWO LANE CROSS SECTION ALONG 8th AND 9th CONCESSION WILL BE SUFFICIENT TO ACCOMODATE TRAFFIC DEMANDS RESULTING IN FULL BUILD OUT OF THE SSMSP AREA. THE NEED FOR TWO ADDITIONAL TRAVEL LANES SHALL BE EVALUATED AS DEVELOPMENT OCCURS WITHIN THIS AREA.
IT IS RECOMMENDED THAT THE LAND REQUIRED TO WIDEN THE EXISTING RIGHT OF WAY TO 26.0m SHALL BE RESERVED FOR FUTURE ROADWORKS.

SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION
8th CONCESSION ROAD
(CYCLE TRACKS & SIDEWALKS)
FIGURE 9-4

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO.
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SCALE
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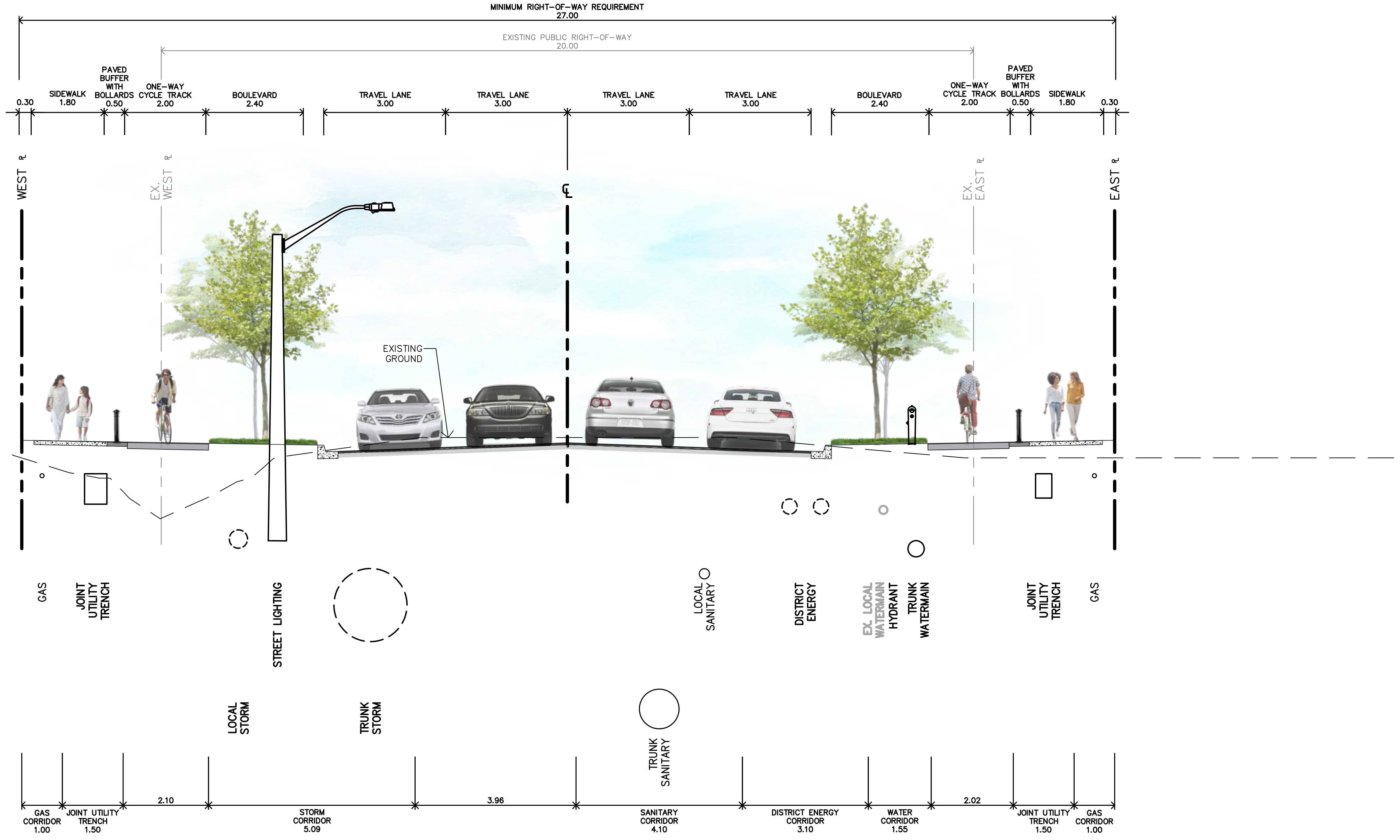
STATUS: FINAL
PROJECT: 19-9817
DATE: April 06, 2023

File Location: c:\pw working directory\projects 2019\31aab\dms70974\199817-02-pic-sections.dwg April, 06, 2023 3:28 PM



NOTE:
THE SSMSP TRANSPORTATION ANALYSIS (2023) NOTES THAT A TWO LANE CROSS SECTION ALONG 8th AND 9th CONCESSION WILL BE SUFFICIENT TO ACCOMODATE TRAFFIC DEMANDS RESULTING IN FULL BUILD OUT OF THE SSMSP AREA. THE NEED FOR TWO ADDITIONAL TRAVEL LANES SHALL BE EVALUATED AS DEVELOPMENT OCCURS WITHIN THIS AREA.
IT IS RECOMMENDED THAT THE LAND REQUIRED TO WIDEN THE EXISTING RIGHT OF WAY TO 26.0m SHALL BE RESERVED FOR FUTURE ROADWORKS.

SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION
9th CONCESSION ROAD
(CYCLE TRACKS & SIDEWALKS)

FIGURE 9-5

THE CITY OF WINDSOR
ONTARIO, CANADA

DILLON
CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO.
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SCALE
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STATUS: FINAL
PROJECT: 19-9817
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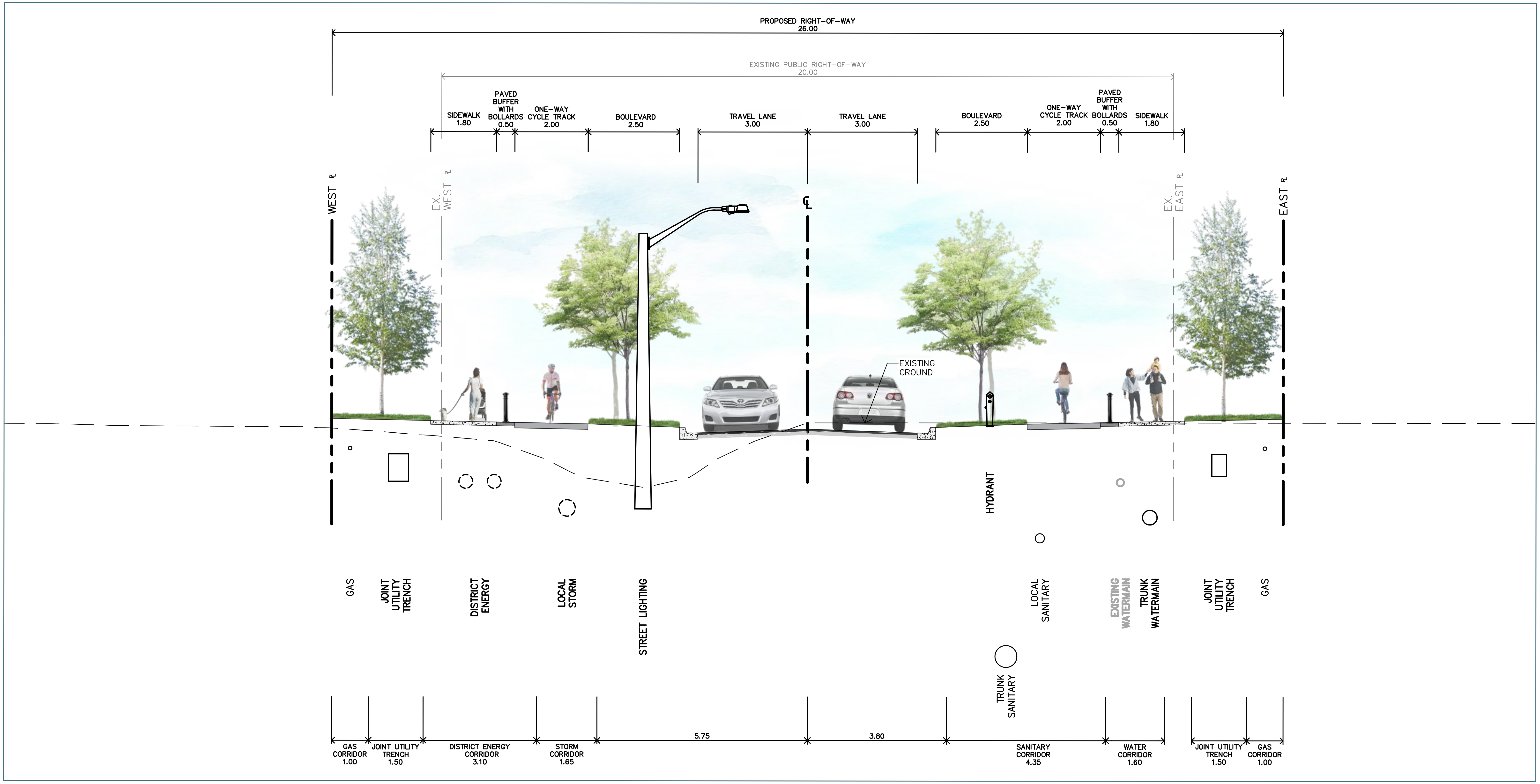

SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION 10th CONCESSION ROAD

(CYCLE TRACKS & SIDEWALKS)

FIGURE 9-6

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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STATUS: FINAL PROJECT: 19-9817 DATE: April 06, 2023

File Location: c:\pw working directory\projects 2019\31aab\dms70974\199817-02-pic-sections.dwg April, 06, 2023 3:41 PM

SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION CLASS II URBAN COLLECTOR OPTION 01

(CYCLE TRACKS & SIDEWALKS)

FIGURE 9-7

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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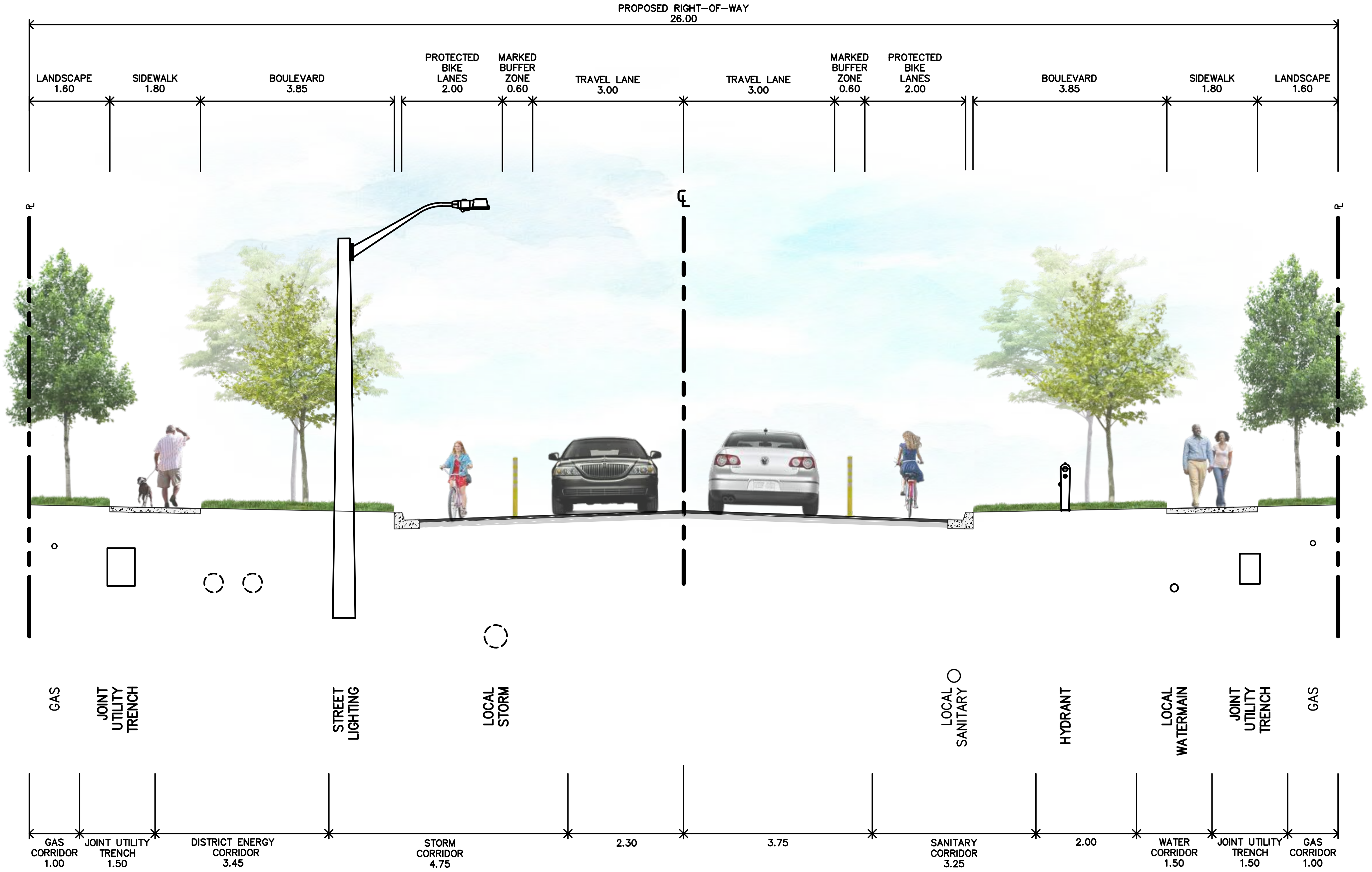
STATUS: FINAL
PROJECT: 19-9817
DATE: April 06, 2023



SANDWICH SOUTH MASTER SERVICING PLAN

CONCEPTUAL ROAD CROSS SECTION CLASS II URBAN COLLECTOR OPTION 02

(PROTECTED BIKE LANES & SIDEWALKS)

FIGURE 9-8

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: JTB
MAP CHECKED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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STATUS: FINAL
PROJECT: 19-9817
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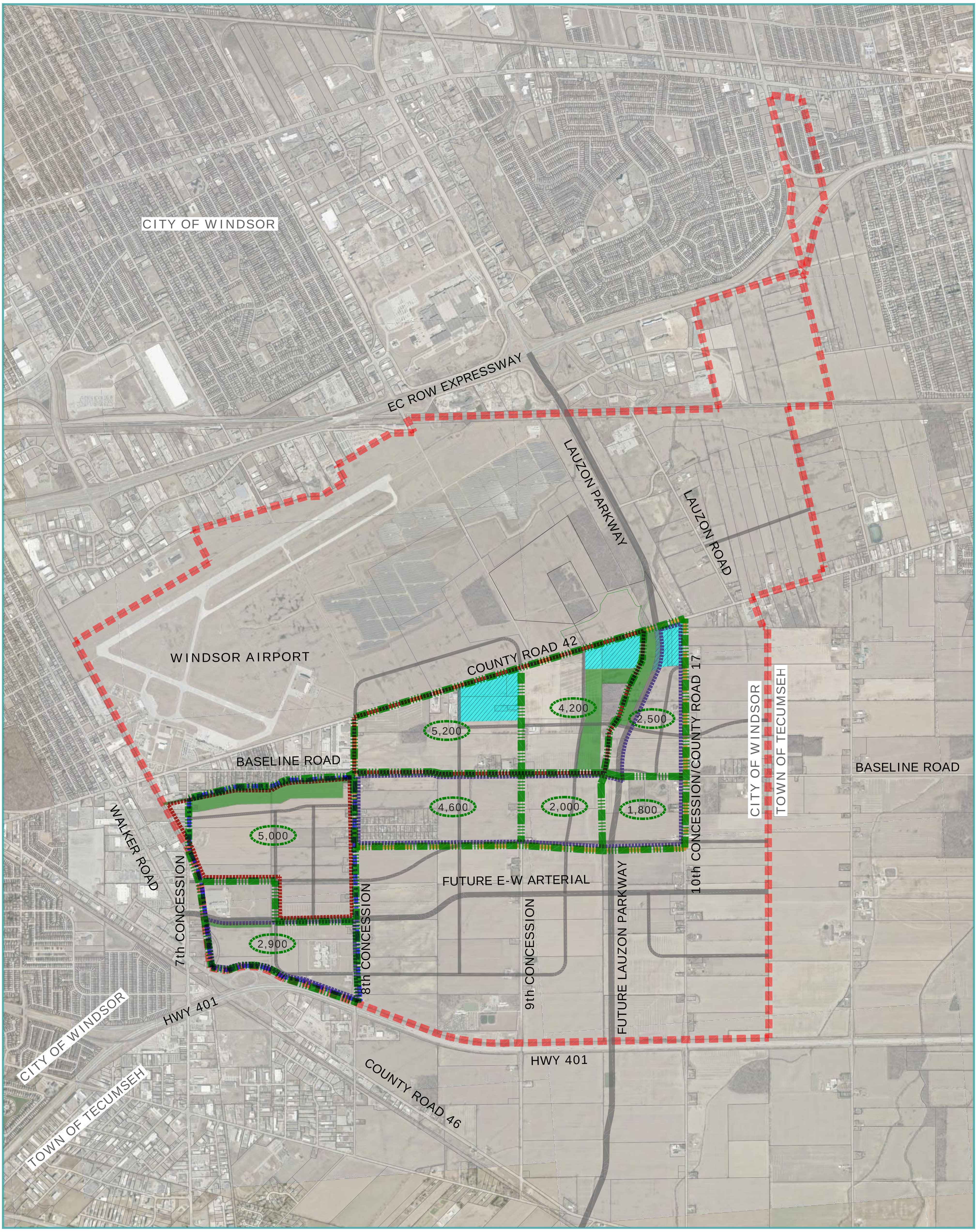

SANDWICH SOUTH
MASTER SERVICING PLAN

STAGING & IMPLEMENTATION MAP

FIGURE 10-0

LEGEND

- 🟥 Sandwich South Project Boundary
- ▭ County Road 42 Secondary Plan Area
- ▭ East Pelton Secondary Plan Area
- ▭ Phase 1 Estimated Development Boundary
- ▭ Phase 2 Estimated Development Boundary
- 2,000 Estimated Population Under Full Build-Out
- 🟩 Population Area Boundary

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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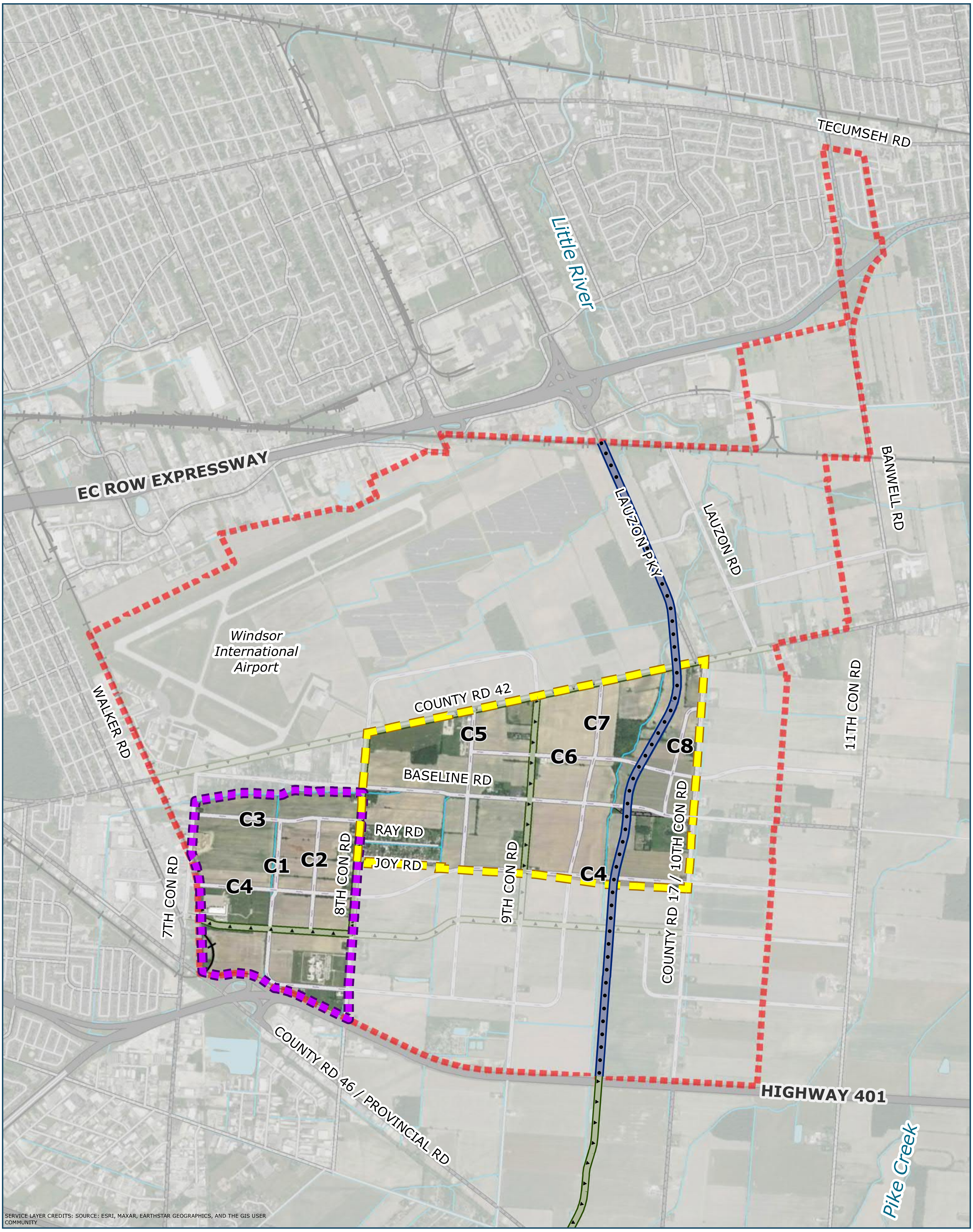
SCALE: 1:15000
STATUS: FINAL
PROJECT: 19-9817

DATE: April 18, 2023

File Location: c:\pw working directory\projects 2019\32rbh\dms76053\19-9817 proposed land use.dwg April, 18, 2023 1:41 PM



SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

SANDWICH SOUTH
MASTER SERVICING PLAN

- 🟨 County Road 42 Secondary Plan Area
- 🟪 East Pelton Secondary Plan Area
- 🟥 Sandwich South Study Area
- ▬ Six-Lane Urban Roadway
- ▬ Four-Lane Urban Roadway
- ▬ Two-Lane Urban Roadway
- ┼ Railway
- ─ Municipal Drain / Watercourse
- 🟦 Waterbody
- **C1** Proposed Future Road Identifier

STAGING PLAN - PROPOSED COLLECTOR ROADS

FIGURE 10-1

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: LK
MAP CHECKED BY: RHB / LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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STATUS: FINAL
PROJECT: 19-9817
DATE: 2023-04-06

File Path: K:\2019\199817-Sandwich_S_LittleRiver\GIS\MXDs\SandwichSouth\Reporting\Transportation\FunctionalDesign\Fig_Functional Design_Final.mxd

Appendix F - 1

Preliminary Geotechnical Assessment

REPORT

Preliminary Geotechnical Assessment

Sandwich South Lands, Windsor, Ontario

Submitted to:

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Dillon Consulting Limited
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Submitted by:

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19120633-R01-Rev0
January 2020

Distribution List

1 E-Copy: Dillon Consulting Ltd.

1 E-Copy: Golder Associates Ltd.

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FIGURES

APPENDICES

1.0 INTRODUCTION

This report provides the results of a preliminary geotechnical assessment carried out for the Sandwich South Lands in Windsor, Ontario as part of the Sandwich South Master Servicing Report and Little River Watershed Flood Plan Mapping currently being undertaken. The Sandwich South Lands cover approximately 2,600 hectares and are generally bounded by Walker Road to the west, properties fronting County Road 17 to the east (South of County Road 42), Banwell Road to the east (north of county Road 42), Highway 401 to the south, and the northern limit of the Windsor Airport Lands to the north. The lands were transferred from the Town of Tecumseh to the City of Windsor in 2002 for the purpose of satisfying the future growth needs of the City.

There is currently development pressure for areas within the Sandwich South Lands, including residential development and, as such, the Sandwich South Master Servicing Report and Little River Watershed Flood Plain Mapping Report are required before any proposed development plans can be appropriately reviewed.

The purpose of this geotechnical assessment was to evaluate the subsurface soil and groundwater conditions within the Sandwich South Lands based on available topographic and geological mapping, historical aerial photographs and borehole and test pit data from previous geotechnical work conducted in the general vicinity, and provide preliminary geotechnical engineering recommendations for the design of sewer and water supply services including: excavations and installations, backfill, pipe bedding, and stormwater management facilities. In addition, recommendations for additional site-specific geotechnical exploration and testing are provided.

Authorization to proceed with the preliminary geotechnical assessment, in accordance with our March 26, 2019 proposal, was provided by Ms. Nicole Caza, P.Eng., of Dillon Consulting Limited by a work order dated May 21, 2019.

This report should be read in conjunction with the attached document “Important Information and Limitations of this Report”, which comprises an integral component hereof. The reader’s attention is specifically drawn to this material, as it is essential for proper use and interpretation of the information presented and discussed herein.

2.0 BACKGROUND

Golder Associates Ltd. (“Golder”) has previously carried out multiple investigations in the general vicinity of the Sandwich South Lands. The results of the geotechnical work were provided in the following reports:

- Golder Report No. 754081 titled “Subsurface Investigation, Proposed Husky Oil Car/Truck Stop Highway 401, County Road 46, Essex County, Ontario”, dated July 1975;
- Golder Report No. 801-4004 titled “Geotechnical Investigation, Proposed Reconstruction of Pillette Road from Plymouth Road to C.N./C.P. Railway, Windsor, Ontario”, dated February 1980;
- Golder Report No. 831-4062 titled “Geotechnical Survey, Proposed Two-Bay Addition to Existing Garage (Unheated) at Windsor Airport, Southern Ontario Task Request No. 29-83-1, Windsor, Ontario”, dated August 1983;
- Golder Report No. 861-4147 titled “Geotechnical Investigation, Proposed Warehouse Structure, County Road 42, Part Lot 16, Concession VI, Township of Sandwich South”, dated October 1986;
- Golder Report No. 901-4269 titled “Geotechnical Investigation, Twin Oaks Industrial Park, City of Windsor”, dated December 1990;

- Golder Report No. 961-4043 titled “Geotechnical Investigation, Rhodes Drive Sanitary Sewer, Pillette Road to Jefferson Boulevard, Windsor, Ontario”, dated June 1996;
- Golder Report No. 961-4114 titled “Geotechnical Investigation, Proposed Twin Oak Industrial Park, Phase I, Windsor, Ontario”, dated August 1996;
- Golder Report No. 971-4045 titled “Geotechnical Investigation, Anchor Lamina Inc., World Headquarters, Windsor, Ontario”, dated April 1997;
- Golder Report No. 971-4135 titled “Geotechnical Investigation, Proposed Sikh Temple (Gurdwara), County Road 42, Township of Sandwich South, Ontario”, dated June 1997;
- Golder Report No. 971-4236 titled “Geotechnical Investigation, Proposed Riverview Steel Co. Plant, Twin oaks Industrial Park, Windsor, Ontario”, dated October 1997;
- Golder Report No. 981-4341 titled “Geotechnical Investigation, Proposed Monopole Tower, Site No ON-820, Provincial and Walker Roads, Windsor, Ontario”, dated January 1999;
- Golder Report No. 991-4228 titled “Geotechnical Investigation, Proposed Additional Track Capacity, Canadian Pacific Railway, Walker Road to Lauzon Parkway, City of Windsor/Town of Tecumseh, Ontario”. Dated November 1999;
- Golder Report No. 001-4112 titled “Geotechnical Investigation, Proposed Industrial Building, Twin Oaks Industrial Park, Windsor, Ontario”, dated May 2000;
- Golder Report No. 001-4195 titled “Geotechnical Investigation, Walker Road Widening, North Roseland Subdivision, Windsor, Ontario”, dated August 2000;
- Golder Report No. 001-4327 titled “Geotechnical Investigation, Proposed Exkor Manufacturing Plant, Valtec Court, Twin Oaks Industrial Park, Windsor, Ontario”, dated January 2001;
- Golder Report No. 011-4121 titled “Geotechnical Investigation, Walker Road Widening and Reconstruction, Phase 3, Division Road to Legacy Park Drive, Windsor, Ontario”, dated May 2001;
- Golder Report No. 031-140357 titled “Geotechnical Investigation, Proposed East Banwell Road Development, Windsor, Ontario”, dated January 2004;
- Golder Report No. 041-140173 titled “Geotechnical Investigation, Walker Road Reconstruction, Legacy Park Drive to Highway 401, Windsor, Ontario” dated October 12, 2004;
- Golder Report No. 06-1140-021 title “Geotechnical Investigation, Sanitary Servicing of Annexed Lands and Town of Tecumseh Lands Phase 1A and 3, Windsor, Ontario”, dated April 24, 2006;
- Golder Report No. 06-1140-248 titled “Geotechnical Investigation, 600 Millimetre Diameter Feedermain, Banwell Road and County Road 42, Town of Tecumseh, Ontario”, dated December 2006;
- Golder Letter No. 07-1140-0030 titled “Exploratory Boreholes, Various Streets, Windsor, Ontario”, dated March 28, 2007;
- Golder Report No.07-1140-0031 titled “Geotechnical Investigation, Proposed Commercial Development, Tecumseh Road East at Southfield Drive, Town of Tecumseh, Ontario” dated April 3, 2007;

- Golder Report No. 07-1140-0178 titled “Preliminary Geotechnical Investigation, Lots 14 to 18, Part Lots 12, 13, and 20, Registered Plan 65 and Part Lots 139, 140 and 141, Concession 3, Former Township of Sandwich South, City of Windsor, Ontario”, dated October 26, 2007;
- Golder Report No. 08-1140-W041 titled “Geotechnical Investigation, Proposed Retail Development, 3800 Block of Walker Road, Windsor, Ontario”, dated April 25, 2008;
- Golder Report No. 08-1140-W044 titled “Geotechnical Investigation, Watermain Replacement, North Service Road at the CP Rail Crossing, City of Windsor, Ontario”, dated May 16, 2008;
- Golder Report No. 08-1140-W125 titled “Geotechnical Investigation, Proposed Site Servicing and Road Work, Shields Avenue East of Banwell Road, Town of Tecumseh, Ontario”, dated September 11, 2008;
- Golder Report No. 09-1140-1122-R01 titled “Test Pit Investigation, Royal Timbers Commercial Development, Windsor, Ontario”, dated May 2010;
- Golder Report No. 10-1140-0096-R01 titled “Geotechnical Investigation, Highway 401 Undercrossing, Trunk Sanitary Sewer, 8th Concession Road, Windsor, Ontario”, dated December 2010;
- Golder Report No. 10-1140-0251-R01 titled “Geotechnical Investigation, Walker Road Reconstruction, Digby Street to Division Road, Windsor, Ontario”, dated February 2011;
- Golder Report No. 12-1140-0094-R01 titled “Geotechnical Investigation, Husky Facility #9105, New Cardlock, Retail Canopy Structures and Facility Sign, Town of Tecumseh, Ontario”, dated November 2012;
- Golder Report No. 12-1140-0207-R01 titled “Geotechnical Investigation, Proposed Retail Building, 3472 Walker Road, Windsor, Ontario”, dated October 2012;
- Golder Report No. 13-1140-0110-R01 titled “Geotechnical Investigation, Proposed Culvert Replacement, County Road 43 at Sullivan Creek (C-43-045), Town of Tecumseh, Ontario”, dated July 2013;
- Golder Report No. 13-1140-0187-R01 titled “Geotechnical Investigation, Proposed Multi-Modal Cargo Facility, Windsor, Ontario”, dated October 2013;
- Golder Report No. 13-1140-0187-Ph2000-R01 titled “Supplementary Geotechnical Investigation, Proposed Multi-Modal Cargo Facility, Windsor, Ontario”, dated February 2014;
- Golder Report No. 1411749-R01 titled “Baseline Road Realignment (14-03551), 11th Concession Road to Sullivan Creek, Town of Tecumseh, Ontario”, dated October 2014;
- Golder Report No. 1403551-R01 titled “Geotechnical Investigation, Proposed Bridge Replacement, Baseline Road over Sullivan Creek, Bridge #1006, Town of Tecumseh, Ontario”, dated May 2014;
- Golder Report No. 14-1140-0005-R01 titled “Geotechnical Investigation, 6th Concession Drain Bank Failure, Baseline Road between 8th and 9th Concession Roads, Windsor, Ontario”, dated February 2014;
- Golder Report No. 1526237-1000-R01 titled “Preliminary Geotechnical and Hydrogeological Investigation, County Road 42 at ninth Concession Road, Windsor, Ontario”, dated May 2015; and
- Golder Report No. 1658070-R01 titled “Geotechnical Investigation, Tecumseh Road and Lesperance Road, Streetscape Improvements, Tecumseh, Ontario”, dated December 2016;

Relevant Record of Borehole and Test Pit Sheets from the above-listed Golder reports are attached in Appendix A and the approximate borehole and test pit locations are shown on Figures 2 to 6.

3.0 METHODOLOGY

The preliminary geotechnical assessment consisted of compiling and conducting a detailed review of the following:

- Available topographic mapping;
- Surficial soil and bedrock geological mapping;
- Aerial photos of various vintages; and
- Existing geotechnical reports available for the area of the site (as listed above).

4.0 SITE DESCRIPTION

The subject Sandwich South Lands cover approximately 2,600 hectares and are generally bounded by Walker Road to the west, properties fronting County Road 17 to the east (South of County Road 42), Banwell Road to the east (north of county Road 42), Highway 401 to the south, and the northern limit of the Windsor Airport Lands to the north. The ground surface within the study area is generally flat with ground surface elevations varying between approximately 180 and 190 metres.

The land use within the study area is mainly agricultural. However, the study area contains the Windsor International Airport, and also includes areas of residential, commercial, and industrial development.

5.0 SITE GEOLOGY

The project area is located in the physiographic region of Southwestern Ontario known as the St. Clair Clay Plains. Within this region, Essex County and the southwestern part of Kent County are normally discussed as a sub-region known as the Essex Clay Plain (Chapman and Putnam, 1984). The clay plain was deposited during the retreat of ice sheets (late Pleistocene Era) when a series of glacial lakes inundated the area.

In general, the ice sheets deposited materials with a glacial-till-like gradation in the area of Windsor. Depending on the locations of the glacial ice sheets and depths of water in the ice-contact glacial lakes, the materials may have been directly deposited at the contact between the ice sheet and the bedrock or, as the lake levels rose and the ice sheets retreated and floated, the soil and rock debris within and at the base of the ice were deposited through the lake water (glaciolacustrine depositional environment). The term “glacial till”, in its common usage, often indicates a very dense or hard composition resulting from consolidation and densification under the weight of the ice sheet and the mineral soil particles typically have a distribution of grain sizes ranging from cobbles to clay. In many areas of Windsor, however, the majority of the soils described as “glacial till” were deposited through water and have a soft to firm consistency below a “crust” that has since become stiff to hard through weathering and desiccation.

The quaternary geology mapping from the Ontario Department of Mines Preliminary Geological Map No. 3253 titled “Quaternary Geology, Essex Count Area (West Half), Southern Ontario”, dated 1994 indicates that the predominant soil type within the project area is Pleistocene deposits consisting of glaciolacustrine silty clay and clayey silt till. In portions of the study area, the till deposits are overlain by a thin discontinuous cover of glaciolacustrine sand. Localized deposits of modern alluvium and glaciofluvial sands and gravels are also present. The quaternary geology of the study area is shown on Figure 7.

The bedrock underlying the study area is reported to consist of Middle Devonian limestone, dolostone, and shale of the Hamilton Group and Dundee Formation. Available bedrock depth mapping from the Ontario Ministry of Northern Development and Mines Map No. P.3255 titled “Drift Thickness, Essex County Area (West Half)”, dated 1994 indicates a bedrock depth of between approximately 20 and 65 metres below the ground surface with the project area .

6.0 HISTORICAL AERIAL PHOTOGRAPHS

Aerial photographs of the Sandwich South Lands area from 1930, 1947, 1953, 1962, 1970, 1982, 1983, 1992, and 1995 were obtained and reviewed. Aerial photography from 2004 and 2017 was reviewed via the County of Essex MapViewer digital mapping online resource. These aerial photographs were reviewed in order to develop a history of the development of the site and surrounding properties.

The 1930 aerial photograph of the north west portion of the site, along with photographs from 1947, show the site and the majority of the surrounding properties as predominantly agricultural land. By 1947, the Windsor International Airport was under construction. By 1953, the airport appeared to have been completed, with an eastward extension to the runway visible in the 1977 aerial photograph.

Surrounding areas developed gradually from inferred residential/agricultural land use in the 1930s to 1960s. North of the airport land, light industrial/commercial properties were developed from the mid-1970s to present. Surrounding property use appeared in the present-day configuration as depicted in the 2017 aerial image. A solar energy generating facility was construction on the Windsor airport lands prior to 2017.

7.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes and test pits advanced within the subject portion of the Sandwich South Lands and within the general project vicinity are detailed on the attached Record of Borehole and Record of Test Pit sheets in Appendix A. The soil boundaries indicated are inferred from non-continuous samples and observations of drilling and sampling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, subsurface conditions may vary significantly between and beyond the borehole locations. It should be noted that the subsurface soil and groundwater conditions discussed in this report are based on previous boreholes from investigations dated as early as 1975 and may have been altered by subsequent development and infrastructure construction. In addition, some of the available information is from outside of the immediate area of the site. The available information from previous investigations is concentrated toward the north, west, and central portions of the study area, with limited information available for the southeast section of the study area.

Based on our review of the available information, the soil conditions within the Sandwich South Lands likely consist of fill or organic surficial soils overlying an extensive deposit of glaciolacustrine silty clay/clayey silt (often referred to as till). Where boreholes were advanced off the existing road alignments in areas of previous development and construction activity, soils may consist of fill of varying composition (silt, sand, clay, organics, deleterious materials, etc.), placed over topsoil in some areas, and of variable depth. Topsoil is expected to overly the silty clay off the roadways in areas not subjected to previous development activity and in areas of agricultural use. In some areas, relatively thin layers of sand and silty sand were present overlying the silty clay/clayey silt. The underlying silty clay/clayey silt contained occasional embedded sand and silt layers. In the roadways, surficial soils are expected to consist of the pavement structure and fill materials overlying the native soils.

Perched groundwater is likely present within the surficial granular fill soils and native sand/silty sand layers (where present) overlying the lower-permeability cohesive materials.

Based on our review of readily available geotechnical and geological data, the subsurface conditions below the fill materials within the Sandwich South Lands appear to be generally consistent with the geological and surficial soils mapping (as shown on Figure 7).

8.0 DISCUSSION

This section of the report provides our interpretation of the available geotechnical data and it is intended for the guidance of the design engineer during conceptual design within the context of the overall geotechnical assessment. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project.

Based on our understanding of the Sandwich South Lands Master Servicing Report and Little River Watershed Flood Plan Mapping requirements, preliminary geotechnical engineering recommendations are required for the design of sewer and water supply services including excavations and installations, pipe bedding, backfill, and stormwater management facilities. In addition, recommendations for additional site-specific geotechnical exploration and testing are provided.

8.1 Excavations

Excavations for the servicing works at this site will generally encounter existing pavement structures, surficial topsoil and/or fill materials underlain by silty clay/clayey silt (till). Cobbles and boulders should be expected within the native silty clay/clayey silt soils.

All excavations should be carried out in accordance with the latest edition of the Occupational Health and Safety Act and Regulations for Construction Projects (OHSA). The OHSA regulations governing excavation support and maximum side wall slope inclinations apply only to excavations extending to depths of greater than 1.2 metres below the adjacent ground surface. In general, under the OHSA criteria, fill, topsoil, and firm silty clay/clayey silt encountered in the project area and above the water table would be classified as Type 3 soils. The stiff to very stiff silty clay/clayey silt would be classified as a Type 2 soil. Any silty sand to sand, or silt layers below the water table would be classified as Type 4 soils. Under the OHSA criteria, unsupported excavations in Type 2 and 3 soils should have side slopes inclined no steeper than 1 horizontal to 1 vertical and unsupported excavations in Type 4 soils should have side slopes inclined no steeper than 3 horizontal to 1 vertical.

In all cases, the OHSA soil type categories are based on generalized ground behaviour conditions with respect to the need for worker protection and compliance with the Act. Further, layered soil types or construction staging of excavations can change the OHSA categorization that might apply. During construction, the exposed ground should be observed by experienced geotechnical personnel to confirm the OHSA classification that will apply.

Based on the available borehole information, groundwater inflow is expected to be nominal from the fine-grained silty clay/clayey silt till materials. Water inflows due to perched groundwater within surficial granular fills or native sands overlying the less permeable cohesive materials are expected to be relatively minor. Nevertheless, some groundwater seepage into open excavations should be anticipated. Typically, inflows may be controlled by pumping from properly filtered and constructed sumps located in the base of the excavation. Care should be taken to direct all surface water away from the excavations. Depending on the prevailing weather conditions, it may be necessary to flatten excavation slopes in the fill materials and/or blanket the slopes with free draining material to enhance stability and control ground losses.

8.2 Pipe Bedding

The bedding material for any new sewer and water supply pipes should consist of an approved granular material, consistent with the type and class of pipe to be used. Ontario Provincial Standard Specification (OPSS) Granular 'A' is typically a suitable bedding material for the study area. The bedding should extend from a minimum of 150 millimetres (mm) below the pipe to at least 300 mm above the pipe. The pipe bedding should be uniformly compacted to at least 95 per cent of the standard Proctor maximum dry density (SPMDD) in loose lifts not exceeding 300 mm in thickness. Hand tamping around the pipe may be required to ensure that no voids are present below the spring line of the pipe. It is also important to provide well compacted granular bedding within the approach zone of the pipe(s) at the manholes. In general, the use of material known locally as "graded clear stone" might be considered for pipe bedding up to the spring line of the pipes; however, in general, such "clear stone" should not be used without the corresponding use of a non-woven geotextile filter fabric completely encapsulating the stone. Otherwise, the native fine-grained soils can soften over time as a result of water within the stone void spaces saturating the surrounding clay and allowing deformation and migration of the native soils into this void space. Granular materials used for pipe bedding can create a subsurface reservoir or conduit for the accumulation and flow of water and if such flow is not acceptable, low-permeability trench plugs should be provided at regular intervals around the utility pipe.

Should excavations be required below the underside of bedding level to remove fill materials or other unsuitable materials, the excavation should be brought to the underside of bedding level using lean concrete or an approved free-draining granular material uniformly compacted to a least 98 per cent of SPMDD in loose lift thickness not exceeding 300 mm.

8.3 General Trench Backfill

Any existing random fill or topsoil materials are not considered suitable for use as general trench backfill and should be wasted or used for grading outside the limits of the roadway, curb and gutter and sidewalks.

The native silty clay/clayey silt may be reused as trench backfill provided the material water contents are at or near the estimated optimum water contents for mechanical compaction purposes at the time of use. The silty clay/clayey silt till may require moisture conditioning (drying) prior to being reused as trench backfill. Provided the moisture contents can be reduced to within 3 per cent of optimum, the reuse of these soils for general trench backfill is considered acceptable and will reduce the material disposal requirements. The use of the silty clay till materials in the lower portions of the trench will also assist in limiting surface water infiltration into the underlying bedding materials.

Backfill materials should be placed in maximum 300 mm thick loose lifts. The placement water content of the silty clay/clayey silt till materials should be within 3 per cent of the optimum water content for compaction. The general trench backfill material should be uniformly compacted to at least 95 per cent of SPMDD. Where the trench backfill forms a pavement subgrade, the materials comprising the upper metre should be uniformly compacted to at least 98 per cent of SPMDD.

Cohesive backfill material that is more than 3 per cent dry of the optimum water content should be wetted during compaction to reduce the size and frequency of voids and the associated potential for post construction settlement, or the material should not be used. If lesser degrees of compaction are achieved, increased settlements will result. Further, if non-uniform compaction of the backfill is achieved, non-uniform settlement of the trench backfill material should be expected. The use of imported granular backfill such as OPSS Granular 'B', Type I could be considered to reduce the amount of post-construction settlement, or if sufficient excavated material is not available. The Granular 'B' should be placed and compacted as described above.

In general, some settlement of trench backfill should be expected. Therefore, consideration should be given to deferring placement of the surface course of pavement until the subsequent construction season.

8.4 Trenchless Methods

Service installations extending under existing rail tracks or roadways may be carried out using trenchless techniques. The following trenchless techniques are generally feasible within the study area:

- Horizontal directional drilling (HDD);
- Jack and bore; and
- Pipe Ramming.

The contractor should be fully responsible for the selection of the trenchless technology which best fits the contract requirements, his equipment and experience and staff availability.

The trenchless crossing of railway rights-of-way must be conducted in accordance with railway requirements. All temporary excavation support systems should be designed and constructed in accordance with OPSS.PROV 539 (Construction Specifications for Temporary Protection Systems, 2014). Where the excavation support system is at least 5 metres beyond the edge of the rail ties, lateral movements of the temporary shoring system should meet Performance Level 2 as specified in OPSS.PROV 539. Where the support system is closer to the rail ties, displacements of the shoring system should meet Performance Level 1 as specified in OPSS.PROV 539. Temporary retaining structures (shoring) and permanent retaining walls or foundations abutting the railway must also be designed to meet the requirements of American Railway Engineering and Maintenance of Way Association (AREMA) guidelines and include surcharge loads associated with rail traffic.

A monitoring program utilizing an array of shallow and deep settlement monitors is recommended. The shallow settlement monitors would consist of settlement plates installed at subballast level with steel riser rods at the end of the ties. The deep monitors should be installed one metre above the sewer/watermain obvert level, concreted in place and a sleeve provided around the remainder of the rod. A review threshold settlement value of 5 mm should be used with the alert level settlement set at 10 mm. Settlement monitoring should be carried out prior to, during and following the pipe installation. Should the 5-mm settlement review level be reached, the survey should be repeated immediately, and the contractor’s methodology reviewed, appropriate adjustments incorporated, and the survey frequency increased. Should the 10-mm alert settlement level be measured, the work should cease, preparation should be made to bulkhead the casing and railway personnel should be notified. The survey should be repeated and checked. The appropriate revisions should be made to the trenchless procedure and the project should only proceed following approval from the railway.

All trenchless work must be carried out by an experienced specialist contractor employing only qualified workers skilled in their trade under the direction of an experienced supervisor. The contractor’s work plan should include a method of sealing the ends of the bore/casing at the end of each workday or in case of an emergency. It should also include a procedure for compensation grouting should uncontrolled loss of ground or drilling fluid occur. It is recommended that the geotechnical aspects of the contractor’s work plan for proposed undercrossings be reviewed by this office prior to construction. The trenchless contractor is advised to carefully expose any underground utilities that intersect or are adjacent to the undercrossing path to confirm their elevations prior to commencement of the work.

Based on the soil conditions encountered in the previous boreholes, undercrossings will likely be installed through firm to very stiff silty clay/clayey silt till. Control of the vertical alignment for the trenchless installation may be problematic should sand/silt layers be present. The presence of cobbles and boulders within the silty clay till should be expected.

8.4.1 Horizontal Directional Drilling

HDD is considered to be a feasible trenchless alternative for railway track or roadway undercrossings. With HDD, a small rotating and steerable bit is launched from the surface at a shallow angle and is used to drill a pilot hole supported with drilling fluid. Once the pilot bore is complete, the drill head is replaced with a backreamer or expander which enlarges the drill hole so that the product pipe or casing can be pulled through. It is adaptable to a range of drilling conditions through selection of compatible drilling fluids, downhole tools, and equipment.

The HDD unit must have sufficient thrust to overcome the soil resistance typical of the very stiff silty clay/clayey silt till. The presence of cobbles and boulders should be anticipated in the silty clay/clayey silt strata present across the project area. Cobbles and boulders have the potential to impede advancement and could also deflect the unit. The drilling fluid, fluid volumes and rate of advancement must be compatible with the ground conditions.

Drilling pressures must be carefully monitored to avoid exceeding the maximum allowable pressure within the bore annulus and “blow out” of drilling fluids to the ground surface and road or railway elevations. Reaming and pullback rates should be carefully controlled so that the annulus is properly prepared, and cuttings are effectively mixed with the slurry. After completion, the borehole diameter will exceed the diameter of the installed pipe. In some cases, the annular gap is filled with grout injected through small separate grout pipes that are pulled through with the final pipeline. In other cases, the drilling fluid is designed with appropriate materials (e.g., bentonite) such that over a period of time after the fluids stop circulating, the combined fluids and cuttings develop sufficient gel strength to form a semi-solid that does not “bleed” or otherwise shrink sufficiently to result in closure of the annular gap. Prior to construction, the properties of the final drilling fluid and methods for filling the annular gap should be reviewed in detail. The gap should not be allowed to close over the lifetime of the new installation otherwise settlement may occur over the installation.

8.4.2 Jack and Bore

With the jack and bore method, entry and receiving pits are first excavated to accommodate the jacking equipment at the entry pit and connections to the main pipe at the receiving pit. The casing is advanced by jacking with simultaneous removal of spoils using helical augers within the casing. Successive lengths of casing are welded together prior to each advance. The lead casing is generally equipped with a shield or thickened leading end to create a minor amount of overcut to reduce shear stress.

The main advantage of this system is that, with suitable soil conditions and good workmanship, limited settlement generally occurs due to the simultaneous installation of the casing. However, glacial tills should be expected to contain cobbles and boulders and jack and bore operations may be problematic if boulders greater than 0.3 times the casing diameter are encountered.

Based on the presence of stiff to very stiff silty clay till, to limit over excavation and loss of ground with resultant post-construction settlements and consistent with typical railway requirements, the auger head should be kept at least 0.9 m behind the end of the casing at all times. The use of an injected bentonite lubricant will probably be required to reduce casing friction/adhesion and jacking loads. Care will be required to maintain alignment and grade during the casing installations.

8.4.3 Pipe Ramming

Pipe ramming utilizes a large horizontal percussion hammer to drive a steel casing into the sidewall of a sending pit. In most instances, the ground within the casing is not removed until the full length of the casing is driven to the receiving pit. Partial removal of material from within the casing may be needed to reduce friction and increase driving efficiency. Similar to jack and bore, pipe ramming would be problematic if boulders are encountered. However, it has the advantage that boulders up to the size of the casing diameter may be ingested. It also is a methodology that results in low settlement, but in some cases, it can result in ground heave.

8.5 Stormwater Management Facilities

It understood that new stormwater management facilities (likely open ponds) may be required within the project area. In general, due to the presence of the extensive underlying silty clay/clayey silt till strata it is not anticipated that stormwater management ponds will require a liner. Side slopes having an inclination of 3 horizontal to 1 vertical can be used for preliminary design purposes for ponds excavated into the native soils.

All excavations for the stormwater management ponds should be carried out in accordance with the current OHSA criteria for the soil types described in Section 8.1. Flatter side slopes and/or blanketing of the slopes with free draining material may be necessary in areas with saturated or loose non-cohesive soil to enhance stability.

It is recommended that any fills used to construct pond berms, where required, consist of inorganic materials excavated from above the ground water level. Depending on the prevailing weather conditions during construction, the excavated materials may require moisture conditioning (wetting or drying) to facilitate compaction. All surficial vegetation, topsoil and any loose, organic or deleterious materials should be subexcavated from the proposed berm footprints. The berm subgrades should be proofrolled under the direction geotechnical engineer prior to placing fill materials. The berm fill materials should be placed in maximum 300-mm thick loose lifts and uniformly compacted to at least 98 per cent of SPMDD. Following filling, the berm side slopes should be trimmed to the design inclinations.

All cut and fill slopes should be provided with appropriate erosion protection. This could consist of rip rap placed on a robust, non-woven geotextile from the base of the pond to 0.5 metres above the high-water levels and vegetation above this level. Care should be taken to ensure filter compatibility between the native soils and any imported granular materials.

Based on the subsurface conditions anticipated for the project area, headwalls associated with stormwater management ponds may be founded on the native soils and should be founded a minimum of 1.2 metres below finished grade. The geotechnical reaction used for the design of headwall foundations should be confirmed in the detailed design phase. All founding surfaces should be inspected by the geotechnical engineer prior to placing the headwalls or pouring concrete to confirm that suitable founding conditions are provided.

8.6 Geotechnical Involvement, Monitoring, Inspections and Testing

Continued geotechnical involvement is recommended during the design and construction stages of this project. As the detailed design progresses, a site-specific geotechnical exploration and testing program should be carried out to address underground services, trenchless service installations, and stormwater management facilities for the proposed project area servicing. Following the completion of the exploration and testing program, the preliminary recommendations in this report may be revised based on the new information.

During construction, a regular program of geotechnical inspections and testing should be carried out to confirm subsurface conditions consistent with those discussed herein and to ensure that the intent of the various design recommendations is met.

We trust that this report provides the preliminary geotechnical information currently required. Should any point require further clarification, please contact this office.

Signature Page

Golder Associates Ltd.

LICENSED PROFESSIONAL ENGINEER
Jan 9. 2020
P. GIULIANI
100128521
PROVINCE OF ONTARIO

Peter Giuliani

Peter Giuliani, P.Eng.
Senior Geotechnical Engineer

Mark A. Swallow, P.E., P.Eng.
Principal and Senior Practice Leader

PG/MAS/vf

https://golderassociates.sharepoint.com/sites/106948/project files/6 deliverables/19120633-r01-rev0 jan 9 20 dillon geo sandwich s servicing.docx

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground Water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

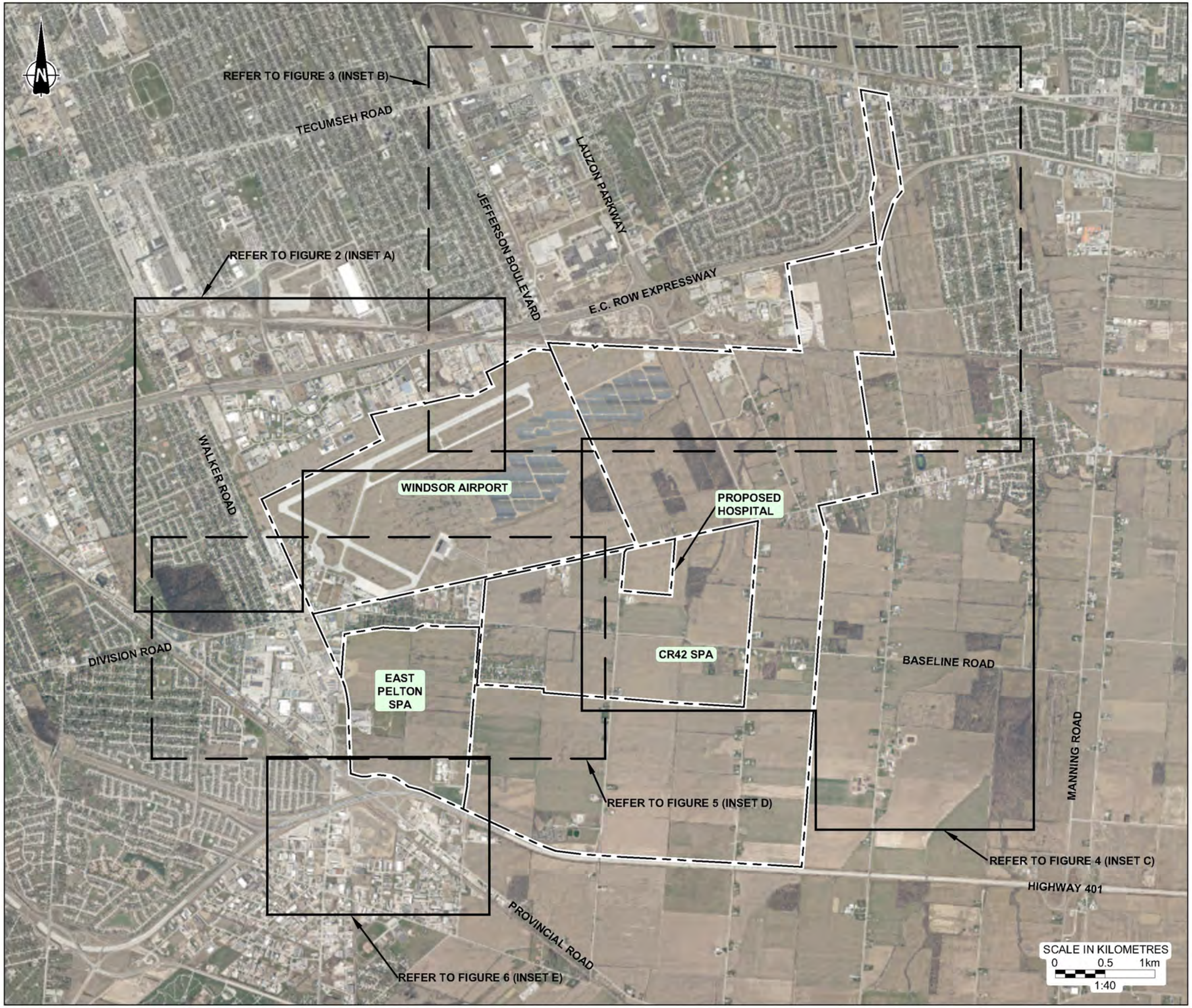
Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

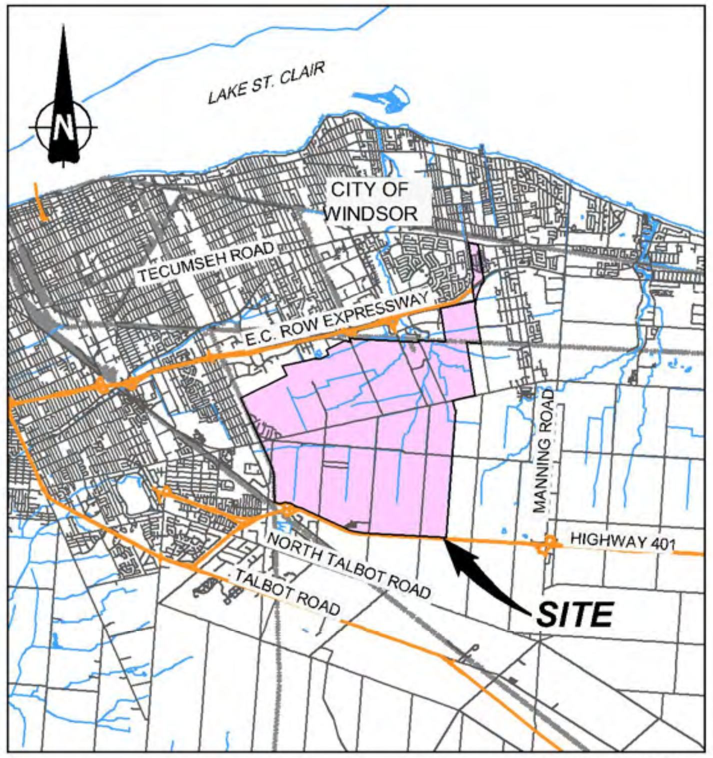
Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

Client: Dillon Consulting

Original Format is Tabloid 279mm x 432mm

Drawing file: 19120633-R01001.dwg Jun 17, 2019 - 3:09pm





KEY PLAN

LEGEND

— - - — APPROXIMATE SITE BOUNDARIES

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION; AND CANMAP STREETFILES V2008.4.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

KEY PLAN

GOLDER

PROJECT No.		19120633	FILE No.	19120633–R01001
			SCALE AS SHOWN	REV.
CADD	AMS	June 17/19	FIGURE 1	
CHECK	P.H.			

Drawing file: 19120633-R01002.dwg Jun 27, 2019 – 4:59pm 0 25mm Original Format is Tabloid 279mm x 432mm Client: Dillon Consulting

LEGEND

– – – APPROXIMATE SITE BOUNDARY

BOREHOLE (PREVIOUS GOLDER INVESTIGATION)

- ◐ 13-1140-187-2
- ◐ 13-1140-187-1
- ⊙ 12-1140-0207
- ◐ 10-1140-0251
- ◐ 08-1140-W044
- ◐ 07-1140-0030
- ◐ 991-4228
- ◐ 961-4043
- ◐ 801-4004

TEST PIT (PREVIOUS GOLDER INVESTIGATION)

- 🟩 08-1140-W041

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

REFER TO FIGURE 1 FOR LOCATION.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

LOCATION PLAN
(INSET A)

GOLDER

PROJECT No.		19120633	FILE No.	19120633-R01002
			SCALE AS SHOWN	REV.
CADD	AMS	June 27/19		
CHECK	P.H.		FIGURE 2	

LEGEND

- - - - APPROXIMATE SITE BOUNDARIES

BOREHOLE (Previous Golder Investigation)

◐ 08-1140-W125

◐ 07-1140-0178

◐ 06-1140-0248

◐ 06-1140-021

◐ 001-4327

◐ 001-4112

◐ 991-4228

◐ 971-4236

◐ 971-4045

◐ 961-4114

◐ 961-4043

◐ 901-4269

TEST PIT (Previous Golder Investigation)

▭ 901-4269

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

REFER TO FIGURE 1 FOR LOCATION.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

LOCATION PLAN
(INSET B)

GOLDER

PROJECT No.	19120633	FILE No.	19120633–R01003
		SCALE	AS SHOWN
CADD	AMS	June 26/19	REV.
CHECK	P.H.		FIGURE 3

Client: Dillon Consulting

Original Format is Tabloid 279mm x 432mm

25mm

0

Jun 26, 2019 – 2:37pm

Drawing file: 19120633–R01003.dwg

LEGEND

- – – – APPROXIMATE SITE BOUNDARY

BOREHOLE (Previous Golder Investigation)

- ⊕ 1658070
- ⊕ 031-140357
- ⊕ 07-1140-0031
- ⊕ 06-1140-021

TEST PIT (Previous Golder Investigation)

- ⊠ 031-140357
- ⊠ 09-1140-1122

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

REFER TO FIGURE 3 FOR LOCATION.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT
PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE
LOCATION PLAN
(INSET B-2)

GOLDER

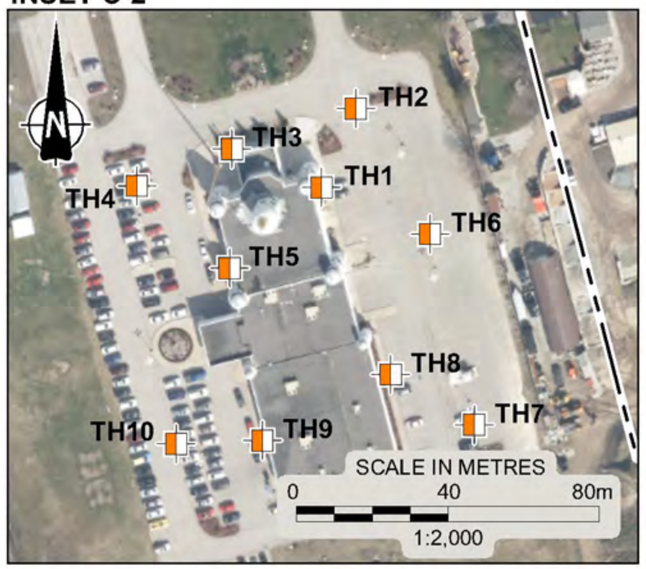
PROJECT No.	19120633	FILE No.	19120633-R01003
		SCALE	AS SHOWN
CADD	AMS	June 24/19	REV.
CHECK	P.H.		

FIGURE 3A

Client: Dillon Consulting
Original Format is Tabloid 279mm x 432mm
0 25mm
Drawing file: 19120633-R01003.dwg Jun 24, 2019 – 4:09pm

Client: Dillon Consulting

INSET C-2



LEGEND

— — — APPROXIMATE SITE BOUNDARY

BOREHOLE (Previous Golder Investigation)

◐ 1526237	◐ 07-1140-0030
◐ 1411749	◐ 06-1140-0248
◐ 1403551	
◐ 13-1140-0110	

TEST PIT (Previous Golder Investigation)

▣ 971-4135

AUGER HOLE (Previous Golder Investigation)

⊙ 1411749

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

REFER TO FIGURE 1 FOR LOCATION.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

LOCATION PLAN
(INSET C)

GOLDER

PROJECT No.	19120633	FILE No.	19120633–R01004
		SCALE	AS SHOWN	REV.
CADD	AHS	June 24/19	
CHECK	P.H.		FIGURE 4

Original Format is Tabloid 279mm x 432mm

25mm

0

Drawing file: 19120633–R01004.dwg Jun 27, 2019 – 5:01pm

Client: Dillon Consulting

Original Format is Tabloid 279mm x 432mm

0 25mm

Jun 25, 2019 - 9:00am

Drawing file: 19120633-R01005.dwg

LEGEND

— — — APPROXIMATE SITE BOUNDARY

BOREHOLE (Previous Golder Investigation)

- ◐ 14-1140-0005
- ◐ 07-1140-0030
- ◐ 041-140173
- ◐ 011-4121
- ◐ 831-4062

TEST PIT (Previous Golder Investigation)

- ◧ 861-4147

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

REFER TO FIGURE 1 FOR LOCATION.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

LOCATION PLAN
(INSET D)

GOLDER

PROJECT No.		19120633	FILE No.	19120633-R01005
			SCALE AS SHOWN	REV.
CADD	AMS	June 25/19	FIGURE 5	
CHECK	P.H.			

LEGEND

- - - APPROXIMATE SITE BOUNDARY

BOREHOLE (Previous Golder Investigation)

- 12-1140-0094
- 754081
- 10-1140-0096
- 041-140173
- 001-4195
- 981-4341

TEST PIT (Previous Golder Investigation)

- 754081

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

REFER TO FIGURE 1 FOR LOCATION.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

LOCATION PLAN
(INSET E)

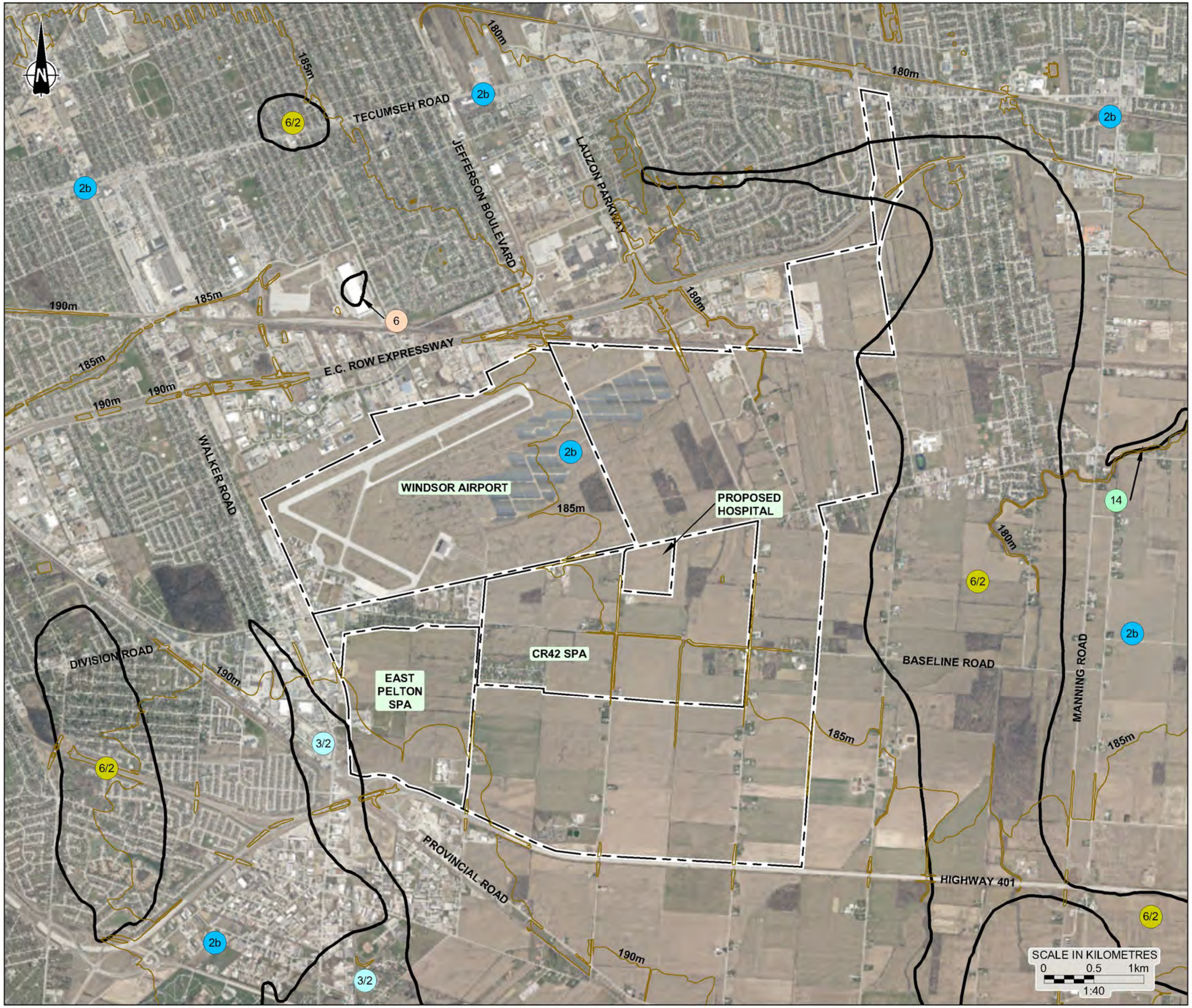
GOLDER

PROJECT No.		19120633	FILE No.	19120633-R01006
			SCALE AS SHOWN	REV.
CADD	AMS	June 19/19	FIGURE 6	
CHECK	P.H.			

Drawing file: 19120633-R01006.dwg Jun 24, 2019 – 4:22pm 0 25mm Original Format is Tabloid 279mm x 432mm Client: Dillon Consulting

Client: Dillon Consulting

Drawing file: 19120633-R01007.dwg Jun 21, 2019 - 4:51pm Original Format is Tabloid 279mm x 432mm



LEGEND

- - - APPROXIMATE SITE BOUNDARIES

— GROUND SURFACE CONTOUR (m amsl)

QUATERNARY GEOLOGY:

— GEOLOGY ZONE LIMIT

RECENT

14	Unsubdivided modern alluvium; silty loam, some organic matter

PLEISTOCENE

6	Glaciolacustrine; medium sand
6/2	Area of till (2) with a thin and discontinuous cover of glacilacustrine medium sand (6)
3/2	Area of till (2) and glaciofluval gravel or gravelly sand (3)
2b	Clayey silt till

REFERENCE

DRAWING BASED ON 2017 AERIAL IMAGE FROM THE COUNTY OF ESSEX INTERACTIVE WEB MAPPING SITE, BY PERMISSION; MNR LIO, OBTAINED 2019 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2019; AND ONTARIO DEPARTMENT OF MINES AND NORTHERN AFFAIRS, QUATERNARY GEOLOGY OF THE WINDSOR ESSEX AREA, WESTERN PART, MAP P. 749.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PRELIMINARY GEOTECHNICAL ASSESSMENT
SANDWICH SOUTH LANDS
WINDSOR, ONTARIO

TITLE

QUATERNARY GEOLOGY

GOLDER

PROJECT No.	19120633	FILE No.	19120633-R01007
		SCALE	AS SHOWN
CADD	AMS	June 21/19	REV.
CHECK			FIGURE 7

APPENDIX A

Previous Records of Boreholes and Test Pits by Golder Associates Ltd.

PROJECT 754081

RECORD OF TEST PIT 1

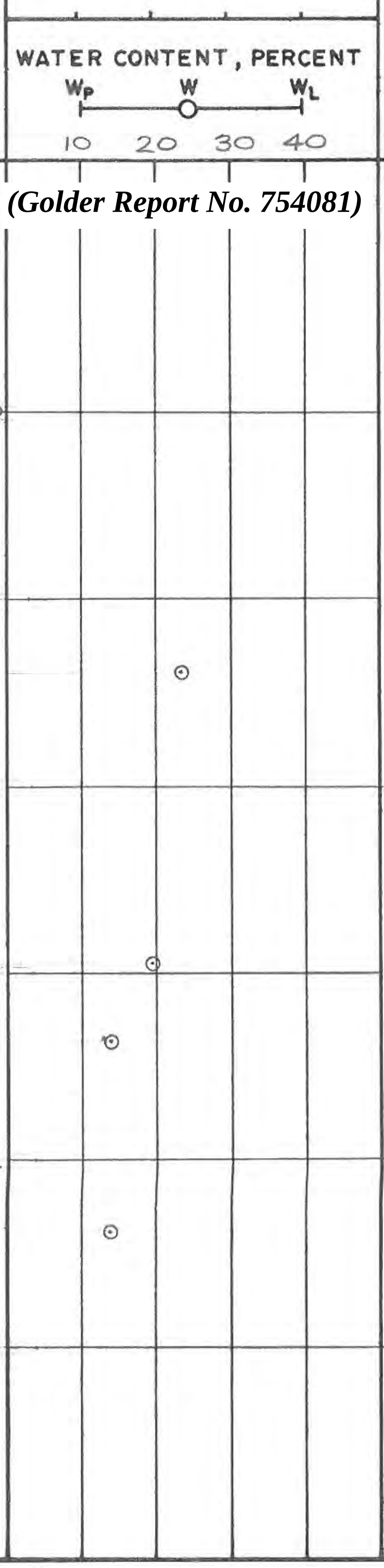
LOCATION See Figure 1 EXCAVATION DATE JUNE 26,1975 DATUM LOCAL

TEST PIT TYPE BACKHOE DUG TEST PIT SIZE 3.0' x 10.0'

(Golder Report No. 754081)

SOIL PROFILE

ELEVN. DEPTH	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
					200		
199.2 0.0	GROUND SURFACE						
	STIFF BLACK CLAYEY **TOPSOIL**						
198.2 1.0					198		
	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL		1	C.S.			
					196		WATER SEEPAGE INTO TEST PIT AT ELEV. 196.2 DURING EXCAVATION JUNE 26,1975
			2	"	194		
193.4 5.8			3	"			
	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)				192		SIDES OF TEST PIT UNSTABLE DURING EXCAVATION
191.2 8.0	END OF TEST PIT		4	"			
					190		



VERTICAL SCALE
1 IN. TO 2 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.-D.-3

PROJECT 754081

RECORD OF TEST PIT 2

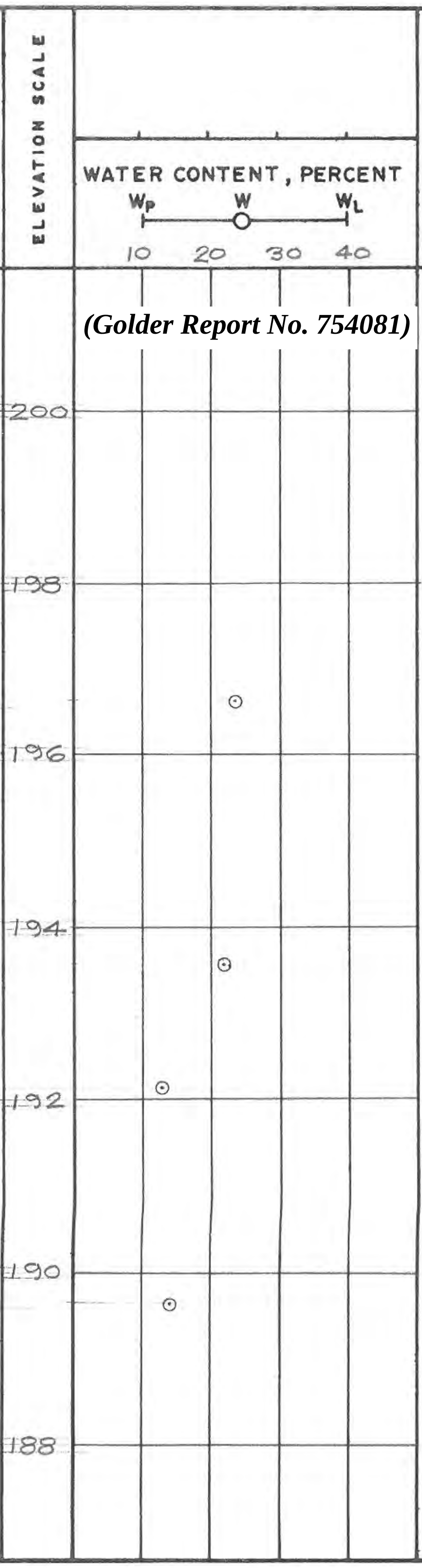
LOCATION See Figure 1 EXCAVATION DATE JUNE 26,1975 DATUM LOCAL

TEST PIT TYPE BACKHOE DUG TEST PIT SIZE 3.0' x 10.0'

SOIL PROFILE

ELEVN. DEPTH	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE
198.6 0.0	GROUND SURFACE		
	STIFF BLACK CLAYEY **TOPSOIL**		
197.6 1.0	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	1	C.S.
		2	"
192.6 6.0	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	3	"
189.6 9.0	END OF TEST PIT	4	"

(Golder Report No. 754081)



ADDITIONAL LAB. TESTING

GROUNDWATER CONDITIONS

WATER SEEPAGE INTO TEST PIT AT ELEV. 195.6 DURING EXCAVATION JUNE 26,1975

SIDES OF TEST PIT UNSTABLE DURING EXCAVATION

VERTICAL SCALE
1 IN. TO 2 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.-D.-3

PROJECT 754081

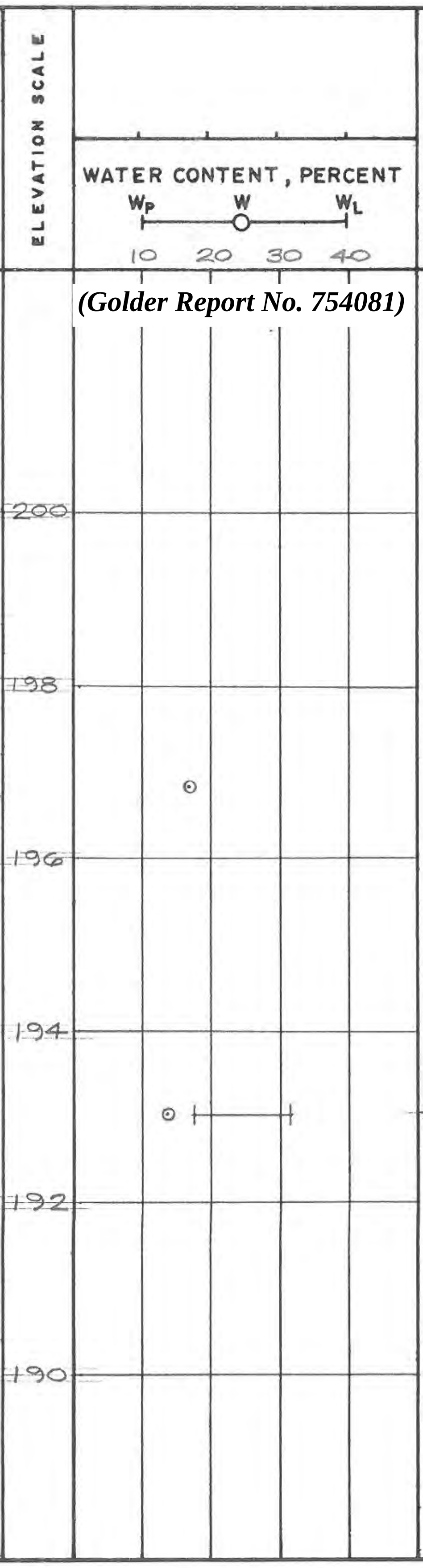
RECORD OF TEST PIT 3

LOCATION See Figure 1 EXCAVATION DATE JUNE 26, 1975 DATUM LOCAL

TEST PIT TYPE BACKHOE DUG TEST PIT SIZE 3.0' x 10.0'

(Golder Report No. 754081)

ELEVN. DEPTH	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
198.8 0.0	GROUND SURFACE				
	STIFF BLACK CLAYEY **TOPSOIL**				
197.8 1.0	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	1	C.S.		SLIGHT WATER SEEPAGE INTO TEST PIT AT ELEV. 194.8 DURING EXCAVATION JUNE 26, 1975
193.1 5.7	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	2	"	MH	SIDES OF TEST PIT UNSTABLE DURING EXCAVATION
191.8 7.0	END OF TEST PIT				



VERTICAL SCALE 1 IN. TO 2 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.-D.-3

PROJECT 754081

RECORD OF TEST PIT 4

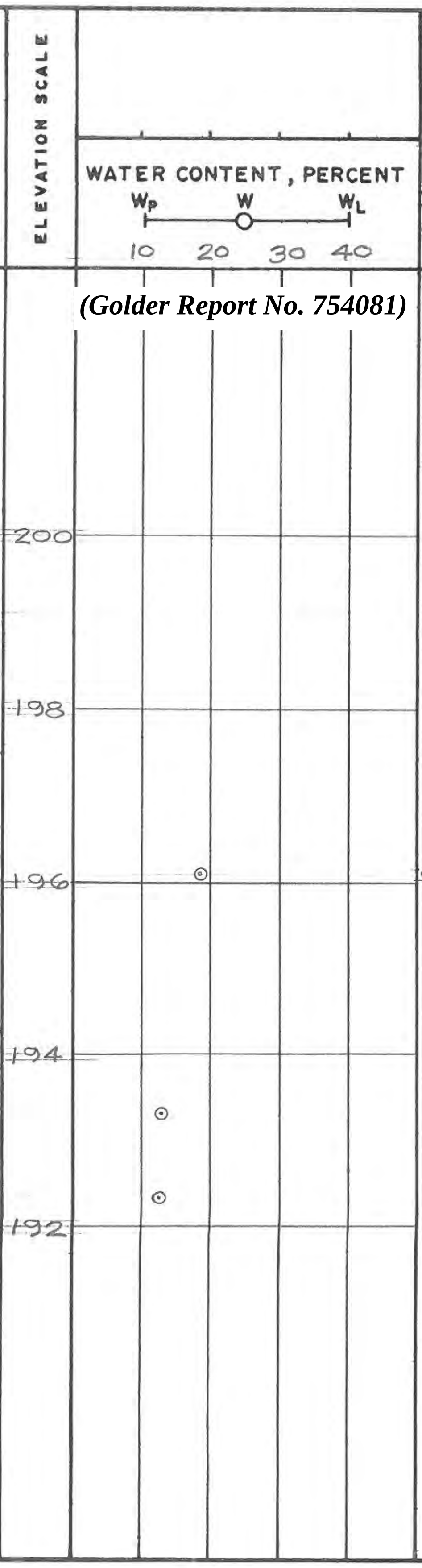
LOCATION See Figure 1 **EXCAVATION DATE** JUNE 26,1975 **DATUM** LOCAL

TEST PIT TYPE BACKHOE DUG **TEST PIT SIZE** 3.0' x 10.0'

(Golder Report No. 754081)

SOIL PROFILE

ELEVN. DEPTH	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
199.1 0.0	GROUND SURFACE				
	STIFF BLACK CLAYEY **TOPSOIL**				
197.7 1.4	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	1	C.S.	C.B.R	
193.4 5.7	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	2 3	" "		SLIGHT WATER SEEPAGE INTO TEST PIT AT ELEV. 194.1 DURING EXCAVATION
192.1 7.0	END OF TEST PIT				



VERTICAL SCALE
1 IN. TO 2 **FT.**

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.-D.-3

PROJECT 754081

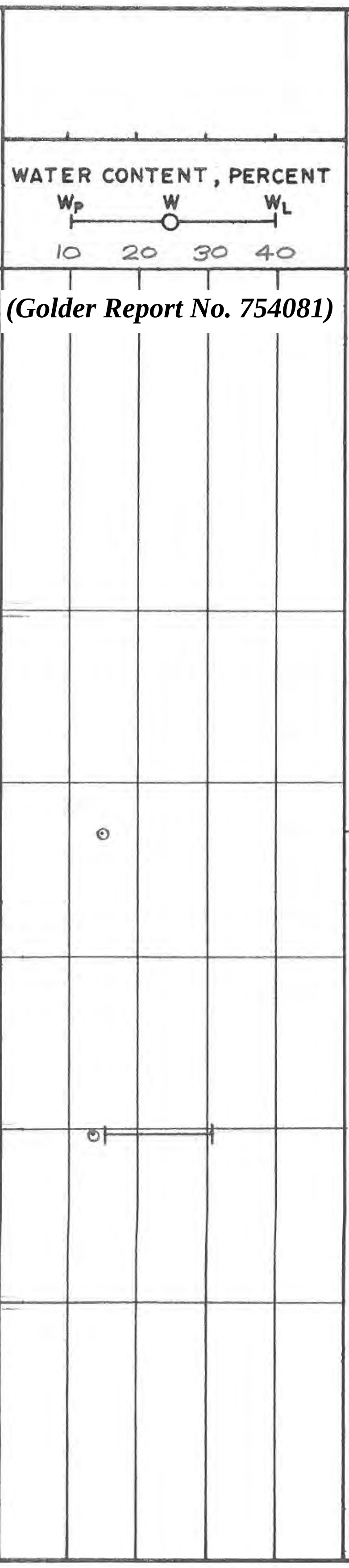
RECORD OF TEST PIT 5

LOCATION See Figure 1 EXCAVATION DATE JUNE 26, 1975 DATUM LOCAL

TEST PIT TYPE BACKHOE DUG TEST PIT SIZE 3.0' x 10.0'

(Golder Report No. 754081)

ELEVN. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
197.9 0.0	GROUND SURFACE STIFF BLACK CLAYEY **TOPSOIL**				
197.2 0.7	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	1	C.S.	MH	
192.9 5.0	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	2	"		WATER SEEPAGE INTO TEST PIT AT ELEV. 193.4 DURING EXCAVATION JUNE 26, 1975
191.5 6.4	END OF TEST PIT				



VERTICAL SCALE 1 IN. TO 2 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.-D.-3

PROJECT 754081

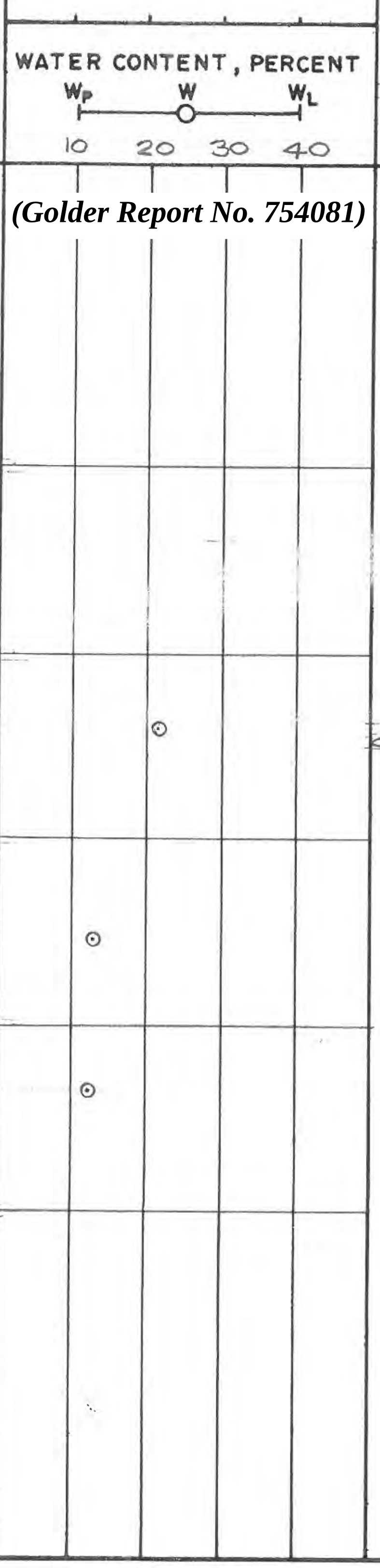
RECORD OF TEST PIT 6

LOCATION See Figure 1 EXCAVATION DATE JUNE 26, 1975 DATUM LOCAL

TEST PIT TYPE BACKHOE DUG TEST PIT SIZE 3.0' x 10.0'

(Golder Report No. 754081)

ELEVN. DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
				198		
197.2	GROUND SURFACE					
0.0	STIFF BLACK CLAYEY **TOPSOIL**					
196.7 0.5	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL			196		
		1	C.S.		MH C.B.R.	
				194		
193.2 4.0	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	2	"			
				192		WATER SEEPAGE INTO TEST PIT AT ELEV. 192.2 DURING EXCAVATION JUNE 26, 1975
191.2 6.0	END OF TEST PIT	3	"			
				190		



VERTICAL SCALE 1 IN. TO 2 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.- D.- 3

PROJECT 754081

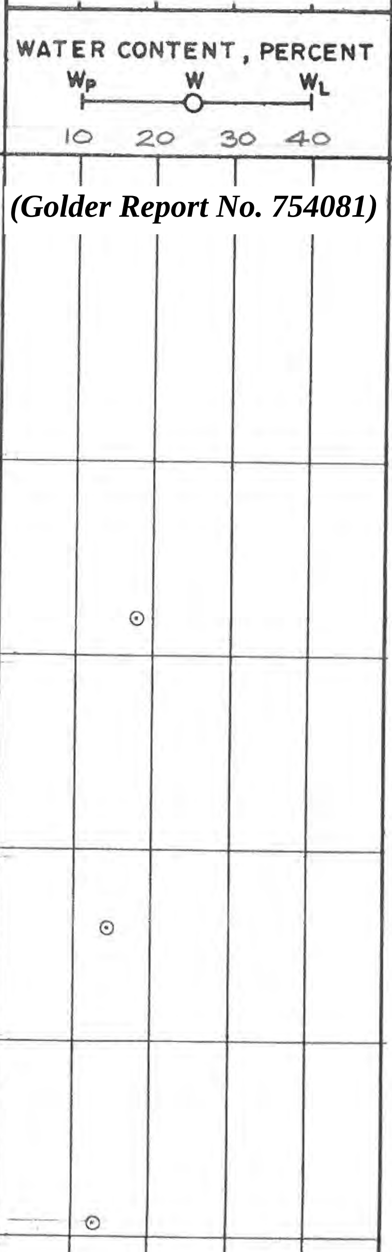
RECORD OF TEST PIT 7

LOCATION See Figure 1 **EXCAVATION DATE** JUNE 26,1975 **DATUM** LOCAL

TEST PIT TYPE BACKHOE DUG **TEST PIT SIZE** 3.0' x 10.0'

(Golder Report No. 754081)

ELEVN. DEPTH	SOIL PROFILE DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
198.1 0.0	GROUND SURFACE						
	STIFF BLACK CLAYEY **TOPSOIL**				198		
197.4 0.7							
	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL		1	C.S.	196		
					194		
193.3 4.8			2	"			▽ WATER SEEPAGE INTO TEST PIT AT ELEV. 193.3 DURING EXCAVATION JUNE 26,1975
	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)				192		
190.1 8.0	END OF TEST PIT		3	"	190		



VERTICAL SCALE
1 IN. TO 2 **FT.**

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A.- D.- 3

PROJECT 754081

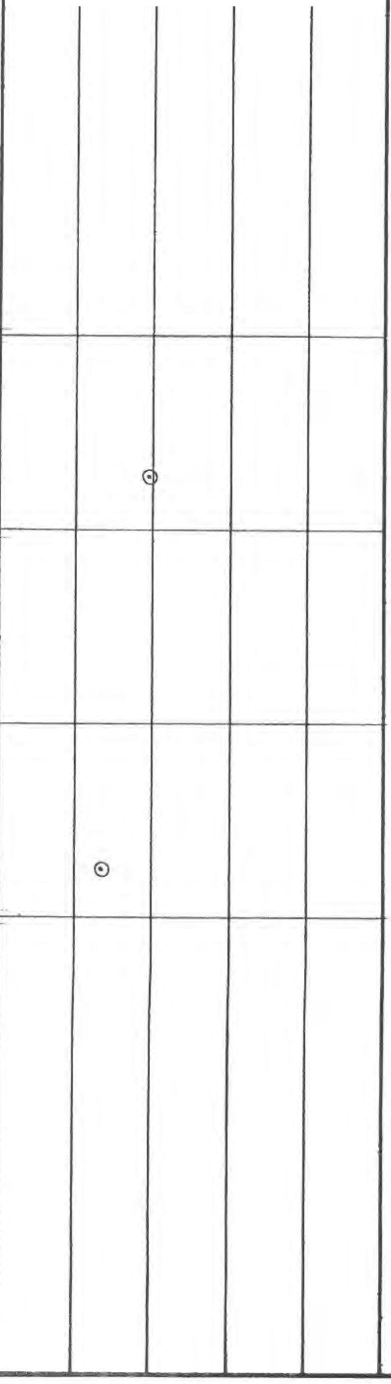
RECORD OF TEST PIT 8

LOCATION See Figure 1 EXCAVATION DATE JUNE 26,1975 DATUM LOCAL

TEST PIT TYPE BACKHOE DUG TEST PIT SIZE 3.0' x 10.0'

SOIL PROFILE							
ELEVN. DEPTH	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT (W_P — W — W_L) 10 20 30 40	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
198.2	GROUND SURFACE						
0.0	STIFF BLACK CLAYEY **TOPSOIL**			198			
197.5 0.7	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	1	C.S.	196			WATER SEEPAGE INTO TEST PIT AT ELEV. 196.2 DURING EXCAVATION JUNE 26,1975
193.2 5.0	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	2	"	194			SIDES OF TEST PIT UNSTABLE DURING EXCAVATION
192.0 6.2	END OF TEST PIT			192			

(Golder Report No. 754081)



VERTICAL SCALE
1 IN. TO 2 FT.

Golder Associates

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CHECKED JFC

Form G.A.-D.-3

Project No. 754081

RECORD OF BOREHOLE 1

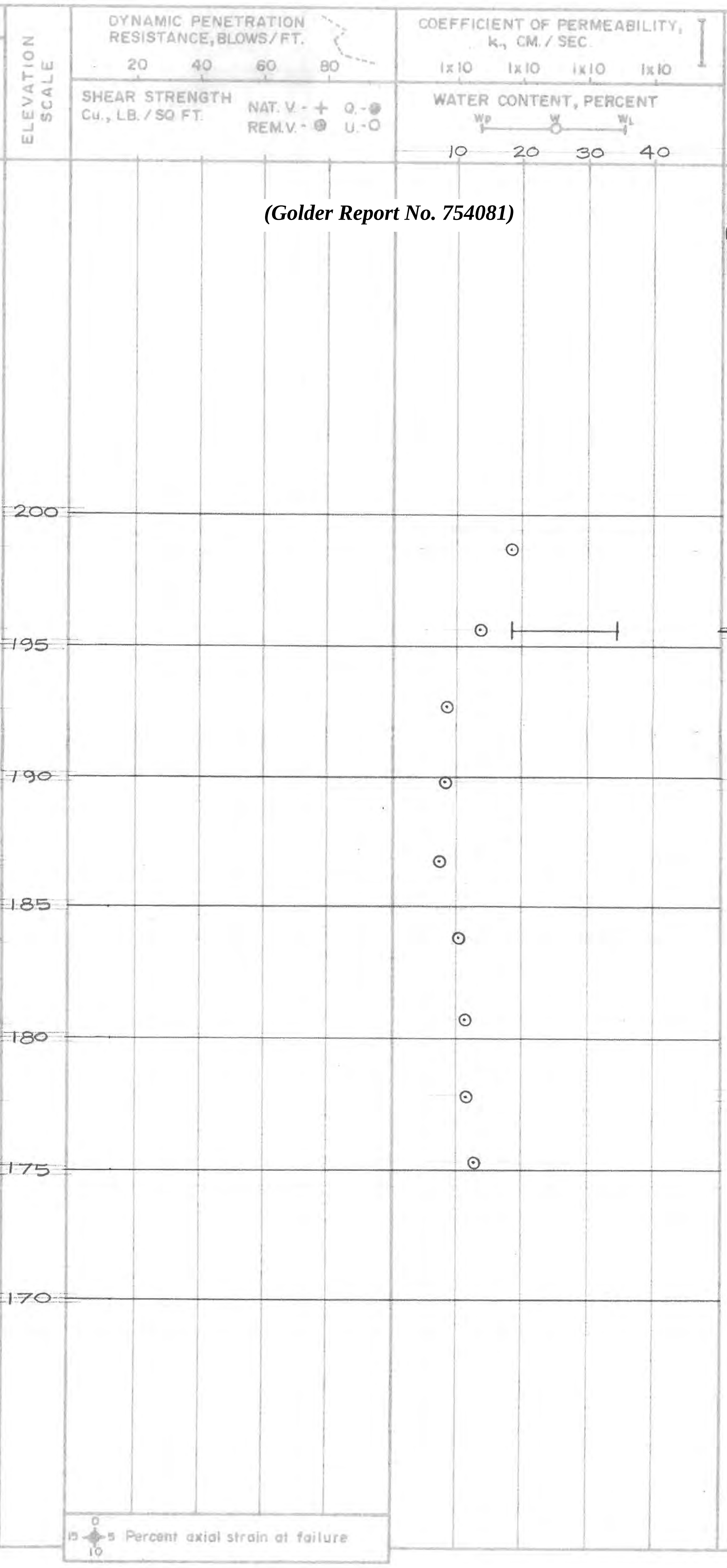
LOCATION See Figure 1 BORING DATE JUNE 17, 1975 DATUM LOCAL

SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

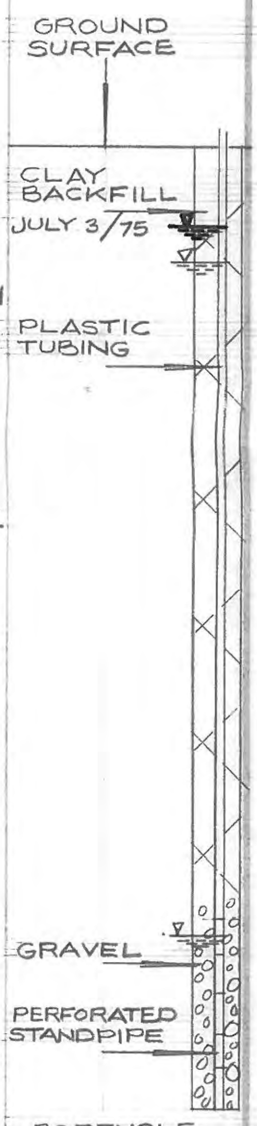
(Golder Report No. 754081)

BORING METHOD: POWER AUGER 4.5" DIA. (UNCASED)

ELEV'N. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	ADDITIONAL LAB. TESTING (BULK DENSITY P.C.F.)
199.4	GROUND SURFACE				
0.0	STIFF BLACK CLAYEY **TOPSOIL**	1	2" D.O.	11	
197.7 1.7	STIFF MOTTLED BROWN AND GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	2	"	12	MH
193.9 5.5	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	3	"	59	
		4	"	59	142
187.4 12.0	HARD BECOMING VERY STIFF GREY **SILTY CLAY** SOME SAND TRACE GRAVEL (TILL-LIKE)	5	"	84	
		6	"	26	
		7	"	27	
		8	"	18	139
		9	"	18	
174.4 25.0	END OF HOLE				



PIEZOMETER OR STANDPIPE INSTALLATION



BOREHOLE DRY DURING DRILLING JUNE 17, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 178.9 JUNE 19, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 196.4 JUNE 26, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 197.4 JULY 3, 1975

VERTICAL SCALE
1 IN. TO 5 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

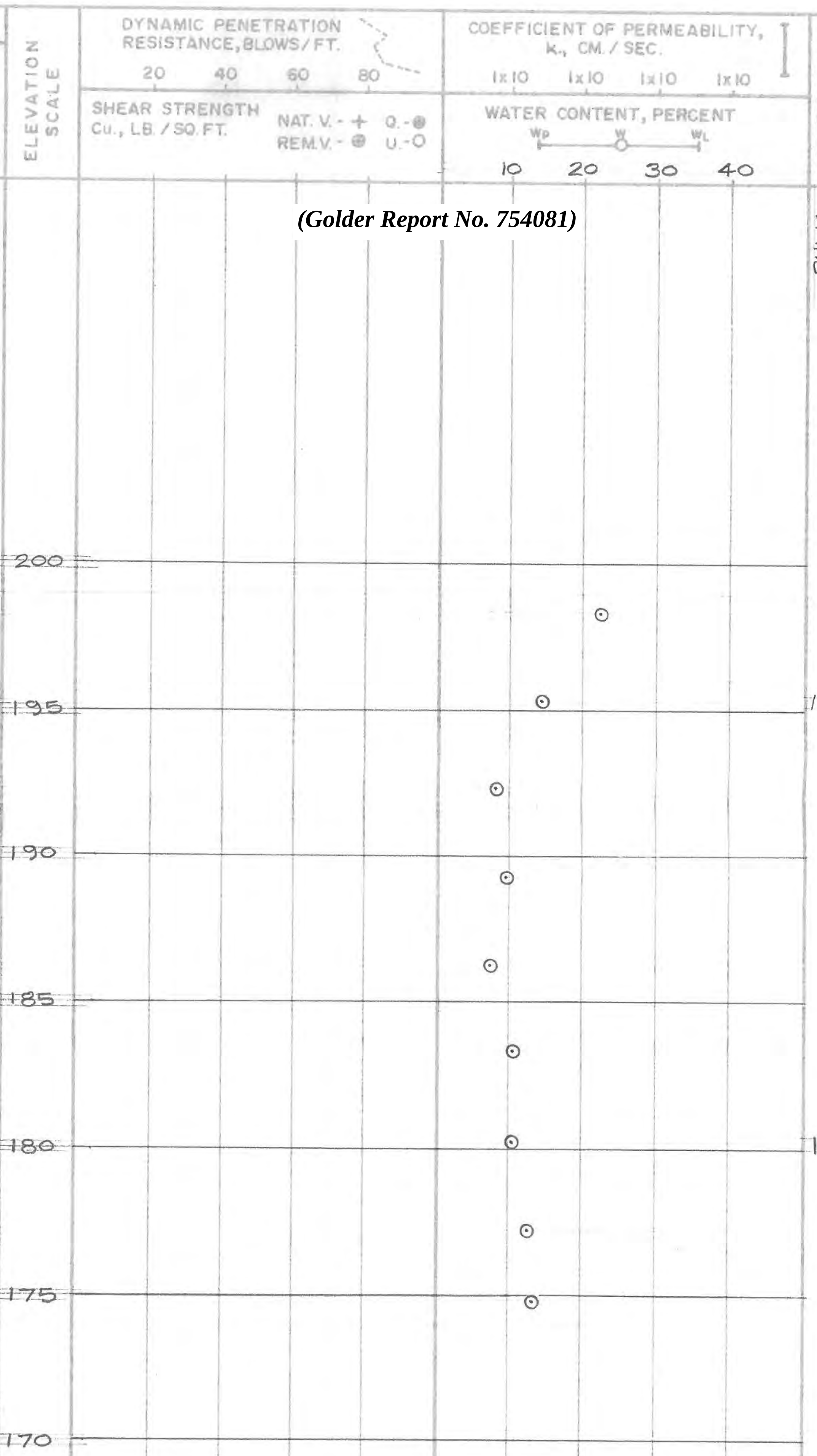
Project No. 754081

RECORD OF BOREHOLE 2

LOCATION See Figure 1
BORING DATE JUNE 16, 1975
DATUM LOCAL
SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN.
PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

(Golder Report No. 754081)

BORING METHOD	SOIL PROFILE ELEV'N. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FT.	ADDITIONAL LAB. TESTING (BULK DENSITY P.C.F.)	PIEZOMETER OR STANDPIPE INSTALLATION
	198.9	GROUND SURFACE					
POWER AUGER 4.5" DIA. (UNCASED)	0.0	STIFF BLACK CLAYEY TOPSOIL	1	2" D.O.	9		BOREHOLE DRY DURING DRILLING JUNE 16, 1975
	196.9 2.0	STIFF MOTTLED BROWN & GREY SILTY CLAY SOME SAND TRACE GRAVEL	2	"	11	134	
	193.7 5.2	HARD BROWN SILTY CLAY FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)	3	"	40		
			4	"	74		
	187.6 11.3	HARD BECOMING VERY STIFF GREY SILTY CLAY SOME SAND TRACE GRAVEL (TILL-LIKE)	5	"	44		
			6	"	27		
			7	"	18	140	
			8	"	19		
			9	"	19		
	173.9 25.0	END OF HOLE					



15-◇-5 Percent axial strain at failure

VERTICAL SCALE
1 IN. TO 5 FT.

Golder Associates

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CHECKED JFC

Project No. 754081

RECORD OF BOREHOLE 3

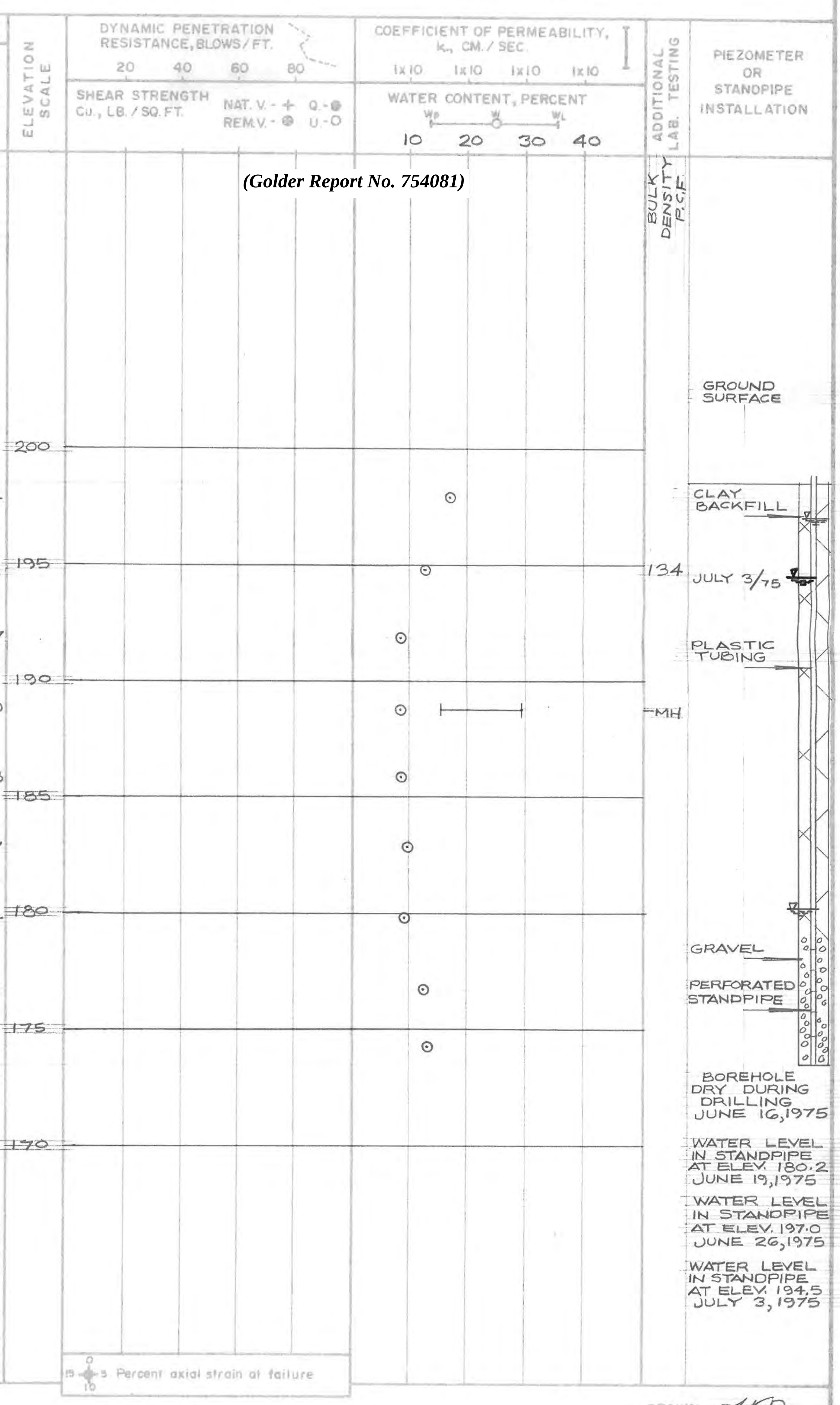
LOCATION See Figure 1 BORING DATE JUNE 16, 1975 DATUM LOCAL

SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

(Golder Report No. 754081)

BORING METHOD: POWER AUGER 4.5" DIA. (UNCASED)

SOIL PROFILE			SAMPLES		
ELEV'N. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FT.
198.5	GROUND SURFACE				
0.0	STIFF BLACK CLAYEY **TOPSOIL**		1	2" D.O.	14
196.3 2.2	STIFF MOTTLED BROWN & GREY **SILTY CLAY** SOME SAND TRACE GRAVEL		2	"	12
192.7 5.8	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)		3	"	77
			4	"	90
187.0 11.5	HARD BECOMING VERY STIFF GREY **SILTY CLAY** SOME SAND TRACE GRAVEL (TILL-LIKE)		5	"	43
			6	"	27
			7	"	24
			8	"	16
			9	"	16
173.5 25.0	END OF HOLE				



BOREHOLE DRY DURING DRILLING JUNE 16, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 180.2 JUNE 19, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 197.0 JUNE 26, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 194.5 JULY 3, 1975

VERTICAL SCALE
1 IN. TO 5 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Project No. 754081

RECORD OF BOREHOLE 4

LOCATION See Figure 1 BORING DATE JUNE 17, 1975 DATUM LOCAL

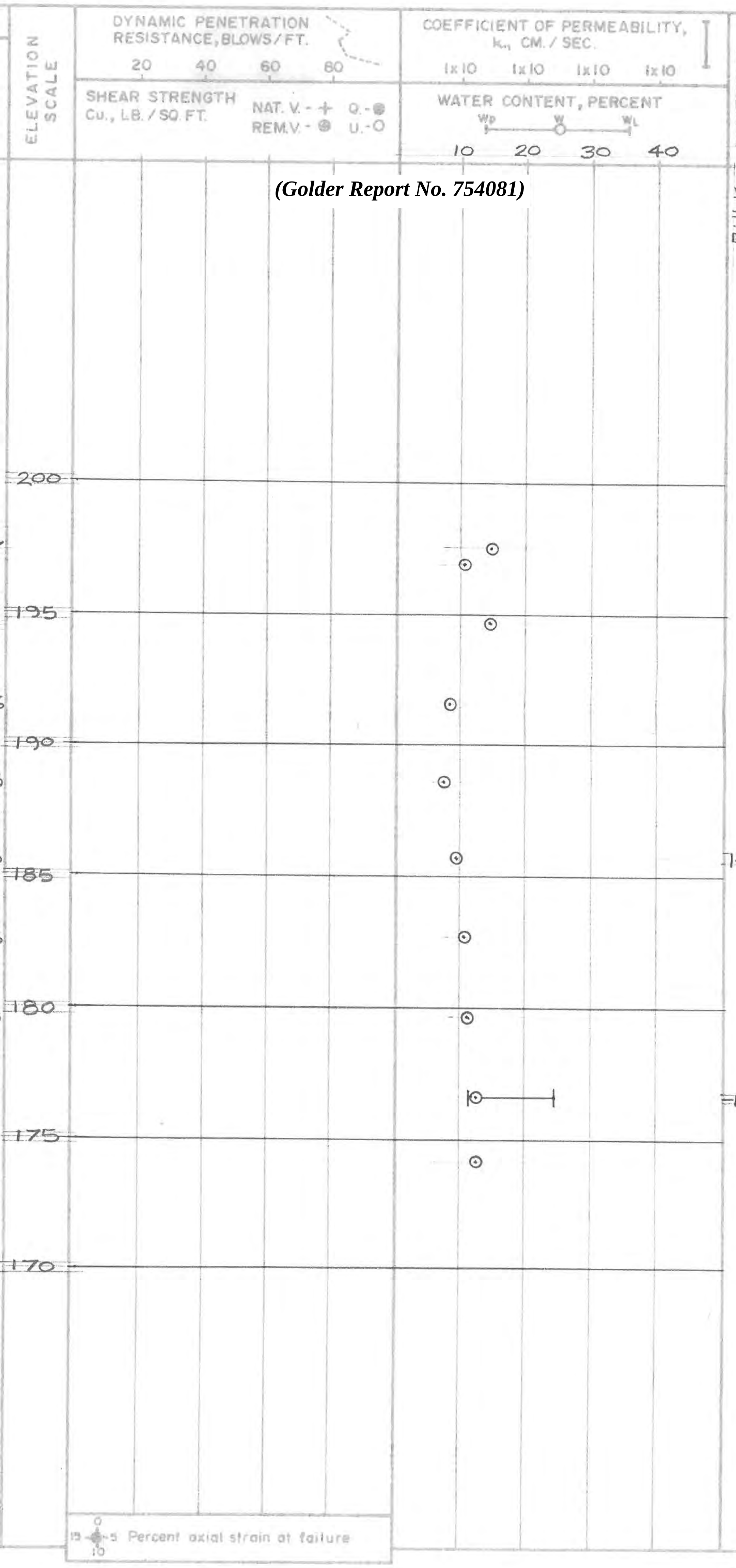
SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN

(Golder Report No. 754081)

BORING METHOD: POWER AUGER 4.5" DIA. (UNCASED)

ELEV'N. DEPTH	DESCRIPTION
198.2	GROUND SURFACE
0.0	STIFF BLACK CLAYEY **TOPSOIL**
197.1 1.1	STIFF MOTTLED BROWN & GREY **SILTY CLAY** SOME SAND TRACE GRAVEL
192.5 5.7	HARD BROWN **SILTY CLAY** FISSURED SOME SAND TRACE GRAVEL (TILL-LIKE)
187.2 11.0	HARD BECOMING VERY STIFF GREY **SILTY CLAY** SOME SAND TRACE GRAVEL (TILL-LIKE)
173.2 25.0	END OF HOLE

NUMBER	TYPE	BLOWS/FT.	ADDITIONAL LAB. TESTING (BULK DENSITY P.C.F.)
1	2" D.O.	7	
2	"	7	
3	"	56	
4	"	65	
5	"	35	143
6	"	26	
7	"	20	
8	"	17	MH
9	"	19	



PIEZOMETER OR STANDPIPE INSTALLATION: BOREHOLE DRY DURING DRILLING JUNE 17, 1975

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

RECORD OF BOREHOLE 5

LOCATION See Figure 1 BORING DATE JUNE 17, 1975 DATUM LOCAL

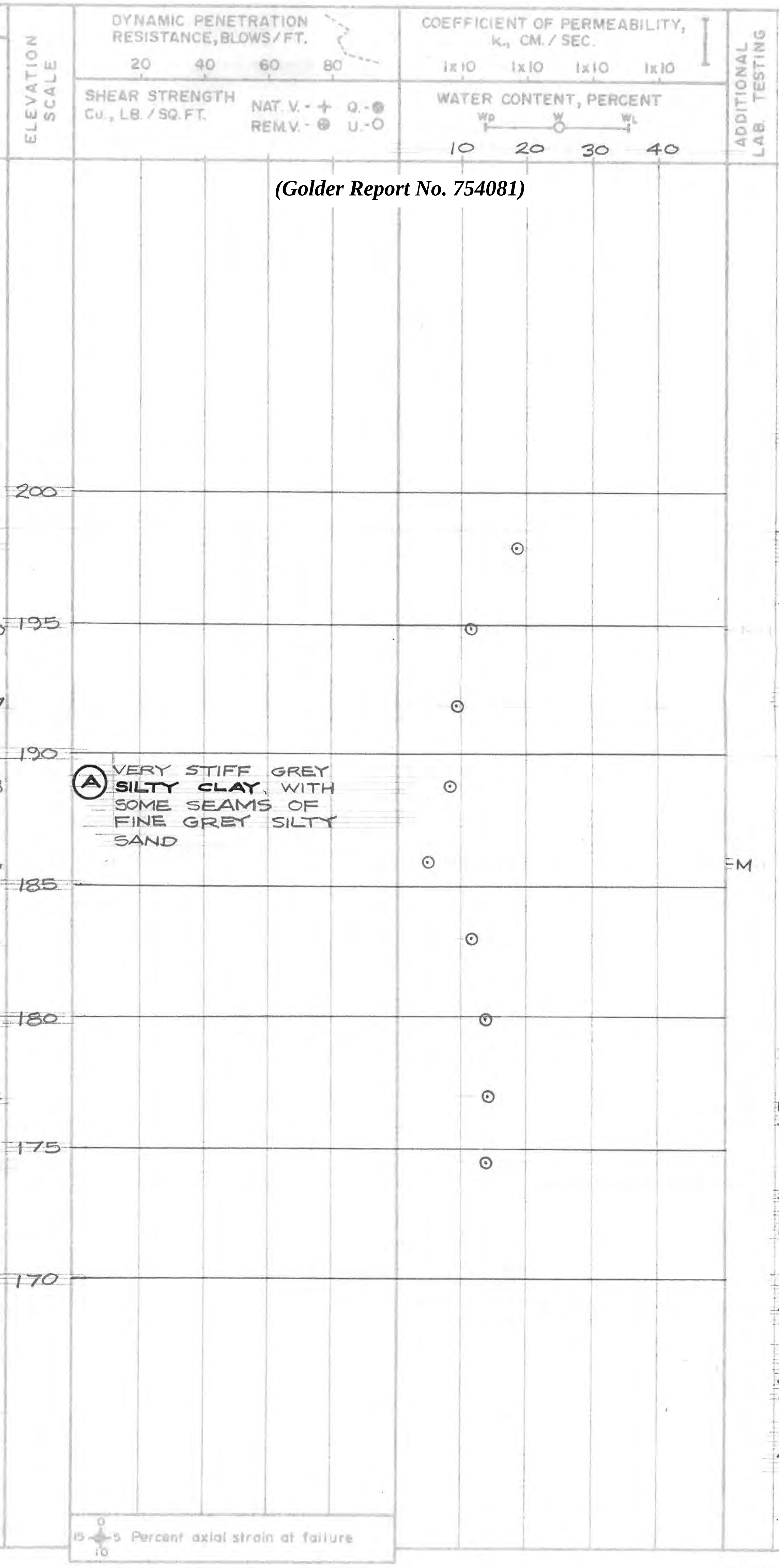
SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

(Golder Report No. 754081)

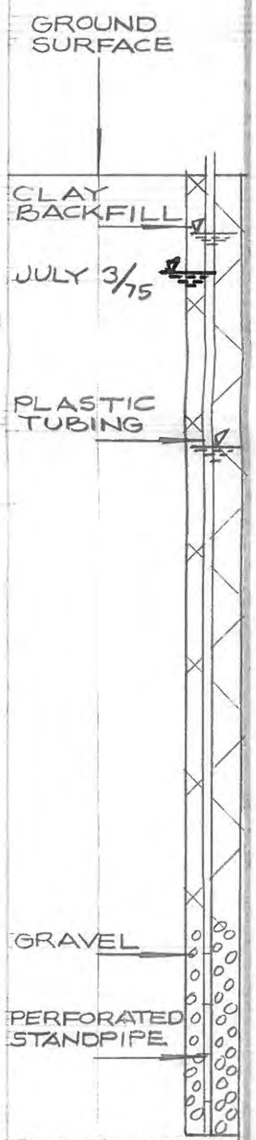
BORING METHOD: POWER AUGER 4.5" DIA. (UNCASED)

SOIL PROFILE ELEV'N. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FT.
198.5	GROUND SURFACE			
0.0	STIFF BLACK CLAYEY **TOPSOIL**	1	2" D.O.	7
196.5 2.0	HARD MOTTLED BROWN & GREY **SILTY CLAY** SOME SAND TRACE GRAVEL	2	"	30
193.5 5.5	HARD BROWN **SILTY CLAY** FISSURED SOME SAND, TRACE GRAVEL (TILL-LIKE)	3	"	67
190.0 8.5	Ⓐ	4	"	48
187.0 11.5	DENSE GREY FINE TO MEDIUM MOIST **SILTY SAND**	5	"	36
184.5 14.0	VERY STIFF GREY **SILTY CLAY** SOME SAND TRACE GRAVEL (TILL-LIKE)	6	"	19
		7	"	16
		8	"	14
		9	"	16
173.5 25.0	END OF HOLE			

Ⓐ VERY STIFF GREY **SILTY CLAY**, WITH SOME SEAMS OF FINE GREY SILTY SAND



PIEZOMETER OR STANDPIPE INSTALLATION



SLIGHT WATER SEEPAGE FROM SILTY SAND LENSE DURING DRILLING

WATER LEVEL IN STANDPIPE AT ELEV. 191.4 JUNE 19, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 197.0 JUNE 26, 1975

WATER LEVEL IN STANDPIPE AT ELEV. 196.0 JULY 3, 1975

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DRAWN A.V.D.
CHECKED JFC

Form G.A. - D - I

Project No. 801- 4004

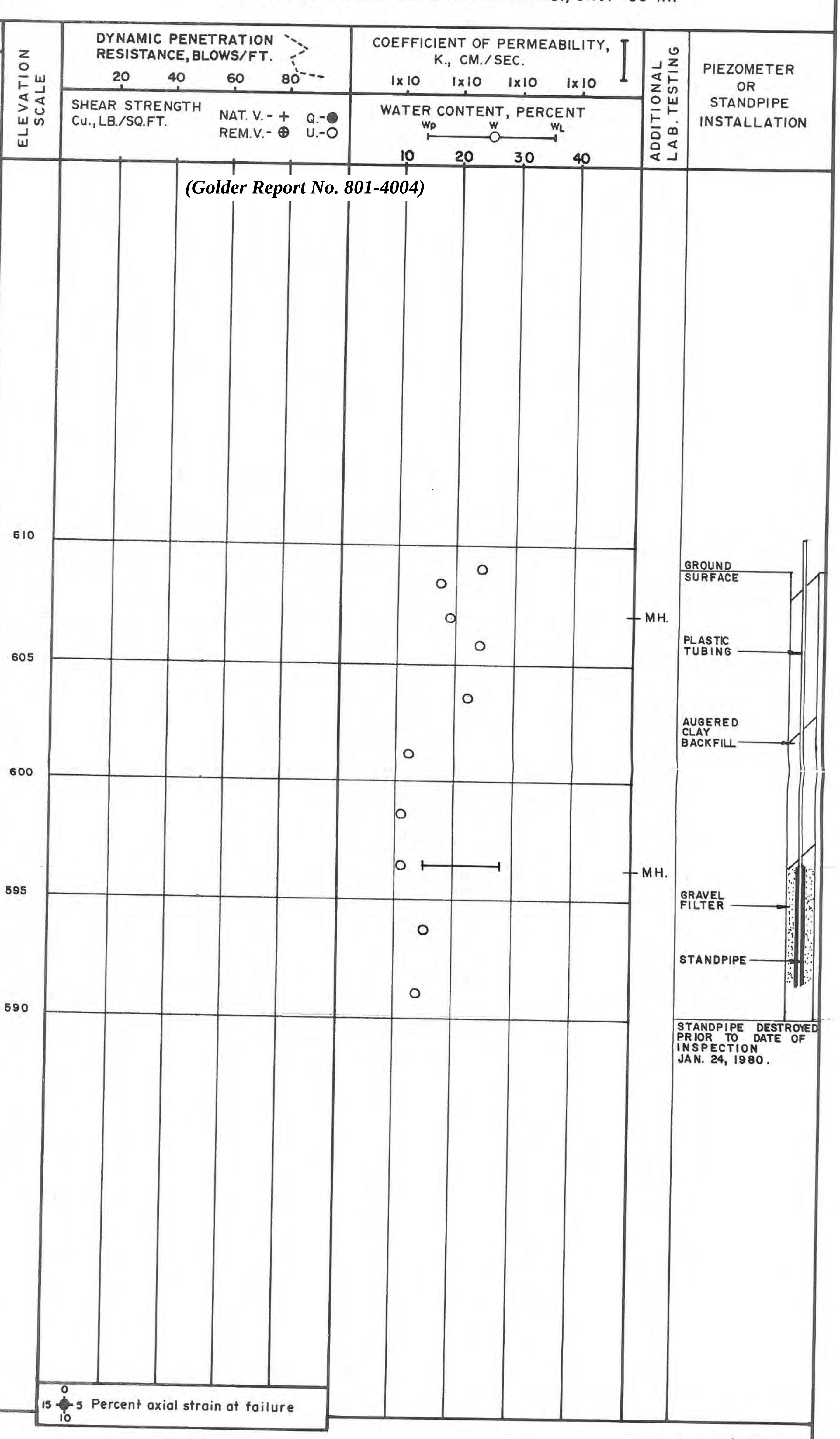
RECORD OF BOREHOLE 1

LOCATION See Figure 2
BORING DATE JAN. 17, 1980
DATUM GEODETIC
SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN.
PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

(Golder Report No. 801-4004)

BORING METHOD: POWER AUGER 4.5" DIA. (UNCASED)

ELEV'N. DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	BLOWS/FT.
609.1	GROUND SURFACE			
0.0 608.3	BLACK SANDY **TOPSOIL**	1	2" DO.	6
0.8 606.1	LOOSE TO COMPACT BROWN FINE **SAND**	2	"	11
3.0 604.4	COMPACT GREY FINE **SAND**	3	"	14
4.7	VERY STIFF TO HARD GREY **SILTY CLAY** SOME SAND TRACE GRAVEL **(TILL-LIKE)**	4	"	20
		5	"	32
		6	"	34
		7	"	37
		8	"	42
590.1		9	"	43
19.0	END OF BOREHOLE			



VERTICAL SCALE
1 IN. TO 5 FT.

Golder Associates

DRAWN L. B.
CHECKED

Form G.A.-D-1(m)

Project No. 831-4062

RECORD OF BOREHOLE 0159-342-1

LOCATION See Figure 2

BORING DATE AUG. 3 , 1983

DATUM LOCAL

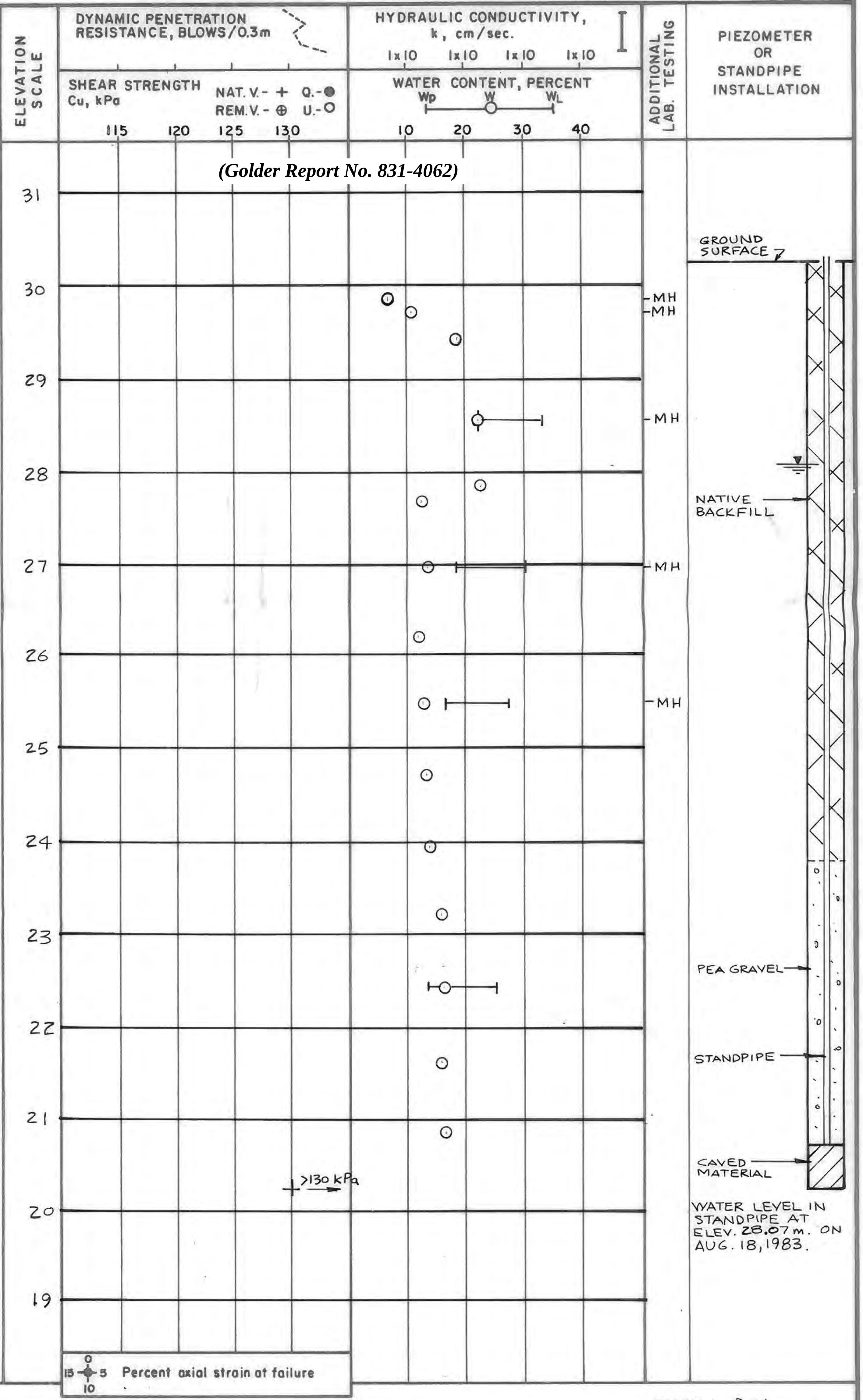
SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

(Golder Report No. 831-4062)

BORING METHOD: POWER AUGER 115 mm. DIAM. (UNCASED)

SOIL PROFILE		SAMPLES		
ELEV'N. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m
30.23	PAVEMENT SURFACE ASPHALT			
0.06 29.78	VERY DENSE GREY CRUSHED STONE BASE **(GM-GC)**	1	50mm D.O.	94
0.45 28.86	VERY DENSE **BLACK CINDER FILL (SP-SM)**	2	"	100
1.37 27.64	SOFT GREY BLACK **SILTY CLAY,** SOME SAND TRACE GRAVEL **(FILL) (CL)**	3 4	" "	4 18
2.59 26.57	VERY STIFF BROWN **SILTY CLAY,** SOME SAND, TRACE GRAVEL **(TILL) (CL)**	5	"	26
3.66 20.23	VERY STIFF GREY **SILTY CLAY,** SOME SAND, TRACE GRAVEL **(TILL) (CL)**	6 7 8 9 10 11 12 13	" " " " " " " "	29 27 27 22 19 17 15 13
10.0	END OF HOLE			



WATER LEVEL IN STANDPIPE AT ELEV. 28.07 m. ON AUG. 18, 1983.

VERTICAL SCALE 1:50 METRIC

Golder Associates

DRAWN D.M.

CHECKED

Form G.A.-D-1(m)

Project No. 831-4062

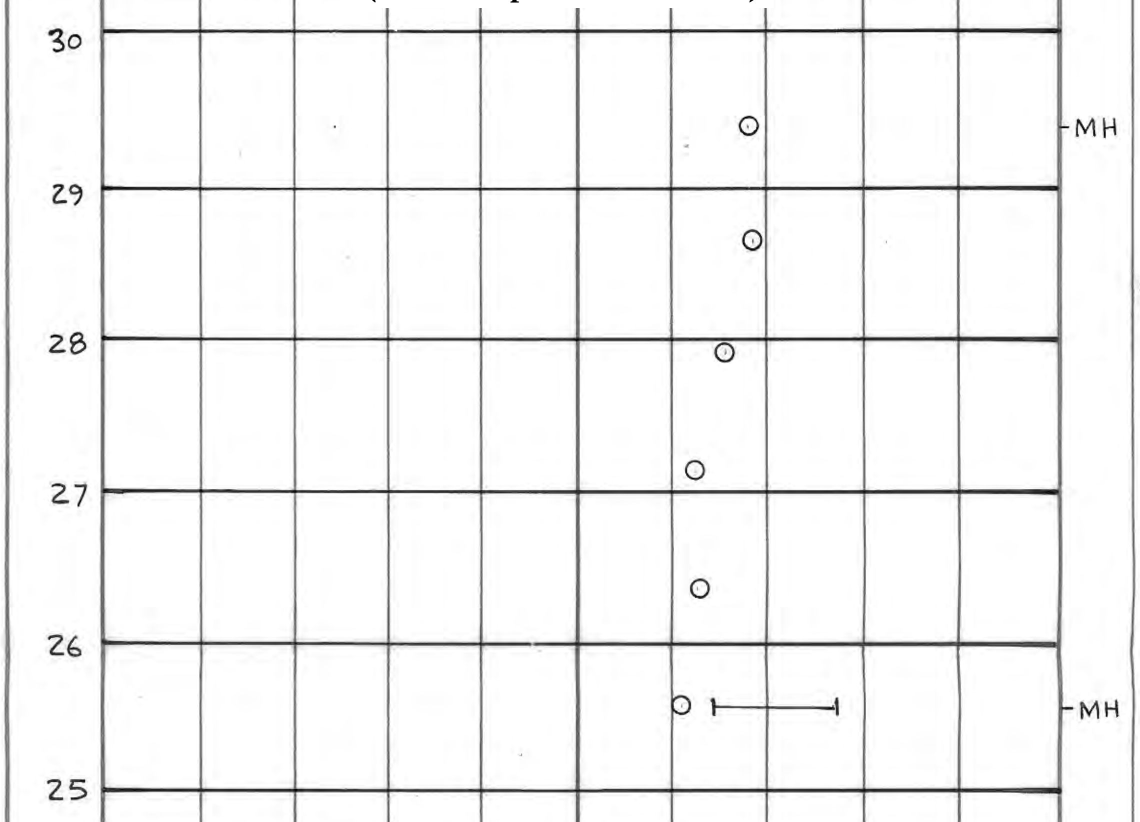
RECORD OF BOREHOLES 0159-342-2 & 0159-342-3

LOCATION See Figure 2
BORING DATE. AUG. 3, 1983
DATUM LOCAL
SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm
PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

BH. 0159-342-2

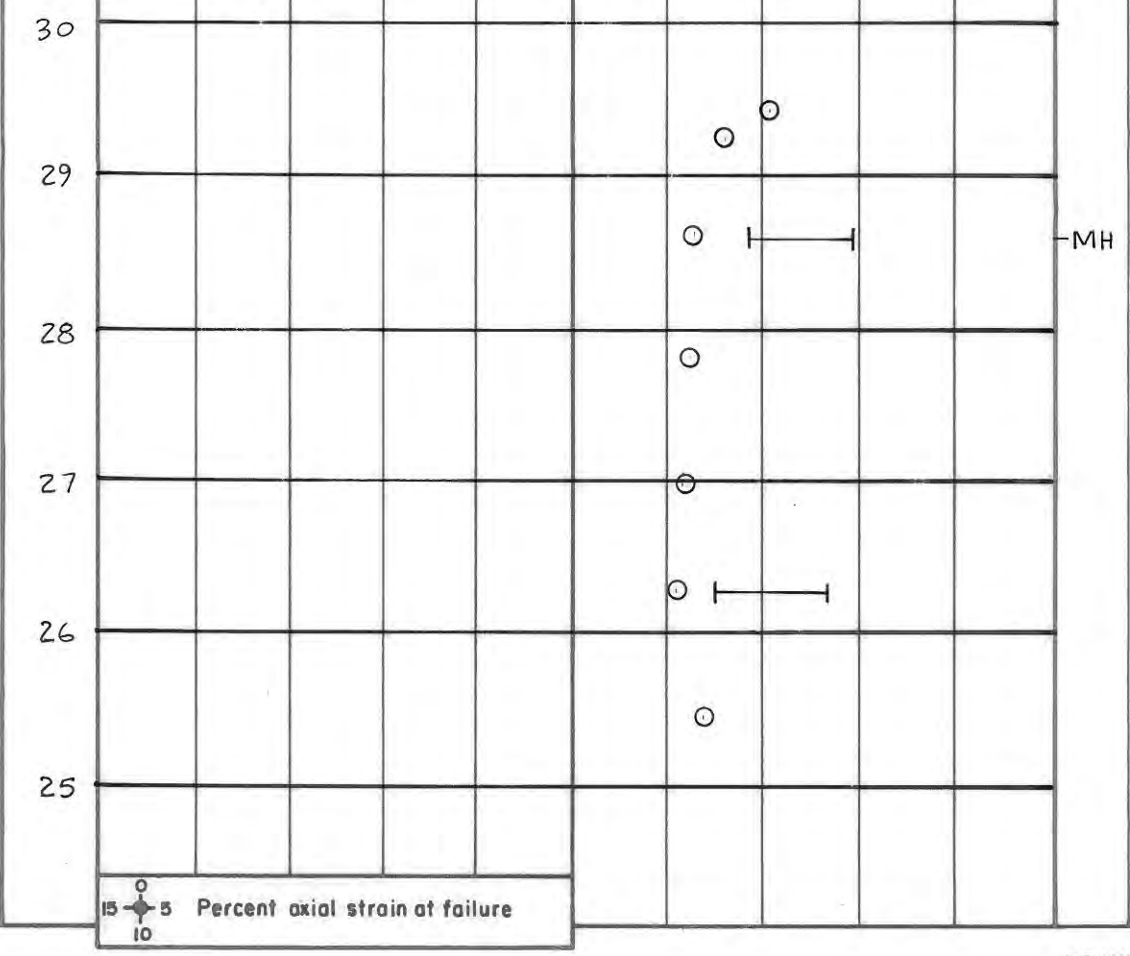
(Golder Report No. 831-4062)

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	30.33	PAVEMENT SURFACE					
POWER AUGER 115 mm. DIAM. (UNCASED)		ASPHALT					
	0.09	VERY DENSE GREY CRUSHED STONE BASE (GM-GC)					
	29.78 0.55	COMPACT BROWN SANDY SILT (FILL) (SM-SC)	1	50mm D.O.	11	MH	
	28.81 1.52	MOTTLED BROWN AND GREY SILTY CLAY (TILL) (CL)	2	"	7		BOREHOLE DRY DURING DRILLING
	28.20 2.13	HARD BROWN SILTY CLAY, SOME SAND, TRACE GRAVEL (TILL) (CL)	3	"	30		
			4	"	41		
	26.67 3.66	VERY STIFF GREY SILTY CLAY, SOME SAND, TRACE GRAVEL (TILL) (CL)	5	"	20		
			6	"	18	MH	
	25.30 5.03	END OF HOLE					



BH. 0159-342-3

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	30.19	PAVEMENT SURFACE					
POWER AUGER 115 mm. DIAM. (UNCASED)		ASPHALT					
	0.09	VERY DENSE GREY CRUSHED STONE BASE (GM-GC)					
	29.64 0.55	COMPACT BLACK CINDER FILL (SP-SM)	1	50mm D.O.	5		
	29.12 1.07	SOFT BROWN CLAVEY SAND FILL (SC)					
	28.67 1.52	VERY STIFF TO HARD BROWN SILTY CLAY SOME SAND, TRACE GRAVEL (TILL) (CL)	2	"	18	MH	BOREHOLE DRY DURING DRILLING
			3	"	33		
	27.14 3.05	HARD TO VERY STIFF GREY SILTY CLAY, SOME SAND, TRACE GRAVEL (TILL) (CL)	4	"	36		
			5	"	19		
			6	"	18		
	25.16 5.03	END OF HOLE					



VERTICAL SCALE
1:50 METRIC

Golder Associates

DRAWN D.M.
CHECKED

Form G.A.-D-I(m) Project No. 831-4062

RECORD OF BOREHOLES 0159-342-4 & 0159-342-5

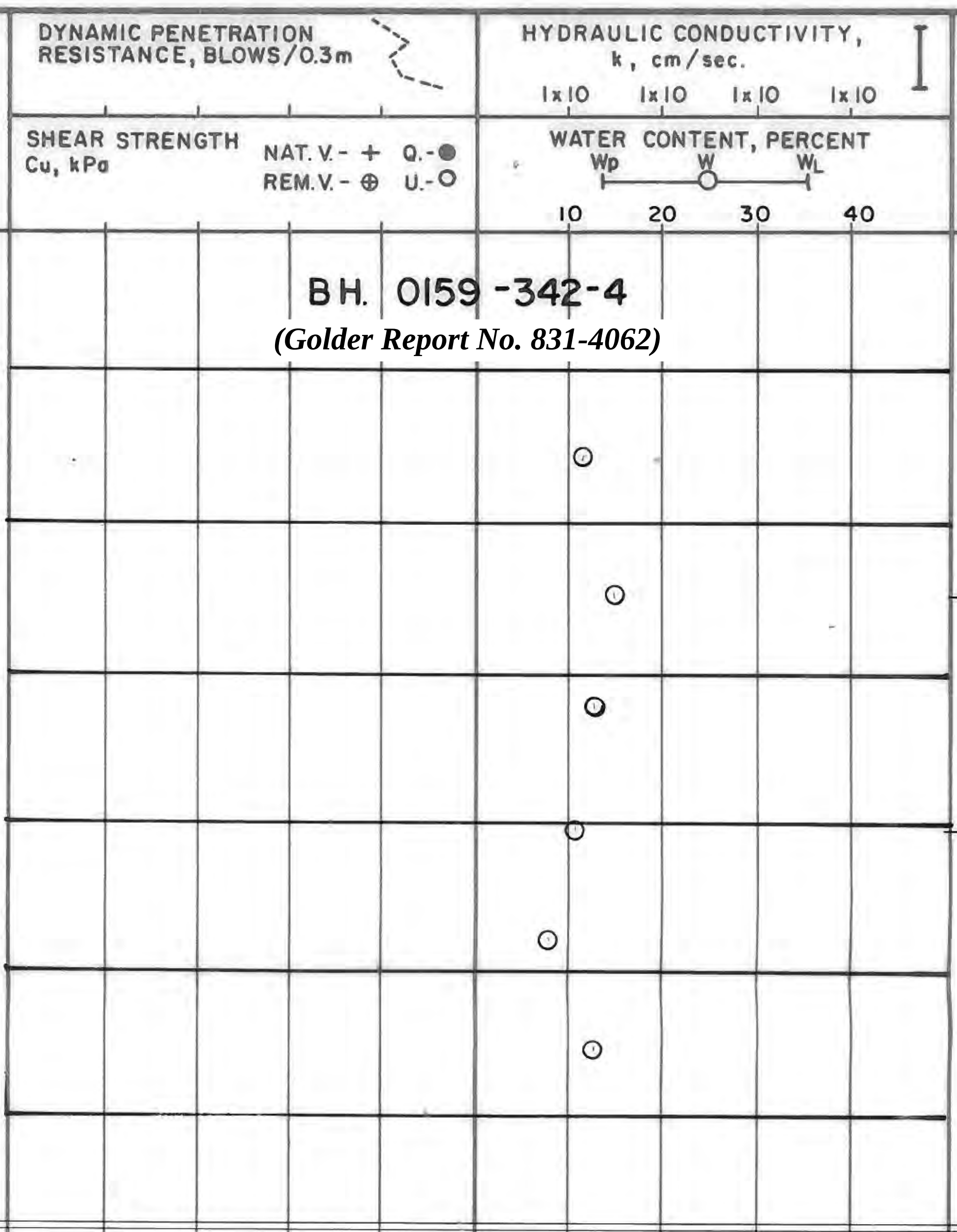
LOCATION See Figure 2 BORING DATE AUG. 3, 1983 DATUM LOCAL

SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

BH. 0159-342-4

(Golder Report No. 831-4062)

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	30.18	PAVEMENT SURFACE ASPHALT				
POWER AUGER 115mm DIAM. (UNCASED)	0.06 29.51	VERY DENSE GREY CRUSHED STONE BASE (GM-GC)				
	0.67 28.97	VERY DENSE BLACK CINDER (FILL) (SP-SM)	1	50mm. D.O.	100	
	1.21 28.05	COMPACT BROWN SILTY SAND, TRACE TO SOME GRAVEL (SM)	2	"	13	MH
	2.13 27.13	VERY STIFF GREY SILTY CLAY SOME SAND, TRACE GRAVEL (TILL) (CL)	3	"	30	
	3.05 26.07	DENSE GREY TO BROWN SILTY SAND, SOME GRAVEL (SM)	4	"	40	MH
			5	"	38	
	4.11 25.15	HARD GREY SILTY CLAY, SOME SAND, TRACE GRAVEL (TILL) (CL)	6	"	31	
	5.03	END OF HOLE				

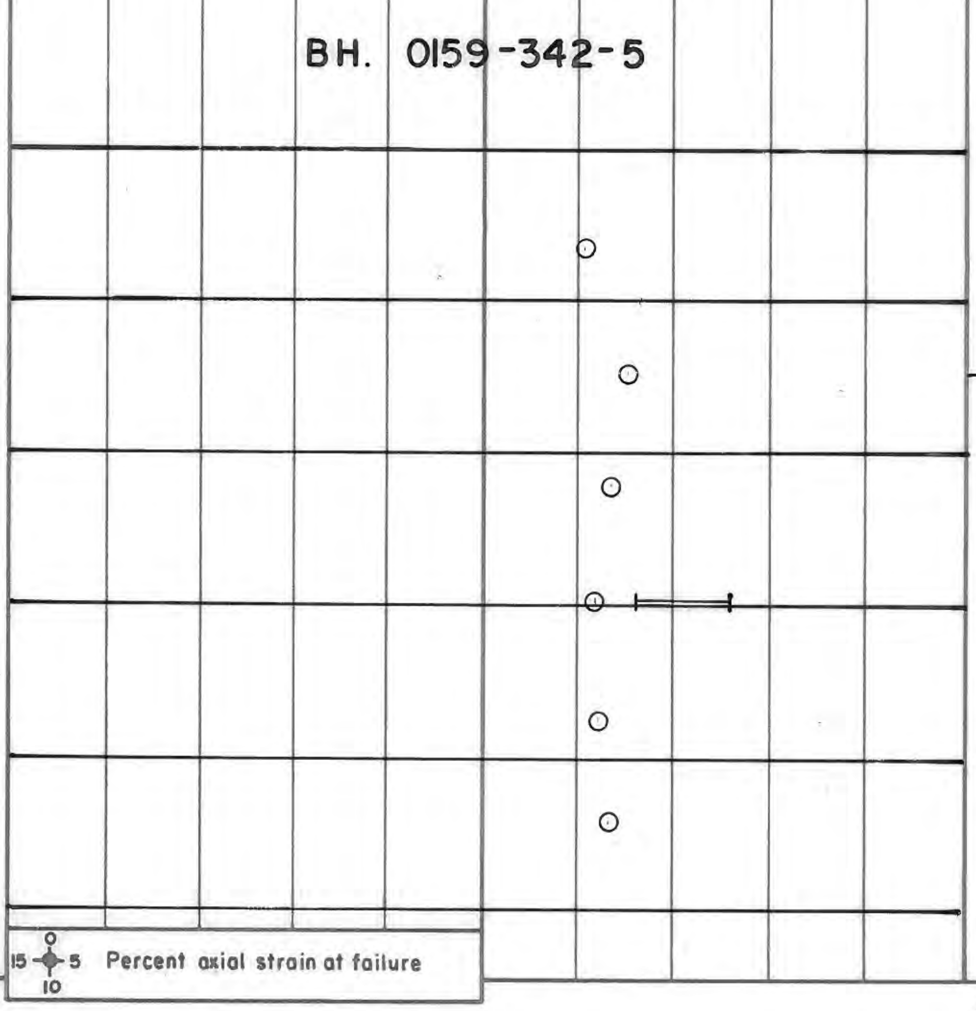


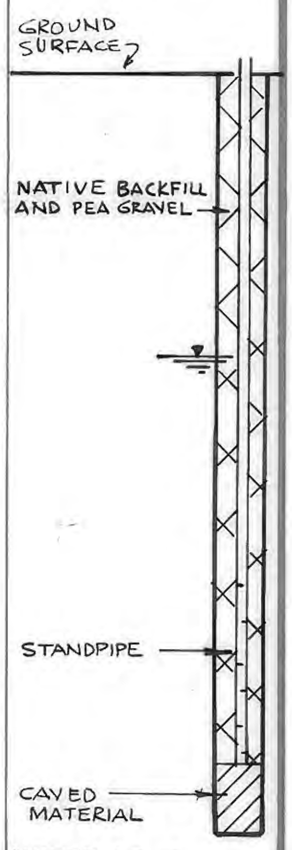
PIEZOMETER OR STANDPIPE INSTALLATION

WATER LEVEL IN BOREHOLE AT ELEV. 28.35 ON AUG. 3, 1983.

BH. 0159-342-5

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	30.31	PAVEMENT SURFACE ASPHALT				
POWER AUGER 115 mm. DIAM. (UNCASED)	0.09 29.76	VERY DENSE GREY CRUSHED STONE BASE (GM-GC)				
	0.55 28.18	VERY LOOSE BLACK CINDER FILL (SP-SM)	1	AS.	-	
			2	50mm. D.O.	3	M
	2.13 25.28	VERY STIFF TO HARD GREY SILTY CLAY, SOME SAND, TRACE GRAVEL (CL)	3	"	15	
			4	"	34	
			5	"	34	
			6	"	24	
	5.03	END OF HOLE				





WATER LEVEL IN STANDPIPE AT ELEV. 28.42 ON AUG. 18, 1983

VERTICAL SCALE

Golder Associates

DRAWN ____________

CHECKED ____________

TABLE I

RECORD OF TEST PITS
PROPOSED WAREHOUSE STRUCTURE
PART LOT 16, CONCESSION VI
SANDWICH SOUTH TOWNSHIP

TEST PIT NO.	ELEVATION (Ft.)	DEPTH (in.)	MATERIAL	WATER CONTENT (%)	REMARKS
1	621.36	0 - 20	Brown and grey silty clay (FILL)	14.4	Test pit dry during excavation
		20 - 25	Black sandy TOPSOIL	16.9	
		25 - 39	Brown SILTY SAND trace gravel	14.0	
		39 - 119	Hard brown SILTY CLAY some sand occasional gravel (TILL)	11.3 10.9 11.4 11.7	Pocket penetrometer readings Cu >4500 psf
			* * *		
2	621.38	0 - 12	Black clayey TOPSOIL	17.9	
		12 - 60	Brown silty clay some sand pieces of asphalt and wood (FILL)		Test pit dry during excavation
		60 - 67	Black fibrous PEAT	80.8	
		67 - 127	Hard grey silty clay some sand occasional gravel (TILL)	11.1 12.0 12.6	Pocket penetrometer readings Cu >4500 psf

TABLE I

RECORD OF TEST PITS
PROPOSED WAREHOUSE STRUCTURE
PART LOT 16, CONCESSION VI
SANDWICH SOUTH TOWNSHIP

TEST PIT NO.	ELEVATION (Ft.)	DEPTH (in.)	MATERIAL	WATER CONTENT (%)	REMARKS
3	620.60	0 - 6	Black silty TOPSOIL	22.1	Water seepage into excavation at 18 inches
		6 - 54	Brown silty clay pocket topsoil, pieces of concrete (FILL)	14.2	
		54 - 60	Black SAND some organic material and brown PEAT	26.1	
		60 - 65	Brown SANDY SILT	14.1	
		65 - 118	Hard brown SILTY CLAY some sand occasional gravel (TILL)	11.2 12.1 11.9	Pocket penetrometer readings Cu >4500 psf

* * *

TEST PIT NO.	ELEVATION (Ft.)	DEPTH (in.)	MATERIAL	WATER CONTENT (%)	REMARKS
4	619.32	0 - 14	Black silty TOPSOIL	18.0	
		14 - 28	Brown SANDY SILT	15.2	Water seepage into excavation at 12 inches
		28 - 53	Very stiff mottled SILTY CLAY some sand occasional gravel (TILL)	13.6	
		53 - 117	Hard brown SILTY CLAY some sand trace gravel (TILL)	11.9 11.6 11.4	Pocket penetrometer readings Cu >4500 psf

TABLE I

RECORD OF TEST PITS
PROPOSED WAREHOUSE STRUCTURE
PART LOT 16, CONCESSION VI
SANDWICH SOUTH TOWNSHIP

TEST PIT NO.	ELEVATION (Ft.)	DEPTH (in.)	MATERIAL	WATER CONTENT (%)	REMARKS
5	619.42	0 - 14	Black silty TOPSOIL	21.7	Water seepage into excavation at 12 inches
		14 - 34	Brown SANDY SILT trave gravel	18.9	
		34 - 60	Very stiff mottled SILTY CLAY some sand occasional gravel (TILL)	15.0	Field vane test undrained shear strength: Cu = 3920 psf at 41 inches
		60 - 121	Hard brown SILTY CLAY some sand occasional gravel (TILL)	12.0 12.1 13.9	Pocket penetrometer readings Cu >4500 psf

PROJECT: 901-4269

LOCATION: See Figure 2

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 1

BORING DATE: Nov. 30, 1990

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 901-4269)

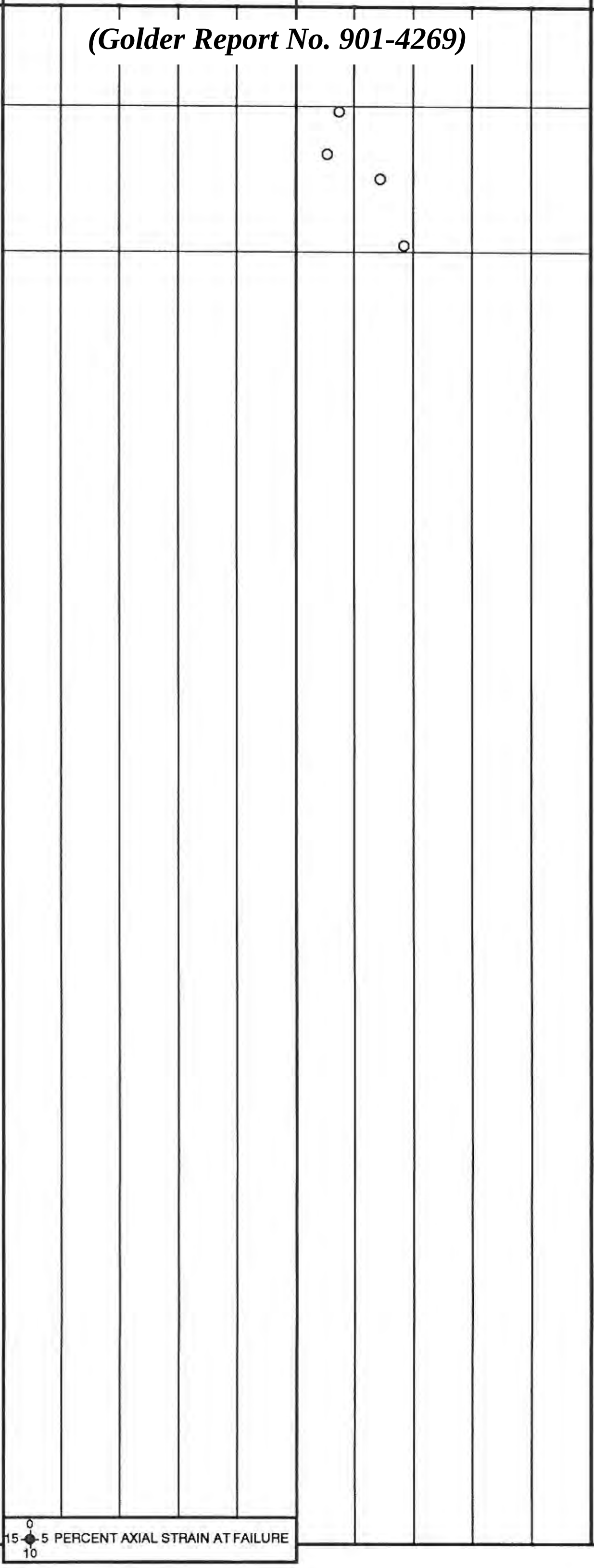
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Prospector 115mm Solid Stem Augers	Ground Surface		181.49					
		Asphalt		0.00					
		Compact GRANULAR 'A' Fill.		0.11	1	DO	17		
1		Stiff to very stiff mottled grey and brown SILTY CLAY, some Sand, trace Gravel. (Till)		180.58 0.91	2	DO	11		
					3	DO	15		Borehole Dry During Drilling.
		End of Borehole - 1.68 metres.		179.81 1.68					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa nat.V - + Q - ● rem.V - ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s

WATER CONTENT, PERCENT Wp W Wl



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DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 901-4269

LOCATION: See Figure 2

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 2

BORING DATE: Nov. 30, 1990

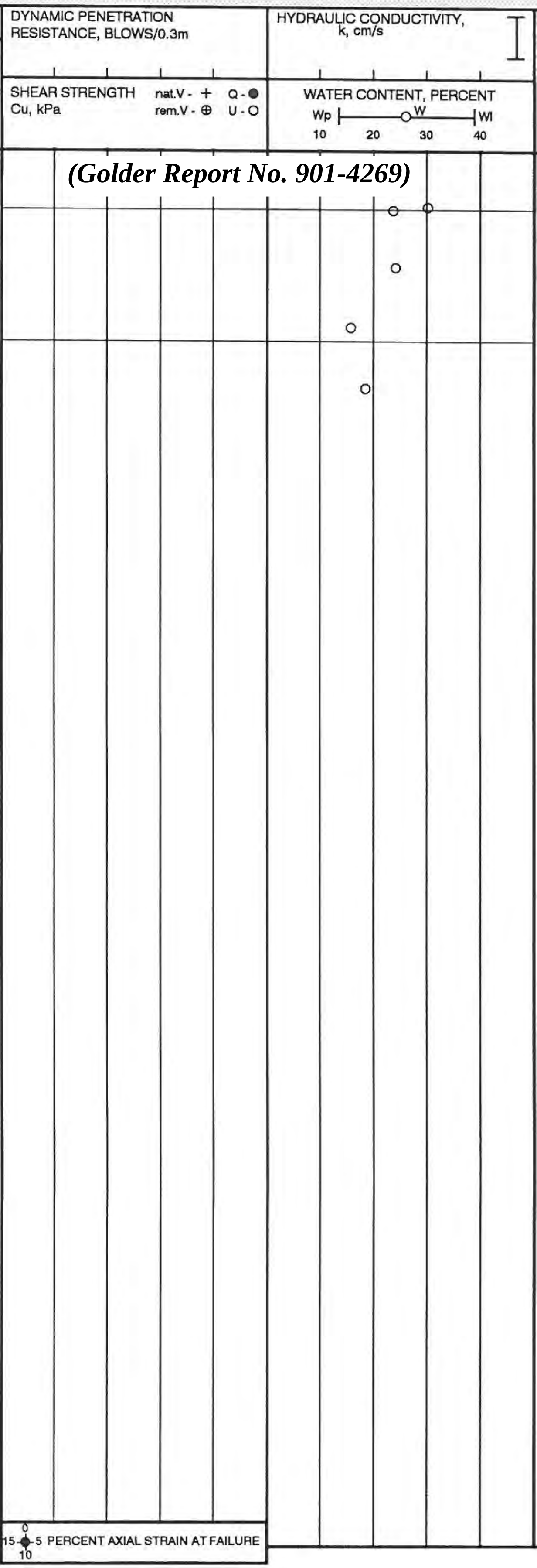
SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 901-4269)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	Prospector 115 mm Solid Stem Augers	Ground Surface	181.24				
		Black Clayey Topsoil	0.00 180.94	1	DO	5	
		Stiff mottled grey and brown SILTY CLAY, some Sand, trace Gravel. (Till)	0.30	2	DO	9	
1			179.87	3	DO	10	
		Very stiff brown SILTY CLAY. Some Sand, trace of Gravel. (Till)	1.37 179.41	4	DO	15	Borehole Dry During Drilling.
2		End of Borehole - 1.83 metres.	1.83				



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED: Ja

DATA INPUT: F269002.BHS

PROJECT: 901-4269

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov. 30, 1990

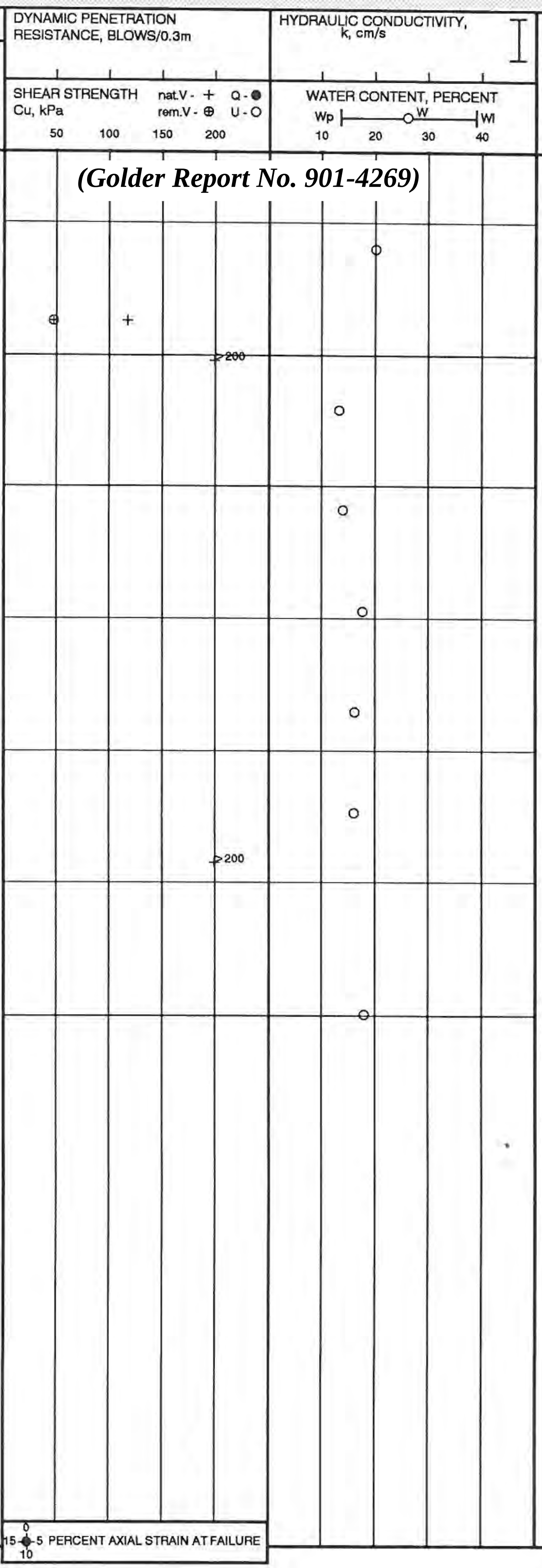
DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

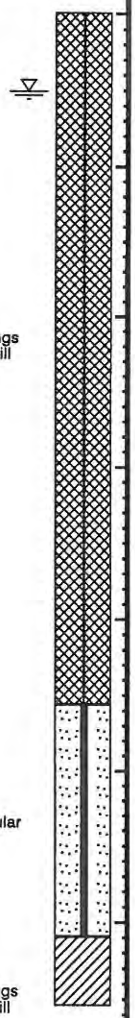
(Golder Report No. 901-4269)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
Prospector 115 mm Solid Stem Augers.	Ground Surface	180.33			
	Black Clayey TOPSOIL.	0.00			
	Stiff mottled brown and grey SILTY CLAY some Sand trace of Gravel (Till).	180.03 0.30	1	DO	8
	Very stiff to hard brown SILTY CLAY, some Sand, trace Gravel (Till).	178.96 1.37	2 3	DO DO	15 30
	Very stiff to stiff grey SILTY CLAY, some Sand, trace of Gravel (Till).	177.28 3.05	4 5 6 7	DO DO DO DO	20 12 12 9
	End of Borehole - 6.55 metres.	173.78 6.55			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Cuttings Backfill

Granular Filter

Cuttings Backfill

Water Seepage at 1.5 metres during drilling.

Water Level at Elev. 179.8 m on Dec. 6, 1990.

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DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 901-4269

LOCATION: See Figure 2

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 4

BORING DATE: Nov. 30, 1990

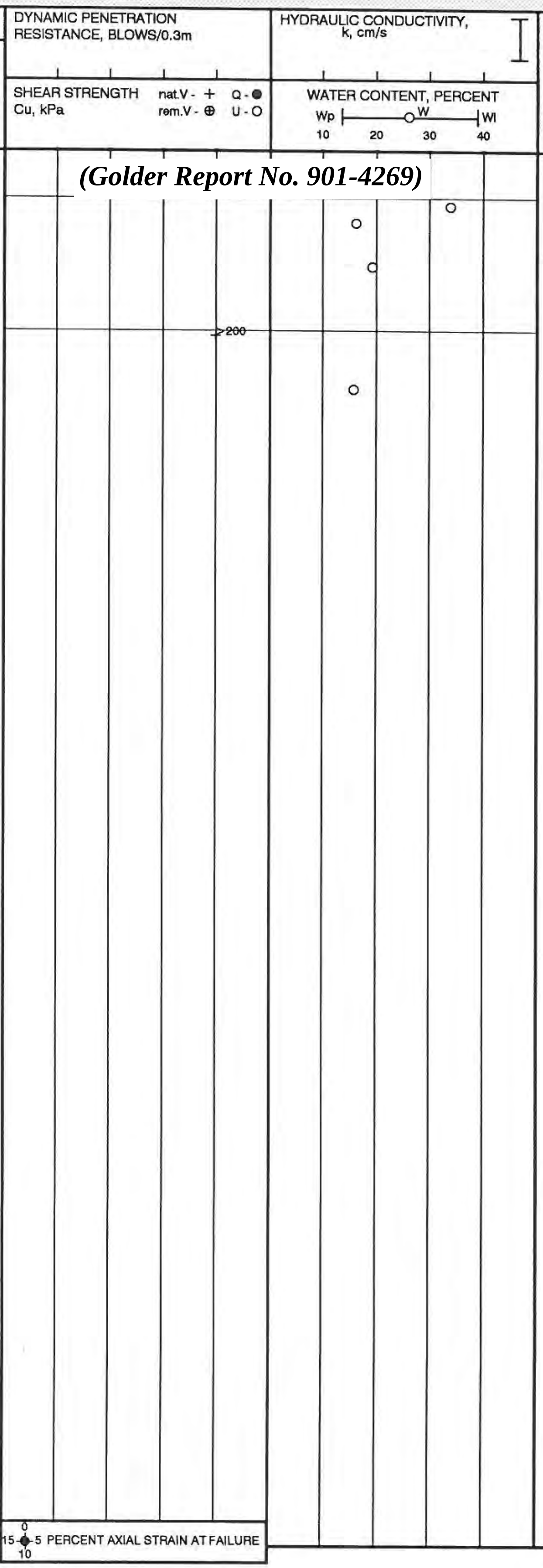
SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 901-4269)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	Prospector 115 mm Solid Stem Augers	Ground Surface		181.16				
		Black Clayey TOPSOIL		0.00 180.89	1	DO	6	
		Firm to Stiff mottled grey and brown SILTY CLAY, some Sand, trace Gravel. (Till)		0.27 180.25	2	DO	9	
1		Very stiff brown SILTY CLAY. Some Sand, trace of Gravel. (Till)		0.91 179.33	3	DO	19	Borehole Dry During Drilling.
2		End of Borehole - 1.83 metres.		1.83				



ADDITIONAL LAB. TESTING

DATA INPUT: F269004.BHS

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED: JU

PROJECT: 901-4269

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov. 30, 1990

DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

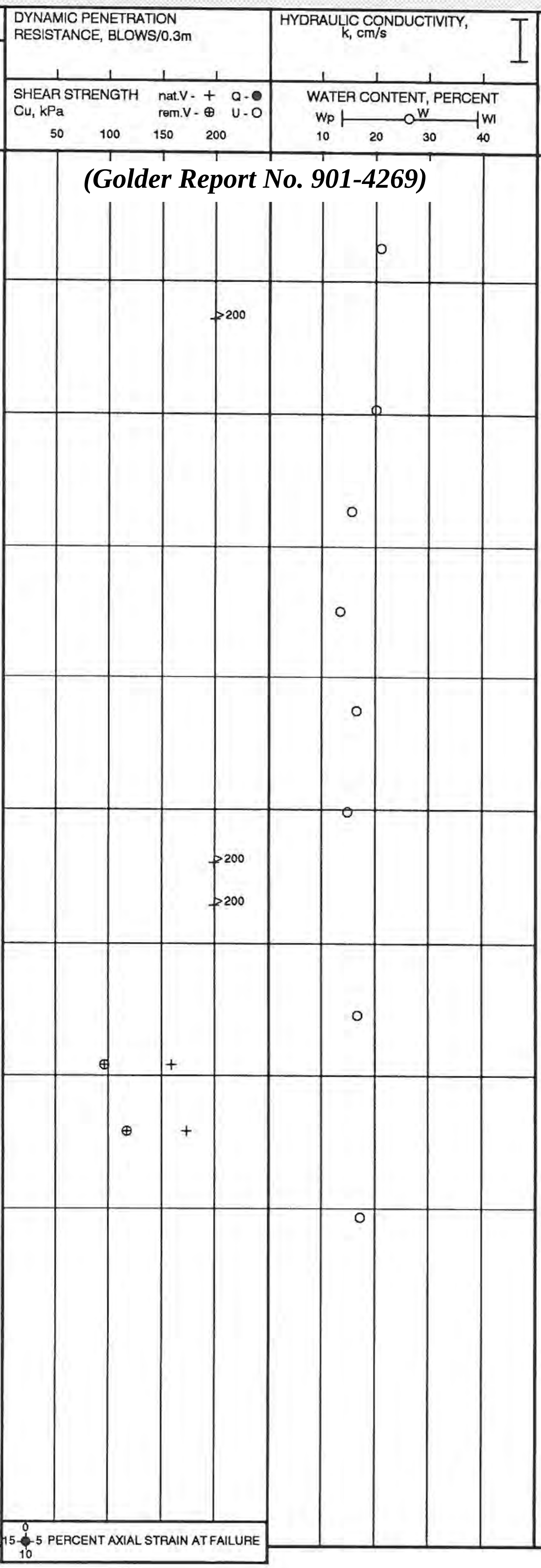
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 901-4269)

BORING METHOD: Prospector 115 mm Solid Stem Augers.

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0	Ground Surface	180.78
	Black Clayey TOPSOIL.	0.00 0.12
	Stiff mottled brown and grey SILTY CLAY some Sand trace of Gravel (Till).	179.71 1.07
1–4	Very stiff brown SILTY CLAY, to CLAYEY SILT, some Sand, trace Gravel (TILL).	176.51 4.27
4–8	Very stiff to stiff grey SILTY CLAY, some Sand, trace of Gravel (Till).	172.70 8.08
8	End of Borehole - 8.08 metres.	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	DO	8
2	DO	23
3	DO	26
4	DO	23
5	DO	14
6	DO	10
7	DO	8
8	DO	7



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Slight of Seepage at 3.7 metres during drilling.

DATA INPUT: F269005.BHS

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 901-4269

LOCATION: See Figure 2

RECORD OF TEST PIT 6

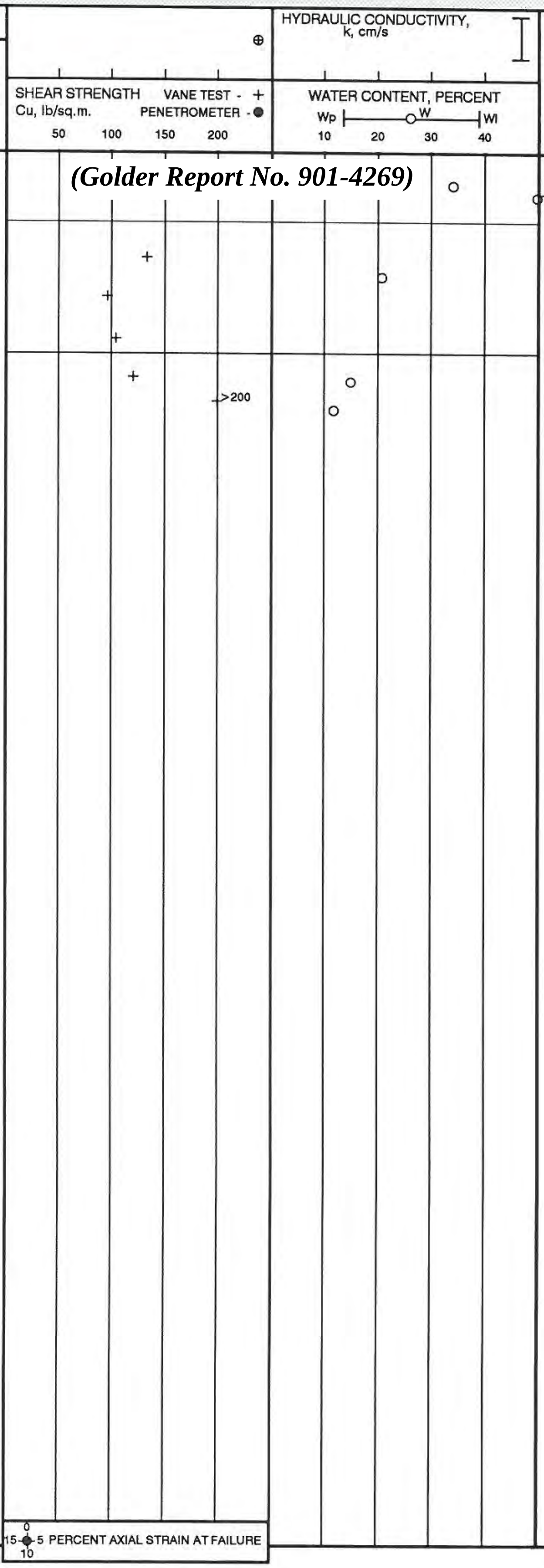
DATE: Dec. 5, 1990

SHEET 1 OF 1

DATUM: Geodetic

(Golder Report No. 901-4269)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
		Ground Surface		180.33					
0	Backhoe 4m X 1m	Brown and Black Clayey TOPSOIL.		0.00	1 2	CS CS			
1		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till).		0.18	3	CS			
		Very stiff brown SILTY CLAY, some Sand, trace of Gravel (Till)		178.88 1.45	4	CS			
2		End of Test Pit - 1.83 metres.		178.50 1.83	5				Slight Seepage at about 1.2 metres during excavation.
3									
4									
5									
6									
7									
8									
9									
10									



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DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 901-4269

LOCATION: See Figure 2

RECORD OF TEST PIT 7

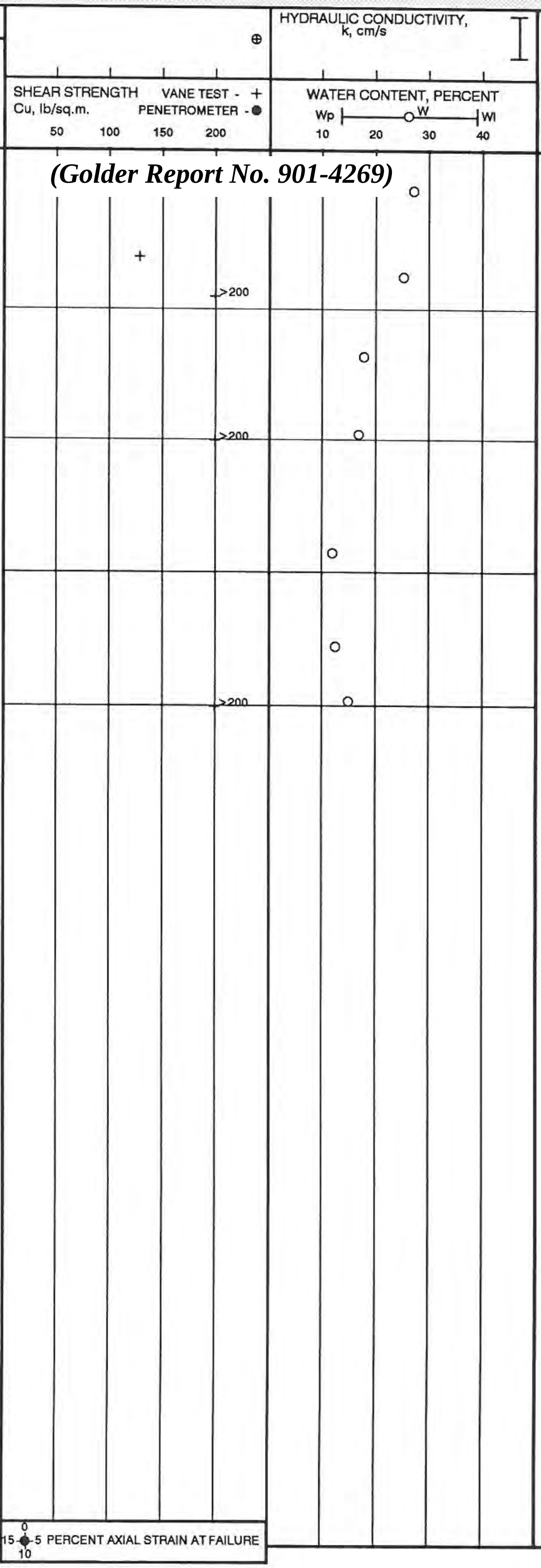
DATE: Dec. 5, 1990

SHEET 1 OF 1

DATUM: Geodetic

(Golder Report No. 901-4269)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
0		Ground Surface	180.99					
		Brown Clayey TOPSOIL.	0.00	1	CS			
		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till).	180.66 0.33	2	CS			
1 2 3	Backhoe 4m X 1m	Very stiff brown SILTY CLAY, some Sand, trace of Gravel (Till)	179.62 1.37	3 4 5 6	CS CS CS CS			Dry During Excavation.
4		Very stiff grey SILTY CLAY, some Sand, trace Gravel (Till).	177.18 3.81	7	CS			
		End of Test Pit - 4.11 metres.	176.88 4.11					
5 6 7 8 9 10								



DATA INPUT: F269007.TSP

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 901-4269
LOCATION: See Figure 2

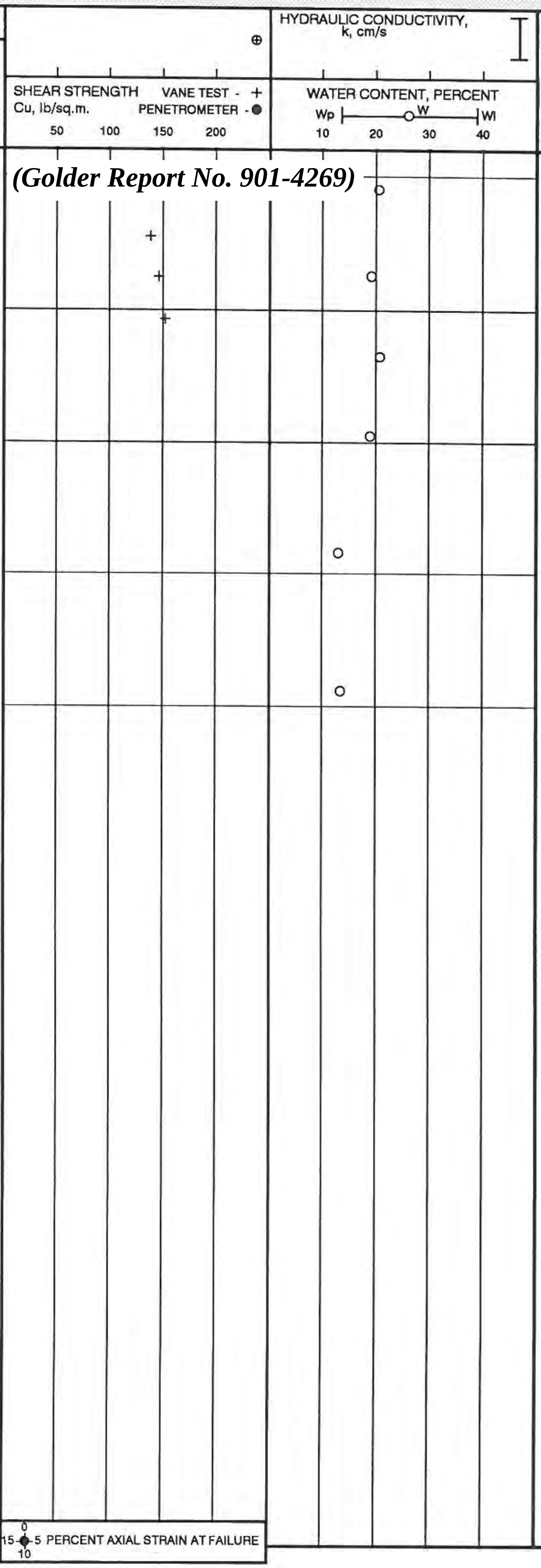
RECORD OF TEST PIT 8

DATE: Dec. 5, 1990

SHEET 1 OF 1
DATUM: Geodetic

(Golder Report No. 901-4269)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
0	Backhoe 4m X 1m	Ground Surface		181.00					
		Brown Clayey TOPSOIL.		0.00	1	CS			
		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till).		0.23	2	CS			
1		Very stiff brown SILTY CLAY, some Sand, trace of Gravel (Till)		179.65 1.35	3	CS			
2					4	CS			Test Pit Dry.
3					5	CS			
		Very stiff grey SILTY CLAY, some Sand, trace Gravel (Till).		177.80 3.20	6	CS			
				177.04	7	CS			
4		End of Test Pit - 3.96 metres.		3.96					
5									
6									
7									
8									
9									
10									



DEPTH SCALE
1 to 50

DATA INPUT: F269008.TSP

Golder Associates

LOGGED: R.W.W.
CHECKED:

PROJECT: 901-4269

LOCATION: See Figure 2

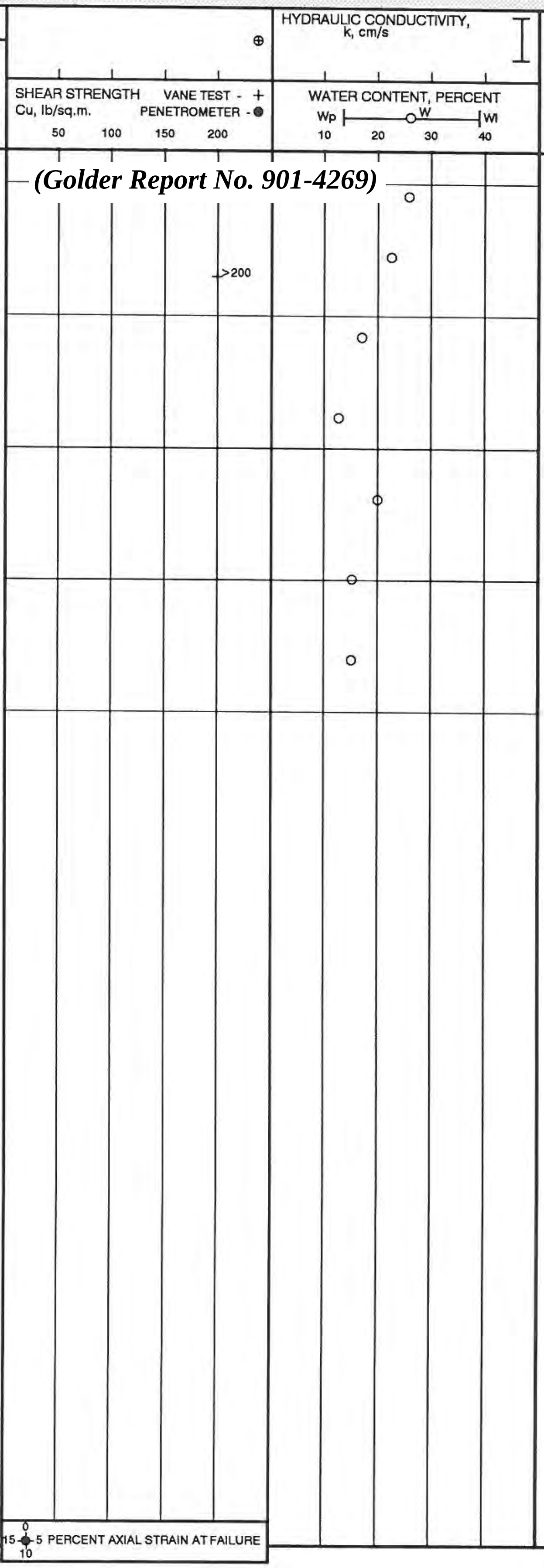
RECORD OF TEST PIT 9

DATE: Dec. 4, 1990

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
		Ground Surface		181.05					
0	Backhoe 4m X 1m	Black Clayey TOPSOIL.		0.00	1	CS			
		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till).		180.75 0.30	2	CS			
1					3	CS			
		Very stiff brown SILTY CLAY, some Sand, trace of Gravel. Fissured, oxidixzed. (Till)		179.22 1.83	4	CS			
2					5	CS			Slight Seepage from Topsoil layer during excavation.
3		Very stiff grey SILTY CLAY, some Sand, trace Gravel (Till).		178.00 3.05	6	CS			
					7	CS			
4		End of Test Pit - 3.96 metres.		177.09 3.96					



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DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.C.

CHECKED: Jar

PROJECT: 901-4269
LOCATION: See Figure 2

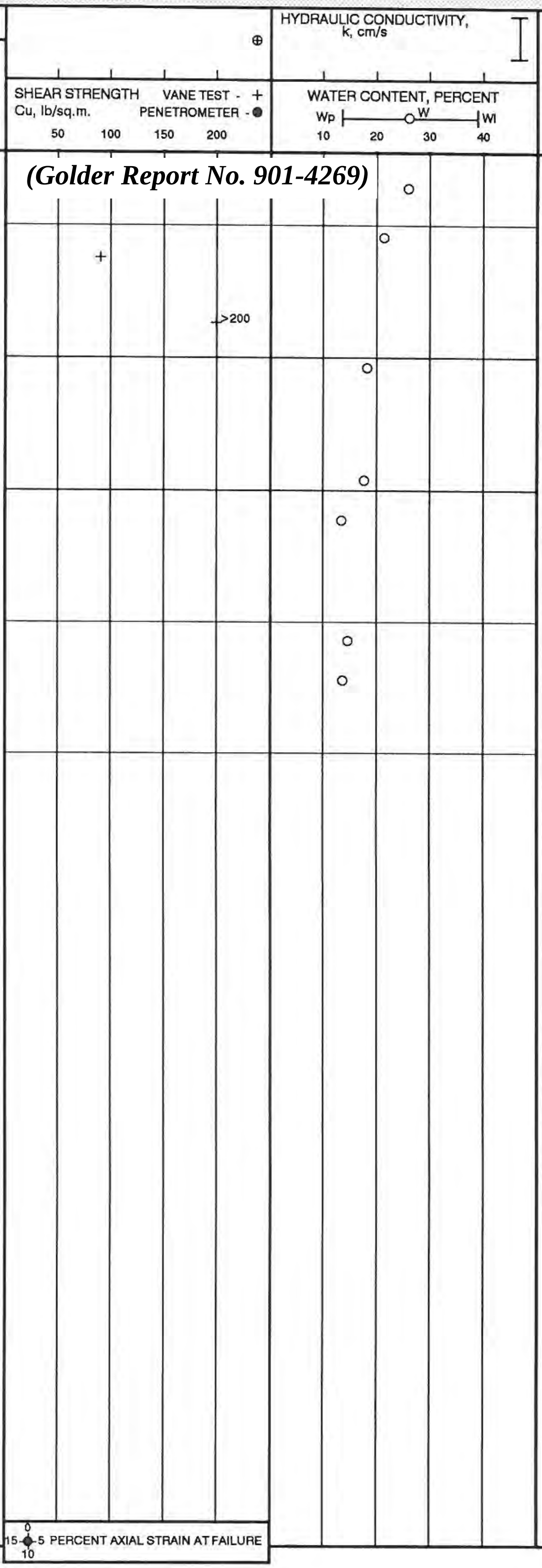
RECORD OF TEST PIT 10

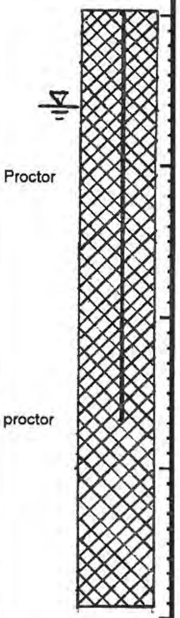
DATE: Dec. 4, 1990

SHEET 1 OF 1
DATUM: Geodetic

(Golder Report No. 901-4269)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
0	Backhoe 4m X 1m	Ground Surface		181.36					
		Black Clayey TOPSOIL		0.00	1	CS			
		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till). Silt Pockets.		0.15	2	CS			
1								M,H	Proctor
					3	CS			
2				179.38 1.98					
		Very stiff brown SILTY CLAY, some Sand, trace of Gravel. Fissured, oxidixzed. (Till)			4	CS			
					5	CS		M,H	proctor
3				178.01 3.35					
		Very stiff grey SILTY CLAY, some Sand, trace Gravel (Till).			6	CS			
				177.40 3.96	7	CS			
4		End of Test Pit - 3.96 metres.							
5		Bulk sample from 0.15 to 1.98m. Bulk sample from 1.98 to 3.35m.							Slight Seepage at 1.5 metres during excavation. Standpipe installed to 2.7 metres. Water level at Elev. 180.7 on Dec. 6, 1990
6									
7									
8									
9									
10									





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DEPTH SCALE
1 to 50

Golder Associates

LOGGED: C.C.
CHECKED:

PROJECT: 901-4269

LOCATION: See Figure 2

RECORD OF TEST PIT 11

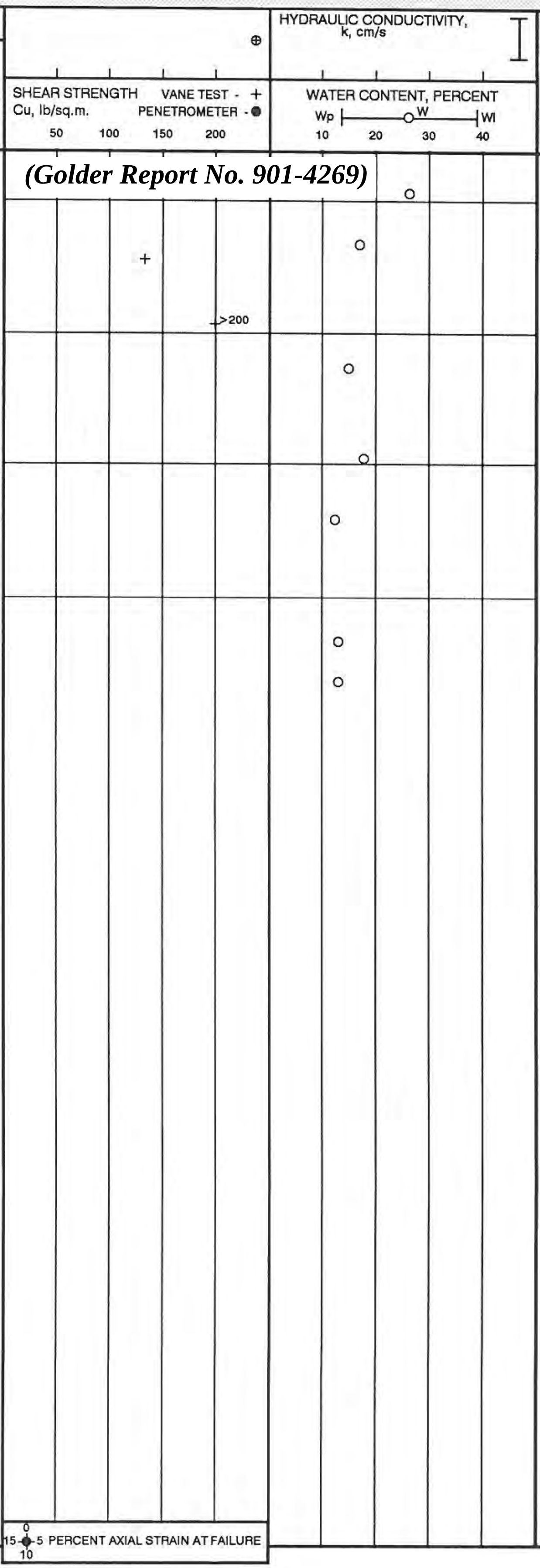
DATE: Dec. 4, 1990

SHEET 1 OF 1

DATUM: Geodetic

(Golder Report No. 901-4269)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
0	Backhoe 4m X 1m	Ground Surface		181.17					
		Black Clayey TOPSOIL.		0.00	1	CS			
		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till). Silt Pockets.		0.23	2 3	CS CS			
2		Very stiff brown SILTY CLAY, some Sand, trace of Gravel. Fissured, oxidixzed. (Till)		179.19 1.98	4 5 6	CS CS CS			Water ponded at ground surface during excavation.
		Very stiff grey SILTY CLAY, some Sand, trace Gravel (Till).		177.51 3.66	7	CS			
4		End of Test Pit - 3.96 metres.		177.21 3.96					



DATA INPUT: F269011.TSP

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: C.C.
CHECKED: Jd

PROJECT: 901-4269

RECORD OF TEST PIT 12

SHEET 1 OF 1

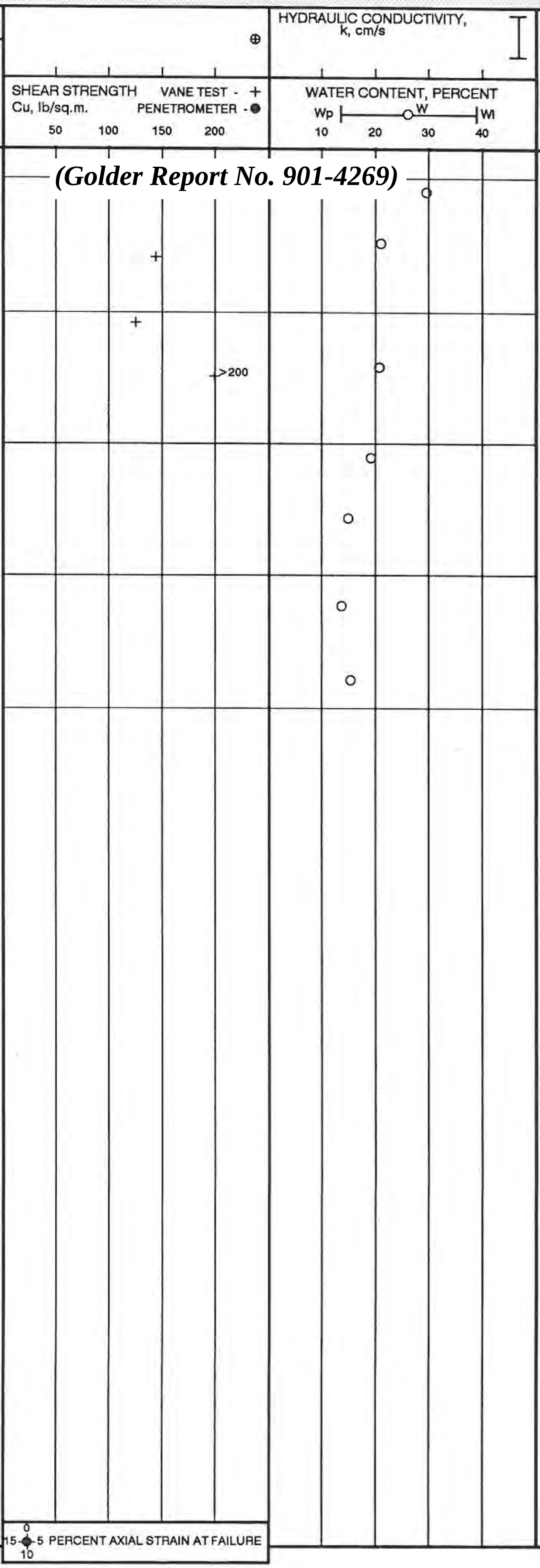
LOCATION: See Figure 2

DATE: Dec. 4, 1990

DATUM: Geodetic

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	USCS	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
	Backhoe 4m X 1m	Ground Surface		181.02					
0		Black Clayey TOPSOIL.		0.00	1	CS			
1		Very stiff mottled brown and grey SILTY CLAY, some Sand, trace of Gravel (Till). Silt Pockets.		0.25	2 3	CS CS			
2 3		Very stiff brown SILTY CLAY, some Sand, trace of Gravel. Fissured, oxidixzed. (Till)		179.19 1.83	4 5	CS CS			Slight Seepage at 1.2 metres during excavation.
		Very stiff grey SILTY CLAY, some Sand, trace Gravel (Till).		177.67 3.35	6 7	CS CS			
4		End of Test Pit - 3.96 metres.		177.06 3.96					
5		Bulk sample from 0.25 to 1.83m.							
6 7 8 9 10									

(Golder Report No. 901-4269)



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DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 961-4043

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: APRIL 17, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4043)

DEPTH SCALE METRES: 0 – 10

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROADWAY SHOULDER	185.6
Compact granular roadbase (FILL)	0.00
Compact brown fine SAND, some silt	185.1 0.46
Very stiff brown SILTY CLAY, some sand and gravel (TILL)	184.2 1.37
Very stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	183.4 2.13
END OF BOREHOLE	177.5 8.08

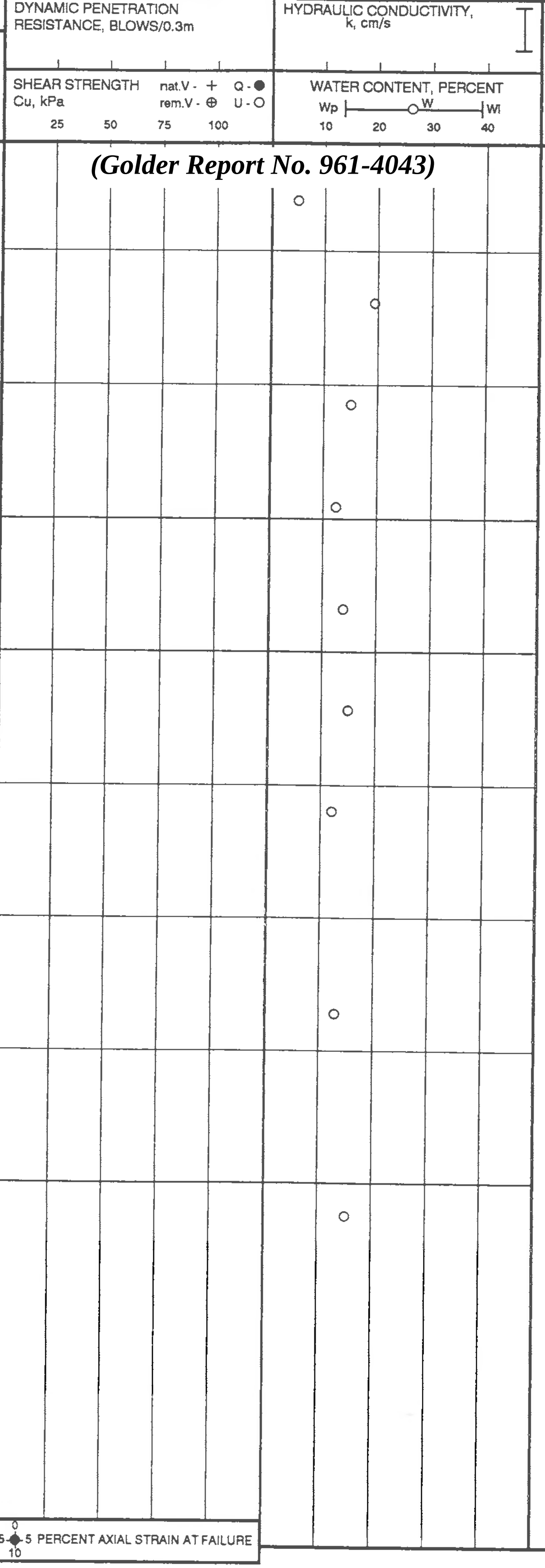
SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	11
2	50 DO	18
3	50 DO	18
4	50 DO	19
5	50 DO	18
6	50 DO	18
7	50 DO	17
8	50 DO	17
9	50 DO	16

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa nat.V - + Q - ● rem.V - ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s

WATER CONTENT, PERCENT Wp ├──○W──┤ Wl



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on April 17, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4043

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: APRIL 17, 1996

DATUM: GEODETIC

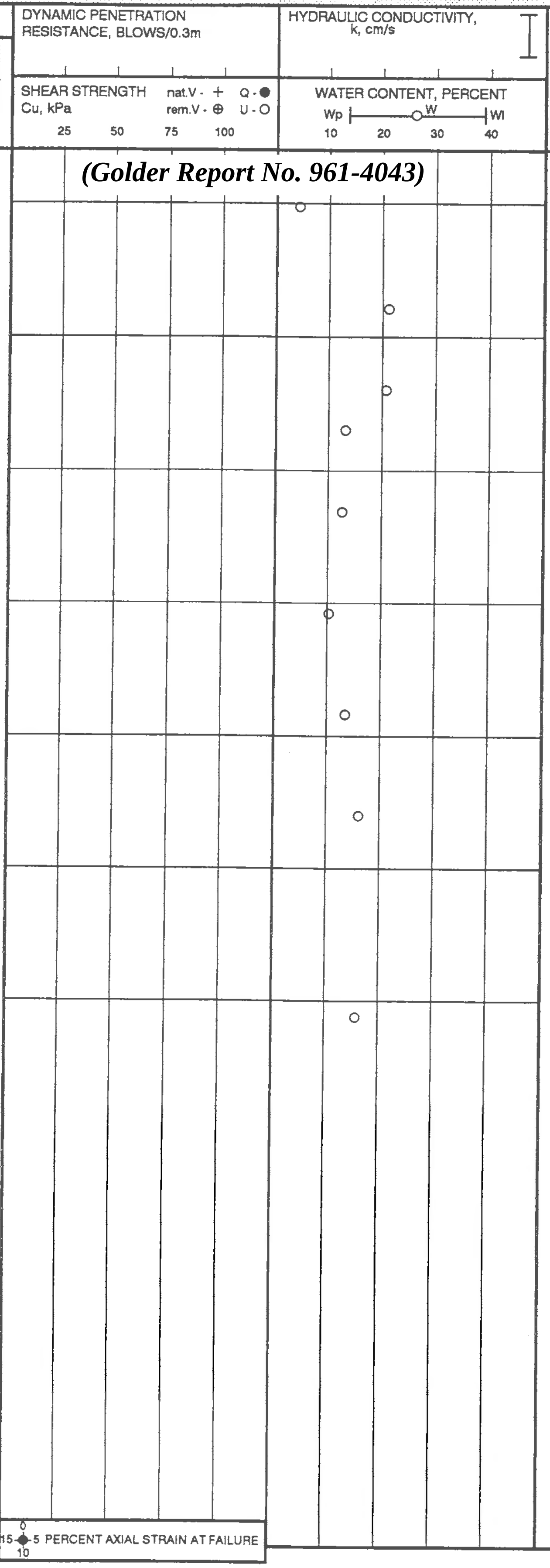
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4043)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
ROADWAY SHOULDER	185.2				
Compact granular roadbase (FILL)	0.00	1	50 DO	17	
Firm to stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	184.5 0.61	2	50 DO	7	
		3	50 DO	13	
Stiff to hard brown SILTY CLAY, some sand and gravel, fissured (TILL)	183.3 1.83	4	50 DO	39	
		5	50 DO	49	Borehole dry during drilling on April 17, 1996
Very stiff to stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	181.5 3.66	6	50 DO	18	
		7	50 DO	17	
		8	50 DO	14	
END OF BOREHOLE	178.6 6.55				



ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4043

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: APRIL 17, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

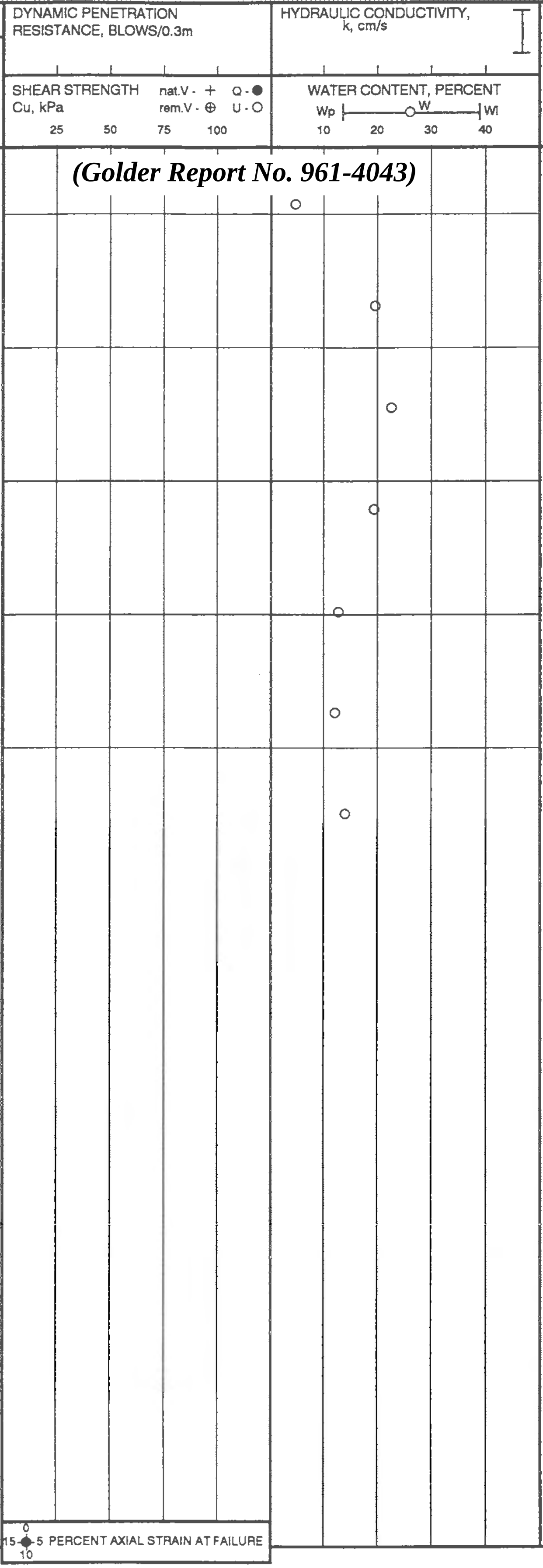
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4043)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROADWAY SHOULDER	185.3
Compact granular roadbase (FILL)	0.00
	184.6
Stiff brown silty clay, trace sand and gravel (FILL)	0.61
	183.9
Firm mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	1.37
	183.1
Stiff to hard brown SILTY CLAY, some sand and gravel, fissured (TILL)	2.13
	181.6
Hard to very stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	3.66
	180.2
END OF BOREHOLE	5.03

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	10
2	50 DO	14
3	50 DO	7
4	50 DO	14
5	50 DO	40
6	50 DO	>30
7	50 DO	27



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on April 17, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4043

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: APRIL 17, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4043)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
ROADWAY SHOULDER		184.5
Compact granular roadbase (FILL)	▩	0.00
Stiff to firm brown silty clay, with topsoil intermixing, some sand and gravel (FILL)	▩	183.8 0.61
Firm grey and black organic silty clay and topsoil, some sand and gravel, occ. sandy pockets (FILL)	▩	183.1 1.37
Firm dark brown to black ORGANIC CLAYEY SILT and PEAT		180.8 3.66
Firm brown SILTY CLAY, some sand and gravel (TILL)		180.0 4.42
Very stiff to stiff grey SILTY CLAY, trace to some sand and gravel (TILL)		179.3 5.20
END OF BOREHOLE		177.9 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	15
2	50 DO	8
3	50 DO	5
4	50 DO	4
5	50 DO	4
6	50 DO	7
7	50 DO	5
8	50 DO	11
9	50 DO	11

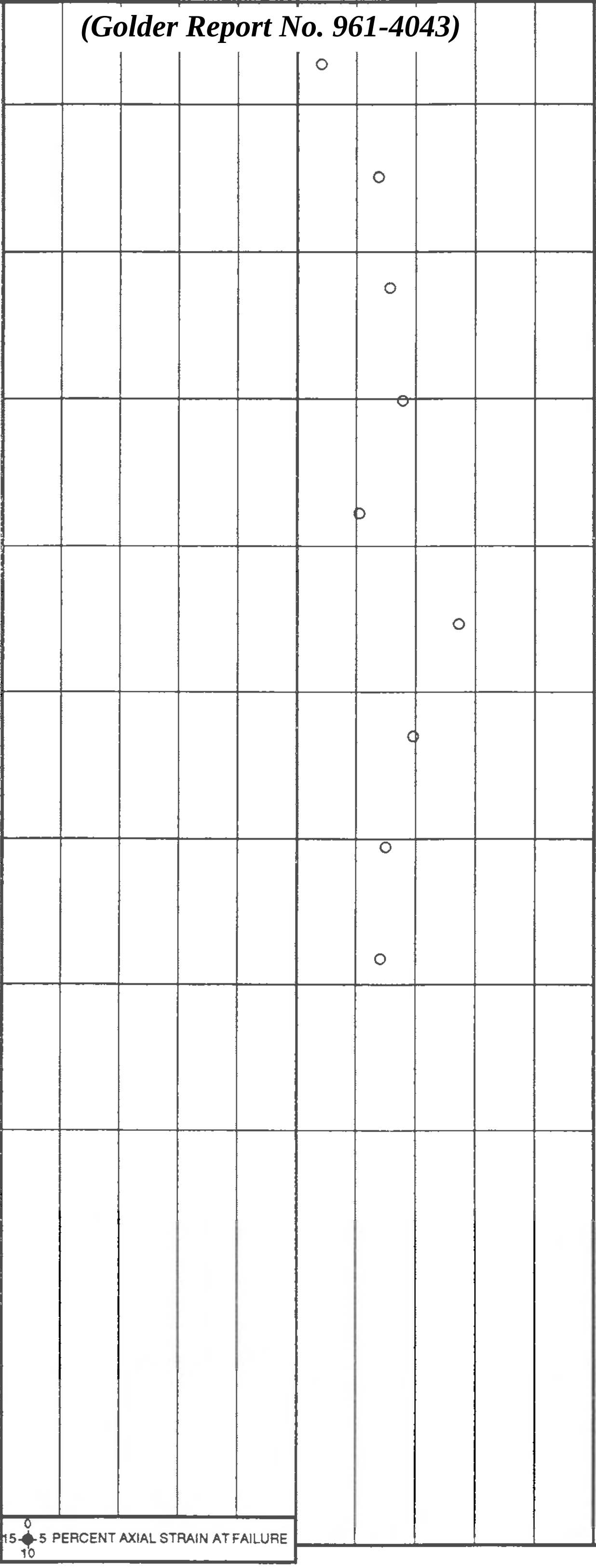
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

HYDRAULIC CONDUCTIVITY, k, cm/s

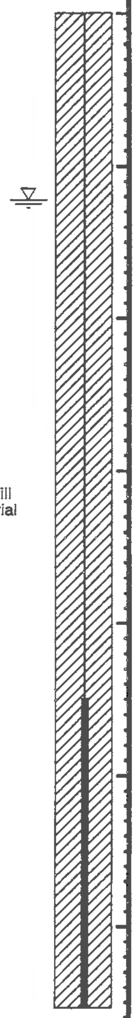
SHEAR STRENGTH Cu, kPa nat.V - + Q - ● rem.V - ⊕ U - ○

WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl

ADDITIONAL LAB. TESTING



PIEZOMETER OR STANDPIPE INSTALLATION



Backfill Material

Borehole dry during drilling on April 17, 1996

Water level in standpipe at elevation 183.5m on June 10, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE 1 to 50

Golder Associates

LOGGED: P.N.

CHECKED: HJ

PROJECT: 961-4043

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: APRIL 17, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

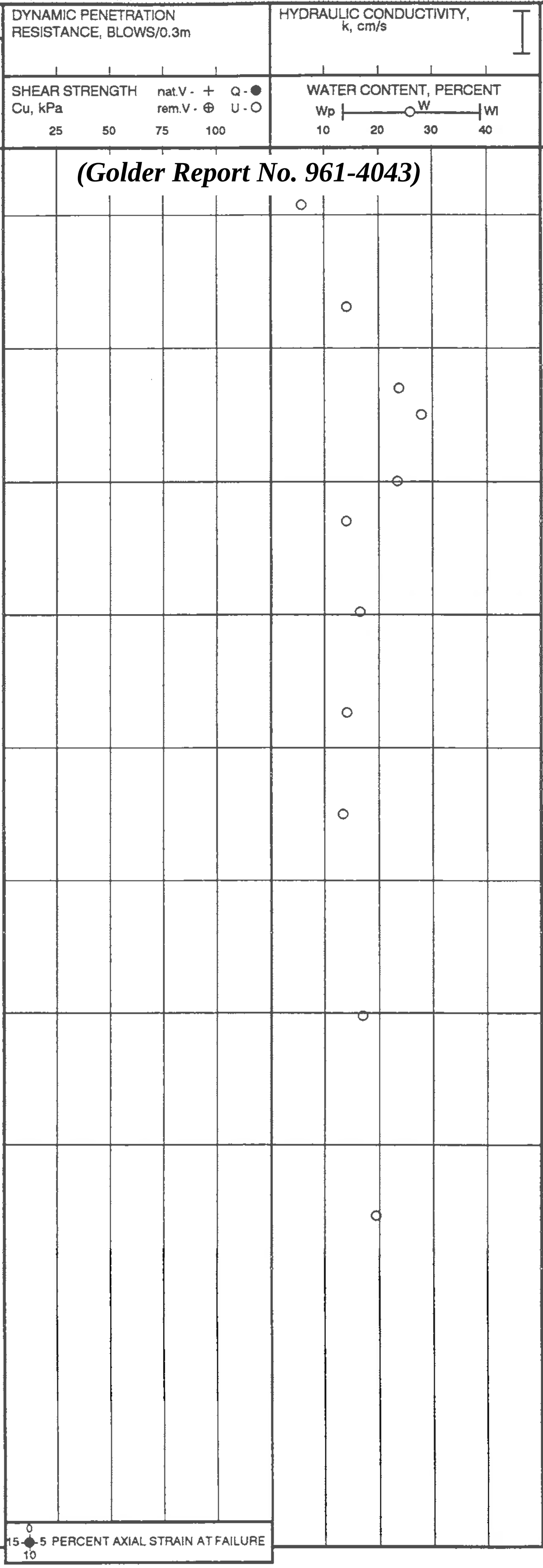
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4043)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROADWAY SHOULDER	184.3
Compact granular roadbase (FILL)	0.00
Stiff to firm brown silty clay, some sand and gravel, trace topsoil (FILL)	183.8 0.46
Stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	182.5 1.75
Very stiff to hard brown SILTY CLAY, some sand and gravel, fissured (TILL)	181.8 2.44
Very stiff to stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	179.8 4.42
END OF BOREHOLE	176.2 8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	23
2	50 DO	11
3	50 DO	8
4	50 DO	18
5	50 DO	47
6	50 DO	30
7	50 DO	19
8	50 DO	13
9	50 DO	10



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION:
Borehole dry during drilling on April 17, 1996

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JUNE 28, 1996

DATUM: GEODETIC

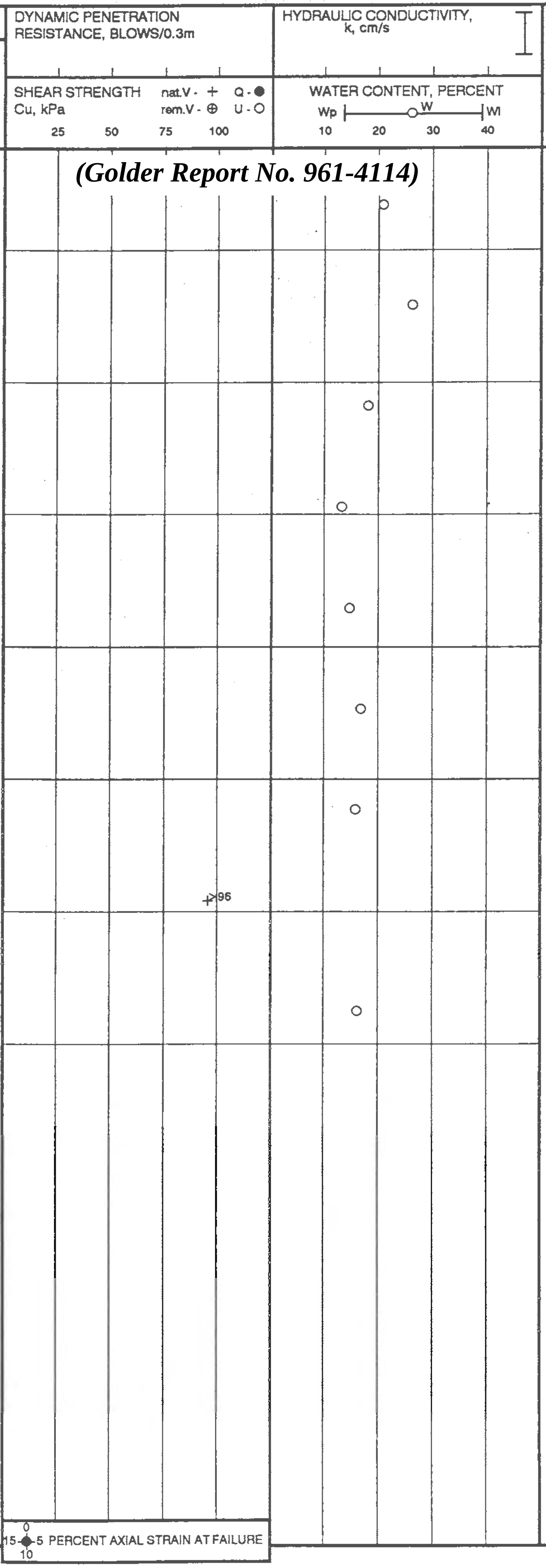
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	180.57 0.00
POWER AUGER SOLID STEM	Black clayey TOPSOIL	180.11 0.46
	Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	179.05 1.52
	Very stiff to hard brown SILTY CLAY, occ. gravel, some sand (TILL)	176.91 3.66
	Very stiff to stiff grey SILTY CLAY, occ. gravel and some sand (TILL)	174.02 6.55
	END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	9
2	50 DO	11
3	50 DO	16
4	50 DO	36
5	50 DO	23
6	50 DO	13
7	50 DO	14
8	50 DO	11



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on June 28, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 2

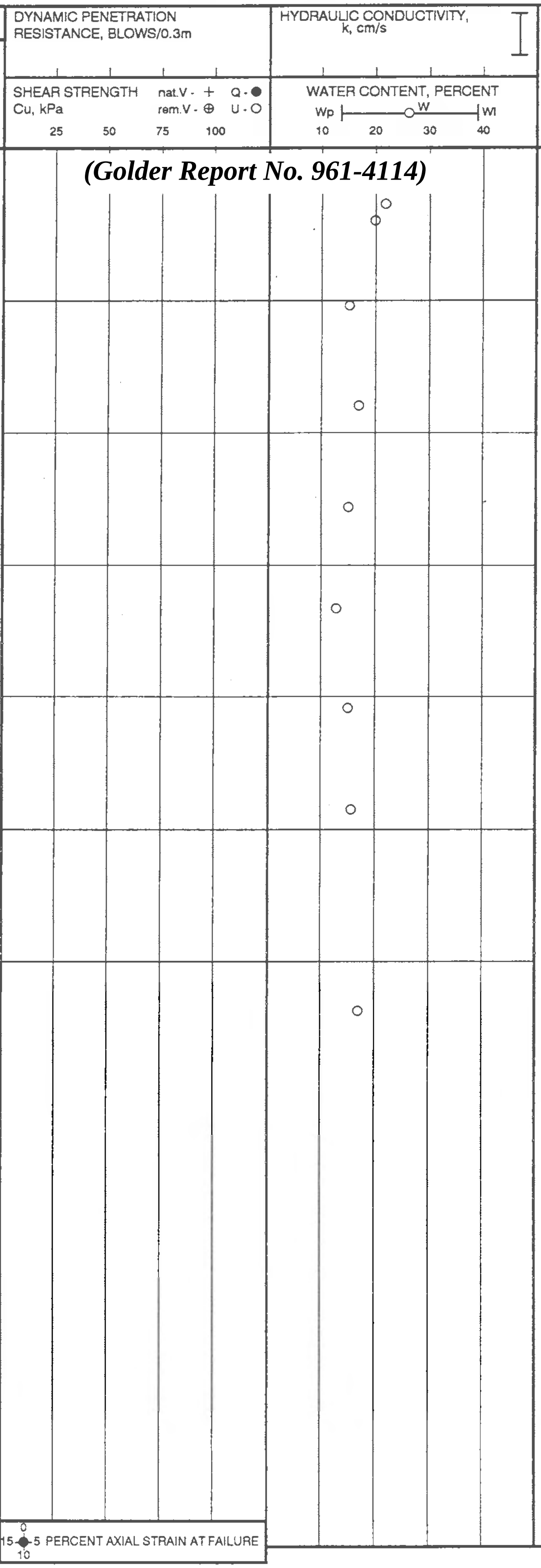
SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN
BORING DATE: JUNE 28, 1996
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	POWER AUGER SOLID STEM	GROUND SURFACE	180.95				
		Black clayey TOPSOIL	0.00	1	50 DO	11	
		Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	180.65 0.30	2	50 DO	9	
2		Very stiff brown SILTY CLAY, occ. gravel, some sand, occ. fissures	179.43 1.52	3	50 DO	25	Borehole dry during drilling on June 28, 1996
				4	50 DO	22	
3				5	50 DO	25	
		Very stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	177.44 3.51	6	50 DO	18	
5				7	50 DO	16	
6				8	50 DO	11	
		END OF BOREHOLE	174.40 6.55				



DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

RECORD OF BOREHOLE 3

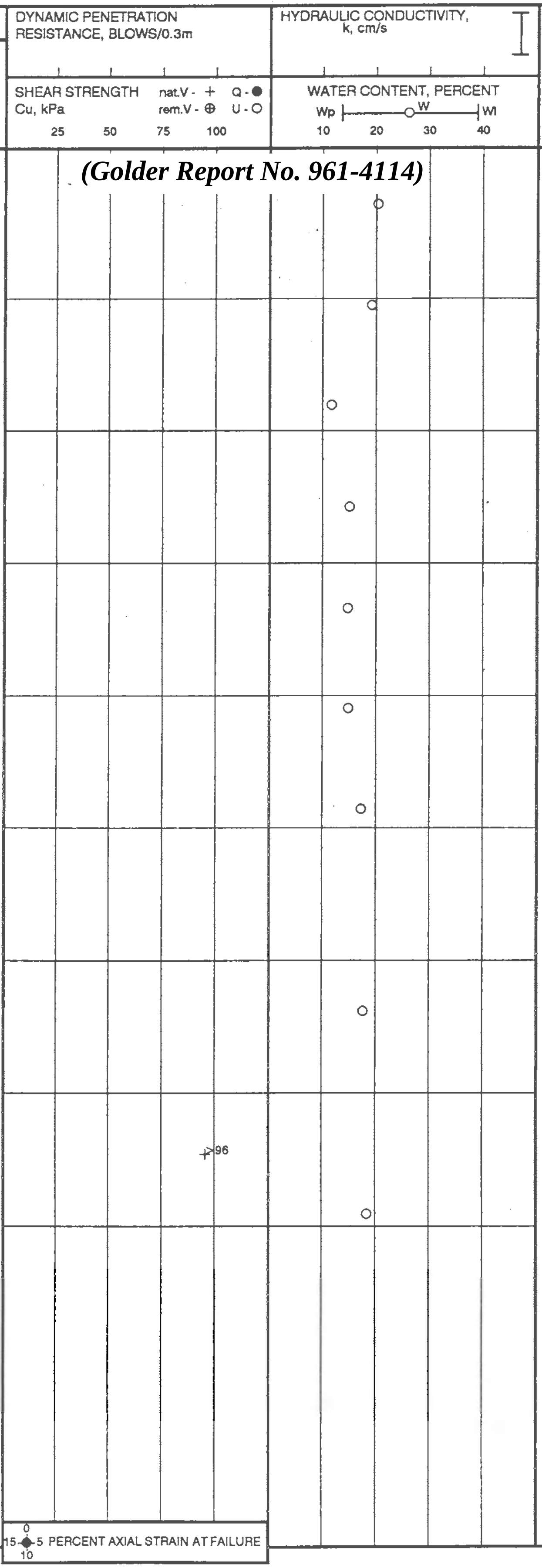
PROJECT: 961-4114
SHEET 1 OF 1
LOCATION: SEE LOCATION PLAN
BORING DATE: JUNE 28, 1996
DATUM: GEODETIC
SAMPLER HAMMER, 63.5kg; DROP, 760mm
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	179.94	
Black clayey TOPSOIL		0.00
Firm to stiff mottled SILTY CLAY, with layers of silty sand and clay (TILL)	179.48	0.46
Very stiff brown SILTY CLAY, occ. gravel, some fissures and sand seams (TILL)	178.57	1.37
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	176.28	3.66
END OF BOREHOLE	171.86	8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	10
2	50 DO	7
3	50 DO	24
4	50 DO	25
5	50 DO	21
6	50 DO	16
7	50 DO	16
8	50 DO	9
9	50 DO	11



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on June 28, 1996

DEPTH SCALE METRES: 0 – 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 4

SHEET 1 OF -2b4T1

LOCATION: SEE LOCATION PLAN

BORING DATE: JUNE 28, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

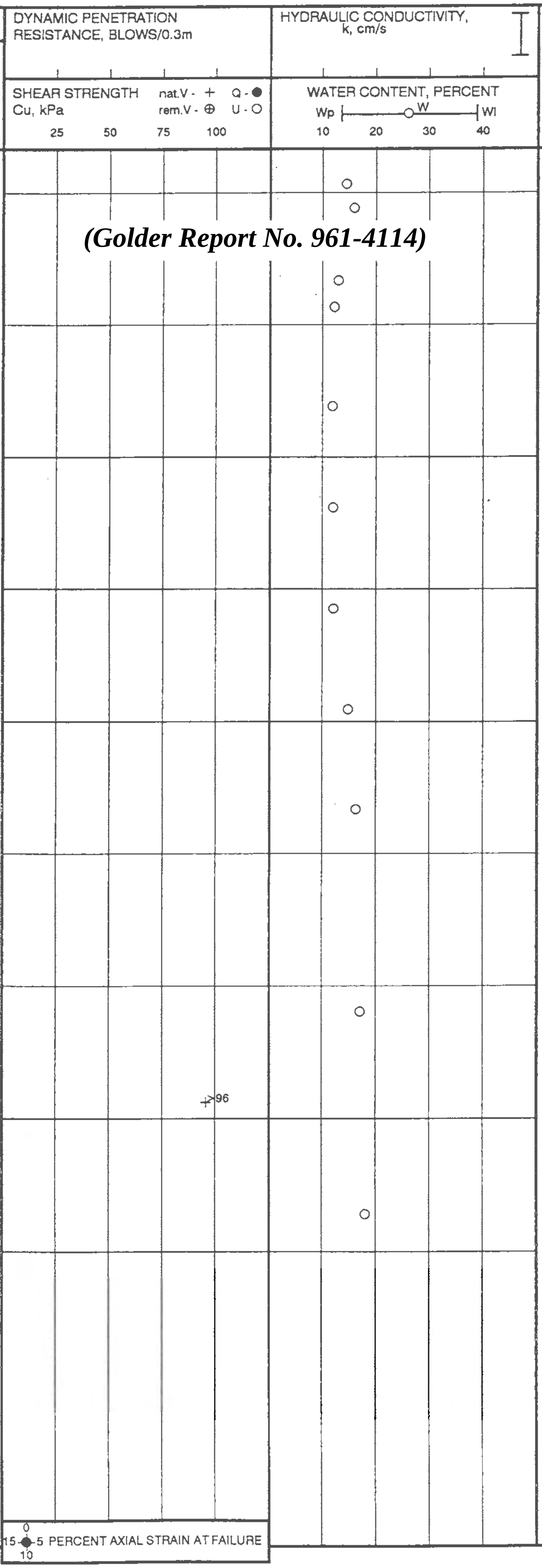
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.13
Black clayey TOPSOIL	179.98 0.15
Mottled brown and grey SILTY CLAY (FILL)	179.29 0.84
Very stiff mottled brown and grey SILTY CLAY, occ. gravel, trace sand (TILL)	178.61 1.52
Very stiff brown SILTY CLAY, occ. gravel, some sand (TILL)	176.62 3.51
Very stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	172.05 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	11
2	50 DO	20
3	50 DO	28
4	50 DO	28
5	50 DO	25
6	50 DO	18
7	50 DO	17
8	50 DO	11
9	50 DO	10



PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on June 28, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 2, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

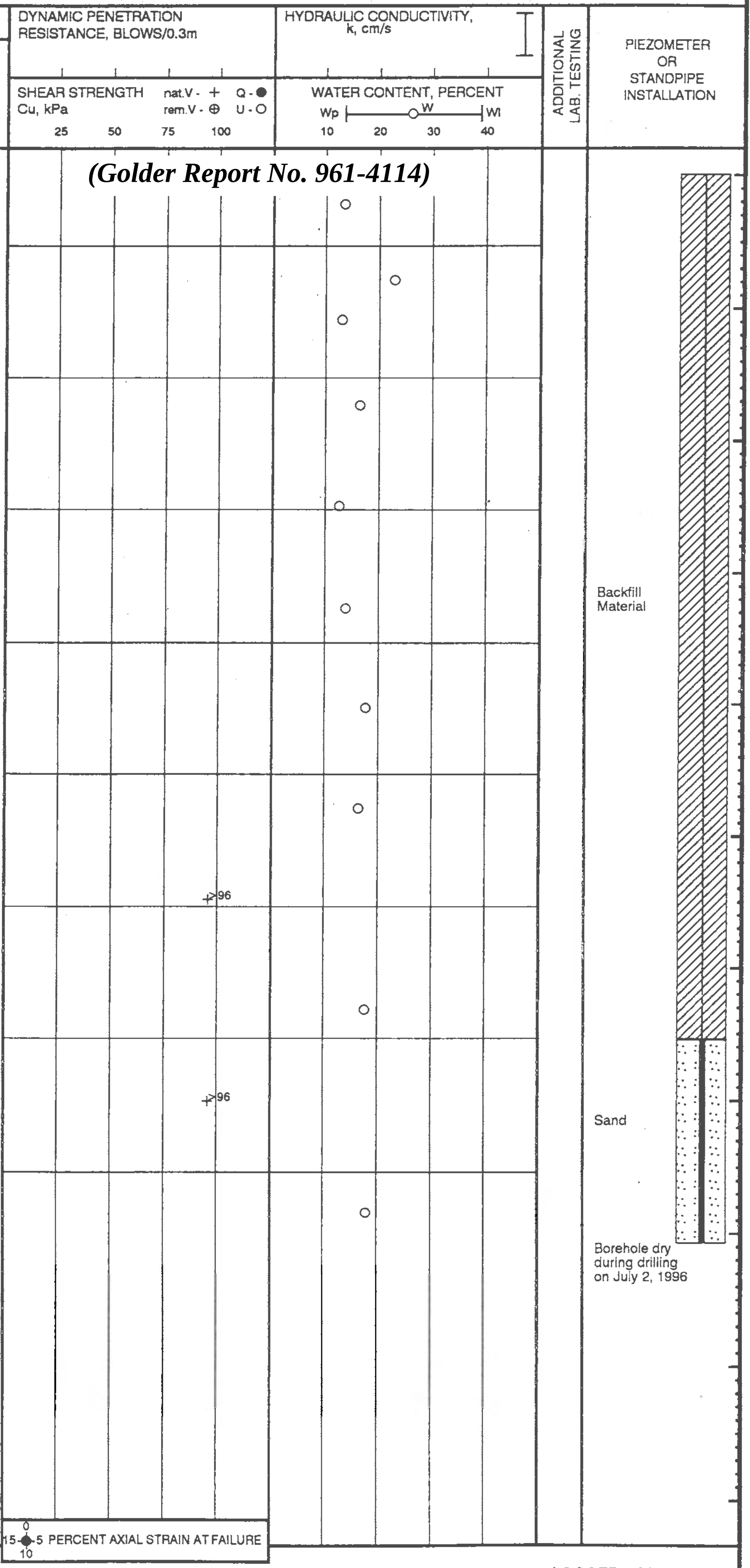
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	180.54 0.00
Stiff black clayey TOPSOIL	179.71 0.83
Stiff mottled brown and grey SILTY CLAY, some sand, trace of gravel (TILL)	178.41 2.13
Very stiff brown SILTY CLAY, some sand trace of gravel (TILL)	176.12 4.42
Very stiff to stiff grey SILTY CLAY, some sand, trace gravel (TILL)	172.46 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	7
2	50 DO	14
3	50 DO	8
4	50 DO	21
5	50 DO	25
6	50 DO	25
7	50 DO	12
8	50 DO	8
9	50 DO	8



Backfill Material

Sand

Borehole dry during drilling on July 2, 1996

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 3, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

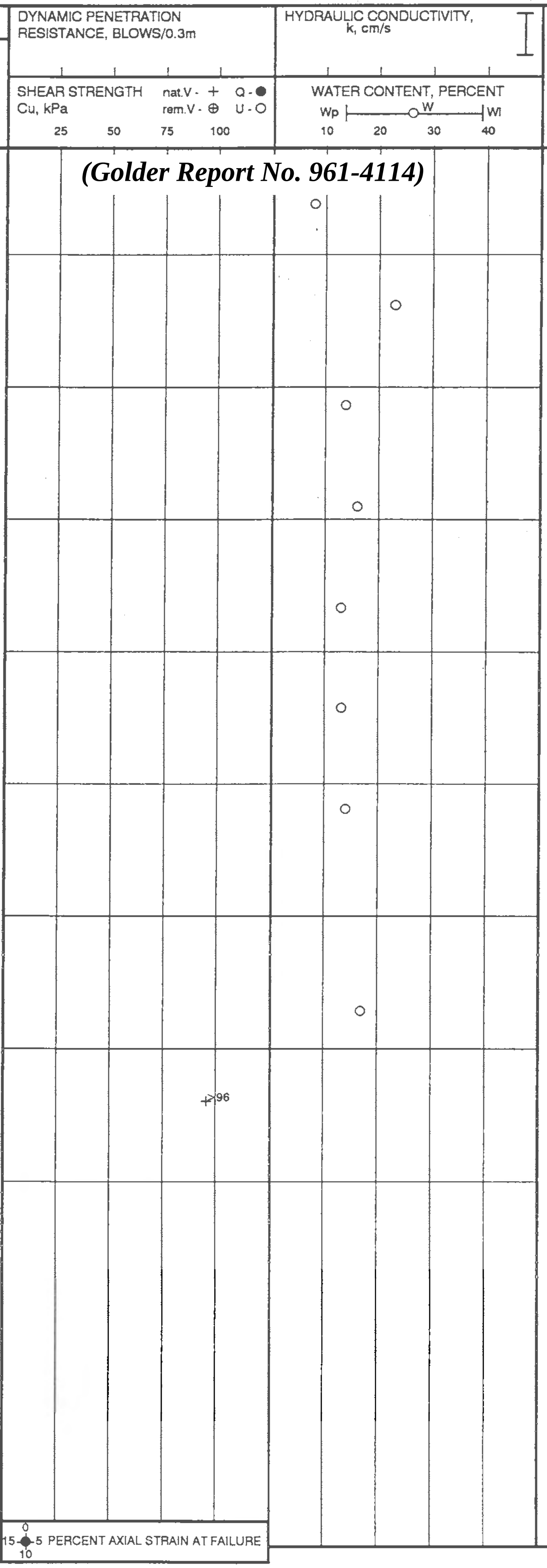
(Golder Report No. 961-4114)

DEPTH SCALE METRES: 0 – 10

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.61 0.00
Black clayey topsoil (FILL)	180.15 0.46
Very stiff brown silty clay (FILL)	179.39 1.22
Very stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	178.93 1.68
Hard brown SILTY CLAY, occ. gravel, some sand (TILL)	176.04 4.57
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	172.53 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	14
2	50 DO	23
3	50 DO	18
4	50 DO	36
5	50 DO	32
6	50 DO	19
7	50 DO	16
8	50 DO	12
9	50 DO	12



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on July 3, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

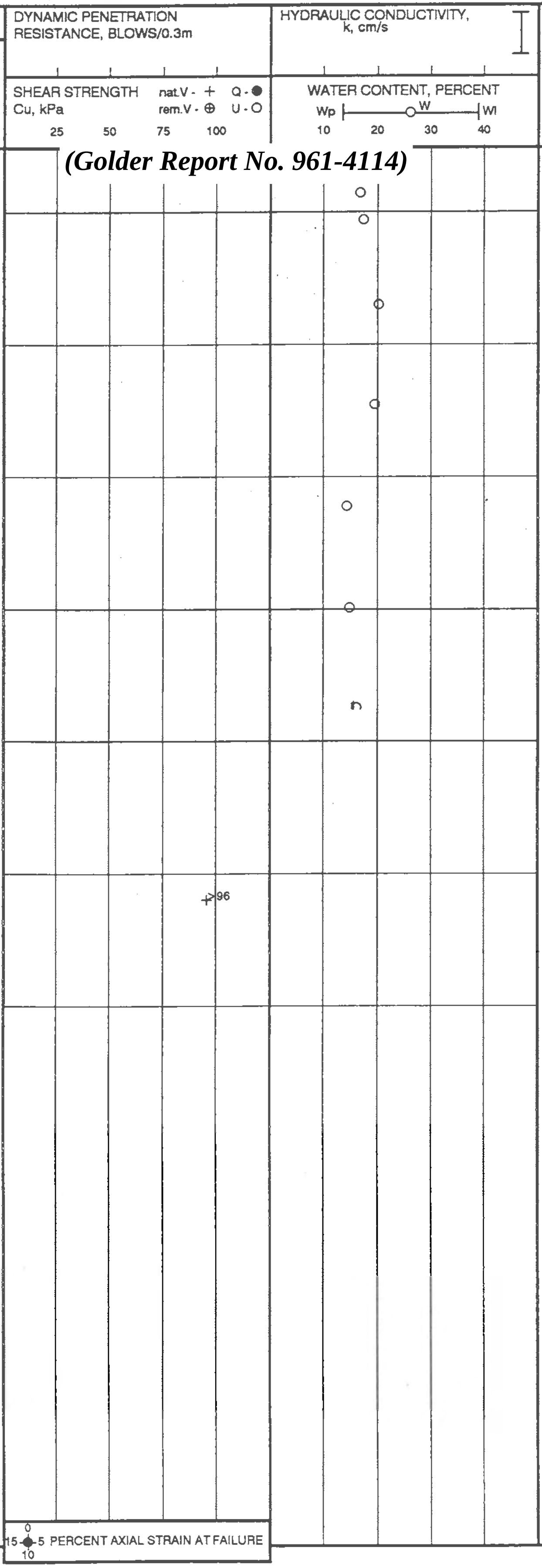
RECORD OF BOREHOLE 7

LOCATION: SEE LOCATION PLAN
BORING DATE: JULY 3, 1996
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
	POWER AUGER SOLID STEM	GROUND SURFACE		180.29			
0		Black clayey TOPSOIL		0.00 179.99 0.30	1	50 DO	7
1		Firm to stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)		178.92 1.37	2	50 DO	9
2		Hard brown SILTY CLAY, occ. gravel, some silt and sand seams, occ. fissures (TILL)			3	50 DO	31
				177.24 3.05	4	50 DO	31
3		Very stiff grey SILTY CLAY, occ. gravel, some sand (TILL)			5	50 DO	16
4					6	50 DO	15
5					7	50 DO	13
6				173.74 6.55	8	50 DO	10
7		END OF BOREHOLE					
8							
9							
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 8

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 3, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

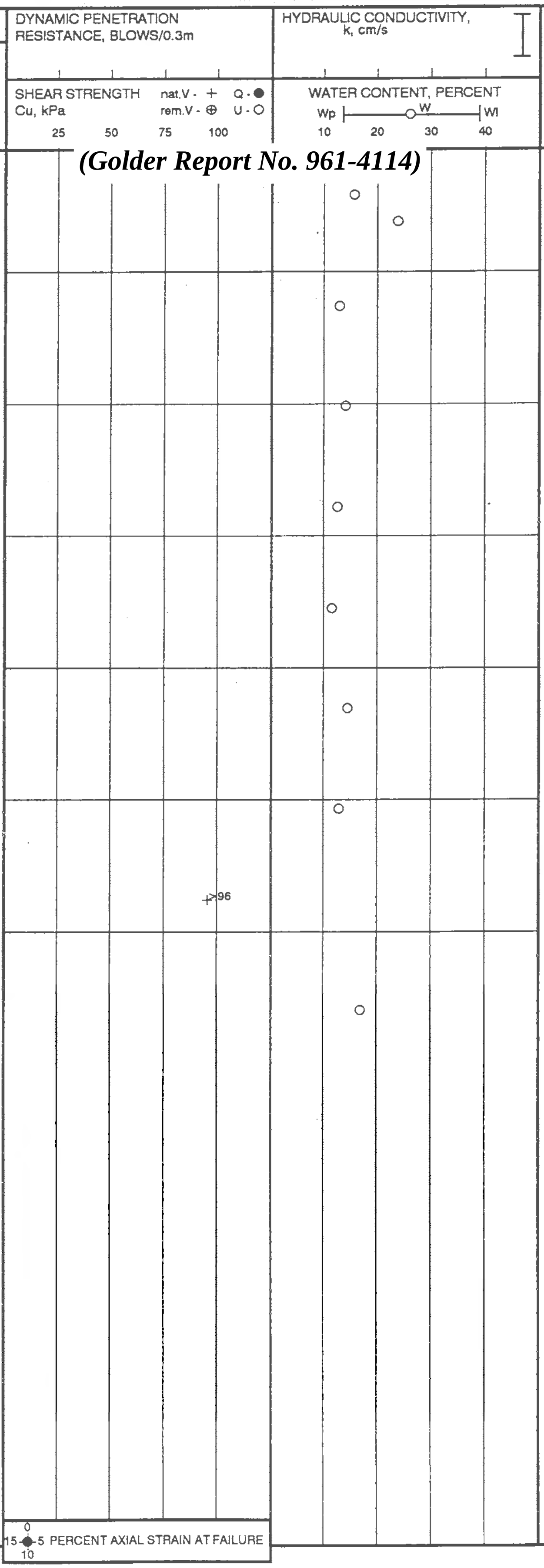
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.73
Brown clayey TOPSOIL	0.00
Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	180.43 0.30
Hard brown SILTY CLAY, occ. gravel, some sand, some fissures (TILL)	178.75 1.98
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	177.07 3.66
END OF BOREHOLE	174.18 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	11
2	50 DO	18
3	50 DO	23
4	50 DO	32
5	50 DO	28
6	50 DO	14
7	50 DO	13
8	50 DO	11



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on July 3, 1996

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 3, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

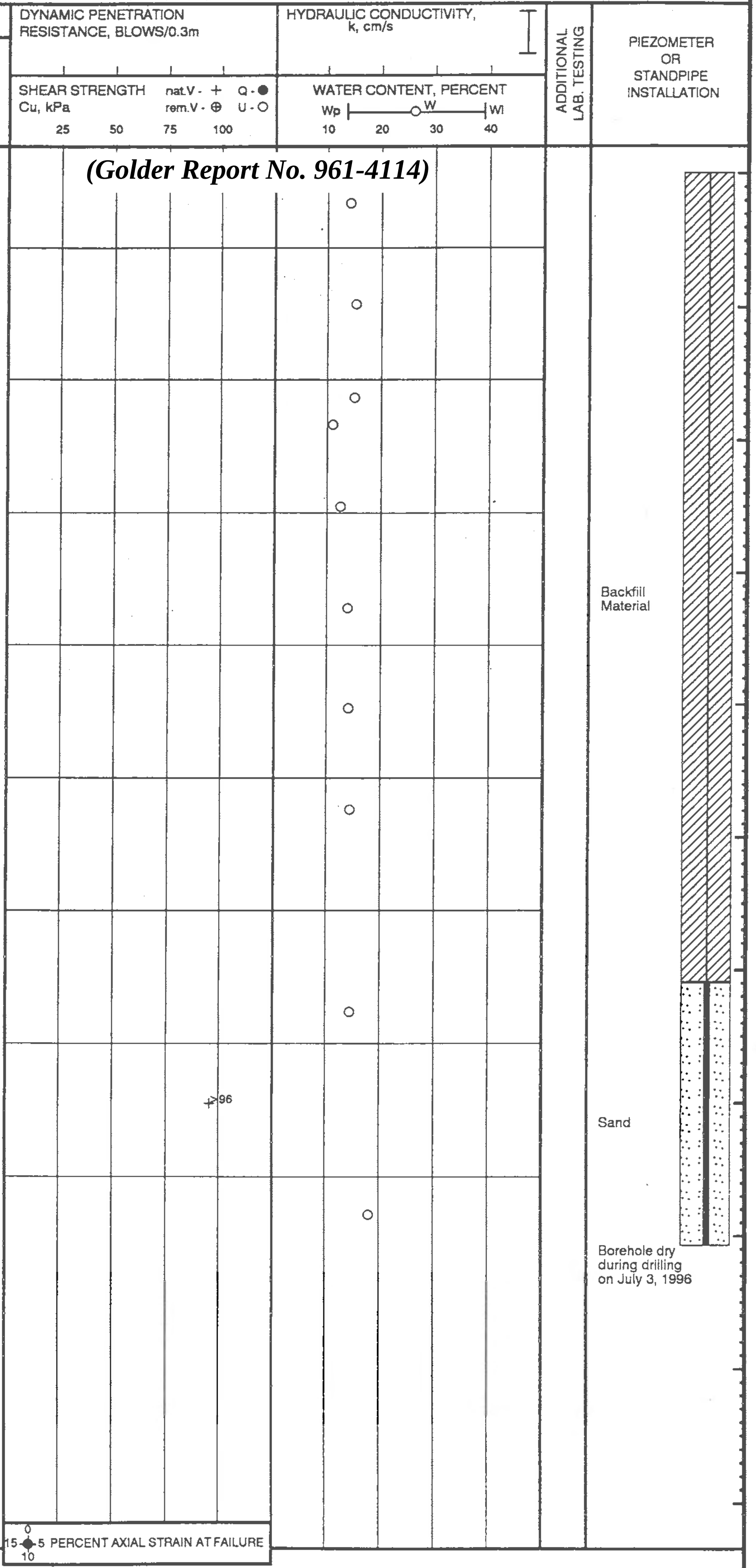
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.56
Black clayey topsoil (FILL)	0.00
Very stiff brown silty clay, some topsoil sand and gravel some organics (FILL)	180.10 0.46
Very stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	179.34 1.22
Hard to very stiff brown SILTY CLAY, occ. gravel, some sand (TILL)	178.73 1.83
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	176.90 3.66
END OF BOREHOLE	172.48 8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	18
2	50 DO	15
3	50 DO	38
4	50 DO	43
5	50 DO	26
6	50 DO	18
7	50 DO	15
8	50 DO	13
9	50 DO	13



DEPTH SCALE 1 to 50

DATA INPUT: TONY MASTROIANNI

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 10

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 3, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

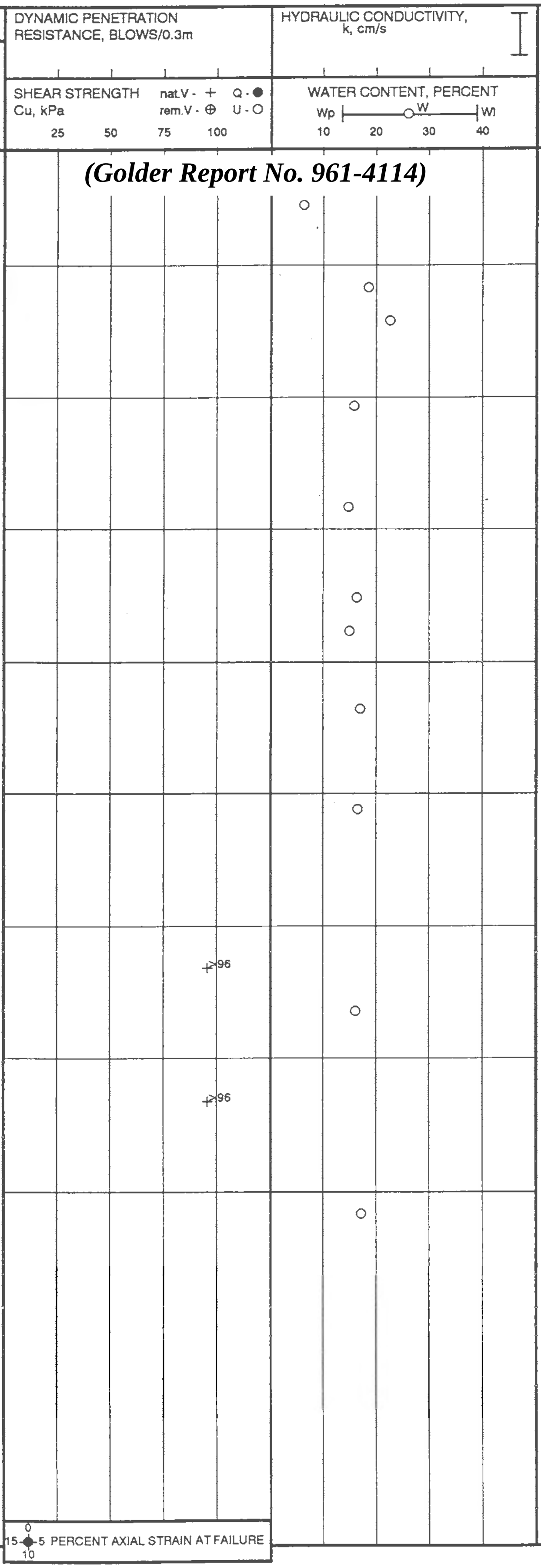
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.68
Brown clayey topsoil (FILL)	0.00
Brown silty clay, some organic topsoil (FILL)	180.22 0.46
Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	179.77 0.91
Hard brown SILTY CLAY to CLAYEY SILT, occ. gravel, some sand with layers of dense silt at 3.0m (TILL)	178.39 2.29
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	176.87 3.81
END OF BOREHOLE	172.60 8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	14
2	50 DO	13
3	50 DO	11
4	50 DO	44
5	50 DO	29
6	50 DO	14
7	50 DO	13
8	50 DO	13
9	50 DO	9



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on July 3, 1996

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 11

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 3, 1996

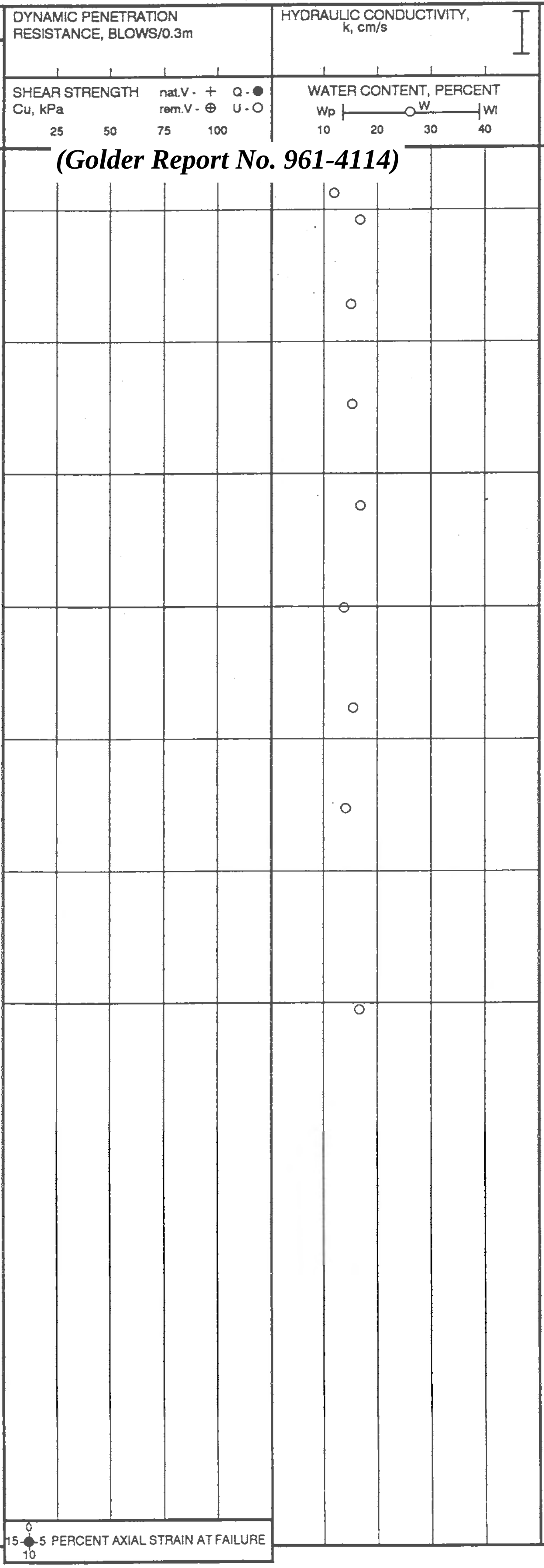
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
POWER AUGER SOLID STEM	GROUND SURFACE	181.27 0.00			
	Brown clayey TOPSOIL	180.97 0.30	1	50 DO	7
	Firm to very stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	179.90 1.37	2	50 DO	20
	Very stiff brown SILTY CLAY to CLAYEY SILT, some fissures and sands	177.61 3.66	3 4 5	50 DO 50 DO 50 DO	24 28 26
	Very stiff brown CLAYEY SILT, some fissures and pockets of silt, some sand and silt partings	176.70 4.57	6	50 DO	28
	Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	174.72 6.55	7 8	50 DO 50 DO	15 11
	END OF BOREHOLE				



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on July 3, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 12

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 3, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

DEPTH SCALE METRES: 0 to 10

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE

DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		181.27
Brown clayey TOPSOIL		0.00
		180.97 0.30
Firm to stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)		
		179.90 1.37
Hard to very stiff brown SILTY CLAY, occ. gravel, some sand, occ. fissures (TILL)		
		177.46 3.81
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)		
		174.72 6.55
END OF BOREHOLE		

SAMPLES

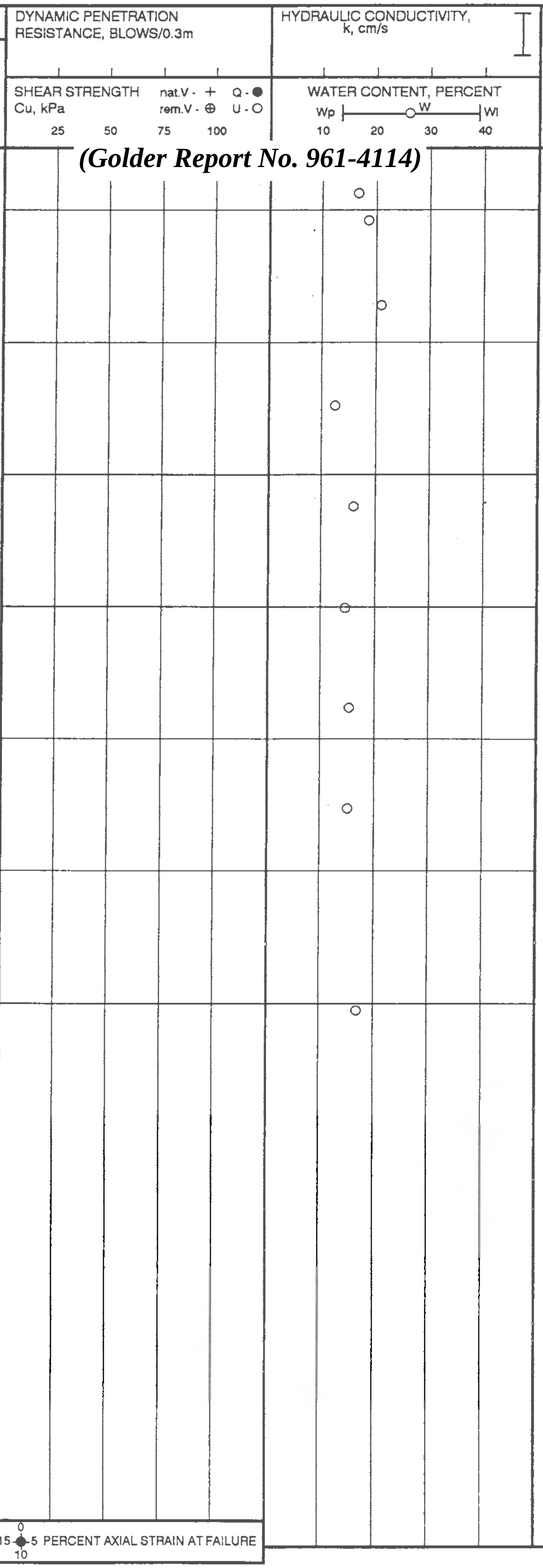
NUMBER	TYPE	BLOWS/0.3m
1	50 DO	7
2	50 DO	12
3	50 DO	31
4	50 DO	30
5	50 DO	24
6	50 DO	17
7	50 DO	15
8	50 DO	10

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu, kPa nat.V - + Q - ● rem.V - ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s

WATER CONTENT, PERCENT Wp ├──○ W──┤ Wl



15 ◆ 5 PERCENT AXIAL STRAIN AT FAILURE 0 10

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on July 3, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE 1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 13

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

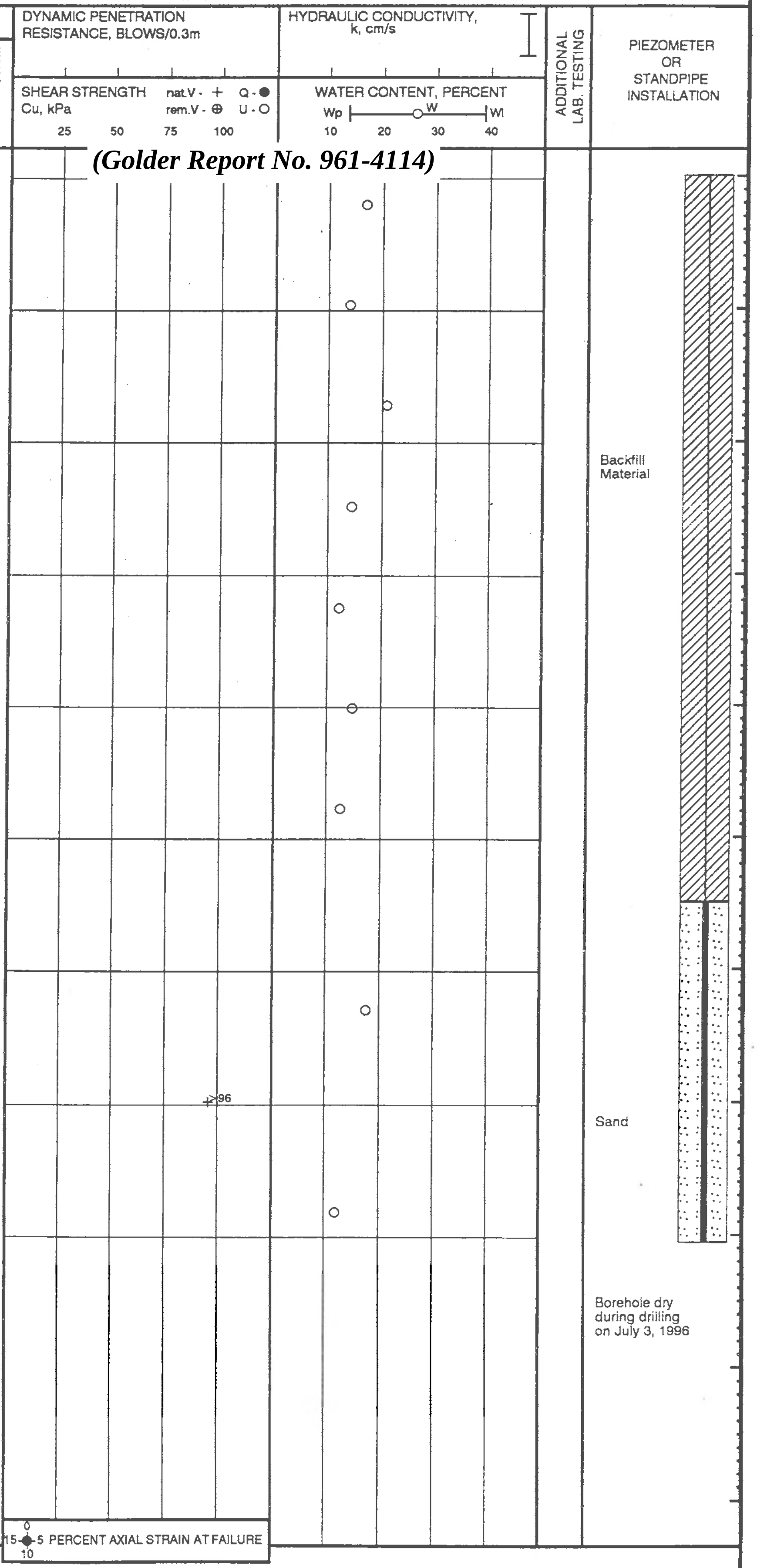
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.03 0.00
Black clayey topsoil (FILL)	180.57 0.46
Brown silty clay, some sand and gravel (FILL)	180.12 0.91
Very stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	178.90 2.13
Brown SILTY CLAY, occ. gravel, some sand (TILL)	177.22 3.81
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	172.96 8.07
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	12
2	50 DO	10
3	50 DO	16
4	50 DO	14
5	50 DO	29
6	50 DO	17
7	50 DO	15
8	50 DO	11
9	50 DO	13



Borehole dry during drilling on July 3, 1996

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 14

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

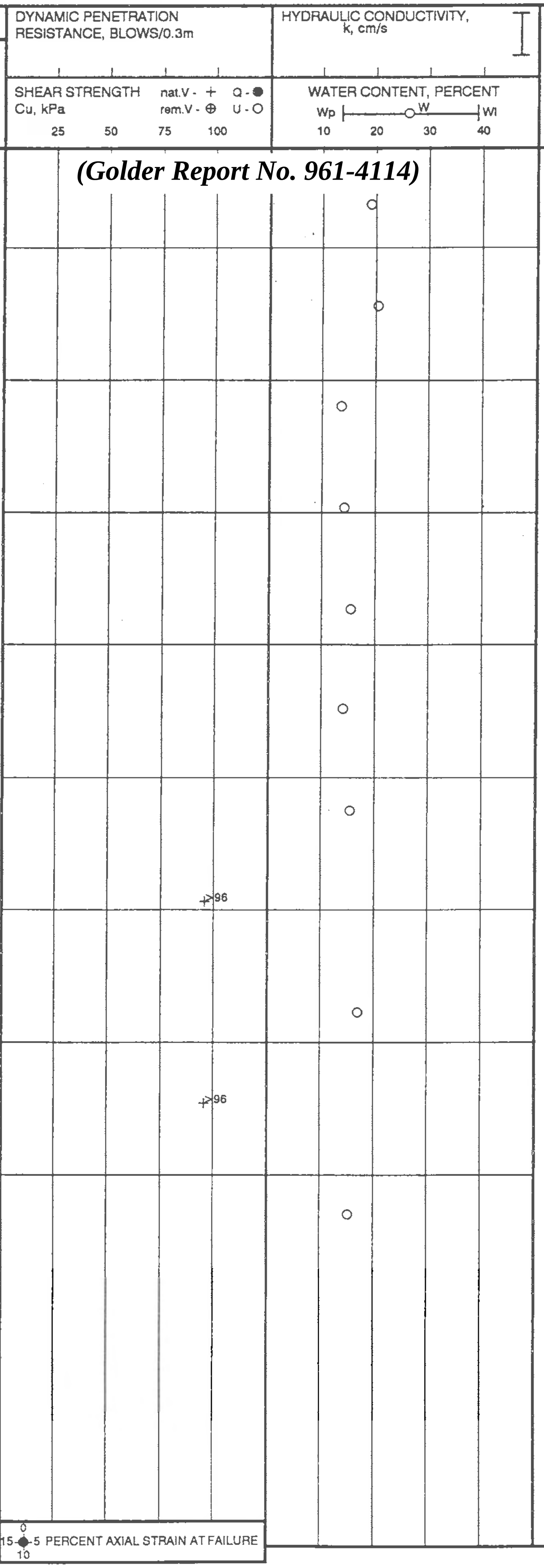
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.55
Brown clayey TOPSOIL, some roots	0.00 180.09
Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	0.46 179.03
Very stiff to hard brown SILTY CLAY, occ. gravel, some sand, occ. fissures (TILL)	1.52 175.98
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	4.57 172.47
END OF BOREHOLE	8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	8
2	50 DO	14
3	50 DO	20
4	50 DO	32
5	50 DO	21
6	50 DO	22
7	50 DO	10
8	50 DO	14
9	50 DO	13



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on July 3, 1996

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 15

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

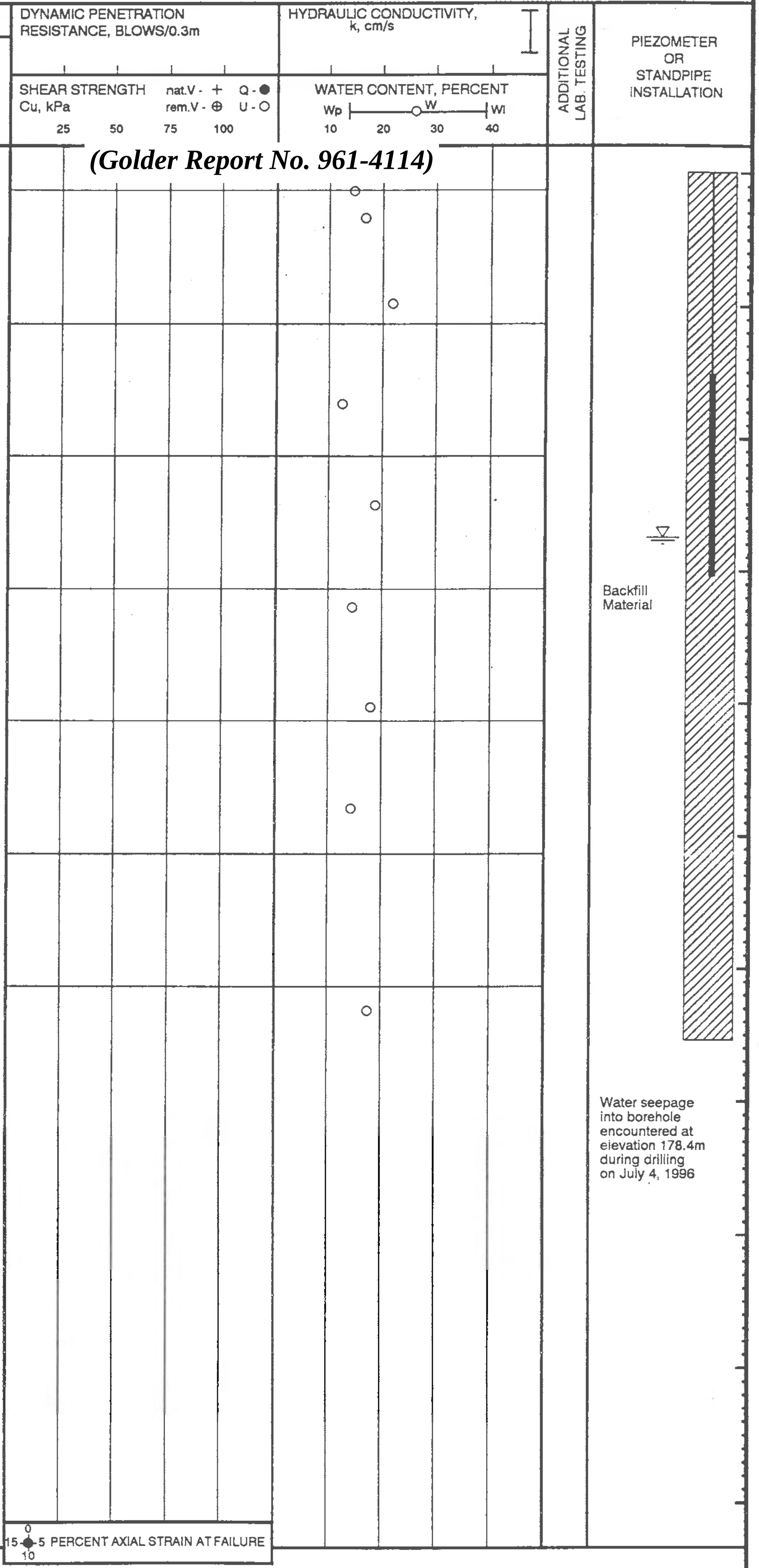
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		181.14
Brown clayey TOPSOIL		0.00
Firm to stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)		180.84 0.30
Very stiff to hard brown SILTY CLAY, occ. gravel, some fissures, some sand seams, trace sand (TILL)		179.62 1.52
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)		177.48 3.66
END OF BOREHOLE		174.59 6.55

SAMPLES: NUMBER	TYPE	BLOWS/0.3m
1	50 DO	8
2	50 DO	14
3	50 DO	20
4	50 DO	34
5	50 DO	28
6	50 DO	22
7	50 DO	15
8	50 DO	11



Water seepage into borehole encountered at elevation 178.4m during drilling on July 4, 1996

DEPTH SCALE 1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

DATA INPUT: TONY MASTROIANNI

PROJECT: 961-4114

RECORD OF BOREHOLE 16

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

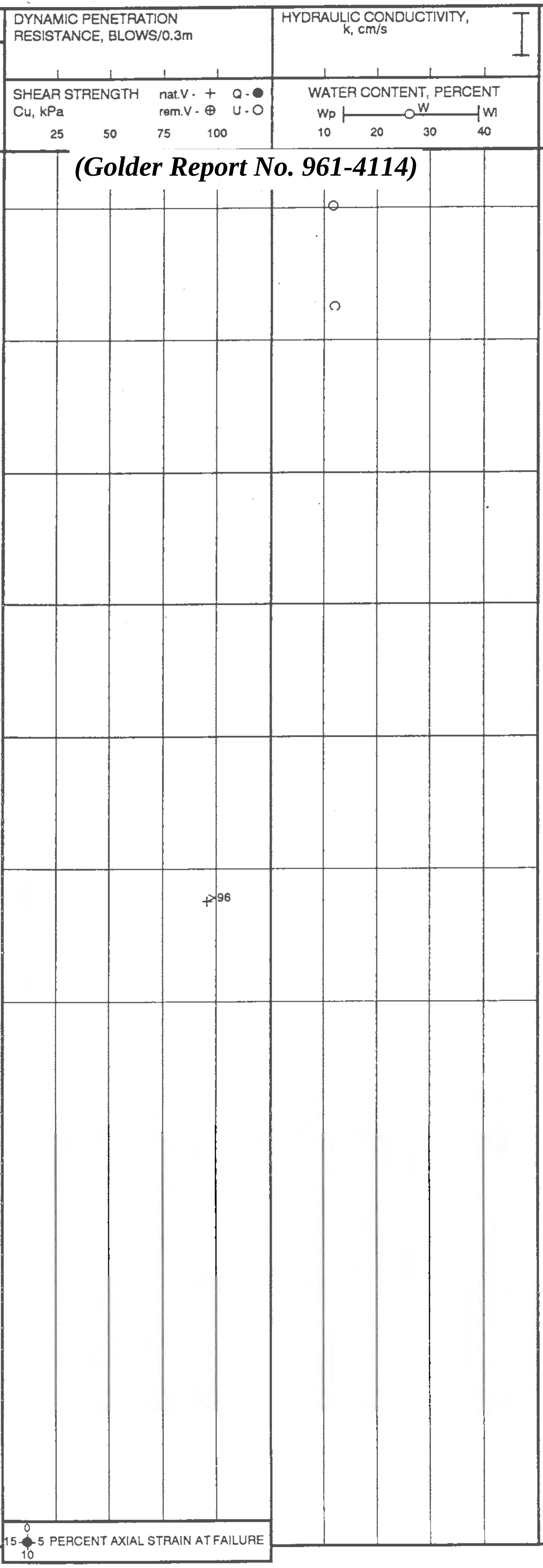
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	181.24			
Brown clayey TOPSOIL	0.00	1	50 DO	9
Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	180.78 0.46	2	50 DO	11
Hard brown SILTY CLAY, occ. gravel some sand (TILL)	179.72 1.52	3	50 DO	33
Compact brown medium to coarse SAND, some clay	178.95 2.29	4	50 DO	27
Hard brown SILTY CLAY (TILL)	178.65 2.59			
Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	178.19 3.05	5 6 7 8	50 DO 50 DO 50 DO 50 DO	22 21 13 11
END OF BOREHOLE	174.69 6.55			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 17

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

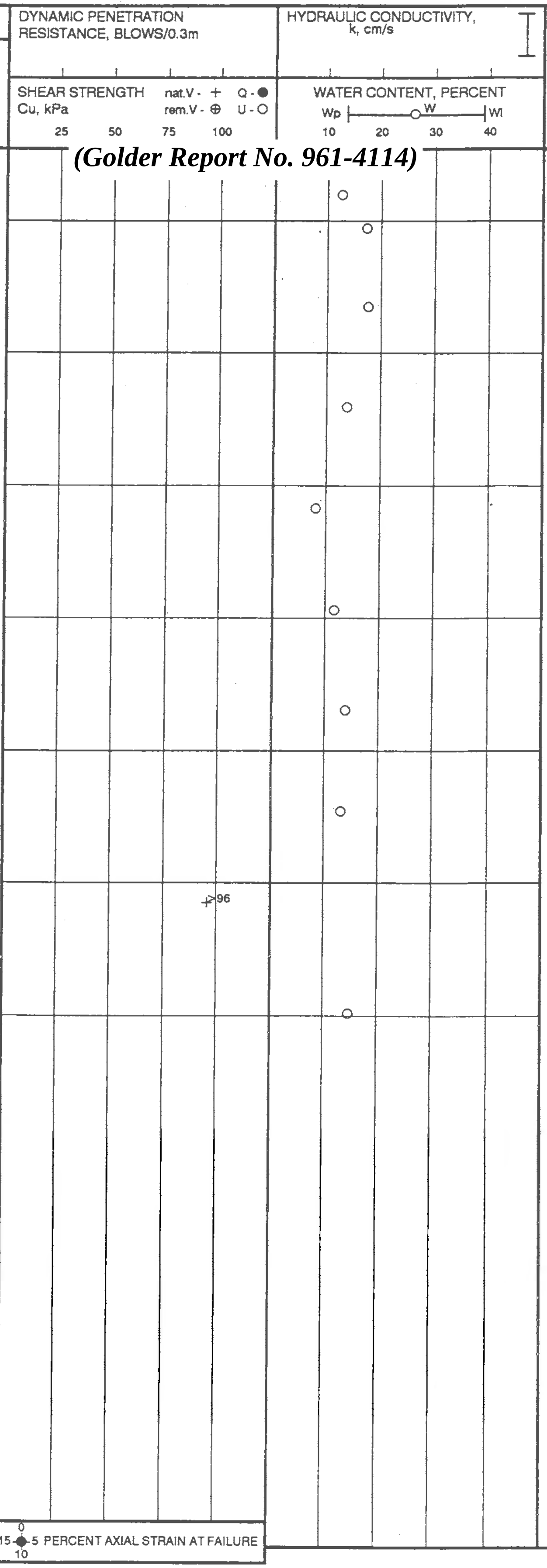
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	181.34			
Brown clayey TOPSOIL	181.20 0.14			
Firm to stiff mottled brown and grey SILTY CLAY (TILL)		1	50 DO	7
		2	50 DO	9
	179.82 1.52			
Very stiff to hard brown SILTY CLAY, some sand, occ. gravel (TILL)		3	50 DO	23
		4	50 DO	39
		5	50 DO	36
	177.68 3.66			
Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel (TILL)		6	50 DO	18
		7	50 DO	14
		8	50 DO	11
	174.79 6.55			
END OF BOREHOLE				



PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on July 4, 1996

DEPTH SCALE 1 to 50

DATA INPUT: TONY MASTROIANNI

LOGGED: P.N.

CHECKED:

Golder Associates

PROJECT: 961-4114

RECORD OF BOREHOLE 18

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

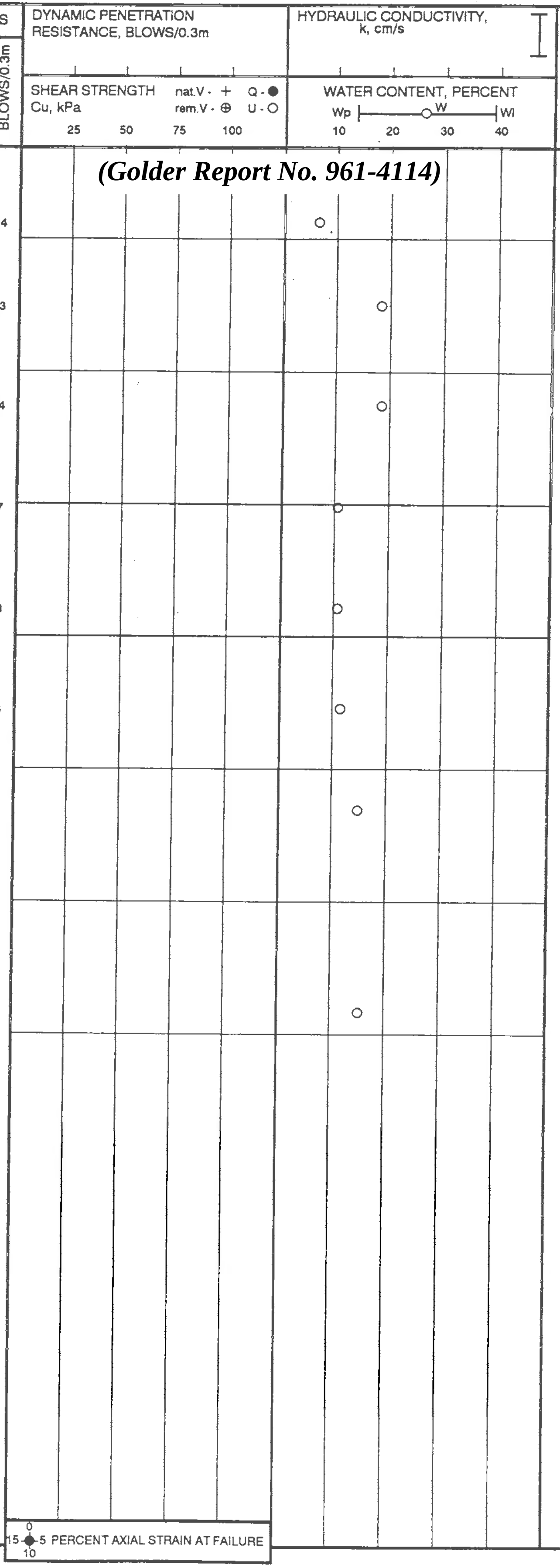
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.49
ASPHALT	181.36 0.13
Compact granular road base (FILL)	180.88 0.61
Very stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	179.97 1.52
Very stiff to hard brown SILTY CLAY, occ. gravel, some sand, occ. fissures (TILL)	177.68 3.81
Very stiff to stiff grey SILTY CLAY, occ. gravel, some sand (TILL)	174.94 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	24
2	50 DO	13
3	50 DO	24
4	50 DO	37
5	50 DO	39
6	50 DO	23
7	50 DO	15
8	50 DO	13



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽

Water seepage into borehole encountered at elevation 181.0m during drilling on July 4, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 19

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 4, 1996

DATUM: GEODETIC

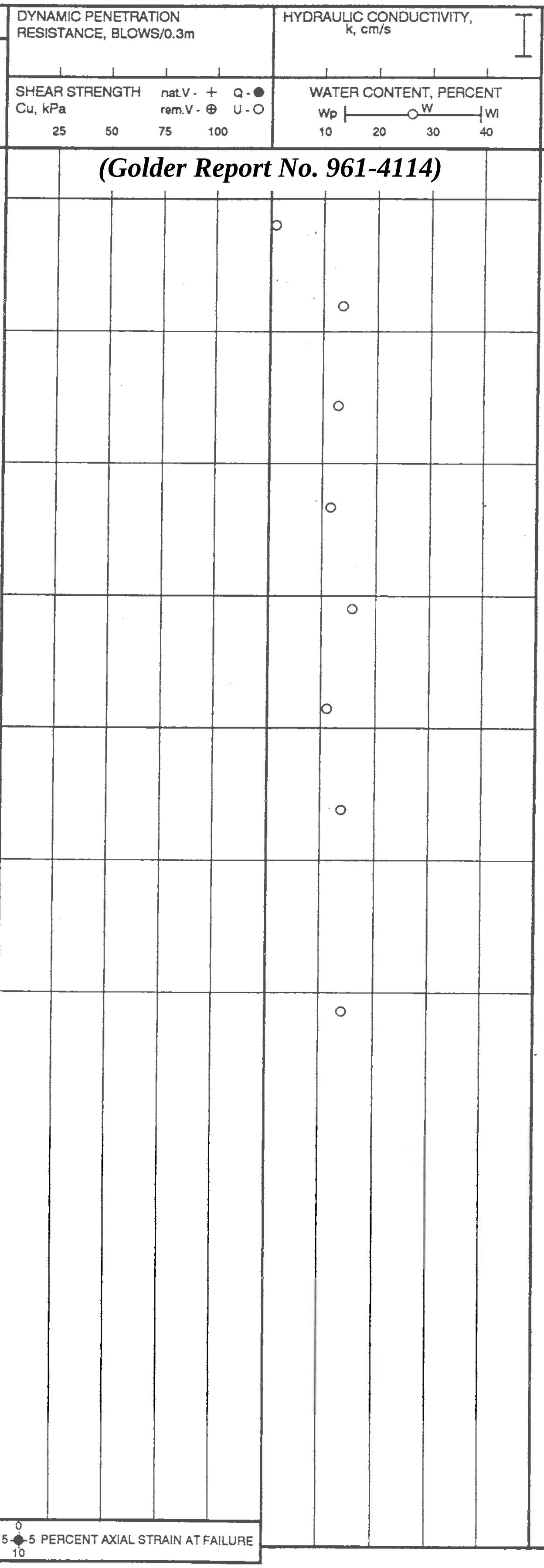
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 961-4114)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
ASPHALT SURFACE	181.18				
100mm ASPHALT over granular road base (FILL)	181.08 0.10				
	180.67 0.51	1	50 DO	9	4T1
Very stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)		2	50 DO	13	
		3	50 DO	17	
	179.20 1.98				
Very stiff to hard brown SILTY CLAY, some sand, occ. gravel (TILL)		4	50 DO	26	
		5	50 DO	38	
		6	50 DO	24	
	176.76 4.42				
Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel (TILL)		7	50 DO	19	
		8	50 DO	13	
	174.63 6.55				
END OF BOREHOLE					



PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 20

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 5, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

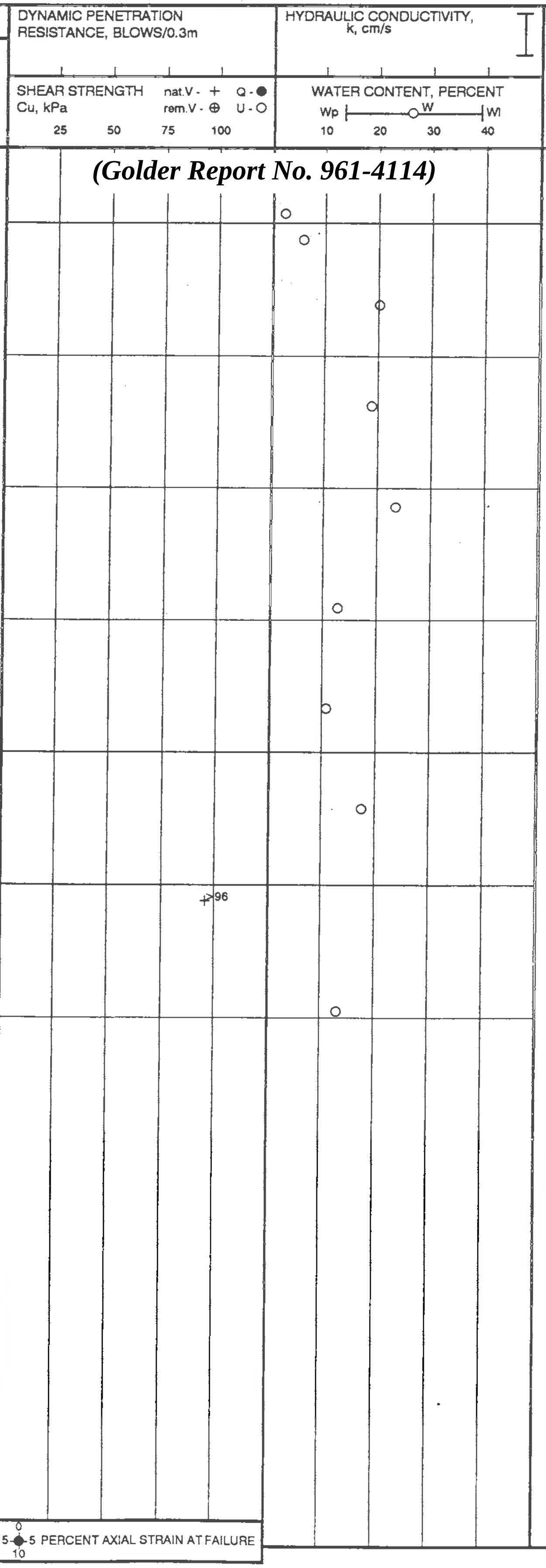
(Golder Report No. 961-4114)

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		181.37 0.00
Granular road base (FILL)	▨	180.91
Brown silty clay (FILL)	▨	180.76 0.61
Very stiff to stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	▨	178.63 2.74
Hard brown SILTY CLAY, some sand, occ. gravel (TILL)	▨	176.95 4.42
Very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	▨	174.82 6.55
END OF BOREHOLE		

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	21
2	50 DO	16
3	50 DO	11
4	50 DO	9
5	50 DO	32
6	50 DO	32
7	50 DO	9
8	50 DO	12



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Water seepage into borehole encountered at elevation 178.7m during drilling on July 5, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 21

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 5, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

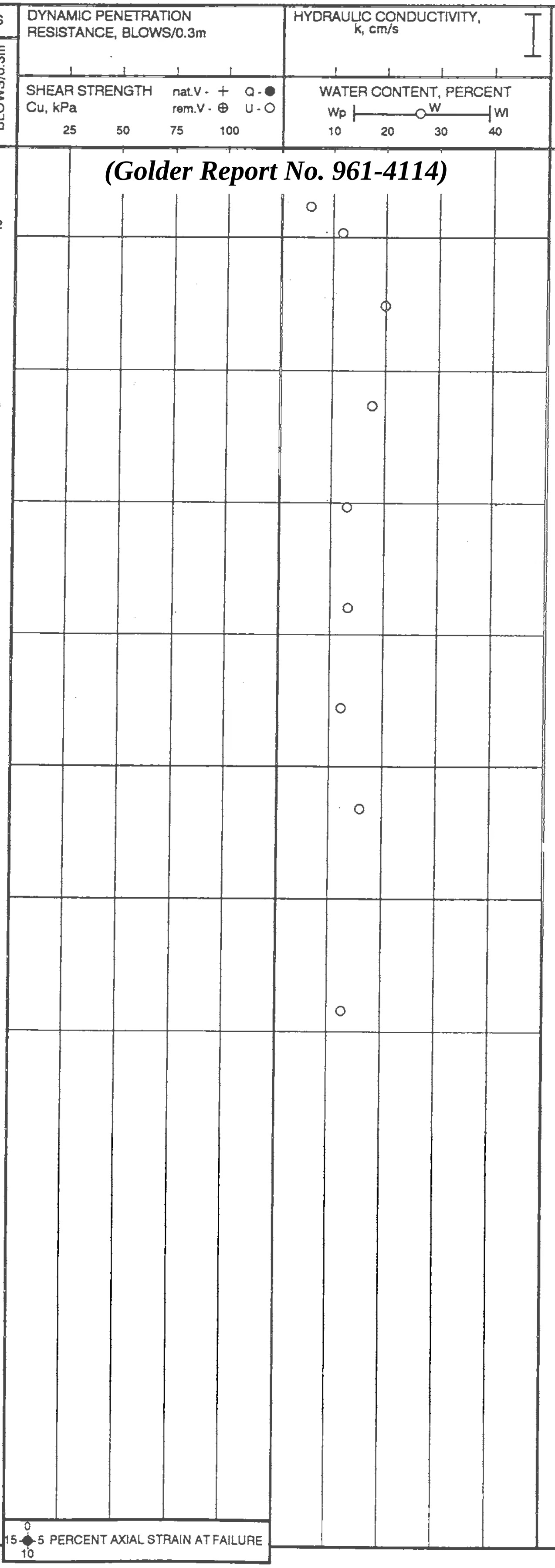
(Golder Report No. 961-4114)

DEPTH SCALE METRES: 0 – 10

BORING METHOD: POWER AUGER
SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.48 0.00
Granular road base (FILL)	181.18 0.30
Very stiff to stiff brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	179.96 1.52
Very stiff to hard brown SILTY CLAY, some sand, occ. gravel (TILL)	177.21 4.27
Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	174.93 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	12
2	50 DO	9
3	50 DO	20
4	50 DO	34
5	50 DO	34
6	50 DO	30
7	50 DO	19
8	50 DO	12



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on July 5, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.
CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 22

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 5, 1996

DATUM: GEODETIC

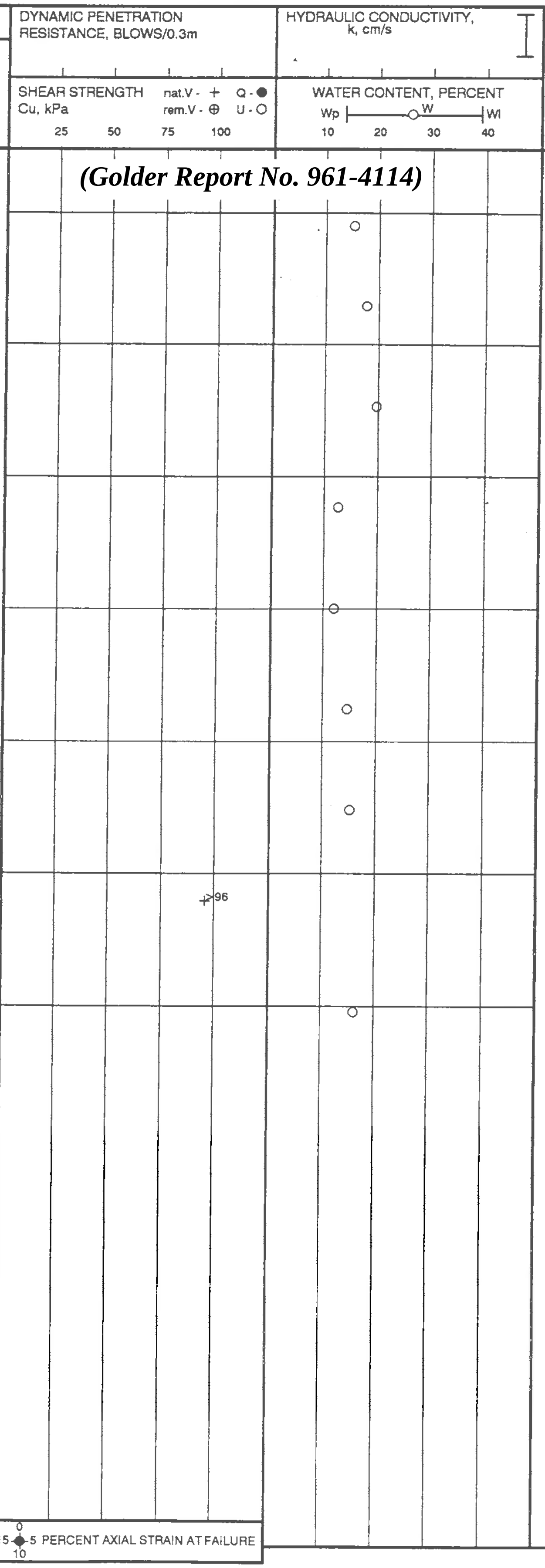
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	181.28 0.00			
Brown clayey TOPSOIL		1	50 DO	8
	180.82 0.46			
Stiff to very stiff mottled brown and grey SILTY CLAY (TILL)		2	50 DO	11
	179.76 1.52			
Very stiff to hard brown SILTY CLAY, occ. fissures, some sand, occ. gravel (TILL)		3	50 DO	19
		4	50 DO	29
		5	50 DO	32
	177.62 3.66			
Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel (TILL)		6	50 DO	18
		7	50 DO	12
		8	50 DO	12
END OF BOREHOLE	174.73 6.55			

(Golder Report No. 961-4114)



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Borehole dry during drilling on July 5, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 23

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

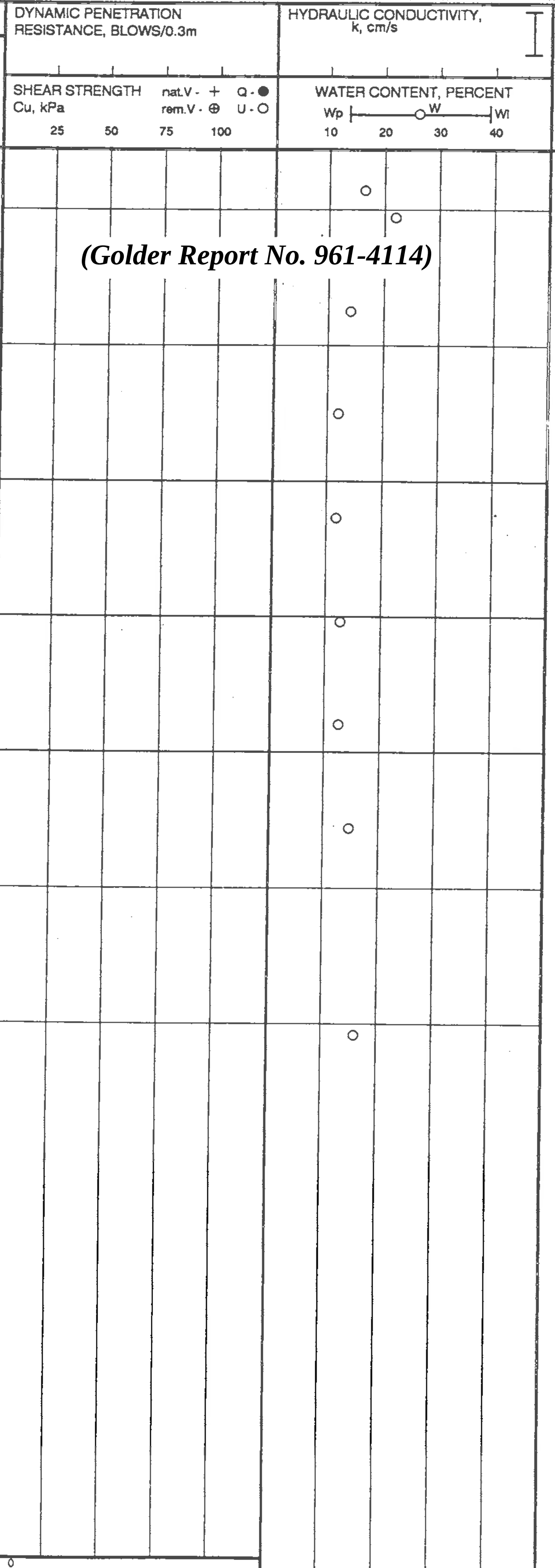
BORING DATE: JULY 5, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
0	POWER AUGER SOLID STEM	GROUND SURFACE		181.24				
		Brown clayey TOPSOIL		0.00 181.04 0.20	1	50 DO	5	
1		Firm to stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		179.72 1.52	2	50 DO	14	
2		Hard brown SILTY CLAY, some sand, occ. gravel and silt pockets (TILL)		178.19 3.05	3	50 DO	30	Borehole dry during drilling on July 5, 1996
					4	50 DO	42	
3		Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel, fissures (TILL)		174.69 6.55	5	50 DO	26	
4					6	50 DO	20	
5					7	50 DO	15	
6					8	50 DO	12	
		END OF BOREHOLE						
7								
8								
9								
10								



(Golder Report No. 961-4114)

15 ◆ 5 PERCENT AXIAL STRAIN AT FAILURE 0 10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 24

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 5, 1996

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

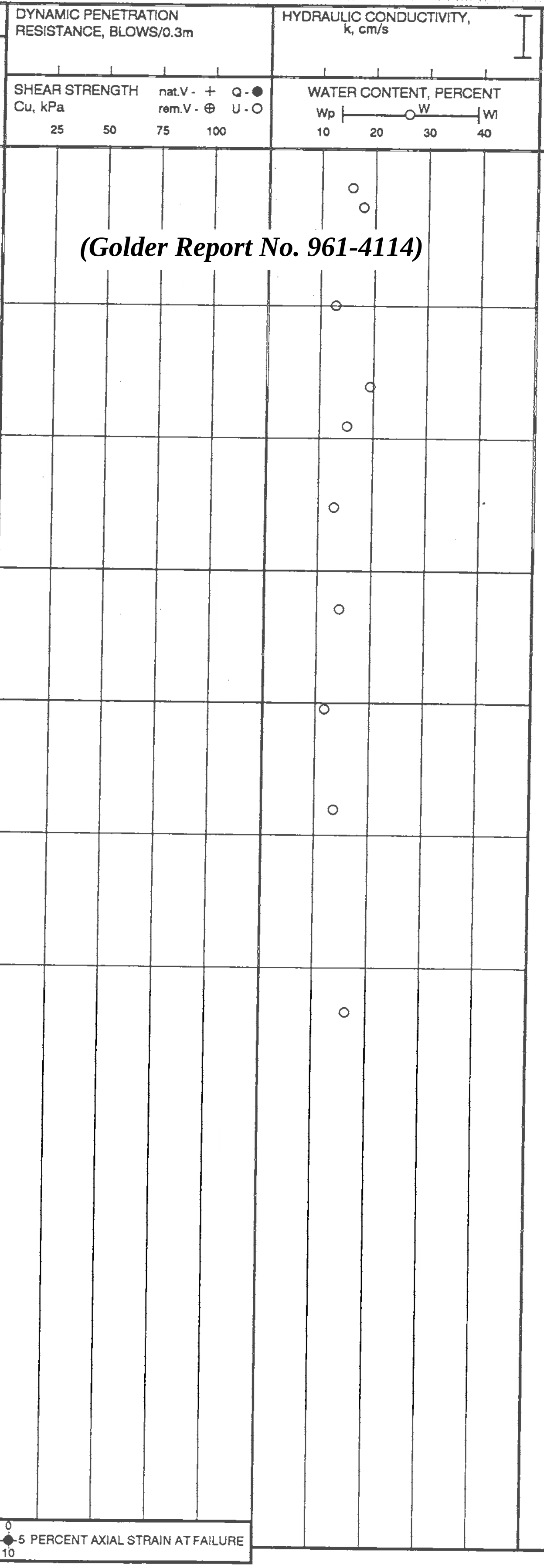
(Golder Report No. 961-4114)

DEPTH SCALE METRES: 0 – 10

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.99
Brown clayey TOPSOIL	0.00
Firm to stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	180.79 0.20
Very stiff to hard brown SILTY CLAY, some sand and silt pockets, occ. gravel, occ. fissures (TILL)	179.16 1.83
Very stiff to stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	176.42 4.57
END OF BOREHOLE	174.44 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	7
2	50 DO	12
3	50 DO	24
4	50 DO	30
5	50 DO	32
6	50 DO	31
7	50 DO	18
8	50 DO	11



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on July 5, 1996

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

PROJECT: 971-4045

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 12, 1997

DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4045)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft.	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft. SHEAR STRENGTH Cu, lb./sq.ft. nat.V - + Q - ● rem.V - ⊕ U - ○ 500 1000 1500 2000	HYDRAULIC CONDUCTIVITY, k, cm/s WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		593.6							
0	POWER AUGER HOLLOW STEM	Brown clayey TOPSOIL		0.0							Borehole dry during drilling on March 12, 1997
		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		592.7 0.8 589.6	1	AS					
		END OF BOREHOLE		4.0							
5											
10											
15											
20											
25											
30											
35											
40											

DATA INPUT: TONY MASTROIANNI

0
15-●-5 PERCENT AXIAL STRAIN AT FAILURE
10

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: C.C.
CHECKED:

PROJECT: 971-4045

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 12, 1997

DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4045)

BORING METHOD: POWER AUGER HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)
GROUND SURFACE	593.8
Brown clayey TOPSOIL	0.0
Stiff to very stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel, fissures and silt pockets (TILL)	593.0 0.8
Hard brown SILTY CLAY, some sand, occ. gravel, occ. silt partings, fissures (TILL)	587.3 6.5
Very stiff to hard grey SILTY CLAY, some sand, occ. gravel (TILL)	580.3 13.5
END OF BOREHOLE	567.3 26.5

SAMPLES NUMBER	TYPE	BLOWS/ft.
1	AS	
2	2" DO	12
3	2" DO	17
4	2" DO	47
5	2" DO	38
6	2" DO	30
7	2" DO	21
8	2" DO	17
9	2" DO	16

DYNAMIC PENETRATION RESISTANCE, BLOWS/ft.

SHEAR STRENGTH Cu, lb./sq.ft. nat.V - + Q - ● rem.V - ⊕ U - ○ 500 1000 1500 2000

HYDRAULIC CONDUCTIVITY, k, cm/s

WATER CONTENT, PERCENT Wp ├──○W──┤ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on March 12, 1997

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

15 -●- 5 (0, 10) PERCENT AXIAL STRAIN AT FAILURE

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4045

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 12, 1997

DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4045)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ft.	DYNAMIC PENETRATION RESISTANCE, BLOWS/ft. SHEAR STRENGTH Cu, lb./sq.ft. nat.V - + Q - ● rem.V - ⊕ U - ○ 500 1000 1500 2000	HYDRAULIC CONDUCTIVITY, k, cm/s WATER CONTENT, PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	POWER AUGER HOLLOW STEM	GROUND SURFACE		594.0							
0		Brown clayey TOPSOIL		0.0 593.2 0.8	1	AS					
		Stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel fissured, occ. silt pockets (TILL)			2	2" DO	12				
5				587.5 6.5	3	2" DO	10				
		Hard brown SILTY CLAY, some sand, occ. gravel, fissured, oxidized (TILL)			4	2" DO	52				
10				581.5 12.5	5	2" DO	40				Borehole dry during drilling on March 12, 1997
		Stiff to very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)			6	2" DO	15				
15					7	2" DO	18				
20					8	2" DO	16				
25				567.5 26.5	9	2" DO	13				
		END OF BOREHOLE									
30											
35											
40											

0
15-●-5 PERCENT AXIAL STRAIN AT FAILURE
10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: C.C.
CHECKED:

PROJECT: 971-4045

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 12, 1997

DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4045)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft.
0	POWER AUGER HOLLOW STEM	GROUND SURFACE	594.2			
		Brown clayey TOPSOIL	0.0 593.2 0.9			
		Very stiff to hard mottled brown and grey SILTY CLAY, some sand, occ. gravel, occ. fissured silt pockets (TILL)	587.7 6.5	1 2 3	AS 2" DO 2" DO	 19 36
5		Hard brown SILTY CLAY, some sand, occ. gravel fissures (TILL)	581.7 12.5	4 5	2" DO 2" DO	49 45
10		Very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	580.2 14.0	6	2" DO	29
15		Very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	572.7 21.5	7 8	2" DO 2" DO	19 17
20		END OF BOREHOLE				
25						
30						
35						
40						

DYNAMIC PENETRATION RESISTANCE, BLOWS/ft.

SHEAR STRENGTH Cu, lb./sq.ft. nat.V - + Q - ● rem.V - ⊕ U - ○

500 1000 1500 2000

HYDRAULIC CONDUCTIVITY, k, cm/s

WATER CONTENT, PERCENT Wp ├──○W──┤ Wl

10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry during drilling on March 12, 1997

0
15-●-5 PERCENT AXIAL STRAIN AT FAILURE
10

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4045

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 12, 1997

DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4045)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS/ft.
		GROUND SURFACE	594.2			
0	POWER AUGER HOLLOW STEM	Brown clayey TOPSOIL	0.0			
		Very stiff to hard mottled brown and grey SILTY CLAY, some sand, occ. gravel, fissured	593.3 0.8	1	AS	
				2	2" DO	21
5				3	2" DO	31
		Very dense brown SANDY SILT	587.2 7.0	4	2" DO	64
10		Hard brown SILTY CLAY, some sand, occ. gravel (TILL)	585.2 9.0	5	2" DO	34
		Very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)	582.2 12.0	6	2" DO	22
15				7	2" DO	21
20				8	2" DO	13
25				9	2" DO	21
		END OF BOREHOLE	567.7 26.5			
30						
35						
40						

DYNAMIC PENETRATION RESISTANCE, BLOWS/ft.	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
SHEAR STRENGTH Cu, lb./sq.ft. nat.V - + Q - ● rem.V - ⊕ U - ○ 500 1000 1500 2000	WATER CONTENT, PERCENT Wp ├──○W──┤ Wl 10 20 30 40		Borehole dry during drilling on March 12, 1997

15 ─◆─ 5 (0 above, 10 below) PERCENT AXIAL STRAIN AT FAILURE

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4135

RECORD OF TEST HOLE 1

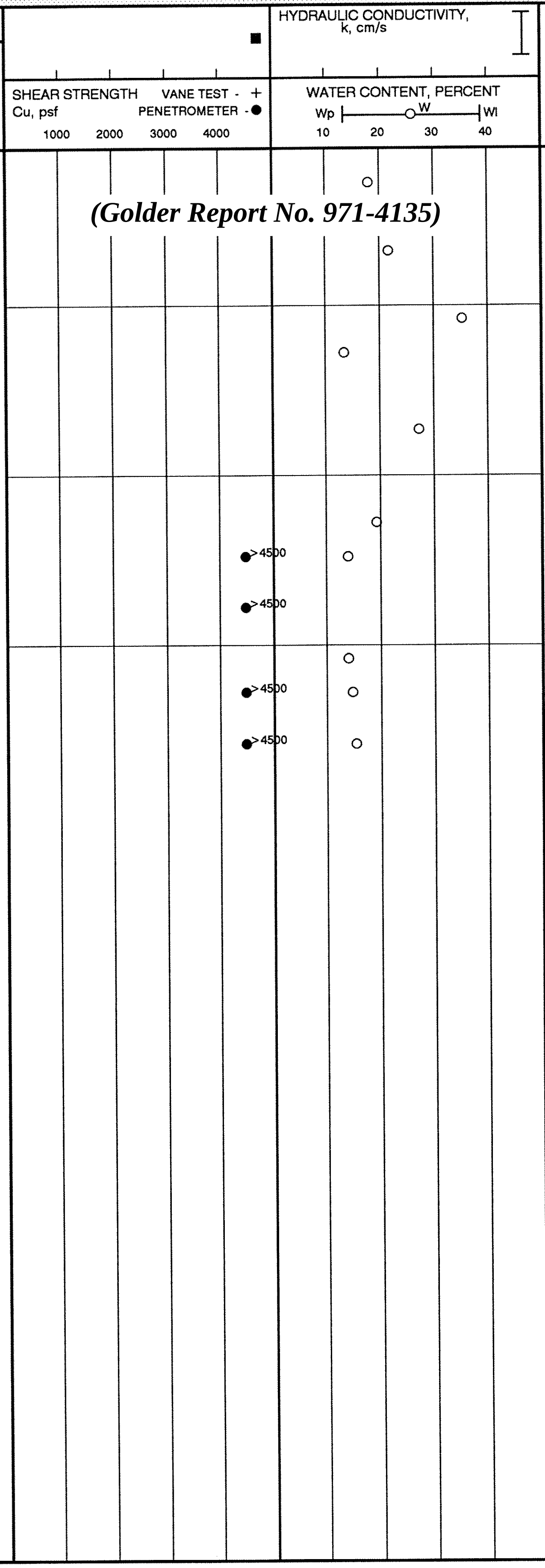
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JUNE 11, 1997

DATUM: GEODETIC

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)
		GROUND SURFACE	604.1
0	BACKHOE	Brown silty clay, occ. gravel, black organic pockets (FILL)	0.0
		Black organic topsoil, pieces of straw and roots (FILL)	599.6 598.8
5		Brown silty clay, pieces of tile and roots, topsoil pockets (FILL)	598.1 597.6
		Black clayey TOPSOIL	6.5
10		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	592.1 12.0
15		Hard brown SILTY CLAY, some sand, occ. gravel (TILL)	586.6 17.5
		END OF TEST HOLE	

SAMPLES NUMBER	TYPE
1	CS
2	CS
3	CS
4	CS
5	CS
6	CS
7	CS
8	CS
9	CS
10	CS



(Golder Report No. 971-4135)

ADDITIONAL LAB. TESTING

GROUND WATER CONDITIONS AND INSTALLATION

Minor water seepage into test hole encountered at elevation 597.1 ft during digging on June 11, 1997

DEPTH SCALE 0 5 10 15 20 25 30 35 40

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4135

RECORD OF TEST HOLE 2

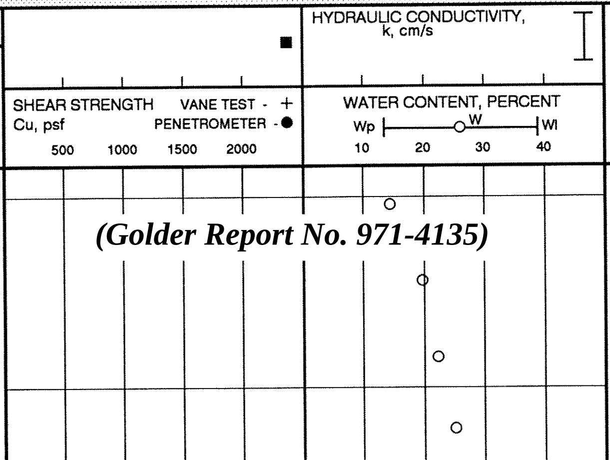
SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JUNE 11, 1997

DATUM: GEODETIC

DEPTH SCALE FEET	METHOD / SIZE	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE	ADDITIONAL LAB. TESTING	GROUND WATER CONDITIONS AND INSTALLATION
		GROUND SURFACE		600.3				
0	BACKHOE	Brown and grey silty clay, pieces of concrete block and gravel (FILL)	▩	0.0	1	CS		
				597.3 3.0	2	CS		
5		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	▨		3	CS		Minor water seepage into test hole encountered at elevation 595.3 ft during digging on June 11, 1997
		END OF TEST HOLE		593.8 6.5	4	CS		



(Golder Report No. 971-4135)

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: BD

PROJECT: 971-4135

LOCATION: SEE LOCATION PLAN

RECORD OF TEST HOLE 3

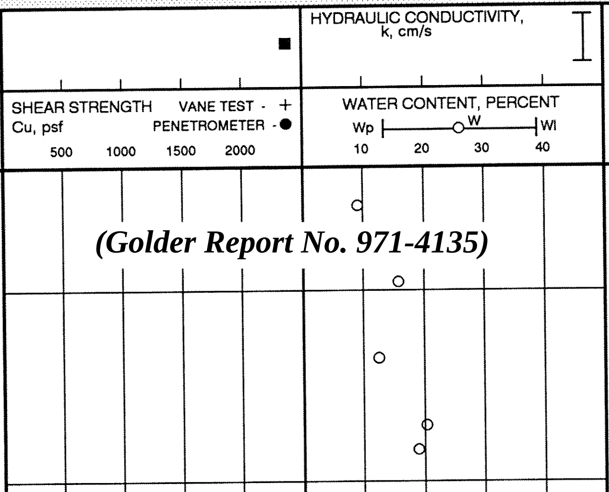
EXCAVATION DATE: JUNE 11, 1997

SHEET 1 OF 1

DATUM: GEODETIC

(Golder Report No. 971-4135)

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	GROUND WATER CONDITIONS AND INSTALLATION
0	BACKHOE	GROUND SURFACE	602.7 0.0			
		Mottled brown and grey silty clay, some topsoil, pieces of tile, gravel and asphalt (FILL)		1	CS	Test hole dry during digging on June 11, 1997
			598.7	2	CS	
		Black clayey to sandy TOPSOIL	4.0 597.9	3	CS	
5		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	4.8	4	CS	
			595.4	5	CS	
		END OF TEST HOLE	7.3			
10						
15						
20						
25						
30						
35						
40						



ADDITIONAL LAB. TESTING

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: D.O.

PROJECT: 971-4135

LOCATION: SEE LOCATION PLAN

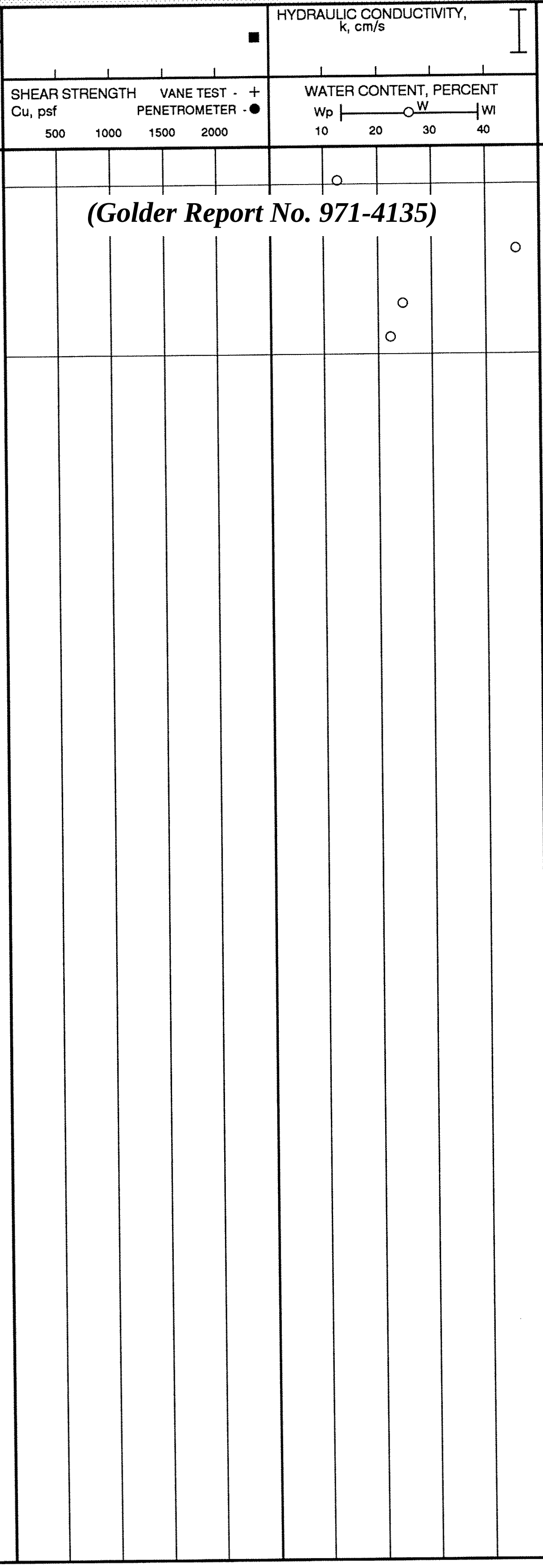
RECORD OF TEST HOLE 4

EXCAVATION DATE: JUNE 11, 1997

SHEET 1 OF 1

DATUM: GEODETIC

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	ADDITIONAL LAB. TESTING	GROUND WATER CONDITIONS AND INSTALLATION
		GROUND SURFACE		600.6				
0	BACKHOE	Brown silty clay, pieces of stone and brick, topsoil pockets (FILL)	▨	0.0 598.5	1	CS		
		Black organic TOPSOIL						
		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		2.5	2	CS		Water seepage into test hole encountered at elevation 598.1ft during digging on June 11, 1997
					3	CS		
5				594.6 6.0	4	CS		
		END OF TEST HOLE						
10								
15								
20								
25								
30								
35								
40								



(Golder Report No. 971-4135)

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4135

LOCATION: SEE LOCATION PLAN

RECORD OF TEST HOLE 5

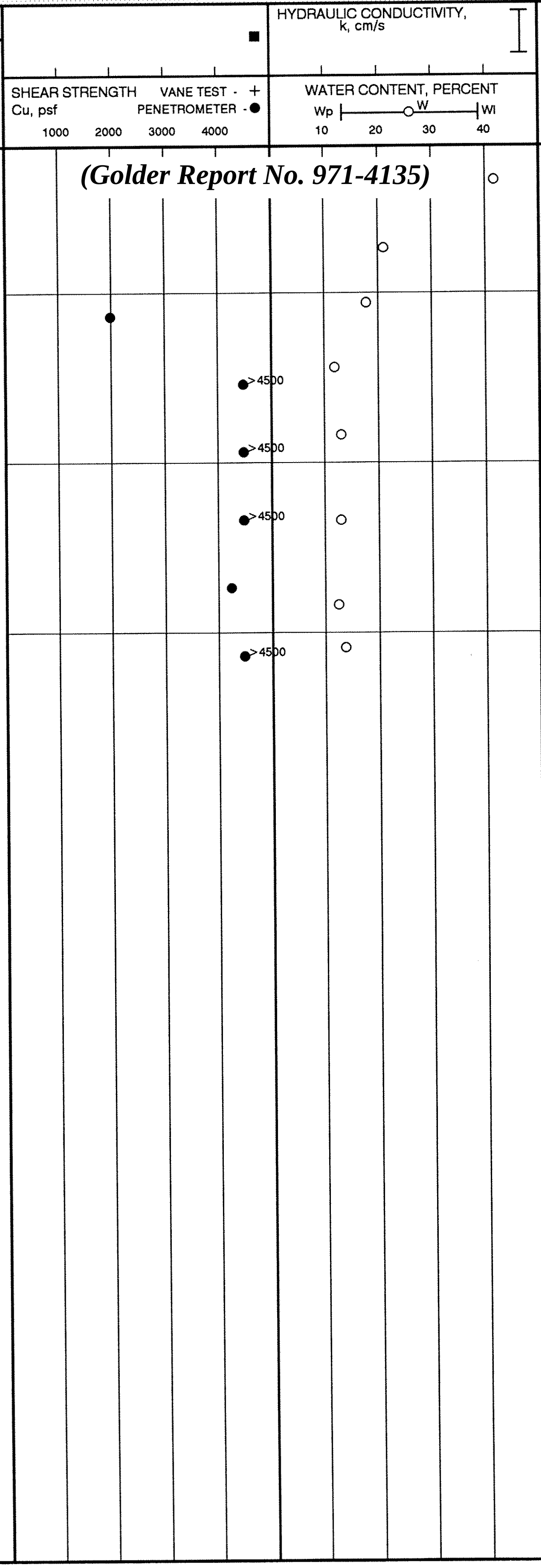
EXCAVATION DATE: JUNE 11, 1997

SHEET 1 OF 1

DATUM: GEODETIC

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	ADDITIONAL LAB. TESTING	GROUND WATER CONDITIONS AND INSTALLATION
		GROUND SURFACE		598.8				
0	BACKHOE	Black clayey TOPSOIL		0.0 597.8 1.0	1	CS		
5		Mottled brown and grey SILTY CLAY, some sand, occ. gravel, heavily rooted to 2.5' (TILL)		592.3 6.5	2 3 4	CS CS CS		Test hole dry during digging on June 11, 1997
10		Brown SILTY CLAY, some sand, occ. gravel (TILL)		586.3 12.5	5 6	CS CS		
		Grey SILTY CLAY, some sand, occ. gravel (TILL)		583.8 15.0	7 8	CS CS		
15		END OF TEST HOLE						
20								
25								
30								
35								
40								

(Golder Report No. 971-4135)



DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: D.D

PROJECT: 971-4135

LOCATION: SEE LOCATION PLAN

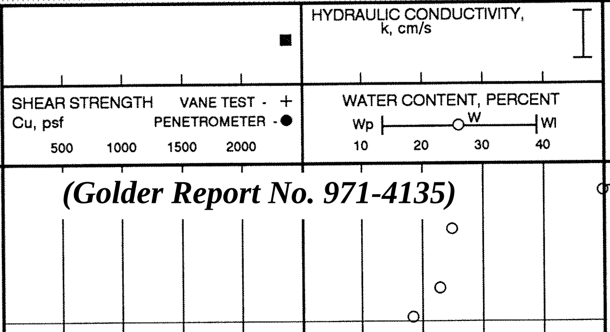
RECORD OF TEST HOLE 6

EXCAVATION DATE: JUNE 11, 1997

SHEET 1 OF 1

DATUM: GEODETIC

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	ADDITIONAL LAB. TESTING	GROUND WATER CONDITIONS AND INSTALLATION
		GROUND SURFACE		598.6				
0	BACKHOE	Black clayey TOPSOIL		598.2 0.4	1	CS		
		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)			2	CS		Test hole dry during digging on June 11, 1997
					3	CS		
				594.6 4.0	4	CS		
		END OF TEST HOLE						



(Golder Report No. 971-4135)

DEPTH SCALE: 0, 5, 10, 15, 20, 25, 30, 35, 40

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4135

LOCATION: SEE LOCATION PLAN

RECORD OF TEST HOLE 7

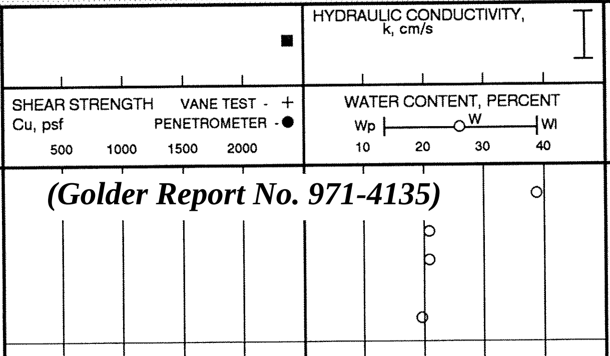
EXCAVATION DATE: JUNE 11, 1997

SHEET 1 OF 1

DATUM: GEODETIC

(Golder Report No. 971-4135)

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	ADDITIONAL LAB. TESTING	GROUND WATER CONDITIONS AND INSTALLATION
0		GROUND SURFACE		599.1				
	BACKHOE	Black clayey TOPSOIL		598.4 0.7	1	CS		
		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		595.1 4.0	2 3 4	CS CS CS		Moinor water seepage into test hole encountered at elevation 596.1 ft. during digging on June 11, 1997
5		END OF TEST HOLE						
10								
15								
20								
25								
30								
35								
40								



DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: BM.

PROJECT: 971-4135

LOCATION: SEE LOCATION PLAN

RECORD OF TEST HOLE 8

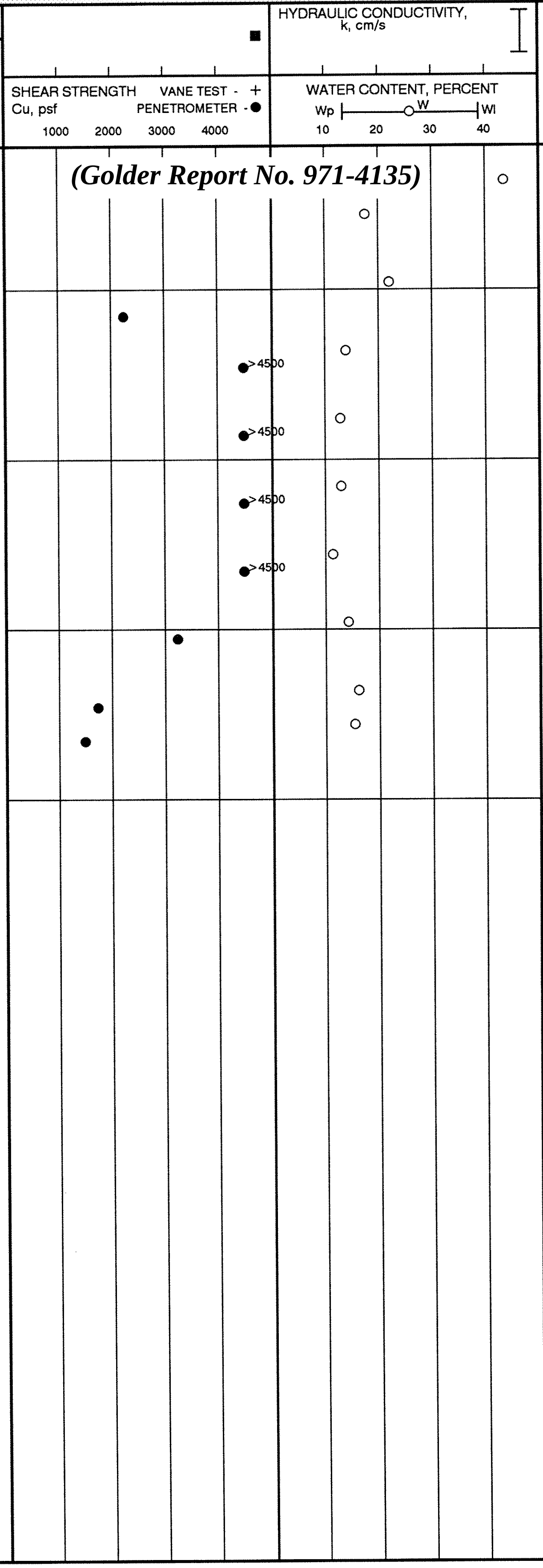
EXCAVATION DATE: JUNE 11, 1997

SHEET 1 OF 1

DATUM: GEODETIC

(Golder Report No. 971-4135)

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	GROUND WATER CONDITIONS AND INSTALLATION
		GROUND SURFACE	598.7			
0	BACKHOE	Black clayey TOPSOIL	0.0 597.7	1	CS	
		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)	1.0 592.2	2 3 4	CS CS CS	
5						Moinor water seepage into test hole encountered at elevation 594.2ft. during digging on June 11, 1997
		Brown SILTY CLAY, some sand, occ. gravel (TILL)	6.5 587.7	5 6	CS CS	
10						
		Grey SILTY CLAY, some sand, occ. gravel (TILL)	11.0 578.7	7 8 9 10	CS CS CS CS	
15						
20		END OF TEST HOLE	20.0			
25						
30						
35						
40						



ADDITIONAL LAB. TESTING

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: D.D.

PROJECT: 971-4135

RECORD OF TEST HOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JUNE 11, 1997

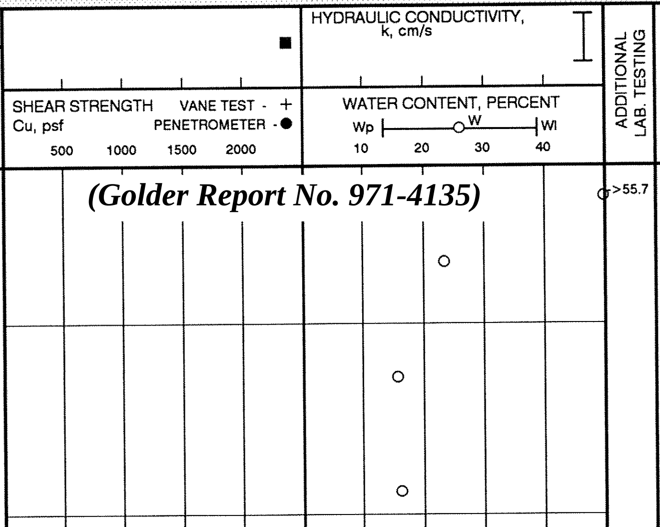
DATUM: GEODETIC

(Golder Report No. 971-4135)

METHOD / SIZE: Manual Auger, Hollow Stem

DEPTH SCALE FEET	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE	
0	GROUND SURFACE		598.6			
	Black clayey TOPSOIL		598.0 0.6			
5	Firm to stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel, silt pockets (TILL)		592.3 6.3	1 2	AS 2" DO	 10
	Hard brown SILTY CLAY, some sand, occ. gravel (TILL)		589.6 9.0	3	2" DO	32
10	END OF TEST HOLE					

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40



ADDITIONAL LAB. TESTING

GROUND WATER CONDITIONS AND INSTALLATION

Water level in test hole at elevation 597.1ft. during drilling on June 13, 1997

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: D.O.

PROJECT: 971-4135

RECORD OF TEST HOLE 10

SHEET 1 OF 1

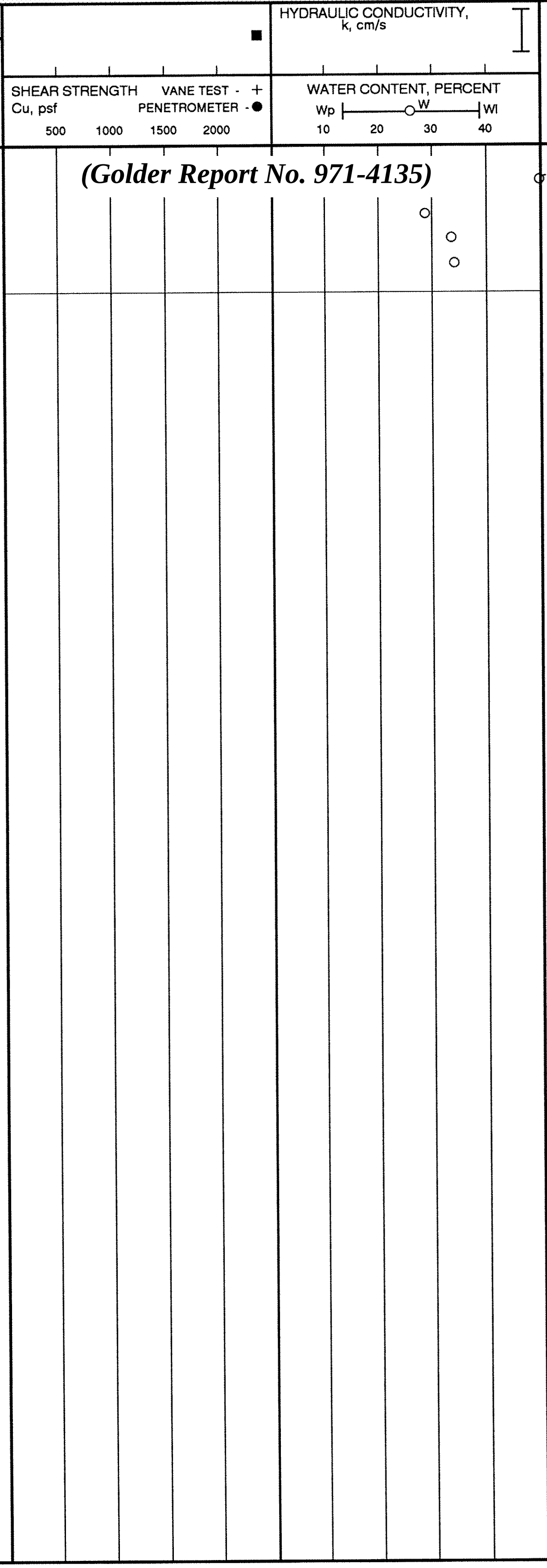
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JUNE 11, 1997

DATUM: GEODETIC

(Golder Report No. 971-4135)

DEPTH SCALE FEET	METHOD / SIZE	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	ADDITIONAL LAB. TESTING	GROUND WATER CONDITIONS AND INSTALLATION
		GROUND SURFACE		598.8				
0	Manual Auger Hollow Stem	Black clayey TOPSOIL		598.1 0.7	1	CS	>77.1	▽ Water level in test hole at elevation 598.0ft. during drilling on June 11, 1997
		Mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		595.3 3.5	2 3 4	CS CS CS		
		END OF TEST HOLE						
5								
10								
15								
20								
25								
30								
35								
40								



DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED: H.D.

PROJECT: 971-4236

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

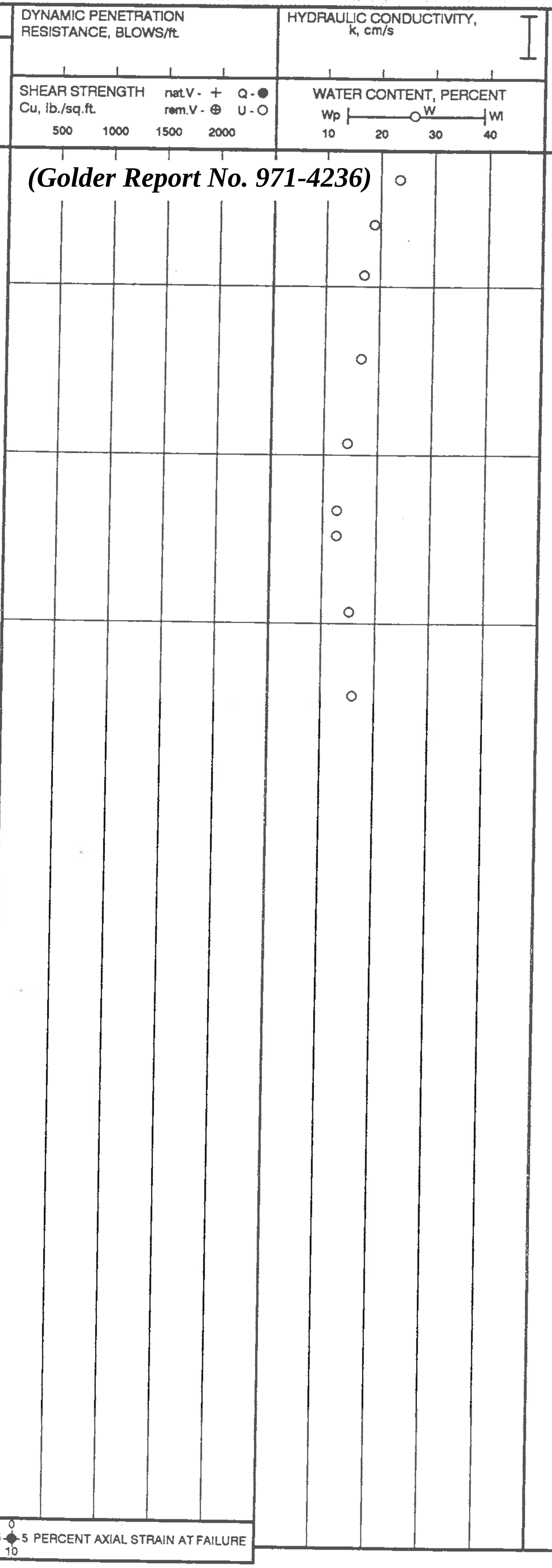
BORING DATE: SEPT. 19, 1997

DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft.	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	POWER AUGER HOLLOW STEM	GROUND SURFACE		593.6					
		Black clayey TOPSOIL		0.0					
		Stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		592.7 0.8	1	AS			
					2	2" DO	13		
5		Very stiff to hard brown SILTY CLAY to CLAYEY SILT, some sand, occ. gravel and fissures (TILL)		588.6 5.0	3	2" DO	26		Borehole dry during drilling on Sept. 19, 1997
					4	2" DO	30		
10		Very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)		582.8 10.8	5	2" DO	33		
					6	2" DO	45		
15					7	2" DO	20		
		END OF BOREHOLE		577.1 16.5					
20									
25									
30									
35									
40									



(Golder Report No. 971-4236)

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4236

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 140lb; DROP, 30in

RECORD OF BOREHOLE 2

BORING DATE: SEPT. 22, 1997

SHEET 1 OF 1

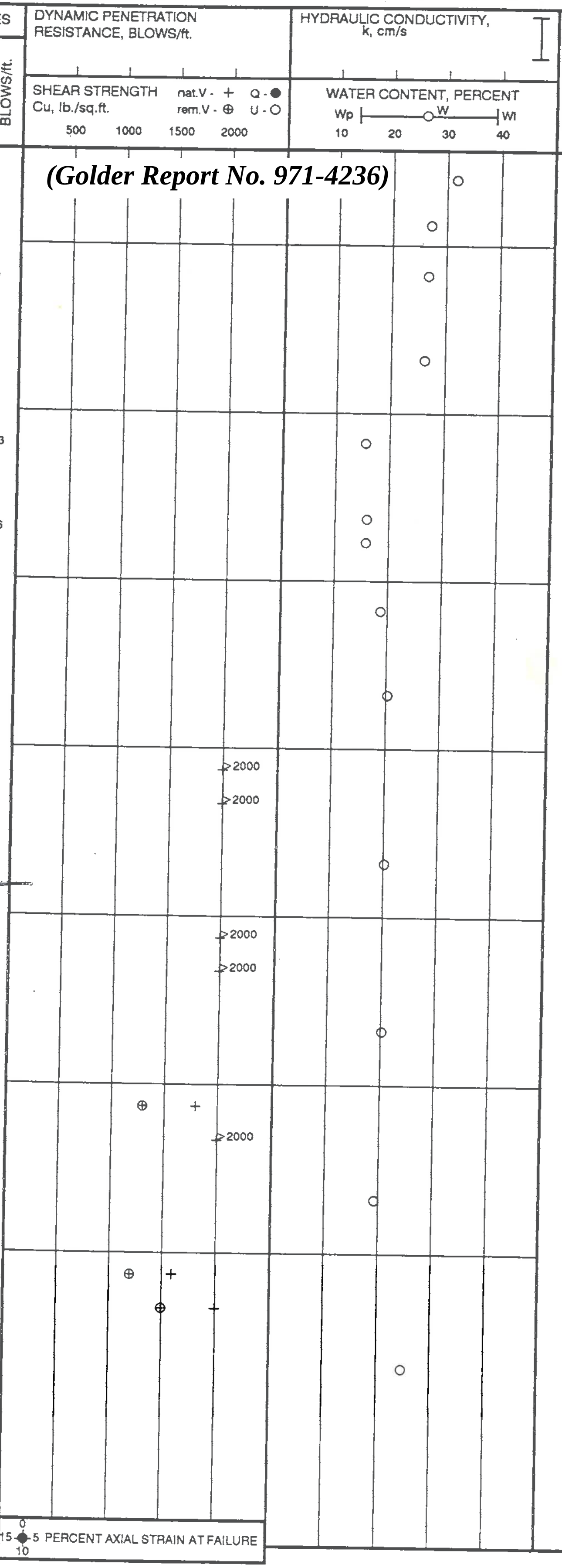
DATUM: GEODETIC

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4236)

BORING METHOD: POWER AUGER HOLLOW STEM

DESCRIPTION	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS/ft.
GROUND SURFACE	592.3			
Brown to black clayey TOPSOIL	0.0 591.4 0.9	1	AS	
Firm to stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		2	2" DO	5
	585.3 7.0	3	2" DO	5
Very stiff to hard brown SILTY CLAY, some sand, occ. gravel, occ. fissures (TILL)		4	2" DO	33
	581.3 11.0	5	2" DO	26
Firm to very stiff grey SILTY CLAY, some sand, occ. gravel (TILL)		6	2" DO	11
		7	2" DO	8
		8	2" DO	10
		9	2" DO	11
		10	2" DO	10
	555.8 36.5	11	2" DO	7
END OF BOREHOLE				



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Water seepage into borehole encountered at elevation 576.3ft. during drilling on Sept. 22, 1997

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 971-4236

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: SEPT. 22, 1997

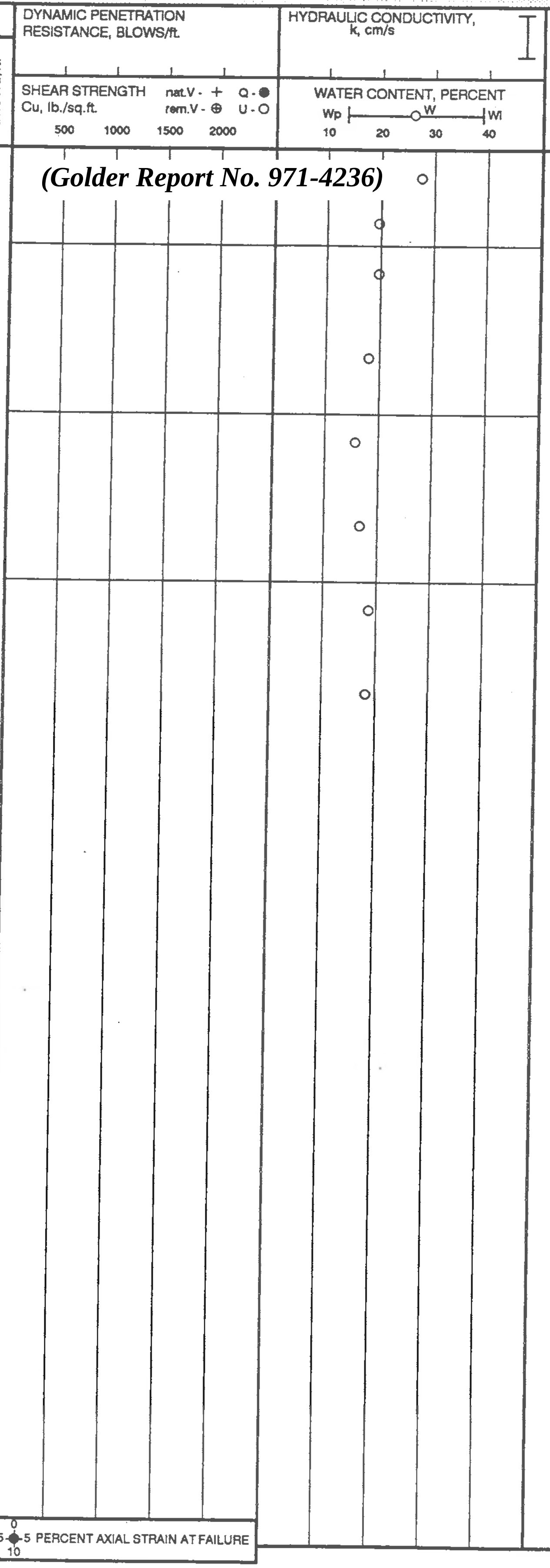
DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 971-4236)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft.
0	POWER AUGER HOLLOW STEM	GROUND SURFACE		592.4			
		Black clayey TOPSOIL		0.0 591.7 0.8			
		Stiff mottled brown and grey SILTY CLAY, some sand, occ. gravel (TILL)			1	AS	
					2	2" DO	12
5		Very stiff to hard brown SILTY CLAY, some sand, occ. gravel and fissures (TILL)		587.4 5.0	3	2" DO	25
					4	2" DO	36
10					5	2" DO	31
					6	2" DO	16
15		Stiff grey SILTY CLAY, some sand, occ. gravel and oxidized fissures (TILL)		578.4 14.0	7	2" DO	14
		END OF BOREHOLE		575.9 16.5			
20							
25							
30							
35							
40							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole dry
during drilling
on Sept. 22, 1997

ASTRO

PUT:

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 961-4114

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JUNE 28, 1996

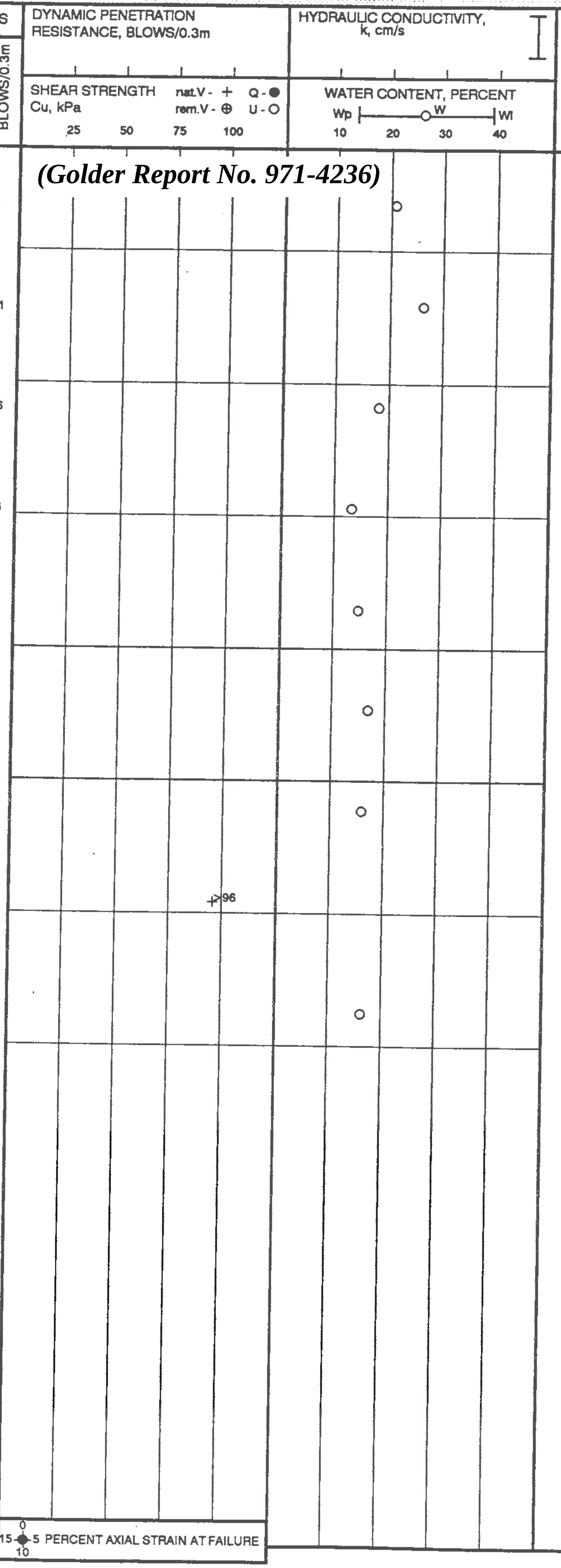
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 971-4236)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE	180.57 0.00					
	POWER AUGER SOLID STEM	Black clayey TOPSOIL	180.11 0.46	1	50 DO	9		
1		Stiff mottled brown and grey SILTY CLAY, occ. gravel, some sand (TILL)	179.05 1.52	2	50 DO	11		
2		Very stiff to hard brown SILTY CLAY, occ. gravel, some sand (TILL)		3	50 DO	16		
				4	50 DO	36		Borehole dry during drilling on June 28, 1996
3			176.91 3.66	5	50 DO	23		
4		Very stiff to stiff grey SILTY CLAY, occ. gravel and some sand (TILL)		6	50 DO	13		
5				7	50 DO	14		
6			174.02 6.55	8	50 DO	11		
7		END OF BOREHOLE						
8								
9								
10								



DEPTH SCALE

1 to 50

Golder Associates

LOGGED: P.N.

CHECKED:

ASTRC.......

IPUT:

PROJECT: 981-4341

RECORD OF BOREHOLE 1

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: DEC. 21, 1998

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

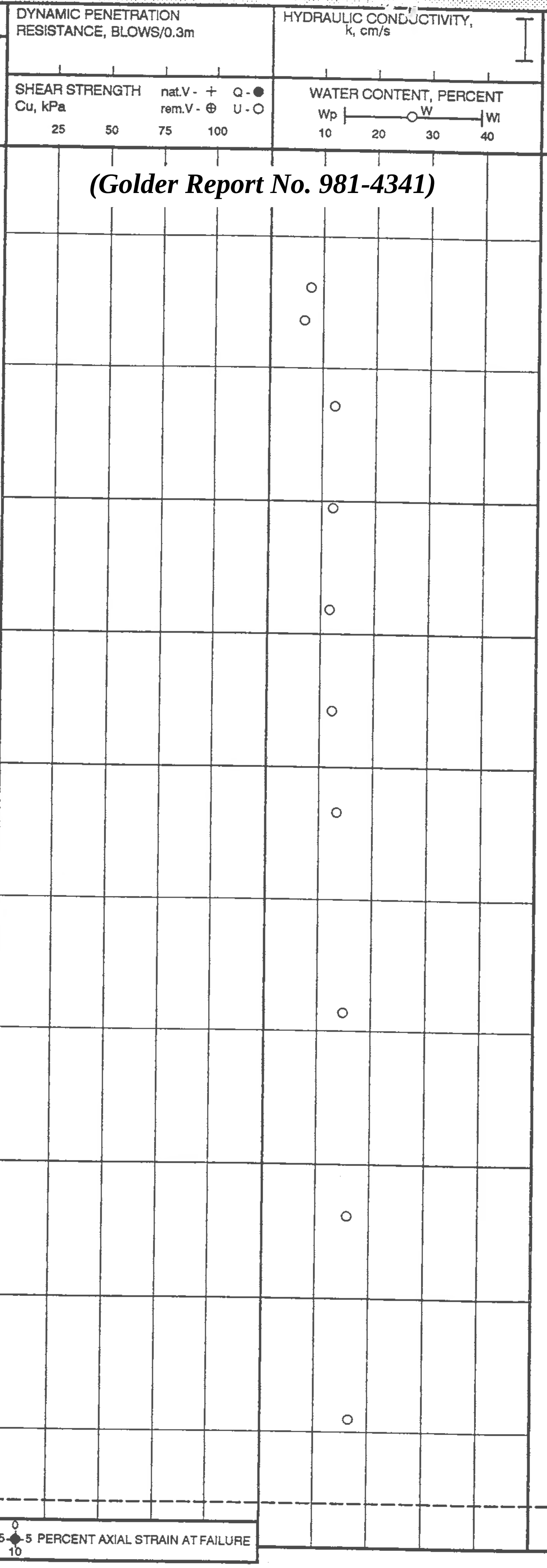
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 981-4341)

BORING METHOD: POWER AUGER HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	96.46
Black clayey topsoil (FILL)	96.31 0.15
Very stiff brown silty clay, some sand and gravel (FILL)	95.55 0.91
Compact brown SILTY FINE SAND, some gravel, occ. clayey zones	95.09 1.37
Hard brown SILTY CLAY, some sand, and gravel, fissured (TILL)	93.56 2.90
Hard to very stiff grey SILTY CLAY, trace to some sand, and gravel (TILL)	
CONTINUED ON NEXT PAGE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	29
2	50 DO	52
3	50 DO	57
4	50 DO	46
5	50 DO	46
6	50 DO	40
7	50 DO	26
8	50 DO	20
9	50 DO	20



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole remained dry during drilling on Dec. 21, 1998

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 981-4341

RECORD OF BOREHOLE 1

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: DEC. 21, 1998

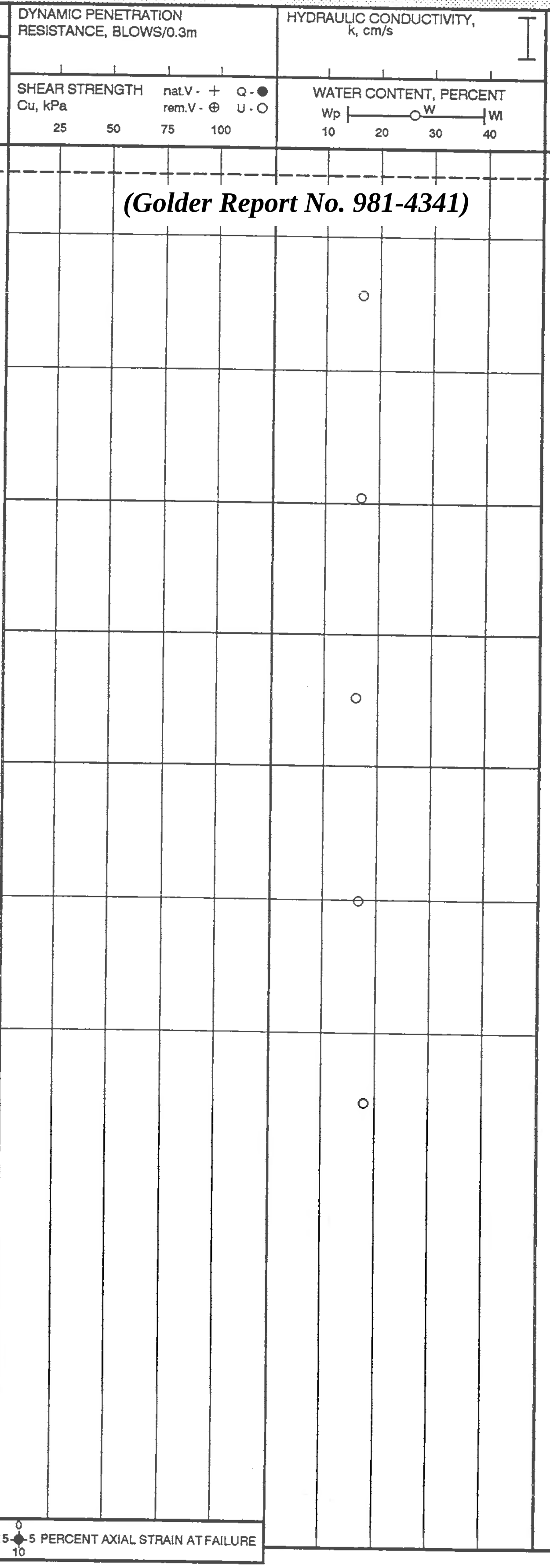
DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 981-4341)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
10		CONTINUED FROM PREVIOUS PAGE					
11					10	50 DO	19
12					11	50 DO	19
13	POWER AUGER HOLLOW STEM	Hard to very stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	▨				
14					12	50 DO	21
15					13	50 DO	21
16							
17				79.24 17.22	14	50 DO	18
		END OF BOREHOLE					
18							
19							
20							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DATA INPUT: TONY MASTROIANNI

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: R.W.W.

CHECKED:

PROJECT: 991-4228

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 18, 1999

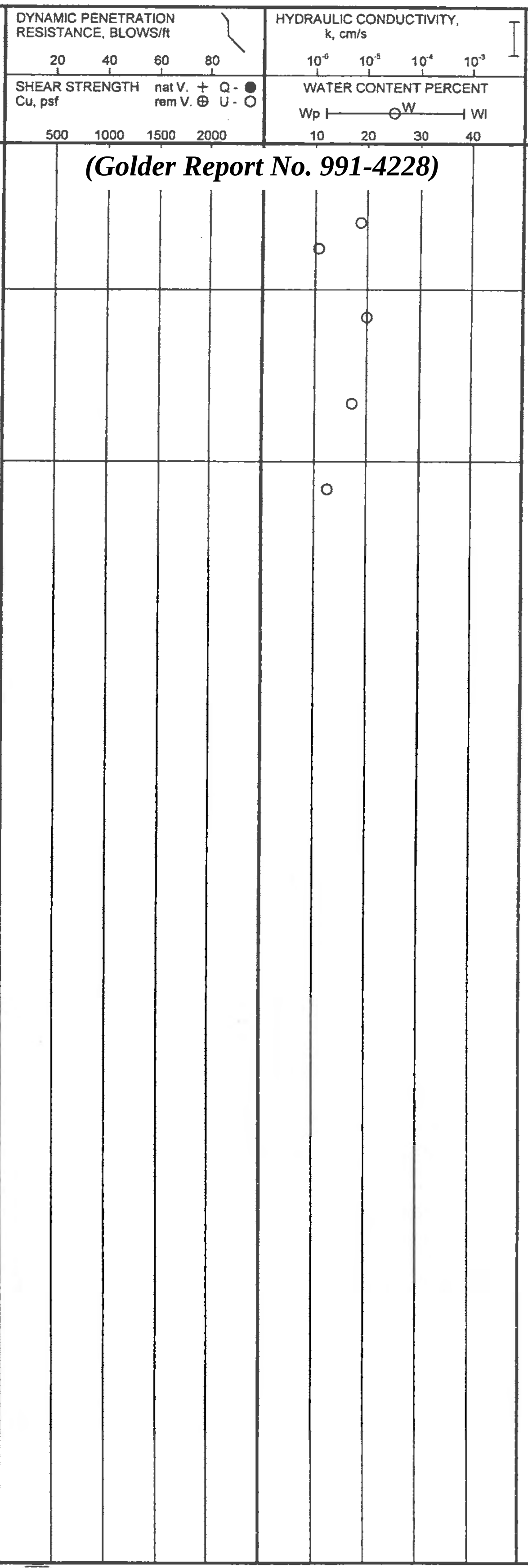
DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		98.4						
	POWER AUGER SOLID STEM	Granular base (FILL)		0.3						
		Stiff to firm brown silty clay, some sand and gravel, some granular intermixing trace organic, (FILL)			1	2" DO	10	95		Borehole dry during drilling on October 18, 1999
				93.9 4.5	2	2" DO	7			
5		Firm to stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)			3	2" DO	10			
				90.4 8.0				90		
		Hard brown SILTY CLAY, some sand and gravel, fissured (TILL)			4	2" DO	36			
				88.4						
10		END OF BOREHOLE		10.0						
15										
20										
25										
30										
35										

(Golder Report No. 991-4228)



DEPTH SCALE

1 inch to 5 feet

LOGGED: K.B.

CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

PROJECT: 991-4228

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 18, 1999

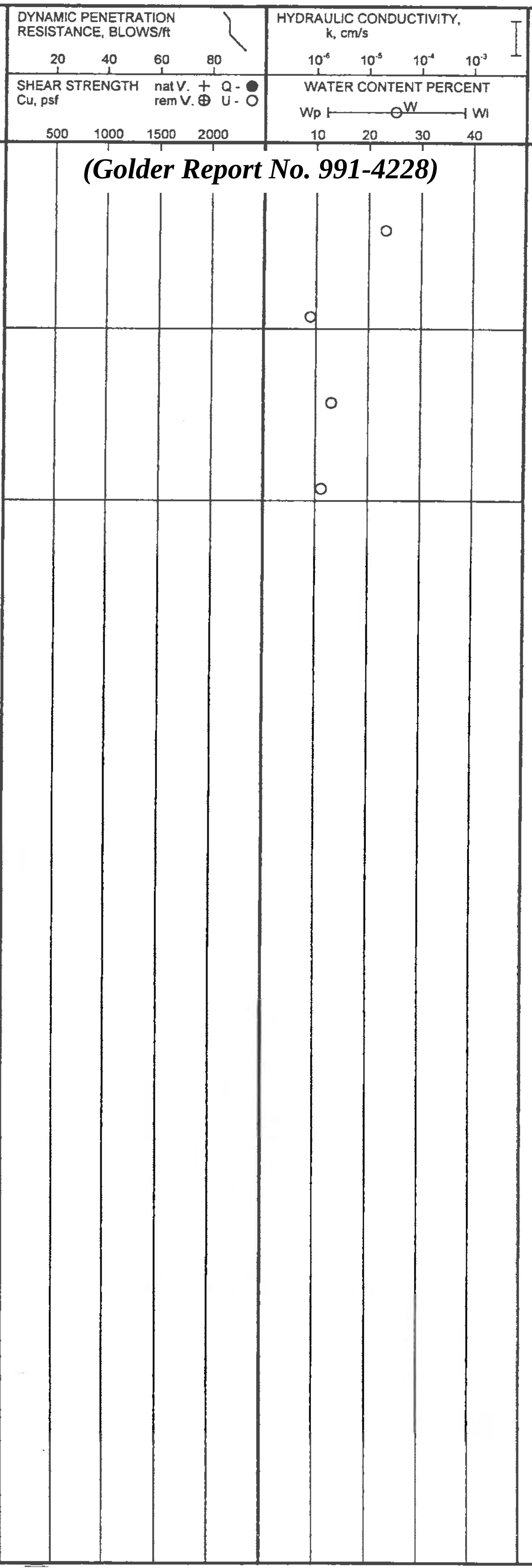
DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	94.6					
0	POWER AUGER SOLID STEM	Black clayey topsoil (FILL)	0.0 93.6 1.0					
		Loose brown sand some silt, trace organics (FILL)	91.6 3.0	1	2" DO	8		
5		Loose brown FINE SAND, trace silt	89.1 5.5	2	2" DO	9	90	Borehole dry during drilling on October 18, 1999
		Very stiff grey and brown SILTY CLAY, some sand and gravel (TILL)	84.6	3	2" DO	27		
10			10.0	4	2" DO	24	85	
		END OF BOREHOLE						



DEPTH SCALE 15 20 25 30 35

DEPTH SCALE

1 inch to 5 feet

LOGGED: K.B.

CHECKED:

PROJECT: 991-4228

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 18, 1999

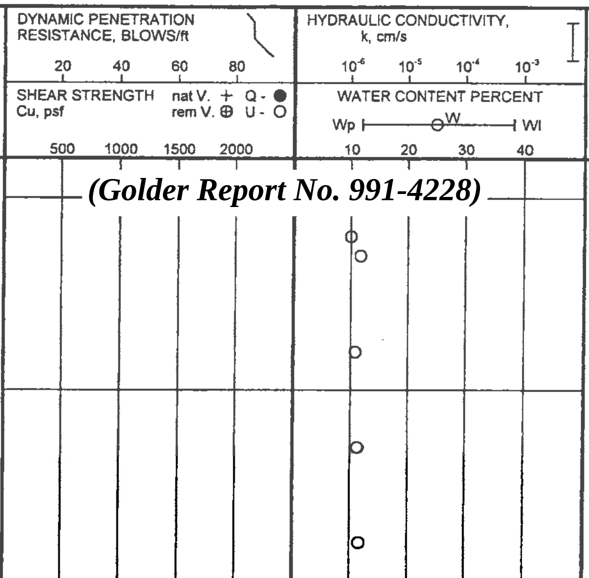
DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	95.2 0.0				95		
		Dark brown clayey TOPSOIL	93.7 1.5						
		Stiff to hard mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)		1	2" DO	10			Borehole dry during drilling on October 18, 1999
				2	2" DO	32			
5			89.7 5.5				90		
		Hard brown SILTY CLAY, some sand and gravel, fissured (TILL)		3	2" DO	34			
				4	2" DO	35			
10		END OF BOREHOLE	85.2 10.0						
15									
20									
25									
30									
35									



LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: K.B.

CHECKED:

PROJECT: 991-4228

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 19, 1999

DATUM: GEODETIC

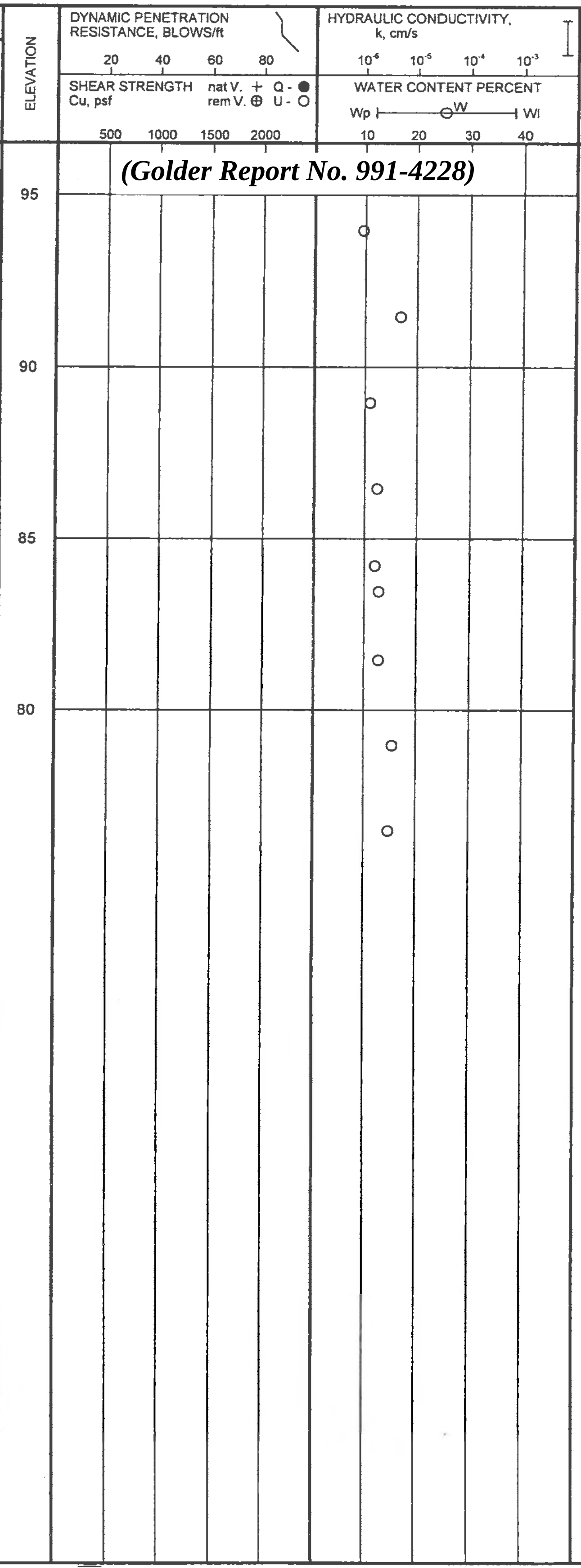
SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

Boring method: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft
GROUND SURFACE	95.7			
Topsoil, granular and ballast (FILL)	0.0			
Stiff dark brown to black silty clay, some sand and gravel, trace organics, occ. slag fragments (FILL)	94.7 1.0	1	2" DO	12
Stifff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)	92.7 3.0	2	2" DO	11
Very stiff to hard brown SILTY CLAY, some sand and gravel, fissured (TILL)	90.2 5.5	3 4 5	2" DO 2" DO 2" DO	29 39 37
Hard to stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	83.7 12.0	6 7 8	2" DO 2" DO 2" DO	19 10 14
END OF BOREHOLE	75.7 20.0			



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on October 19, 1999

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: K.B.
CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastrolanni

PROJECT: 991-4228

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5lb; DROP, 760in

RECORD OF BOREHOLE 8

BORING DATE: October 19, 1999

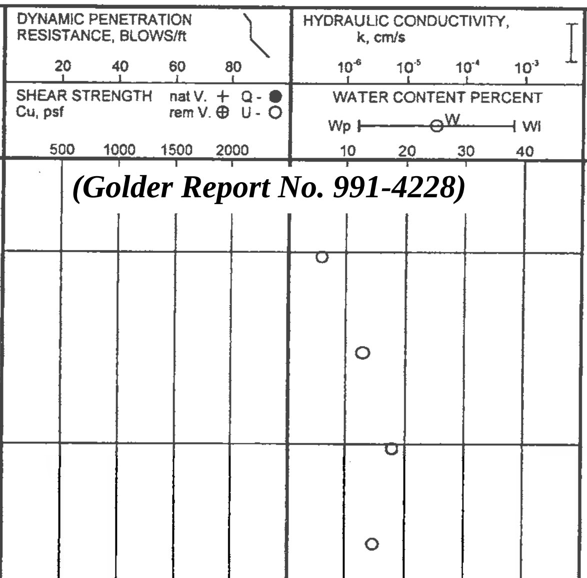
SHEET 1 OF 1

DATUM: GEODETIC

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ft	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		96.6					
	POWER AUGER SOLID STEM	Topsoil intermixed with granular (FILL)	▩	0.0					∇
		Dense to loose brown granular (FILL)	▩	95.6 1.0	1 2	2" DO 2" DO	34 5	95	Considerable water seepage into borehole encountered from about elevation 95.5 ft. during drilling on October 19, 1999
5	HOLLOW STEM	Stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)		91.1 5.5	3	2" DO	11	90	
		Very stiff brown SILTY CLAY, some sand and gravel (TILL)		88.6 8.0	4	2" DO	28		
10		END OF BOREHOLE		86.6 10.0					



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: K.B.

CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

PROJECT: 991-4228

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 19, 1999

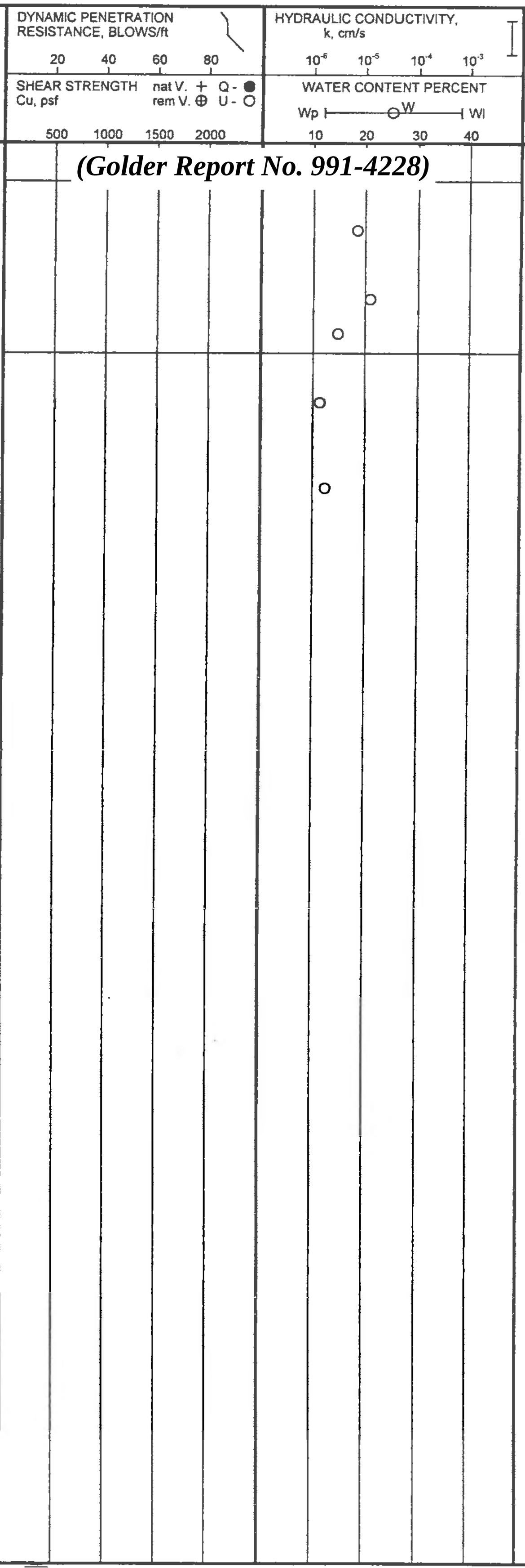
DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ft	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		95.3						
	POWER AUGER SOLID STEM	Stiff black clayey topsoil (FILL)		0.0				95		
		Stiff brown silty clay, some topsoil intermixing (FILL)		93.8 1.5	1	2" DO	13			
		Very stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)		92.3 3.0	2	2" DO	18			Borehole dry during drilling on October 19, 1999
5		Hard brown SILTY CLAY, some sand and gravel, fissured (TILL)		89.8 5.5	3	2" DO	35	90		
					4	2" DO	38			
10		END OF BOREHOLE		85.3 10.0						
15										
20										
25										
30										
35										



DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: K.B.

CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

PROJECT: 991-4228

RECORD OF BOREHOLE 10

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 19, 1999

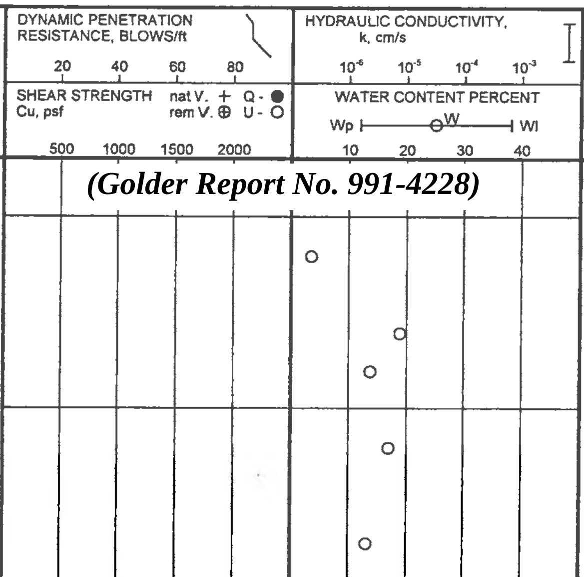
DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	95.7 0.0				95	
	POWER AUGER SOLID STEM	Loose to compact grey silty sand, occ. pieces of asphalt (FILL)	92.7 3.0	1	2" DO	10		
5		Stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)	90.2 5.5	2	2" DO	11	90	Borehole dry during drilling on October 19, 1999
		Very stiff to hard brown SILTY CLAY, some sand and gravel, fissured (TILL)	85.7 10.0	3	2" DO	23		
				4	2" DO	49		
10		END OF BOREHOLE						



ADDITIONAL LAB. TESTING

15

20

25

30

35

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: K.B.

CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

PROJECT: 991-4228

RECORD OF BOREHOLE 11

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 19, 1999

DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

BORING METHOD: POWER AUGER, SOLID STEM

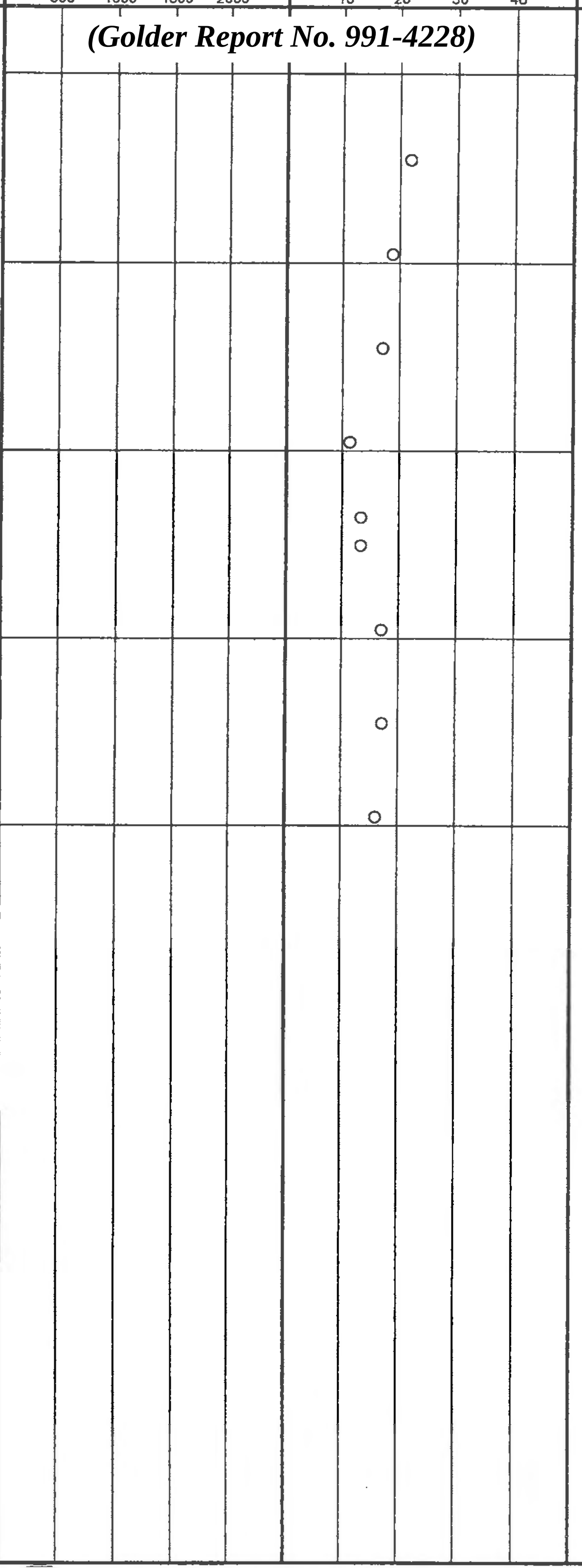
DESCRIPTION	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS/ft
GROUND SURFACE	96.0 0.0			
Black topsoil, some granular, occ. cobbles (FILL)	93.5 2.5	1	2" DO	>12
Firm to stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)	89.0 7.0	2 3	2" DO 2" DO	8 8
Very stiff to hard brown SILTY CLAY, some sand and gravel, occ. silt parting fissured (TILL)	83.0 13.0	4 5	2" DO 2" DO	17 36
Hard to stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	74.5 21.5	6 7 8 9	2" DO 2" DO 2" DO 2" DO	32 16 14 10
END OF BOREHOLE				

DYNAMIC PENETRATION RESISTANCE, BLOWS/ft: 20 40 60 80

SHEAR STRENGTH Cu, psf: nat V. + Q - ● rem V. ⊕ U - ○ 500 1000 1500 2000

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Water seepage into borehole encountered from about elevation 93.5 ft. during drilling on October 19, 1999

DEPTH SCALE 1 inch to 5 feet

LOGGED: K.B.

CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

PROJECT: 991-4228

RECORD OF BOREHOLE 12

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 19, 1999

DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

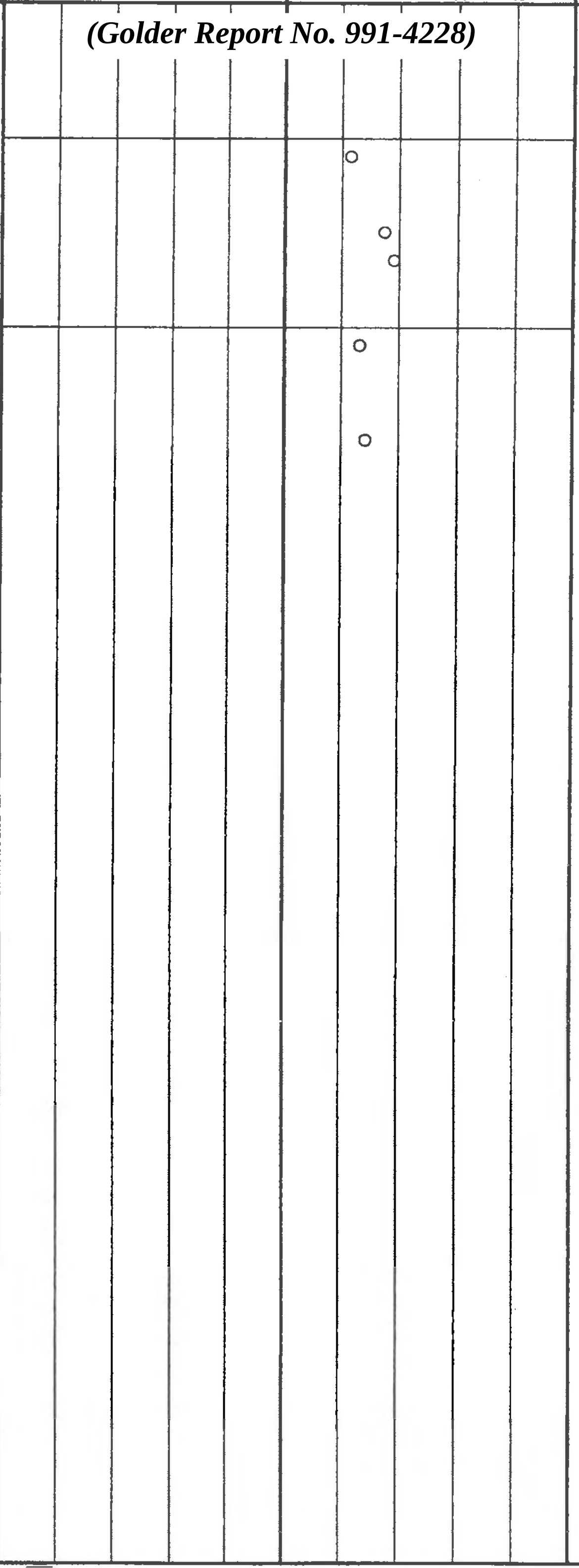
DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	97.8 0.0				
		Compact grey and brown granular and concrete rubble mixed with asphalt and clay (FILL)	93.8 4.0	1	2" DO	16	Borehole dry during drilling on October 19, 1999
5		Stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)	92.3 5.5	2	2" DO	13	
		Stiff to hard brown SILTY CLAY, some sand and gravel, fissured (TILL)	86.8	3	2" DO	35	
10				4	2" DO	24	
		Very stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	86.3 11.5				
		END OF BOREHOLE					

DYNAMIC PENETRATION RESISTANCE, BLOWS/ft 20 40 60 80 — SHEAR STRENGTH Cu, psf nat V. + Q - ● rem V. ⊕ U - ○ 500 1000 1500 2000

HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} — WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

(Golder Report No. 991-4228)



DEPTH SCALE 15 20 25 30 35

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: K.B.
CHECKED:

PROJECT: 991-4228

RECORD OF BOREHOLE 13

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 20, 1999

DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

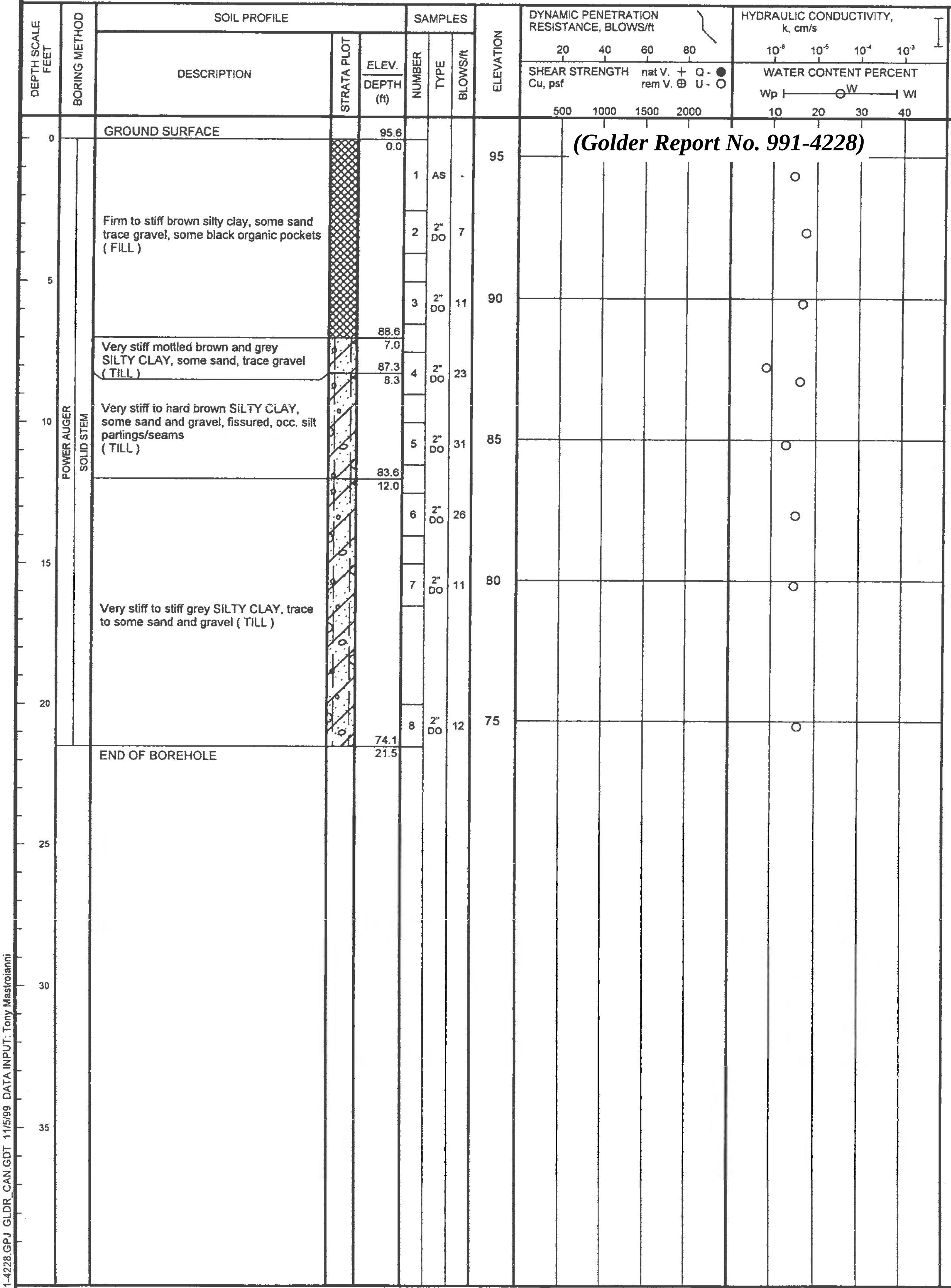
PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 991-4228)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (ft)
GROUND SURFACE	95.6 0.0
Firm to stiff brown silty clay, some sand trace gravel, some black organic pockets (FILL)	88.6 7.0
Very stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)	87.3 8.3
Very stiff to hard brown SILTY CLAY, some sand and gravel, fissured, occ. silt partings/seams (TILL)	83.6 12.0
Very stiff to stiff grey SILTY CLAY, trace to some sand and gravel (TILL)	74.1 21.5
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/ft
1	AS	-
2	2" DO	7
3	2" DO	11
4	2" DO	23
5	2" DO	31
6	2" DO	26
7	2" DO	11
8	2" DO	12



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on October 20, 1999

DEPTH SCALE
1 inch to 5 feet

LOGGED: K.B.
CHECKED:

LDN_BHS 991-4228.GPJ GLDR_CAN.GDT 11/5/99 DATA INPUT: Tony Mastroianni

PROJECT: 991-4228

RECORD OF BOREHOLE 14

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: October 19, 1999

DATUM: GEODETIC

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ft	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE		99.0 0.0						
		Dense brown granular base, occ. pieces of asphalt (FILL)		96.8 2.3	1	2" DO	48			
5		Dense to compact brown sand and gravel, trace silt, occ. clayey inclusions (FILL)		93.5 5.5	2	2" DO	13	95		Borehole dry during drilling on October 18, 1999
		Stiff to very stiff mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)		89.0 10.0	3	2" DO	9			
					4	2" DO	22	90		
10		END OF BOREHOLE								

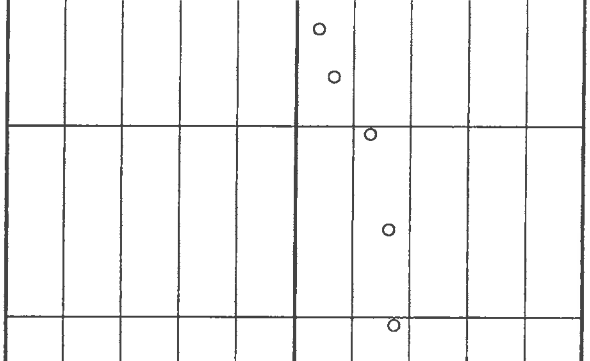
DYNAMIC PENETRATION RESISTANCE, BLOWS/ft: 20 40 60 80

SHEAR STRENGTH Cu, psf: nat V. + Q - ● rem V. ⊕ U - ○ 500 1000 1500 2000

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

(Golder Report No. 991-4228)



DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: K.B.
CHECKED:

PROJECT: 001-4112

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

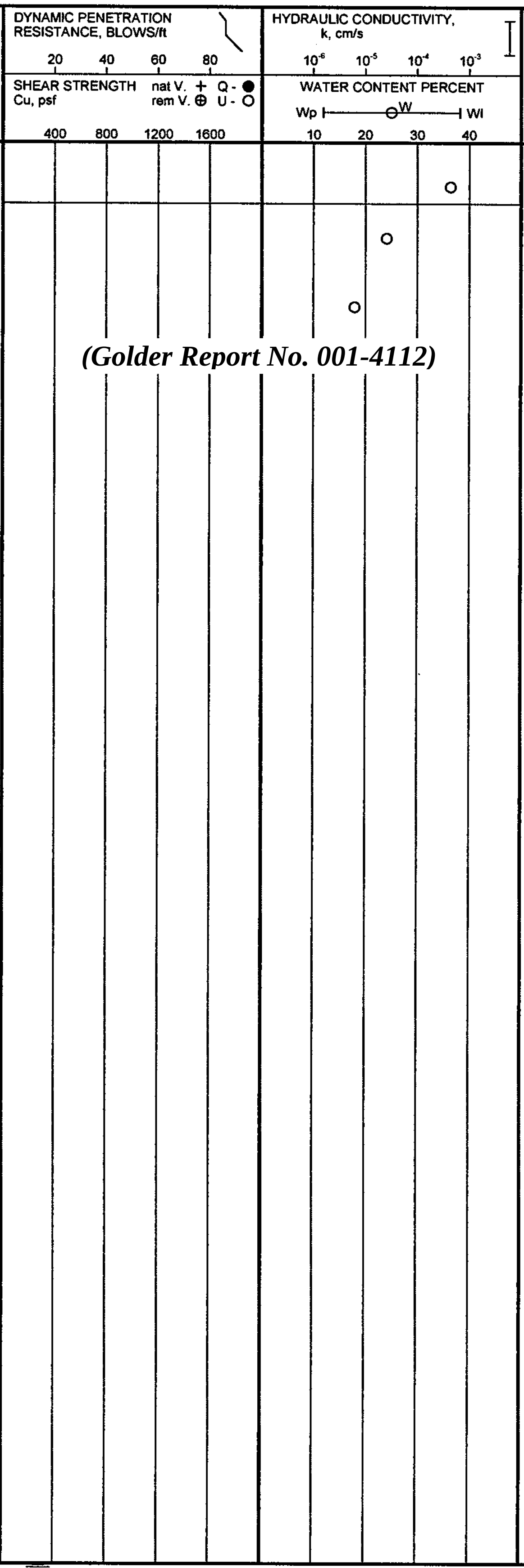
BORING DATE: APRIL 27, 2000

DATUM: LOCAL

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		96.0						
	POWER AUGER HOLLOW STEM	Brown clay TOPSOIL		95.3 0.7	1	AS		95		
		Stiff, mottled brown and grey SILTY CLAY with some sand, trace gravel (TILL)			2	2" DO	8			Borehole dry during drilling on April 27, 2000
					3	2" DO	13			
5		END OF BOREHOLE		91.0 5.0						
10										
15										
20										
25										
30										
35										



(Golder Report No. 001-4112)

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: CC.

CHECKED: YL

PROJECT: 001-4112

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

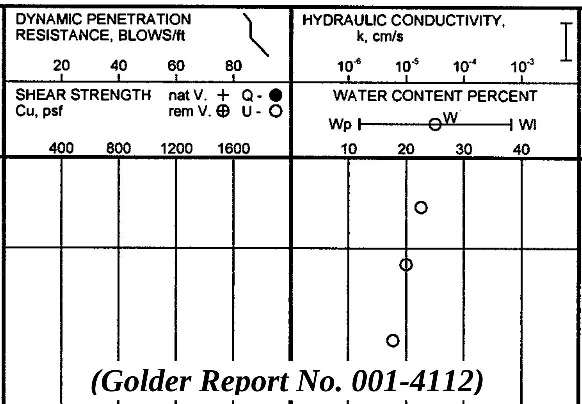
BORING DATE: APRIL 27, 2000

DATUM: LOCAL

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE		ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		96.6						
	POWER AUGER HOLLOW STEM	Brown clay TOPSOIL		0.0 95.7	1	AS				
		Stiff to very stiff, mottled brown and grey SILTY CLAY with some sand, trace gravel occasional silt pockets fissured (TILL)		0.8	2	2" DO	8	95		Borehole dry during drilling on April 27, 2000
					3	2" DO	25			
5		END OF BOREHOLE		91.6 5.0						
10										
15										
20										
25										
30										
35										



(Golder Report No. 001-4112)

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: C.C.

CHECKED:

LDN_BHS 001-4112.GPJ GLDR_CAN.GDT 5/15/00 DATA INPUT: Mary Napier

PROJECT: 001-4112

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: APRIL 27, 2000

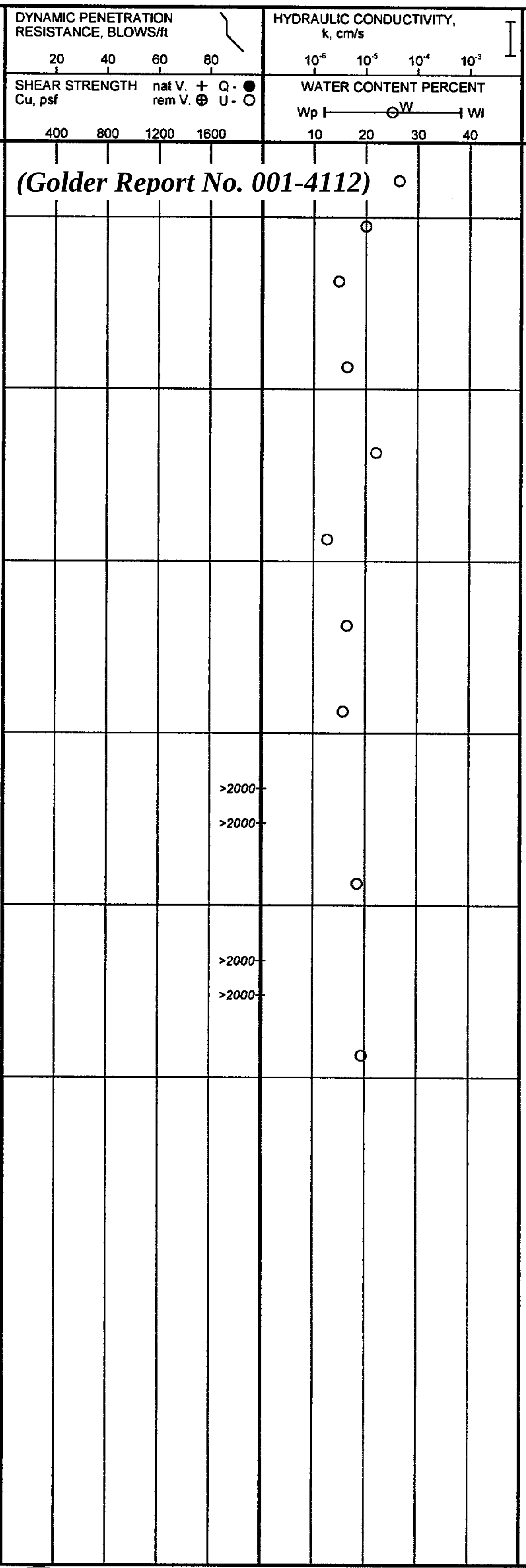
DATUM: LOCAL

SAMPLER HAMMER, 63.5lb; DROP, 760in

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 001-4112)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/ft	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER HOLLOW STEM	GROUND SURFACE	96.4					
		Soft, brown clayey TOPSOIL	95.6 0.8	1	2" DO	4	95	
5		Stiff to very stiff, mottled brown and grey SILTY CLAY with some sand, trace gravel, fissured (TILL)	89.9 6.5	2 3	2" DO 2" DO	17 16	90	
		Compact, brown SILT trace to some clay	87.4 9.0	4	2" DO	27		Borehole dry during drilling on April 27, 2000
10		Very stiff, brown SILTY CLAY with some sand, trace gravel, fissured, oxidized (TILL)	82.4 14.0	5 6	2" DO 2" DO	28 18	85	
15 20 25		Very stiff brown to grey SILTY CLAY with some sand, trace gravel (TILL)	69.9 26.5	7 8 9	2" DO 2" DO 2" DO	11 9 9	80 75 70	
30 35		END OF BOREHOLE						



ADDITIONAL LAB. TESTING

LDN_BHS 001-4112.GPJ GLDR_CAN.GDT 5/15/00 DATA INPUT: Mary Napier

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: C.C.
CHECKED:

PROJECT: 001-4112

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5lb; DROP, 760in

RECORD OF BOREHOLE 4

BORING DATE: APRIL 27, 2000

SHEET 1 OF 1

DATUM: LOCAL

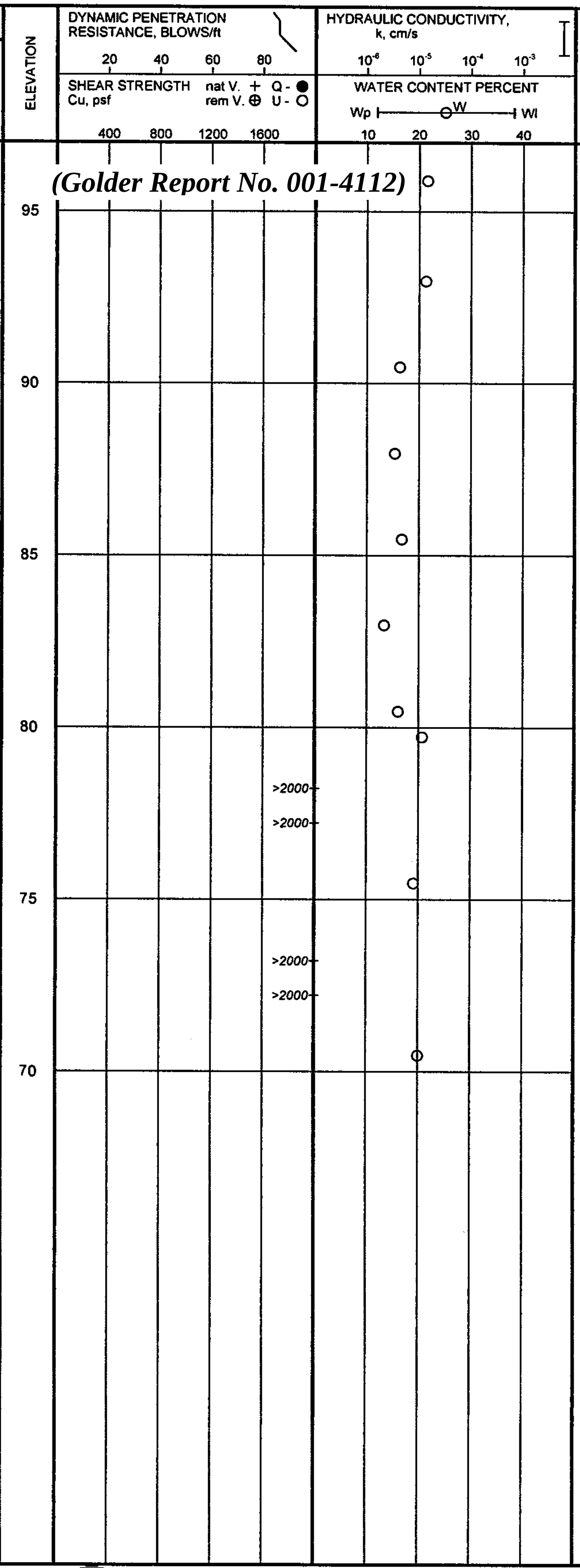
PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 001-4112)

BORING METHOD: POWER AUGER, HOLLOW STEM

DESCRIPTION	ELEV. DEPTH (ft)
GROUND SURFACE	96.2
Brown clayey TOPSOIL	95.5 0.8
Soft to very stiff, mottled brown and grey SILTY CLAY with some sand, trace gravel, occasional silt pockets (TILL)	89.7 6.5
Very stiff, brown SILTY CLAY with some sand, trace gravel, fissured, oxidized (TILL)	82.2 14.0
Firm to very stiff, grey SILTY CLAY with some sand, trace gravel (TILL)	69.7 26.5
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/ft
1	2" DO	4
2	2" DO	6
3	2" DO	14
4	2" DO	24
5	2" DO	22
6	2" DO	18
7	2" DO	11
8	2" DO	10
9	2" DO	7



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on April 27, 2000

DEPTH SCALE 1 inch to 5 feet

LOGGED: C.C.

CHECKED:

LDN_BHS 001-4112.GPJ GLDR_CAN.GDT 5/15/00 DATA INPUT: Mary Napier

PROJECT: 001-4112

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5lb; DROP, 760in

RECORD OF BOREHOLE 5

BORING DATE: APRIL 27, 2000

SHEET 1 OF 1

DATUM: LOCAL

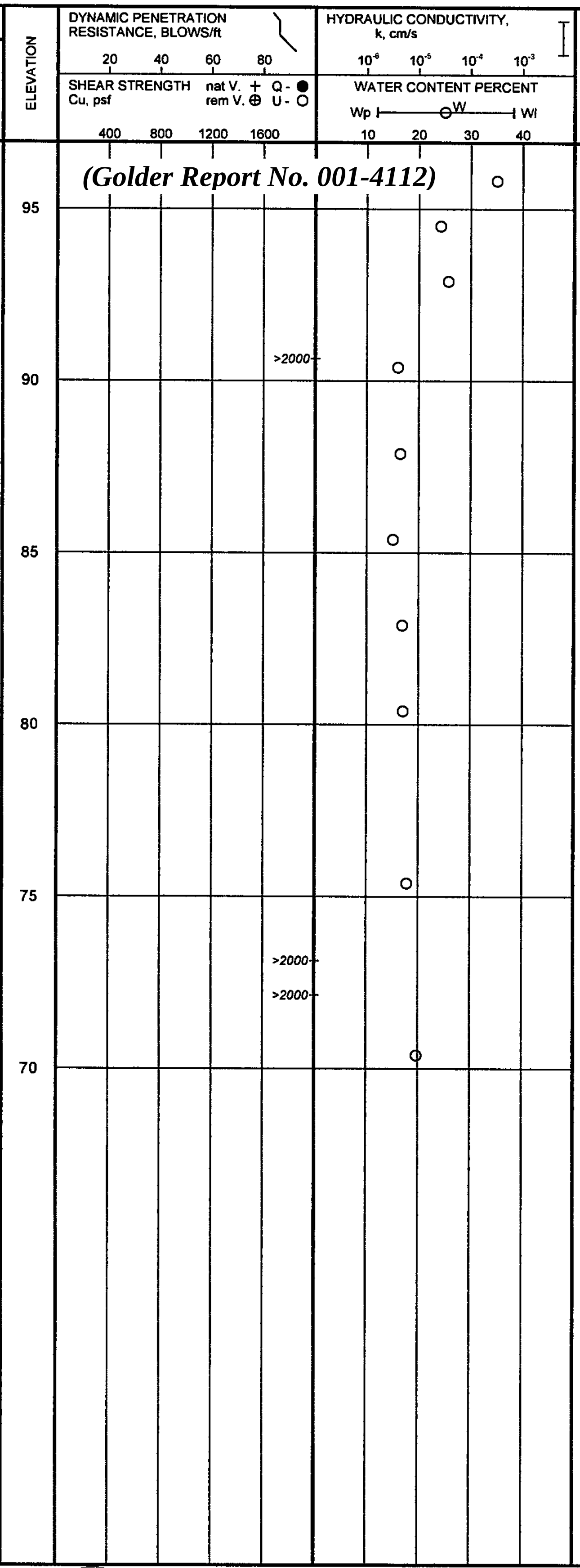
PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 001-4112)

BORING METHOD: POWER AUGER HOLLOW STEM (0 to 26.5 ft)

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ft
GROUND SURFACE	96.1			
Brown clayey TOPSOIL	95.4 0.7			
Soft, motttled brown and grey SILTY CLAY with some sand, trace gravel, occasional silt pockets (TILL)		1	2" DO	4
		2	2" DO	5
	89.6 6.5	3	2" DO	15
Very sitff, brown SILTY CLAY with some sand, trace gravel, fissured, oxidized (TILL)		4	2" DO	19
		5	2" DO	22
	82.1 14.0	6	2" DO	16
Stiff to very stiff, brown SILTY CLAY with some sand, trace gravel (TILL)		7	2" DO	12
		8	2" DO	7
	69.6 26.5	9	2" DO	8
END OF BOREHOLE				



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

▽

Water seepage into borehole encountered at elevation 5.0 ft. during drilling on April 27, 2000

DEPTH SCALE

1 inch to 5 feet

LOGGED: C.C.

CHECKED:

PROJECT: 001-4112

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5lb; DROP, 760in

RECORD OF BOREHOLE 6

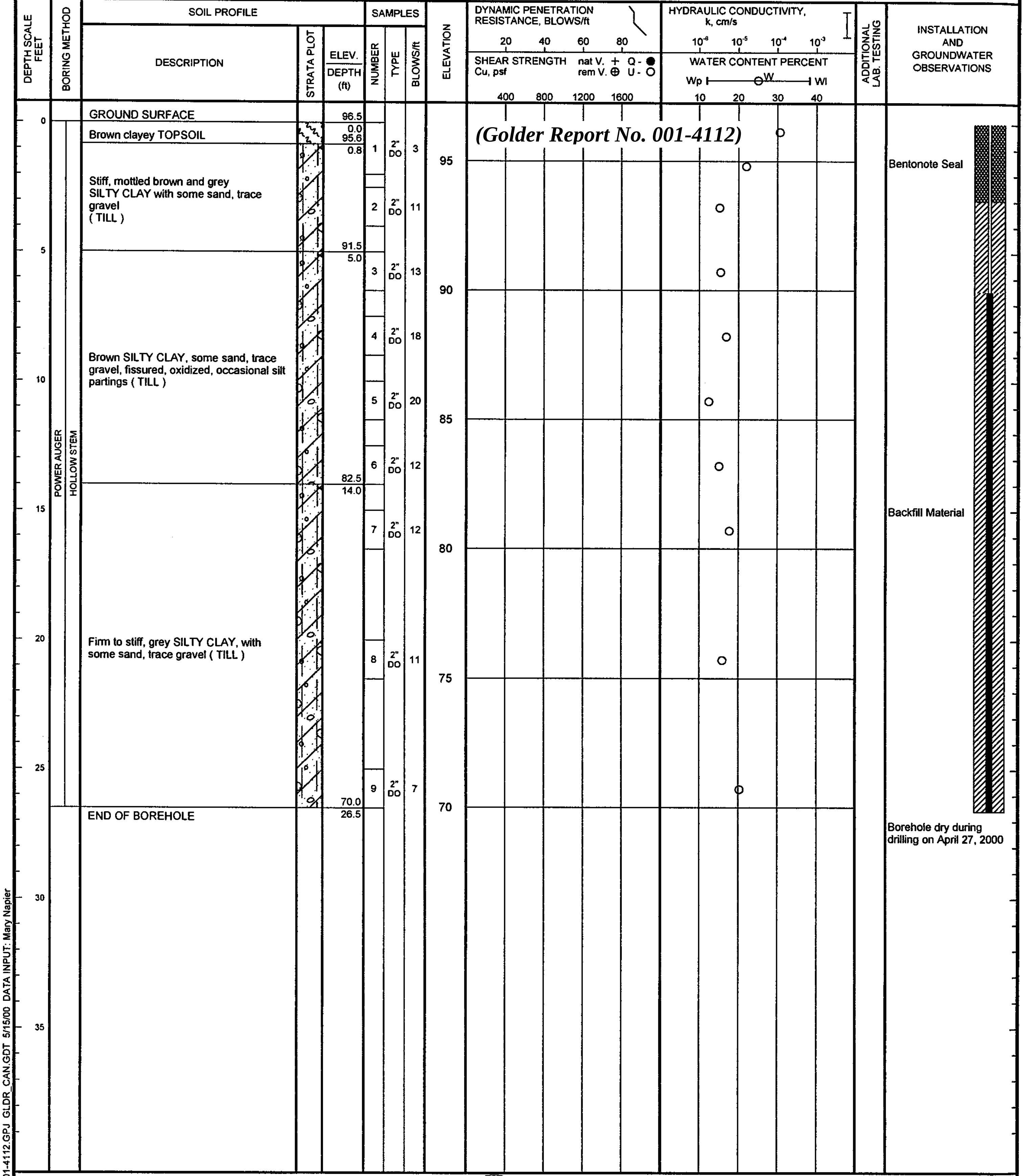
BORING DATE: APRIL 27, 2000

SHEET 1 OF 1

DATUM: LOCAL

PENETRATION TEST HAMMER, 63.5lb; DROP, 760in

(Golder Report No. 001-4112)



DEPTH SCALE FEET	BORING METHOD	DESCRIPTION	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS/ft
0	POWER AUGER HOLLOW STEM	GROUND SURFACE	96.5			
		Brown clayey TOPSOIL	0.0 95.6 0.8	1	2" DO	3
		Stiff, mottled brown and grey SILTY CLAY with some sand, trace gravel (TILL)		2	2" DO	11
5			91.5 5.0	3	2" DO	13
		Brown SILTY CLAY, some sand, trace gravel, fissured, oxidized, occasional silt partings (TILL)		4	2" DO	18
10				5	2" DO	20
				6	2" DO	12
15			82.5 14.0	7	2" DO	12
20		Firm to stiff, grey SILTY CLAY, with some sand, trace gravel (TILL)		8	2" DO	11
25				9	2" DO	7
		END OF BOREHOLE	70.0 26.5			
30						
35						

Borehole dry during drilling on April 27, 2000

LDN_BHS 001-4112.GPJ GLDR_CAN.GDT 5/15/00 DATA INPUT: Mary Napier

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: CC

CHECKED:

PROJECT: 001-4195

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 20, 2000

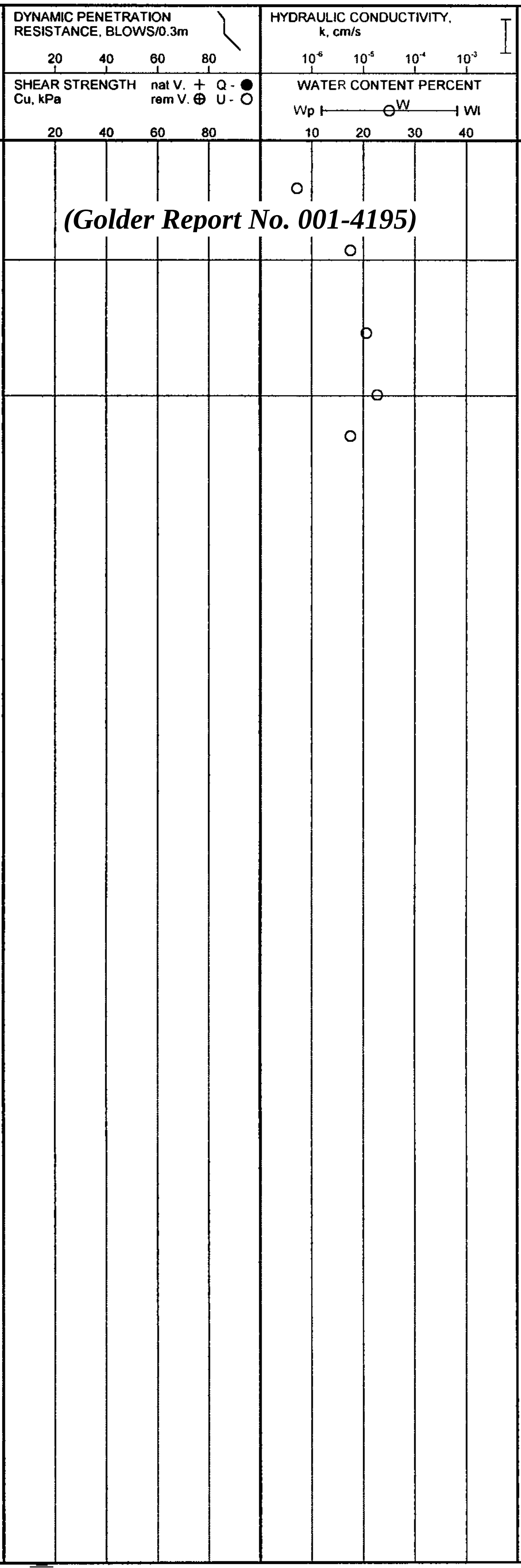
DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		190.68						
0	POWER AUGER SOLID STEM	Crushed granular (FILL)	▩	0.00 190.38	1	AS	-			
		Stiff, mottled brown and grey clayey silt, some sand, occ. gravel, trace topsoil (FILL)	▩	0.30 189.77	2	50 DO	8	190		Borehole remained dry during drilling on July 20, 2000
1		Firm to stiff, mottled brown to greenish grey clayey silt, some sand, occ. gravel, black organic silt pockets (FILL)	▩	0.91 188.85	3	50 DO	6	189		
2		Stiff, brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		1.83 188.55	4	50 DO	12			
		END OF BOREHOLE		2.13						
3										
4										
5										
6										
7										
8										
9										
10										

(Golder Report No. 001-4195)



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.P.

CHECKED:

LDN_BHS 001-4195.GPJ GLDR_CAN.GDT 8/14/00 DATA INPUT: M. Napier

PROJECT: 001-4195

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 2

BORING DATE: JULY 20, 2000

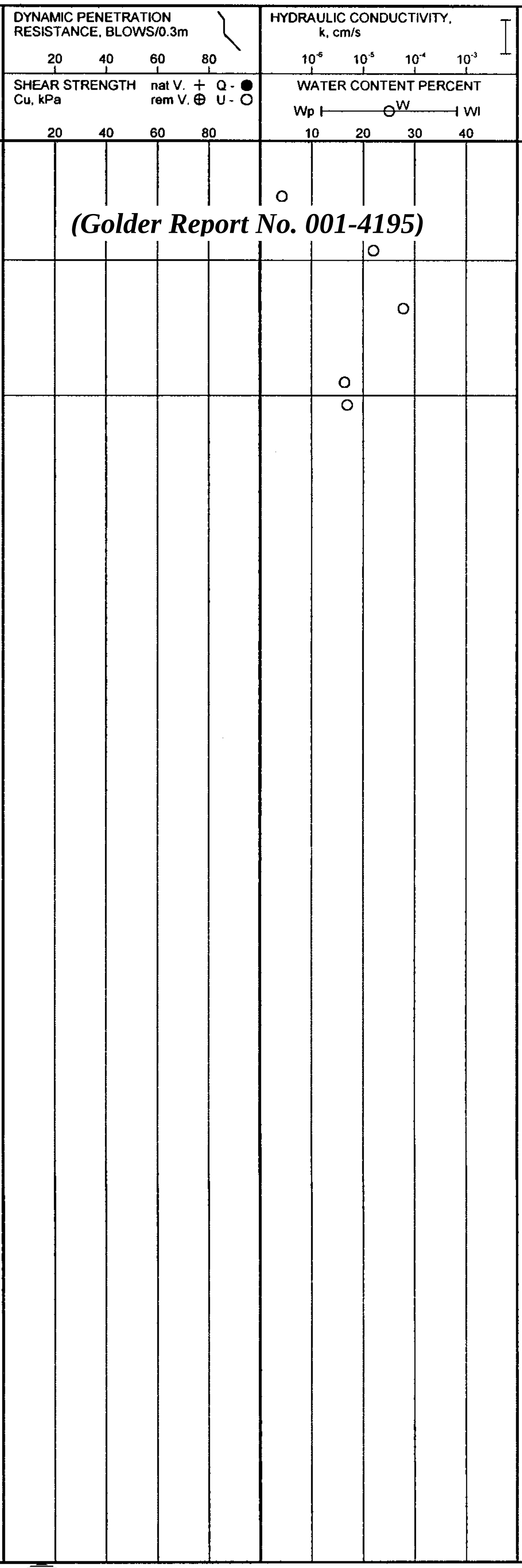
SHEET 1 OF 1

DATUM: LOCAL

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4195)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SURFACE		190.68						
	POWER AUGER SOLID STEM	ASPHALT	■	190.57						
		Crushed granular, some sand and gravel (FILL)	▨	190.38 0.30	1	AS	-			
		Stiff, mottled greenish grey to brown clayey silt, some sand, occ. gravel, black topsoil pockets (FILL)	▨	189.77 0.91	2	50 DO	9	190		Borehole remained dry during drilling on July 20, 2000
1		Soft, black silt, some organics, some sand, occ. gravel, trace clay (FILL)	▨	189.21 1.47	3	50 DO	4			
		Firm to stiff, brown and grey SILTY CLAY, some sand, occ. gravel (TILL)		188.70 1.98	4	50 DO	13	189		
2		END OF BOREHOLE								
3										
4										
5										
6										
7										
8										
9										
10										



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.P.

CHECKED:

LDN_BHS 001-4195.GPJ GLDR_CAN.GDT 8/14/00 DATA INPUT: M. Napier

PROJECT: 001-4195

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

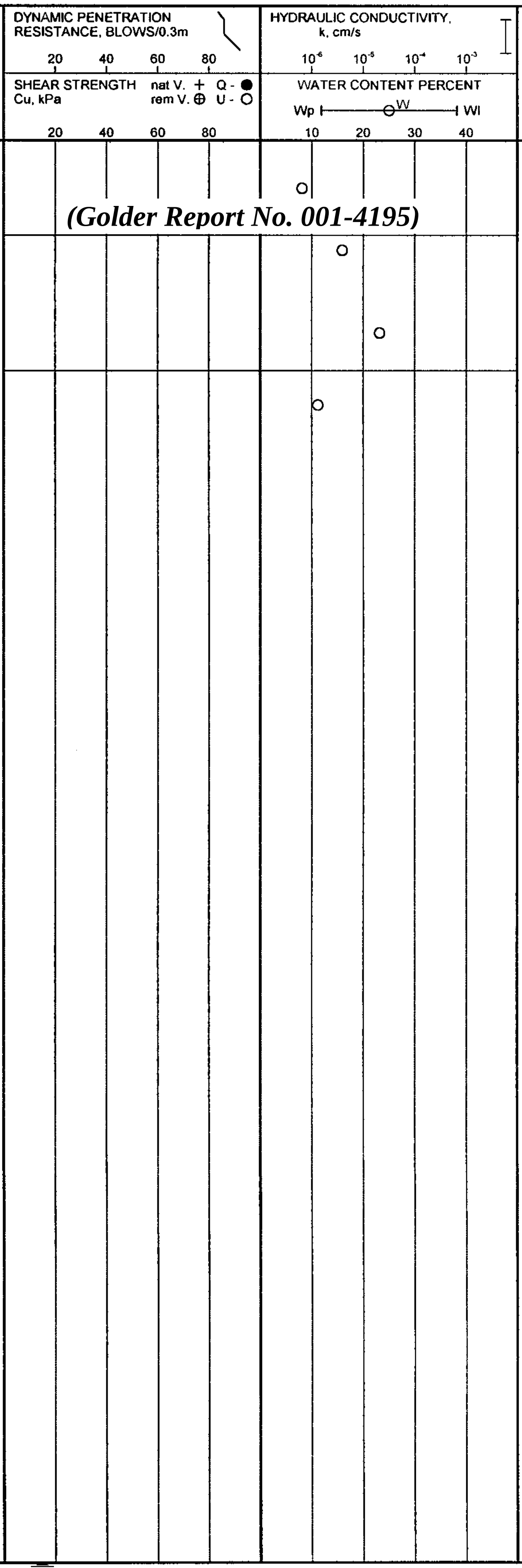
BORING DATE: JULY 20, 2000

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		190.50						
	POWER AUGER SOLID STEM	Crushed granular (FILL)	▨	0.00 190.20 0.30	1	AS	-			
1		Stiff to soft, mottled greenish grey and brown clayey silt, some sand, occ. gravel, black clayey organic pockets, roots (FILL)	▨		2	50 DO	9	190		Borehole remained dry during drilling on July 20, 2000
					3	50 DO	4	189		
				188.67	4	50 DO	17			
2		Compact, brown medium to fine SILTY SAND, some clayey silt pockets, occ. gravel		188.52 1.98						
		END OF BOREHOLE								
3										
4										
5										
6										
7										
8										
9										
10										



(Golder Report No. 001-4195)

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.P.
CHECKED:

LDN_BHS 001-4195.GPJ GLDR_CAN.GDT 8/14/00 DATA INPUT: M. Napier

PROJECT: 001-4195

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 20, 2000

DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4195)

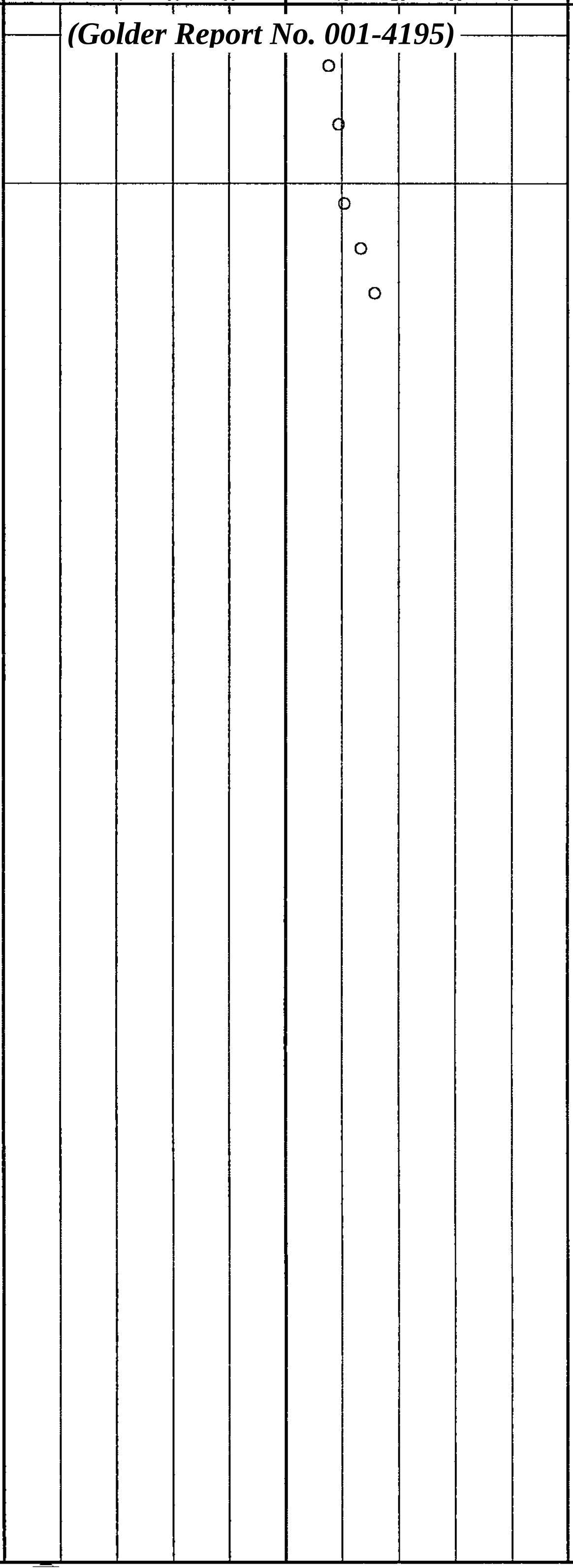
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SURFACE		191.01				191		
	POWER AUGER SOLID STEM	ASPHALT	■	190.88						
		Dark brown sand and gravel, clay tile pieces (FILL)	▨	190.70 0.30	1	AS	-			
		Stiff, brown clayey silt and sand, occ. gravel, black organics (FILL)	▨	190.09 0.91	2	50 DO	12			Borehole remained dry during drilling on July 20, 2000
1		Loose, brown coarse to medium SAND, some silt, occ. gravel, trace clay		189.64 1.37	3	50 DO	7	190		
		Firm to very stiff, mottled brown and grey to brown SILTY CLAY, some sand, sand pockets, occ. gravel (TILL)		189.03 1.98	4	50 DO	20			
2		END OF BOREHOLE								

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl: 10 20 30 40



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.P.

CHECKED:

LDN_BHS 001-4195.GPJ GLDR_CAN.GDT 8/14/00 DATA INPUT: M. Napier

PROJECT: 001-4195

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JULY 20, 2000

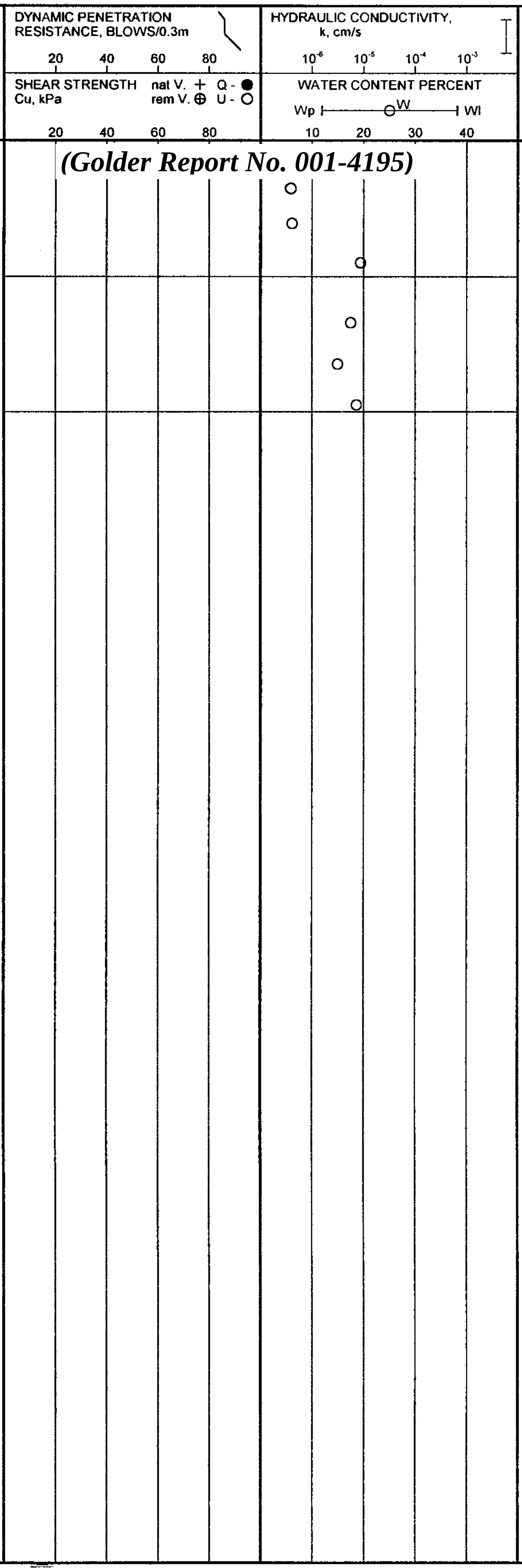
DATUM: LOCAL

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4195)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		190.80					
0	POWER AUGER SOLID STEM	Crushed granular (FILL)	▩	0.00 190.50	1	AS	-		
		Loose, brown medium sand, occ. gravel, trace silt (FILL)	▩	0.30 190.30 0.51	2	50 DO	7		Borehole remained dry during drilling on July 20, 2000
		Firm, dark brown to black clayey silt, some organics, some sand, occ. gravel (FILL)	▩	189.89				190	
1		Loose, brown and grey SILTY SAND, occ. gravel		0.91 189.43	3	50 DO	3		
		Soft to stiff, mottled brown and grey SILTY CLAY, some sand, occ. gravel, sand pockets (TILL)		1.37 188.82	4	50 DO	14	189	
2		END OF BOREHOLE		1.98					



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

LOGGED: AR

CHECKED:

LDN_BHS 001-4195.GPJ GLDR_CAN.GDT 8/14/00 DATA INPUT M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 14, 2000

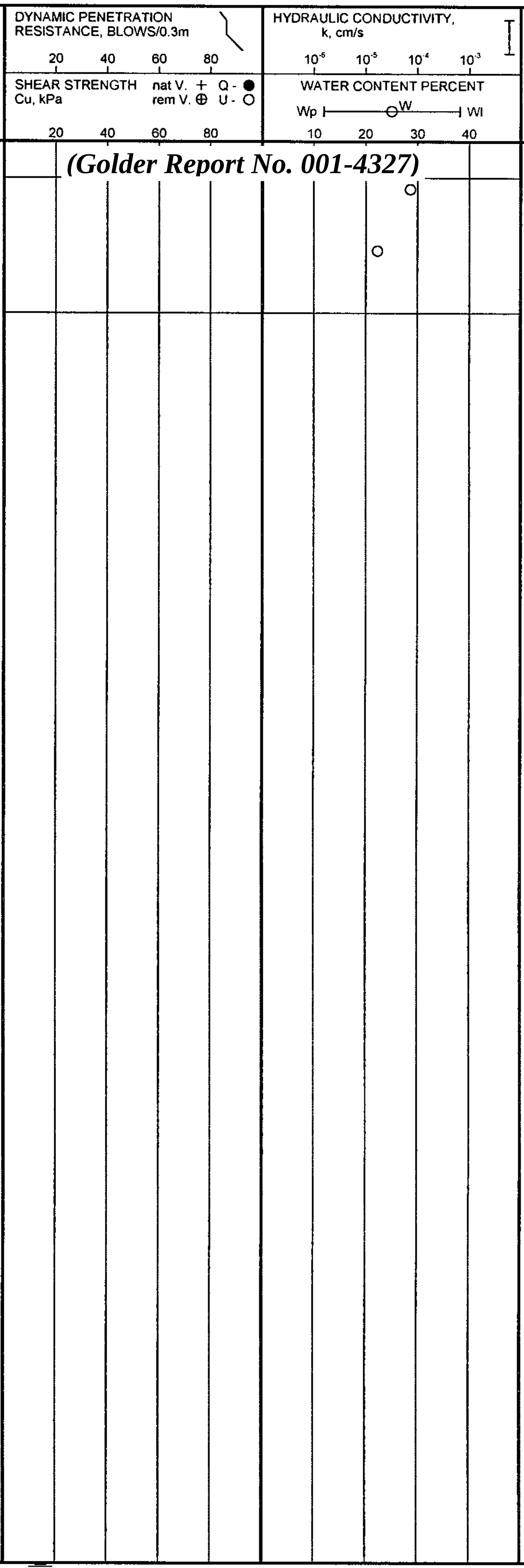
DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4327)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		99.07						
	POWER AUGER SOLID STEM	Brown clayey TOPSOIL		0.00 98.82 0.25	1	AS	-	99		
		Stiff to very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)			2	50 DO	10			∇
1				97.55 1.52	3	50 DO	27	98		Water seepage into borehole at 0.45 m. depth during drilling on December 14, 2000
		END OF BOREHOLE								
2										
3										
4										
5										
6										
7										
8										
9										
10										



LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CC

CHECKED:

PROJECT: 001-4327

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

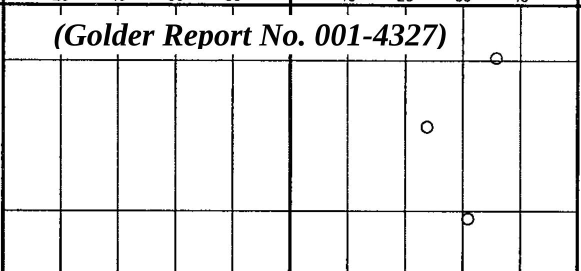
BORING DATE: DECEMBER 15, 2000

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80; SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3}; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		99.17								
	POWER AUGER SOLID STEM	Brown clayey TOPSOIL		0.00	1	AS	-	99		○		
		Stiff to very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel (TILL)		98.86 0.30	2	50 DO	14			○		Borehole remained dry during drilling on December 15, 2000
1					3	50 DO	21	98		○		
		END OF BOREHOLE		97.65 1.52								
2												
3												
4												
5												
6												
7												
8												
9												
10												



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: C.C
CHECKED:

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

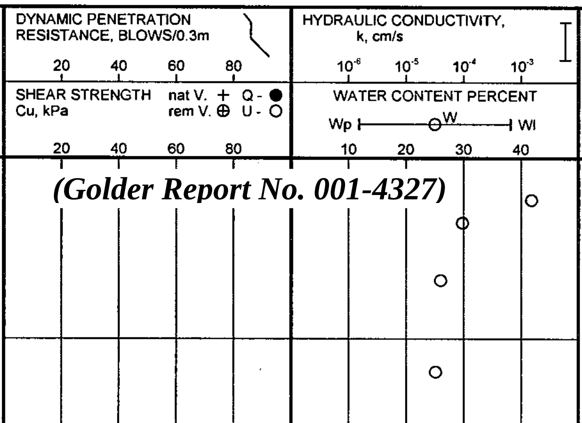
BORING DATE: DECEMBER 19, 2000

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		99.00						
	POWER AUGER SOLID STEM	Bornw heavily rooted clayey TOPSOIL		0.00	1	AS	-			
		Firm, mottled brown and grey to brown SILTY CLAY, some sand, trace gravel, fissured, occ. organic intrusions (TILL)		0.15	2	50 DO	4			Borehole remained dry during drilling on December 19, 2000
1					3	50 DO	5	98		
				97.48 1.52						
		END OF BOREHOLE								
2										
3										
4										
5										
6										
7										
8										
9										
10										



(Golder Report No. 001-4327)

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: C.C

CHECKED:

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 15, 2000

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

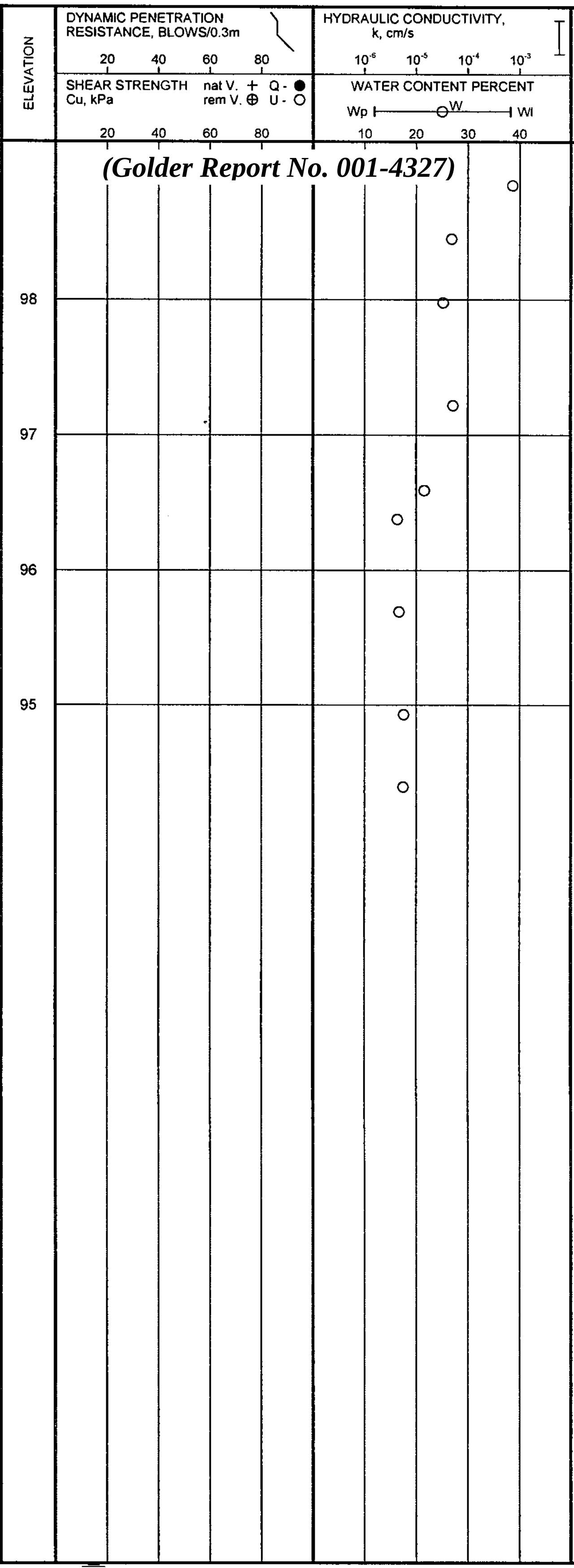
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4327)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	98.97 0.00
Brown clayey TOPSOIL	98.63 0.34
Stiff to very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel, fissured (TILL)	96.38 2.59
Very stiff, brown SILTY CLAY, some sand, trace gravel, fissured, oxidized (TILL)	95.46 3.51
Very stiff, grey SILTY CLAY, some sand, trace gravel (TILL)	94.09 4.88
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	50 DO	11
3	50 DO	12
4	50 DO	25
5	50 DO	28
6	50 DO	18
7	50 DO	21



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole remained dry during drilling on December 15, 2000

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: C.C.

CHECKED:

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 14, 2000

DATUM:

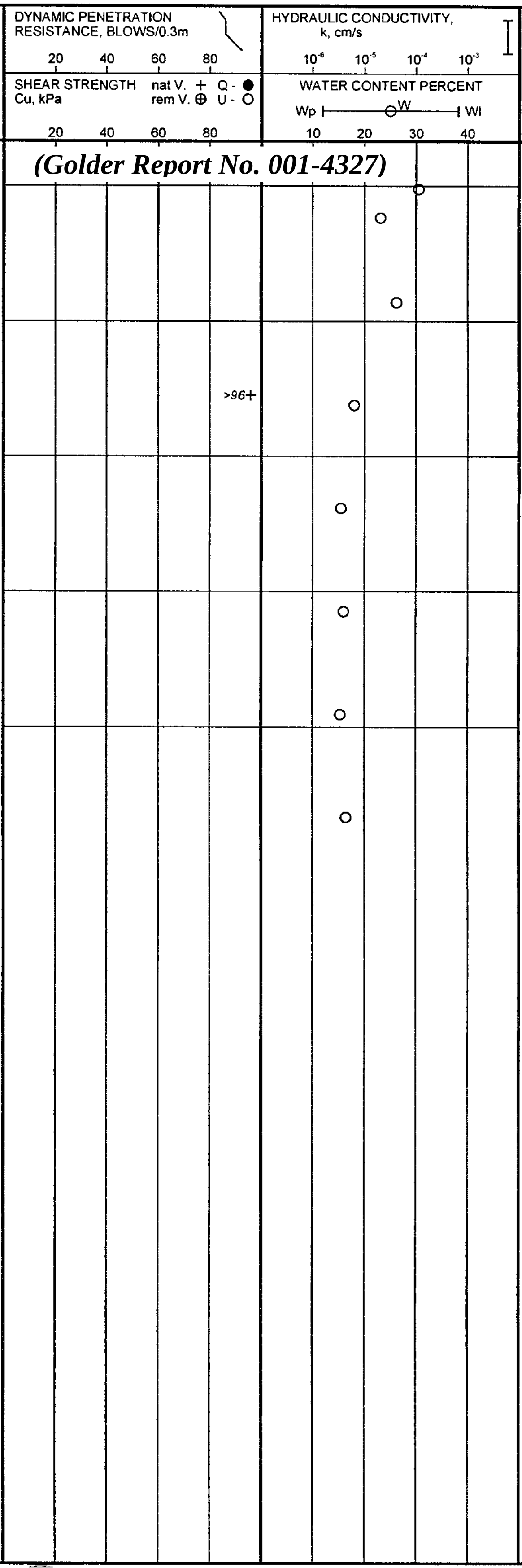
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4327)

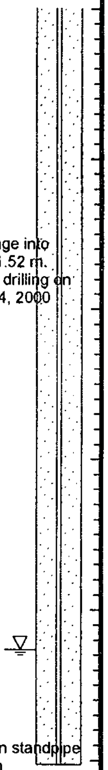
BORING METHOD: POWER AUGER, HOLLOW STEM

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
0	GROUND SURFACE	99.13				
	Stiff, mottled brown and grey silty clay (FILL)	0.00				
	Stiff, brown clayey TOPSOIL	0.15 98.77 0.36	1	50 DO	11	99
1	Stiff to very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel, fissured (TILL)		2	50 DO	10	98
		97.15 1.98	3	50 DO	11	
2	Very stiff to hard, brown SILTY CLAY, some sand, trace gravel, fisssured (TILL)		4	50 DO	37	97
3		95.32 3.81	5	50 DO	27	96
4	Very stiff, grey SILTY CLAY, some sand, trace gravel, fissured (TILL)		6	50 DO	14	95
			7	50 DO	9	
5	END OF BOREHOLE	94.10 5.03				
6						
7						
8						
9						
10						



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS



Water seepage into borehole at 1.52 m. depth during drilling on December 14, 2000

Water level in standpipe at 4.26 m. on December 18, 2000

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: C.C.
CHECKED: Q

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 14, 2000

DATUM:

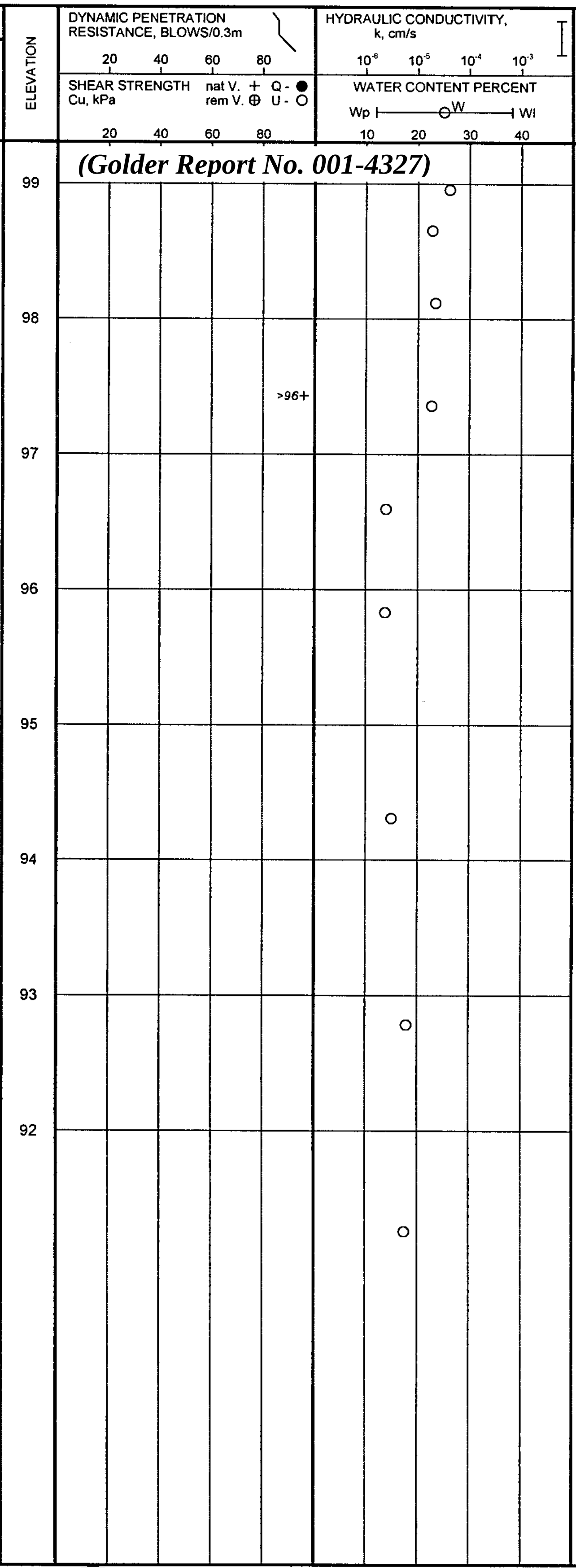
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

BORING METHOD: POWER AUGER HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	99.11 0.00
Stiff, brown clayey TOPSOIL	98.83 0.28
Stiff to very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel, occ. silt and sand pockets, fissured, rootlets (TILL)	97.13 1.98
Hard, brown SILTY CLAY, some sand, trace gravel, fissured, oxidized (TILL)	95.60 3.51
Stiff to very stiff, grey SILTY CLAY, some sand, trace gravel (TILL)	91.03 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	
1	50 DO	11
2	50 DO	9
3	50 DO	12
4	50 DO	35
5	50 DO	34
6	50 DO	18
7	50 DO	12
8	50 DO	11
9	50 DO	17



(Golder Report No. 001-4327)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole remained dry during drilling on December 14, 2000

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: C.C.
CHECKED:

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 15, 2000

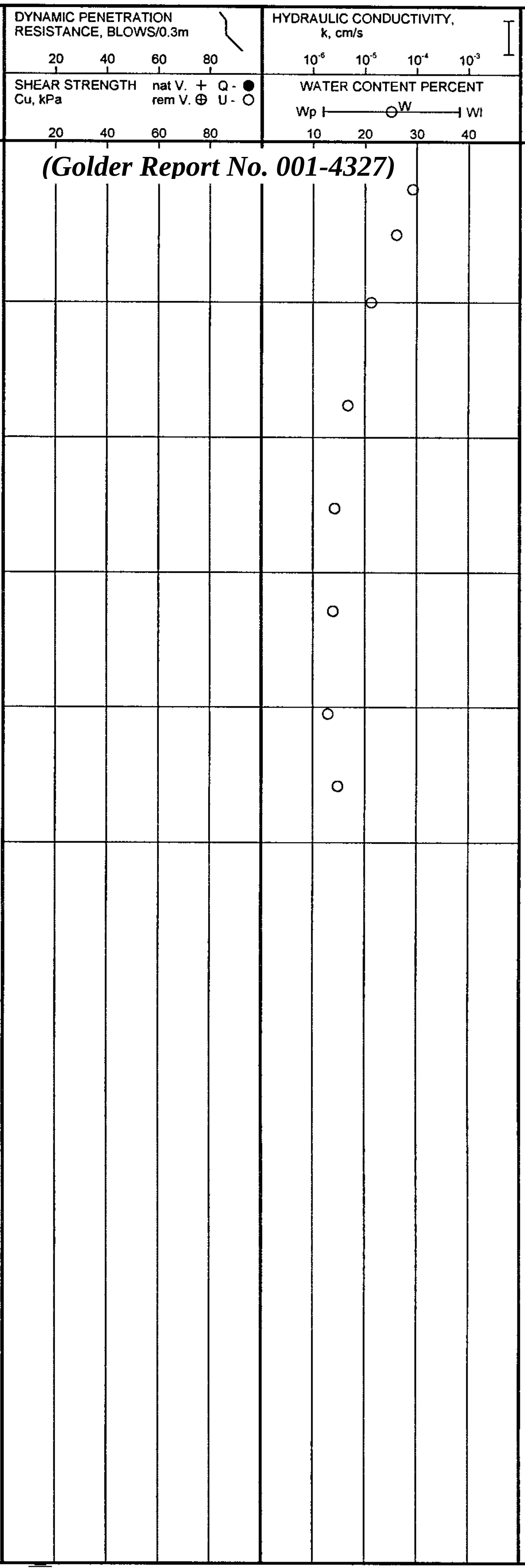
DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4327)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE		ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	98.99					
	POWER AUGER SOLID STEM	Brown clayey TOPSOIL	0.00					
		Stiff to very stiff, brown and grey SILTY CLAY, some sand, trace gravel, fissured (TILL)	98.69 0.30	1	AS	-		
1				2	50 DO	14	98	
				3	50 DO	17		Borehole remained dry during drilling on December 14, 2000
2		Hard, brown SILTY CLAY, some sand, trace gravel, fissured, oxidized (TILL)	97.01 1.98				97	
				4	50 DO	39		
3				5	50 DO	46	96	
		Very stiff to hard, grey SILTY CLAY, some sand, trace gravel (TILL)	95.33 3.66					
4				6	50 DO	19	95	
				7	50 DO	31		
5		END OF BOREHOLE	94.11 4.88				94	
6								
7								
8								
9								
10								



ADDITIONAL LAB. TESTING

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: C.C.

CHECKED:

PROJECT: 001-4327

RECORD OF BOREHOLE 8

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 19, 2000

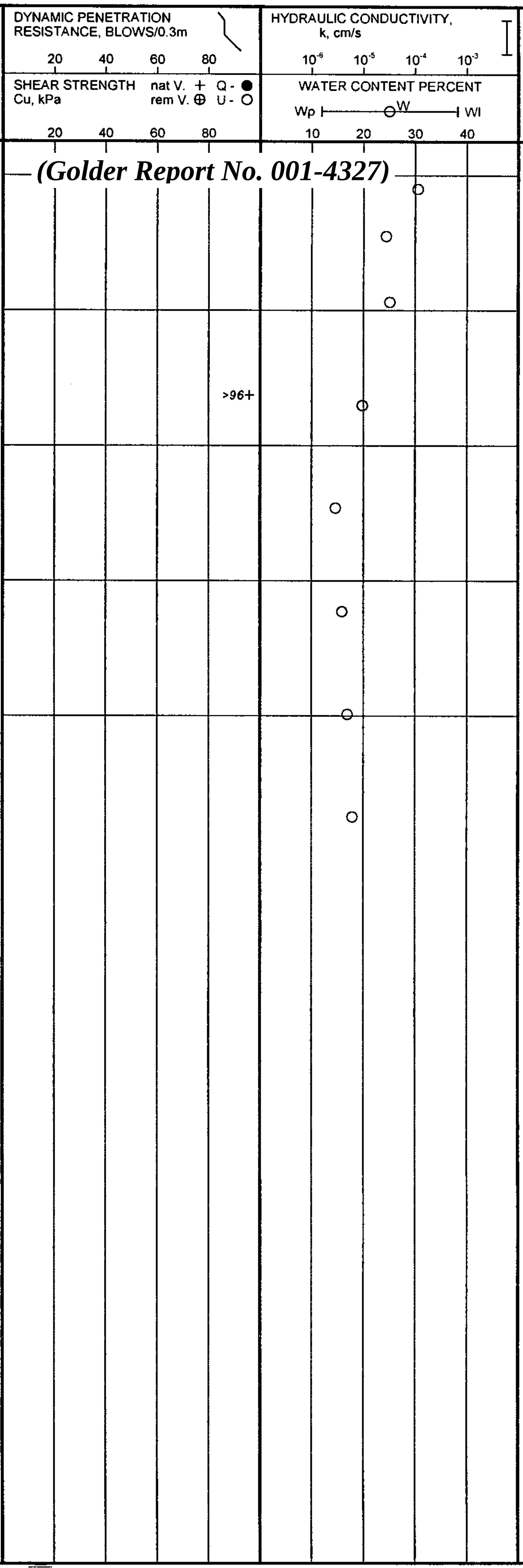
DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4327)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER HOLLOW STEM	GROUND SURFACE	99.05						
		Brown clayey TOPSOIL	0.00				99		
			98.75 0.30	1	AS	-			
1		Very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel, fissured, occ. silt pockets (TILL)		2	50 DO	10	98		
				3	50 DO	15		>96+	Borehole remained dry during drilling on December 14, 2000
2			97.07 1.98				97		
		Very stiff, brown SILTY CLAY, some sand, trace gravel (TILL)		4	50 DO	25			
3				5	50 DO	24	96		
			95.39 3.66						
4		Stiff, grey SILTY CLAY, some sand, trace gravel (TILL)		6	50 DO	11	95		
				7	50 DO	10			
5		END OF BOREHOLE	94.02 5.03						



ADDITIONAL LAB. TESTING

DEPTH SCALE 6 7 8 9 10

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: C.C.
CHECKED:

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 001-4327

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 19, 2000

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 001-4327)

DEPTH SCALE METRES: 0 – 10

BORING METHOD: POWER AUGER, HOLLOW STEM (0.00 – 6.55 m)

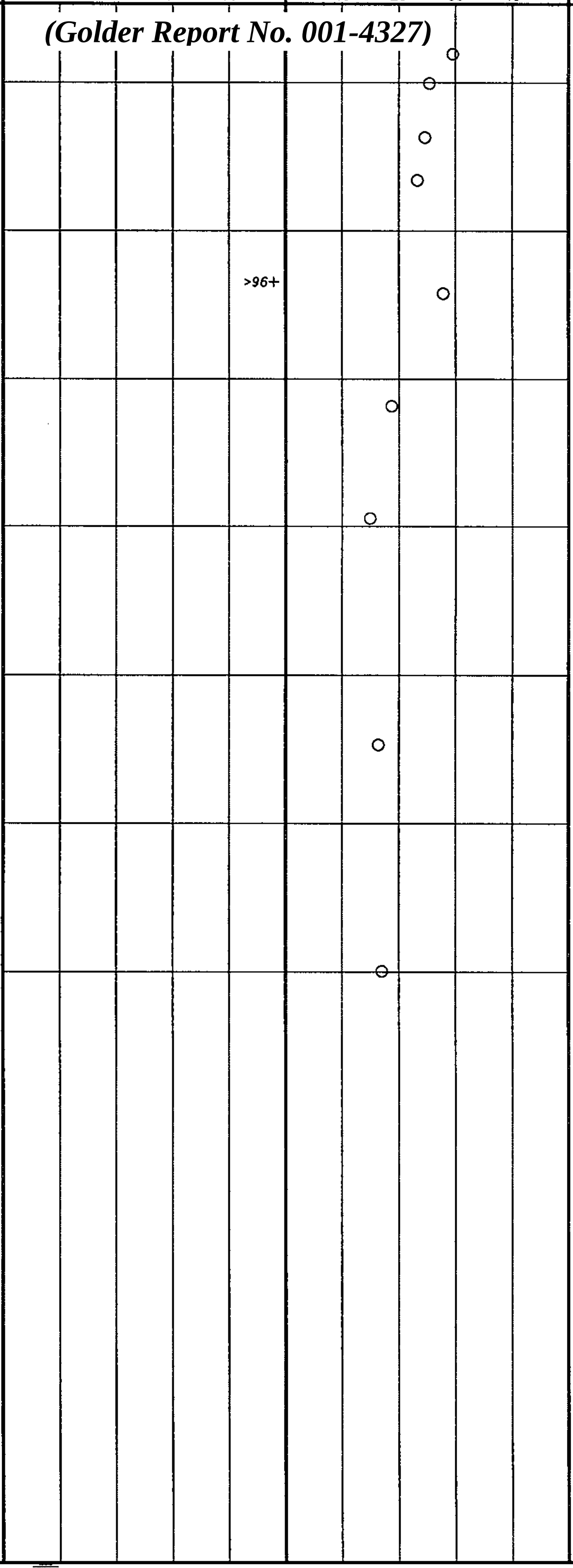
SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE		ELEVATION
GROUND SURFACE	99.33				
Mottled brown and grey silty clay, some sand, trace gravel (FILL)	0.00				
Brown clayey TOPSOIL	99.05 0.28	1	AS	-	99
Stiff to very stiff, mottled brown and grey SILTY CLAY, some sand, trace gravel, occ. silt pockets, fissured (TILL)	98.80 0.53	2	50 DO	6	
		3	50 DO	10	98
Hard, brown SILTY CLAY, some sand, trace gravel, fissured, oxidized (TILL)	97.20 2.13	4	50 DO	43	97
		5	50 DO	43	96
Stiff to very stiff, grey SILTY CLAY, some sand, trace gravel (TILL)	95.22 4.11	6	50 DO	16	95 94
		7	50 DO	10	93
END OF BOREHOLE	92.78 6.55				

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ├──○W──┤ Wl ; 10 20 30 40



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole remained dry during drilling on December 14, 2000

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: C.C.

CHECKED:

LDN_BHS 001-4327.GPJ GLDR_CAN.GDT 4/1/01 DATA INPUT: M. Napier

PROJECT: 031-140357

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JANUARY 8, 2004

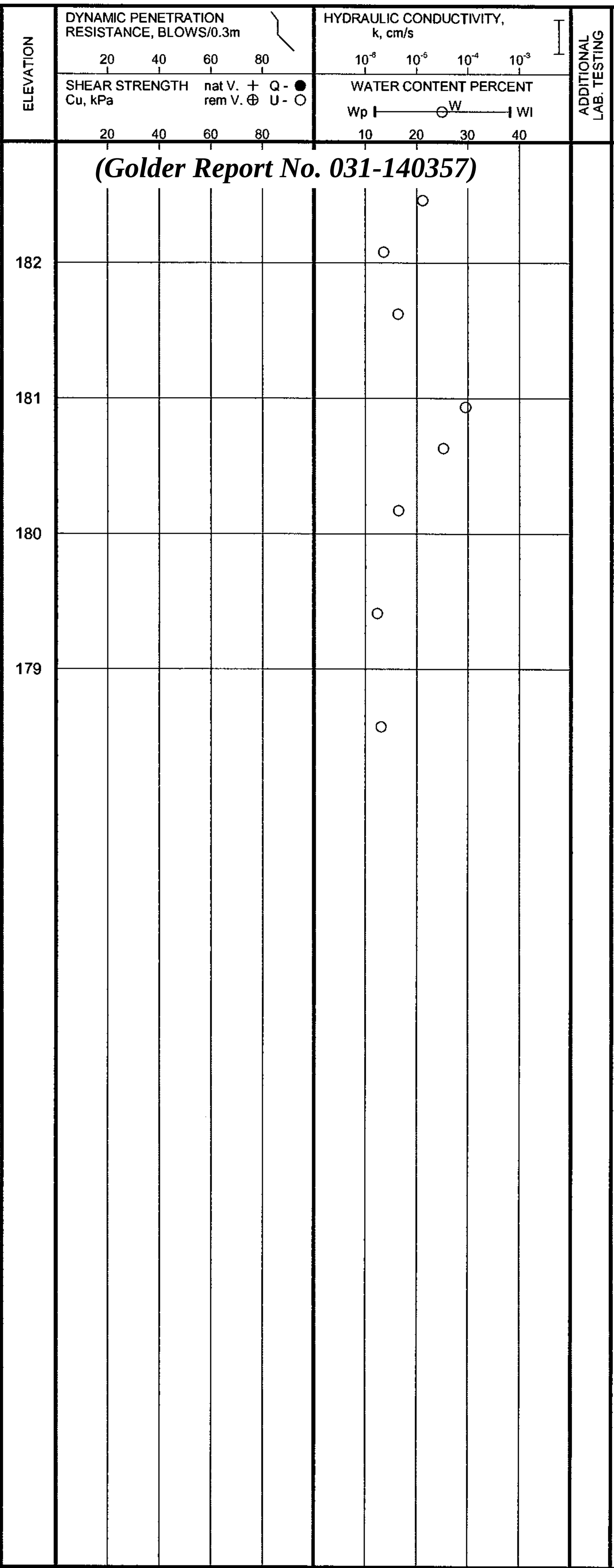
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 031-140357)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	182.69 0.00				
		Brown, clayey topsoil, trace gravel (FILL)	182.23 0.46	1	AS	-	
1		Stiff, brown, silty clay, some sand, some gravel, pieces of ceramic tile, rubble (FILL)	181.01 1.68	2	50 DO	11	▽ Water seepage into borehole enountered at about elevation 181.7m on January 8, 2004
2		Very Stiff, Brown, **SILTY CLAY**, trace to some gravel, trace sand (TILL)	180.71 1.98	3	50 DO	16	
		Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel, sightly laminated (TILL)		4	50 DO	12	
3				5	50 DO	16	
4			178.27 4.42	6	50 DO	10	
		END OF BOREHOLE					
5							
6							
7							
8							
9							
10							



DEPTH SCALE

1 : 50

LOGGED: C.C./A.B.

CHECKED:

LDN_BHS 031-140357.GPJ GLDR_CAN.GDT 1/23/04 DATA INPUT: Tony Mastroianni

PROJECT: 031-140357

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JANUARY 9, 2004

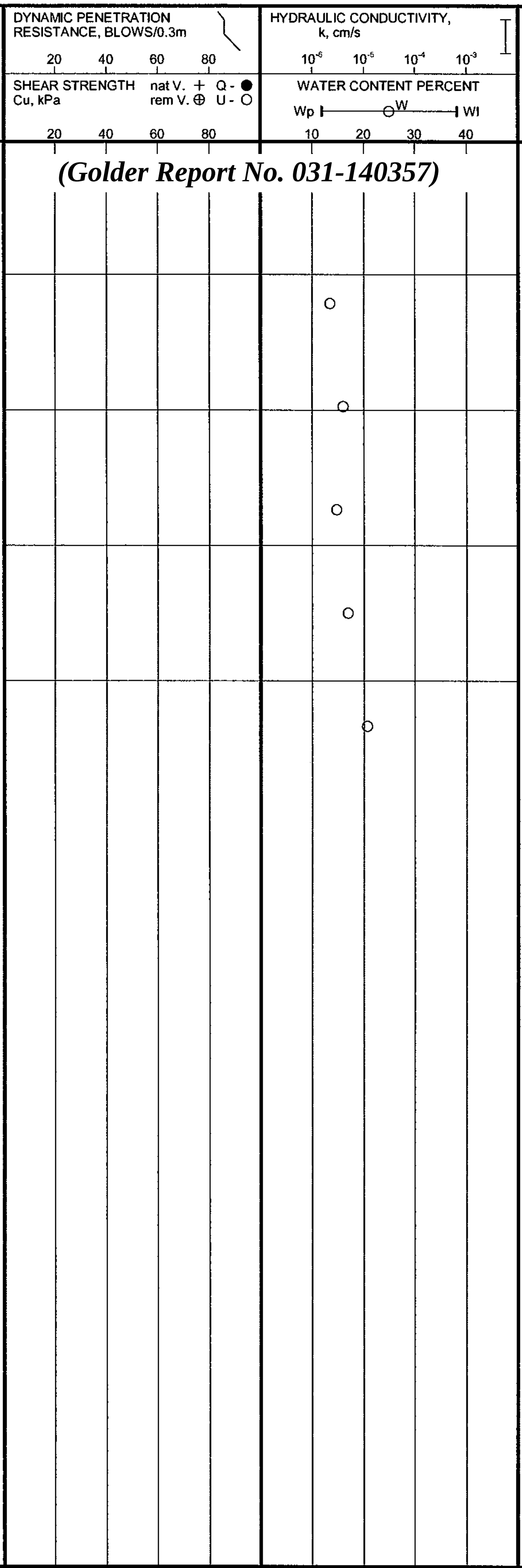
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 031-140357)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
POWER AUGER SOLID STEM	GROUND SURFACE	182.78 0.00					
	Firm, brown, silty clay and topsoil, trace sand, gravel and rootlets (FILL)		1 2	AS 50 DO	- 7	182	∇ Water seepage into borehole enountered at about elevation 181.8m on January 9, 2004
	Loose, brown and grey, **SILTY SAND**, trace gravel	181.41 1.37	3	50 DO	6	181	
	Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, silt pockets (TILL)	180.65 2.13	4	50 DO	26	180	
	Very stiff, grey, **SILTY CLAY**, some gravel, some sand, fissured (TILL)	179.88 2.90	5 6	50 DO 50 DO	22 27	179	
	END OF BOREHOLE	178.36 4.42					



ADDITIONAL LAB. TESTING

DEPTH SCALE METRES 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

LOGGED: C.C./ A.B.

CHECKED: ak

LDN_BHS 031-140357.GPJ GLDR_CAN.GDT 1/23/04 DATA INPUT: Tony Mastroianni

PROJECT: 031-140357

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: JANUARY 9, 2004

DATUM: GEODETIC

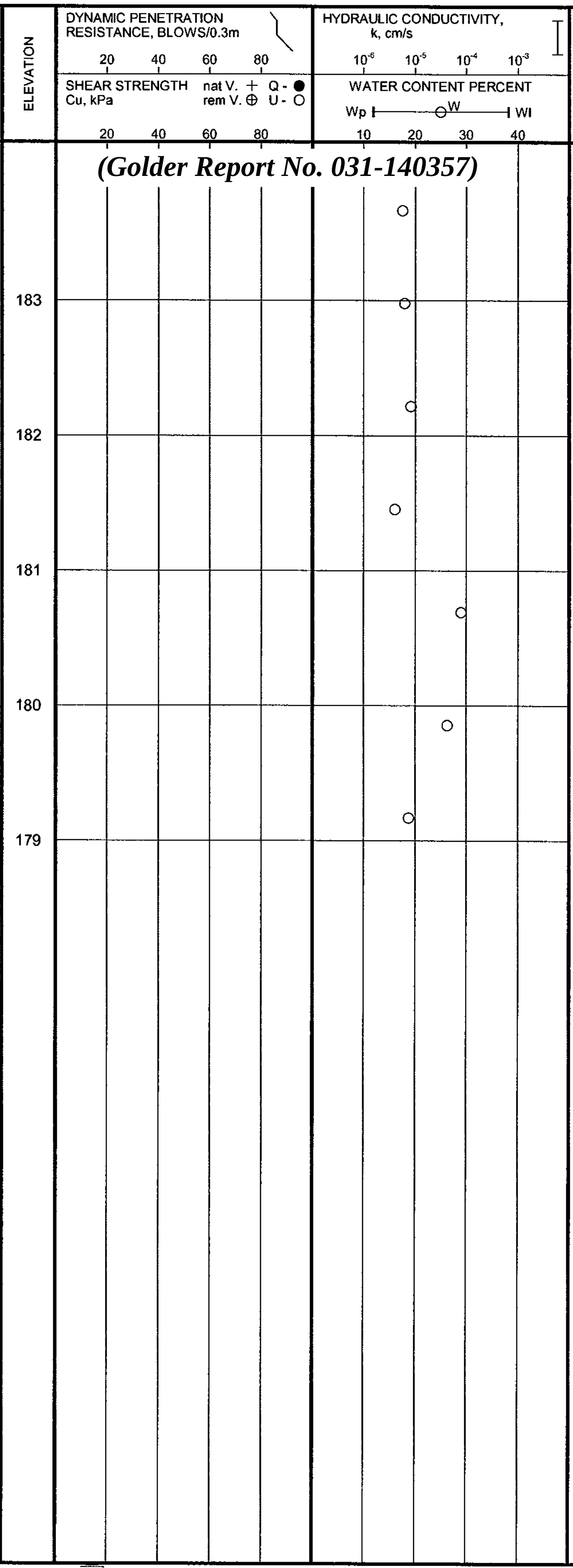
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	183.97 0.00
Firm to very stiff, silty clay, and topsoil, some sand, trace gravel (FILL)	
Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand (TILL)	181.38 2.59
Very stiff to hard, grey, **SILTY CLAY**, some sand, trace gravel (TILL)	180.31 3.66
END OF BOREHOLE	178.94 5.03

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	50 DO	17
3	50 DO	5
4	50 DO	12
5	50 DO	6
6	50 DO	31
7	50 DO	24



(Golder Report No. 031-140357)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

∇

Water seepage into borehole enountered at about elevation 183.0m on January 9, 2004

LDN_BHS 031-140357.GPJ GLDR_CAN.GDT 1/23/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: C.C./ A.B.
CHECKED:

PROJECT: 031-140357

RECORD OF TEST PIT 1

SHEET 1 OF 1

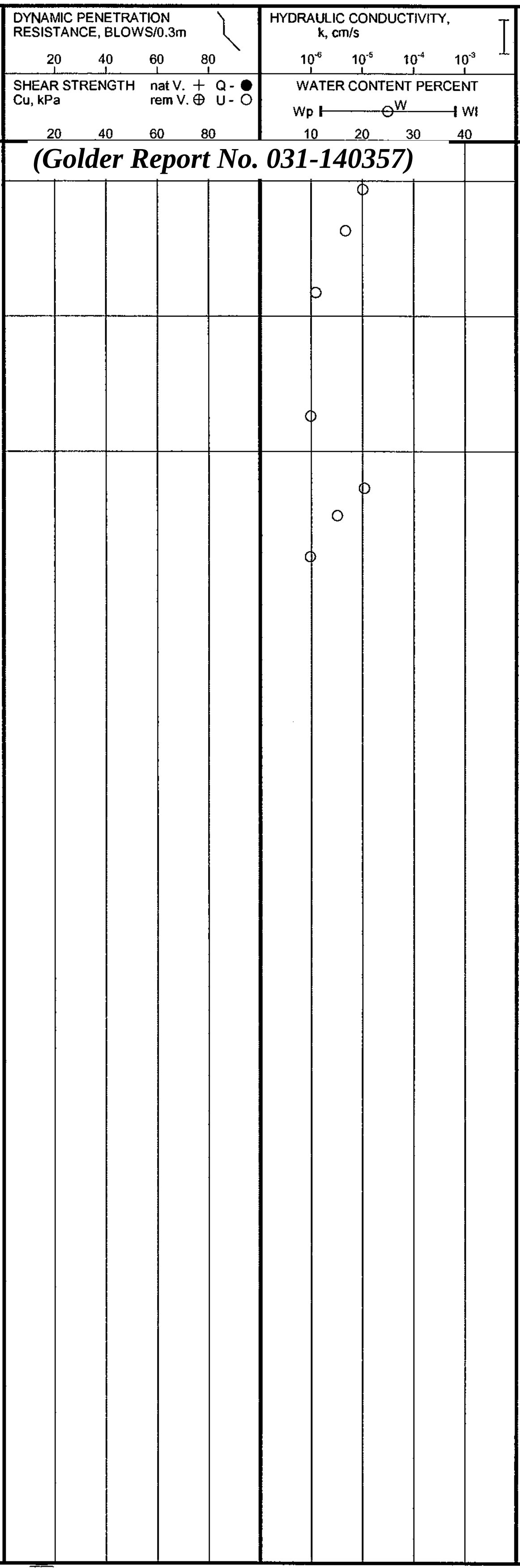
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JANUARY 7, 2004

DATUM: GEODETIC

(Golder Report No. 031-140357)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	179.09				
	BACKHOE 0.6m x 2.4m	Brown, clayey **TOPSOIL**	0.00 178.79	1	CS	179	
		Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, trace rootlets and topsoil (TILL)	0.30 178.33	2	CS		
1		Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (TILL)	0.76 177.62	3	CS	178	
2		Brown, **SILTY CLAY**, some sand, trace gravel, trace rootlets and silt pockets, fissured, oxidized (TILL)	1.47 176.81	4	CS	177	
		Brown, **FINE SILTY SAND**, becoming grey	2.29 176.40	5	CS		∇
3		Grey, **SILTY CLAY**, some sand, trace gravel (TILL)	2.69 176.04	6	CS		Water seepage into Test pit encountered at about elevation 176.8m during digging
		END OF BOREHOLE	3.05				
4							Caving of Test pit sides encountered during digging on January 7, 2004
5							
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

LOGGED: S.P.

CHECKED:

LDN_BHS 031-140357.GPJ GLDR_CAN.GDT 1/23/04 DATA INPUT: Tony Mastroianni

PROJECT: 031-140357

RECORD OF TEST PIT 2

SHEET 1 OF 1

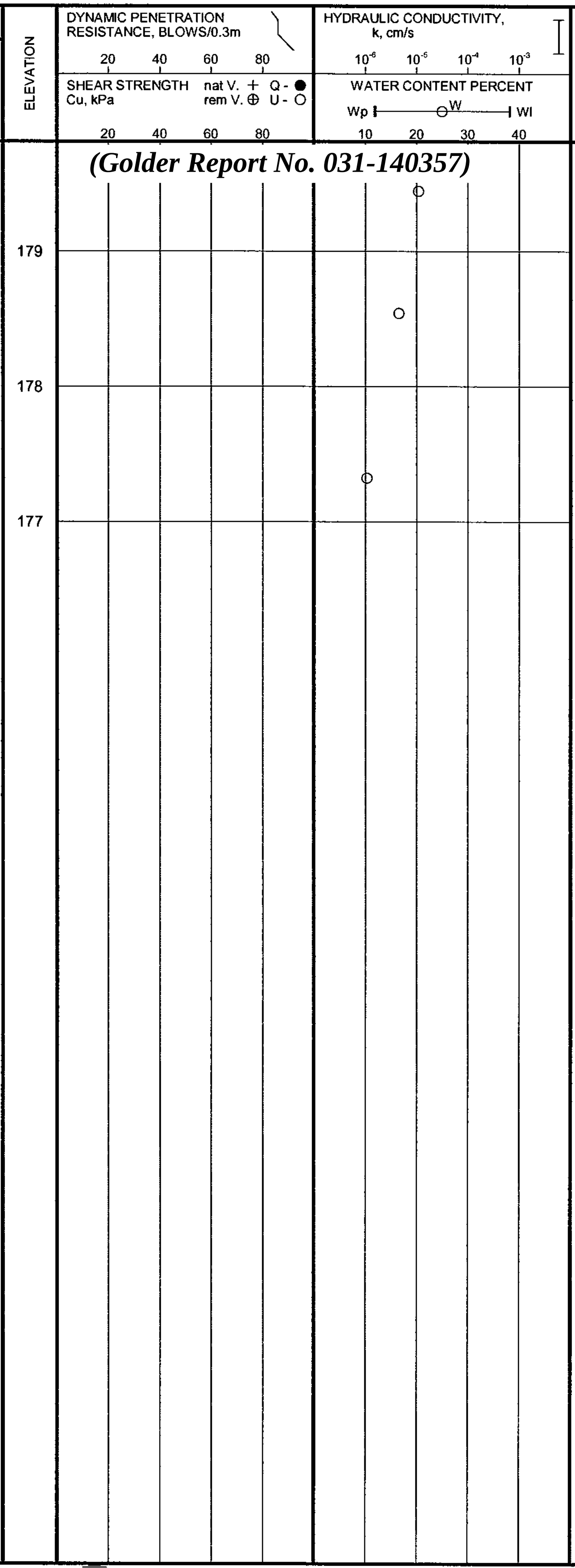
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JANUARY 7, 2004

DATUM: GEODETIC

(Golder Report No. 031-140357)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	179.61			
	BACKHOE 0.6m x 2.4m	Black, clayey **TOPSOIL**	0.00	1	CS	
		Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	179.28 0.33	2	CS	Test pit dry during digging on January 7, 2004
		Brown, **SILTY CLAY**, some sand, trace gravel, oxidized, fissured (**TILL**)	178.03 1.58	3	CS	
3		END OF BOREHOLE	176.56 3.05			



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: S.P.

CHECKED:

PROJECT: 031-140357

RECORD OF TEST PIT 3

SHEET 1 OF 1

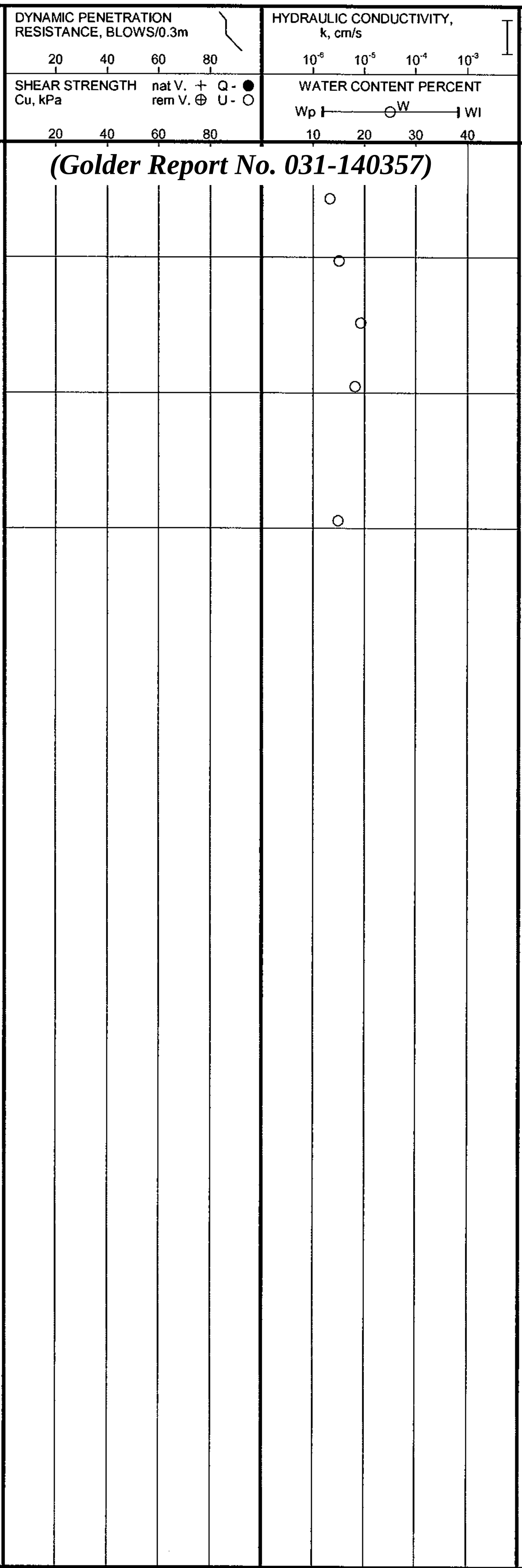
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JANUARY 7, 2004

DATUM: GEODETIC

(Golder Report No. 031-140357)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION
0		GROUND SURFACE	181.65			
	BACKHOE 0.6m x 2.4m	Brown, sandy **TOPSOIL**	0.00 181.22	1	CS	
		Brown, **FINE TO MEDIUM SAND**, trace to some gravel, some to trace silt	0.43 180.61	2	CS	181
1		Brown **SILTY CLAY** to **CLAYEY SILT**, some sand (TILL)	1.04 180.25	3	CS	
		Grey, **SILTY CLAY**, some sand, trace gravel (TILL)	1.40	4	CS	180
2				5	CS	179
3		END OF BOREHOLE	178.60 3.05			



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

∇

Water seepage into Test pit encountered at about elevation 180.7m during digging

Caving of Test pit sides encountered during digging on January 7, 2004

LDN_BHS 031-140357.GPJ GLDR_CAN.GDT 1/23/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: S.P.

CHECKED: h

PROJECT: 031-140357

RECORD OF TEST PIT 4

SHEET 1 OF 1

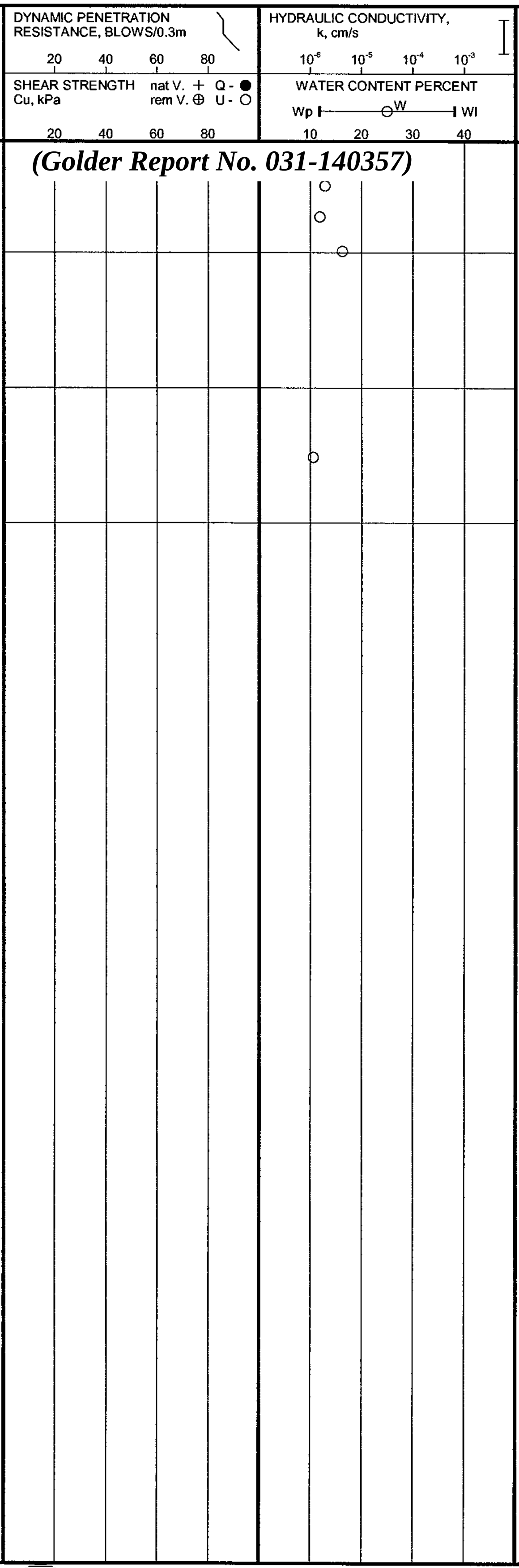
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: JANUARY 7, 2004

DATUM: GEODETIC

(Golder Report No. 031-140357)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		180.62					
	BACKHOE 0.6m x 2.4m	Brown, sandy **TOPSOIL**		0.00	1	CS			
		Brown, **FINE TO MEDIUM SAND**, trace gravel, some to trace silt		180.37 0.25	2	CS			
		Mottled brown and grey, **SILTY CLAY** to **CLAYEY SILT**, some sand, trace gravel, silt pockets (TILL)		180.16 0.46	3	CS	180		
1									
		Brown, **SILTY CLAY**, some sand, trace gravel, oxidized, slightly fissured (TILL)		179.17 1.45			179		Test pit dry during digging on January 7, 2004
2					4	CS			
							178		
3		END OF BOREHOLE		177.57 3.05					
4									
5									
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: S.P.

CHECKED:

LDN_BHS 031-140357.GPJ GLDR_CAN.GDT 1/23/04 DATA INPUT: Tony Mastroianni

PROJECT: 031-140357

LOCATION: SEE LOCATION PLAN

RECORD OF TEST PIT 5

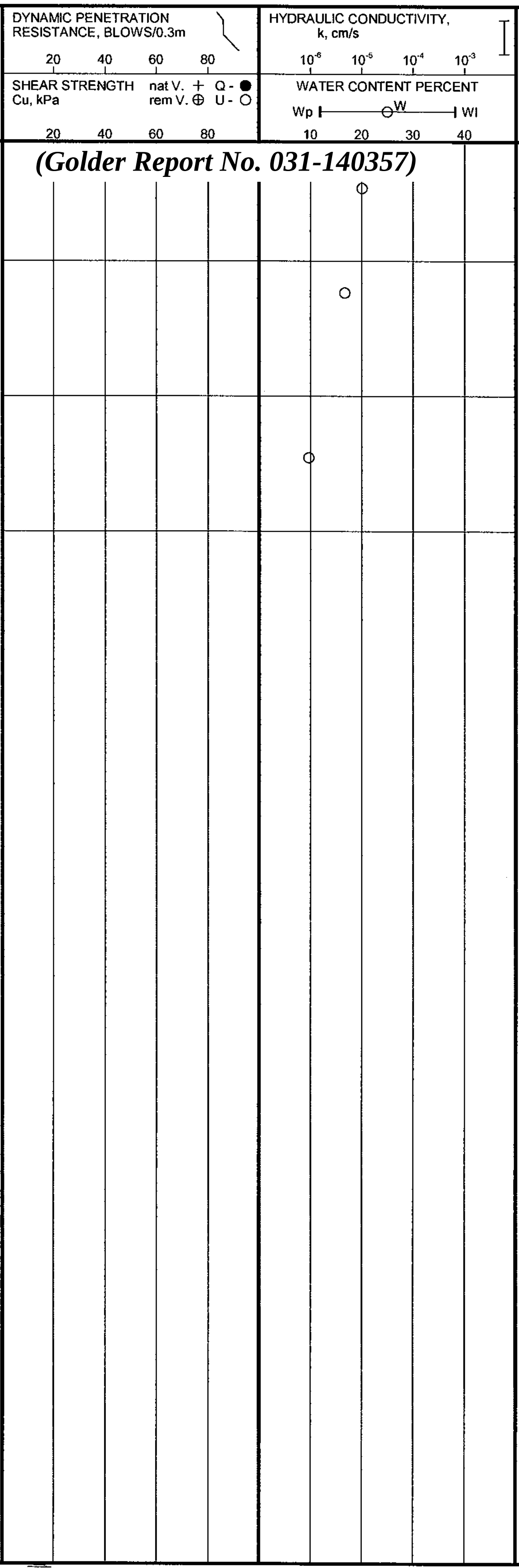
EXCAVATION DATE: JANUARY 7, 2004

SHEET 1 OF 1

DATUM: GEODETIC

(Golder Report No. 031-140357)

DEPTH SCALE METRES	METHOD	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	BACKHOE 0.6m x 2.4m	GROUND SURFACE	179.68				
		Black, clayey **TOPSOIL**	0.00	1	CS		
		Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel and topsoil, roots (TILL)	179.40 0.28			179	▽
1			178.77 0.91	2	CS		Water seepage into Test pit encountered at about elevation 179.0m during digging
2		Brown, **SILTY CLAY**, some sand, trace gravel, oxidized, fissured (TILL)		3	CS	178	Caving of Test pit sides encountered during digging on January 7, 2004
3		END OF BOREHOLE	176.63 3.05			177	



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

LOGGED: S.P.

CHECKED: ah

PROJECT: 041-140173

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

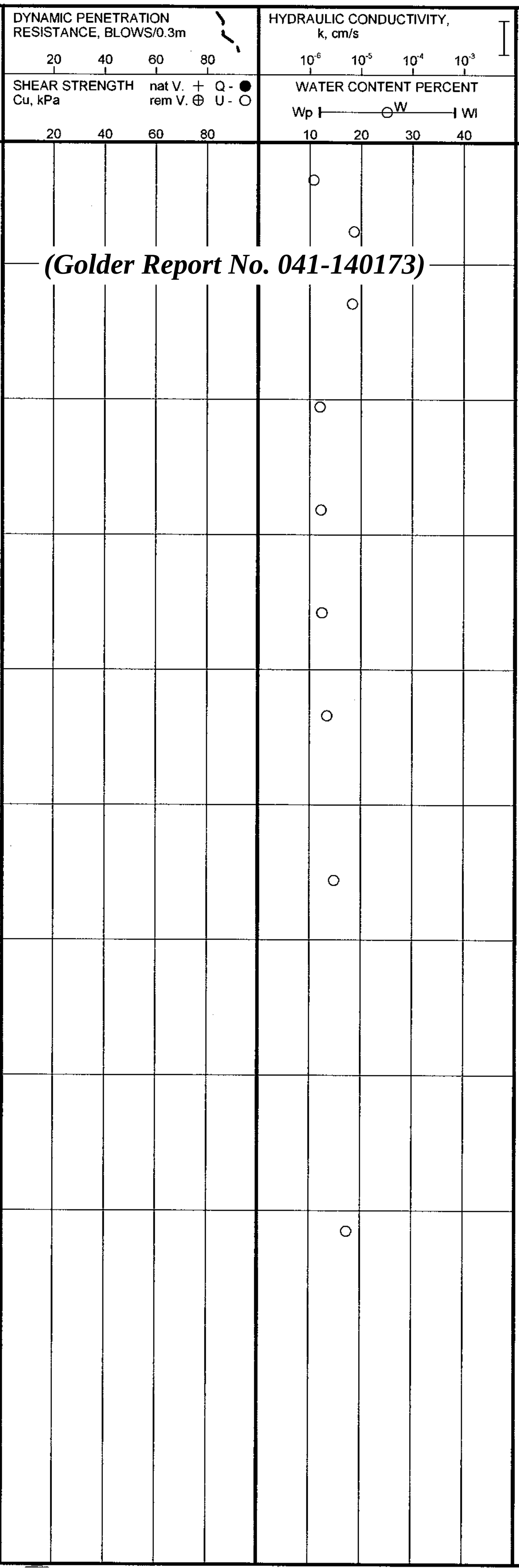
BORING DATE: AUGUST 24, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	189.70					
		Brown, clayey **TOPSOIL**, some gravel	0.00					
		Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)	0.15	1	AS	-	189	
1				2	50 DO	7		
		Hard, brown, **SILTY CLAY**, some sand, trace gravel, silt seams and pockets (**TILL**)	188.18 1.52	3	50 DO	40	188	
2				4	50 DO	41	187	
3				5	50 DO	49		Borehole dry during drilling on August 24, 2004
		Very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	186.04 3.66				186	
4				6	50 DO	21	185	
5				7	50 DO	17	184	
6							183	
7							182	
8			181.62 8.08	8	50 DO	17		
		END OF BOREHOLE						
9								
10								



(Golder Report No. 041-140173)

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.B.
CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 24, 2004

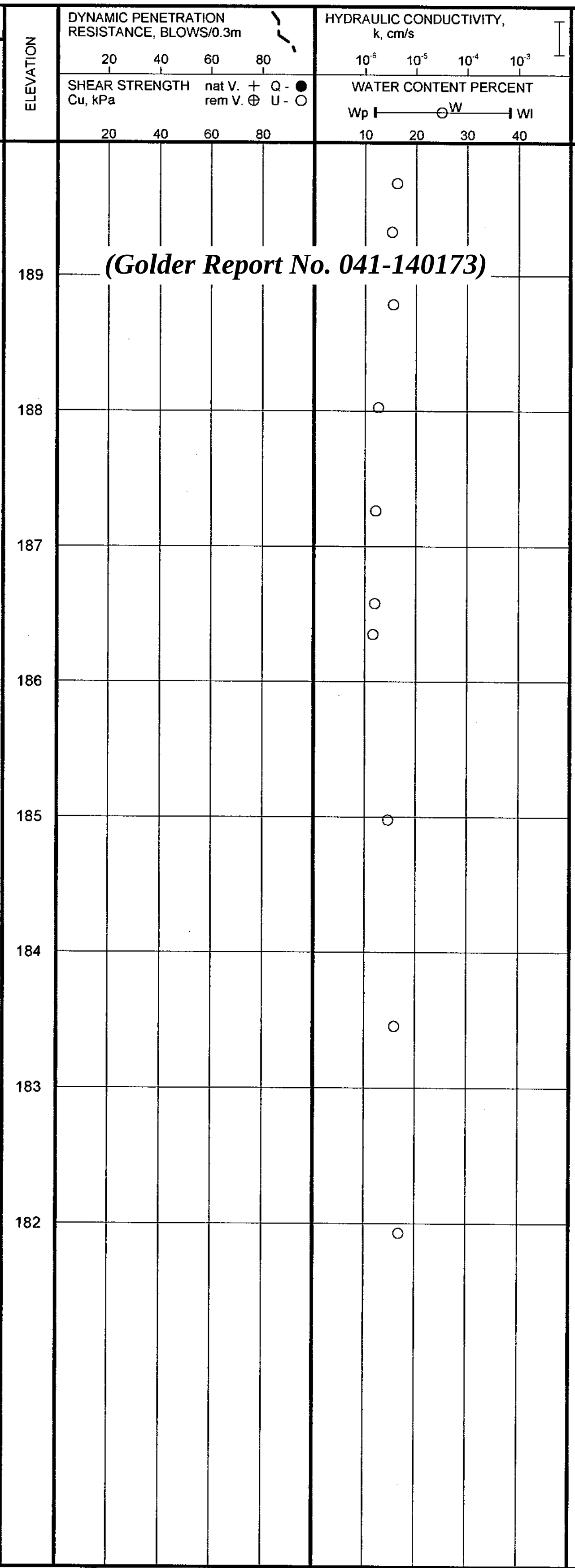
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
POWER AUGER SOLID STEM	GROUND SURFACE	189.78				
	Brown, clayey **TOPSOIL**, some gravel	0.00				
	Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)	189.58 0.20	1 2	AS 50 DO	- 7	
	Hard, brown, **SILTY CLAY**, some sand, trace gravel, silt seams and pockets (**TILL**)	188.41 1.37	3 4 5	50 DO 50 DO 50 DO	42 37 33	Borehole dry during drilling on August 24, 2004
	Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	186.43 3.35	6 7 8	50 DO 50 DO 50 DO	14 14 16	
	END OF BOREHOLE	181.70 8.08				



ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.B.
CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 24, 2004

DATUM: GEODETIC

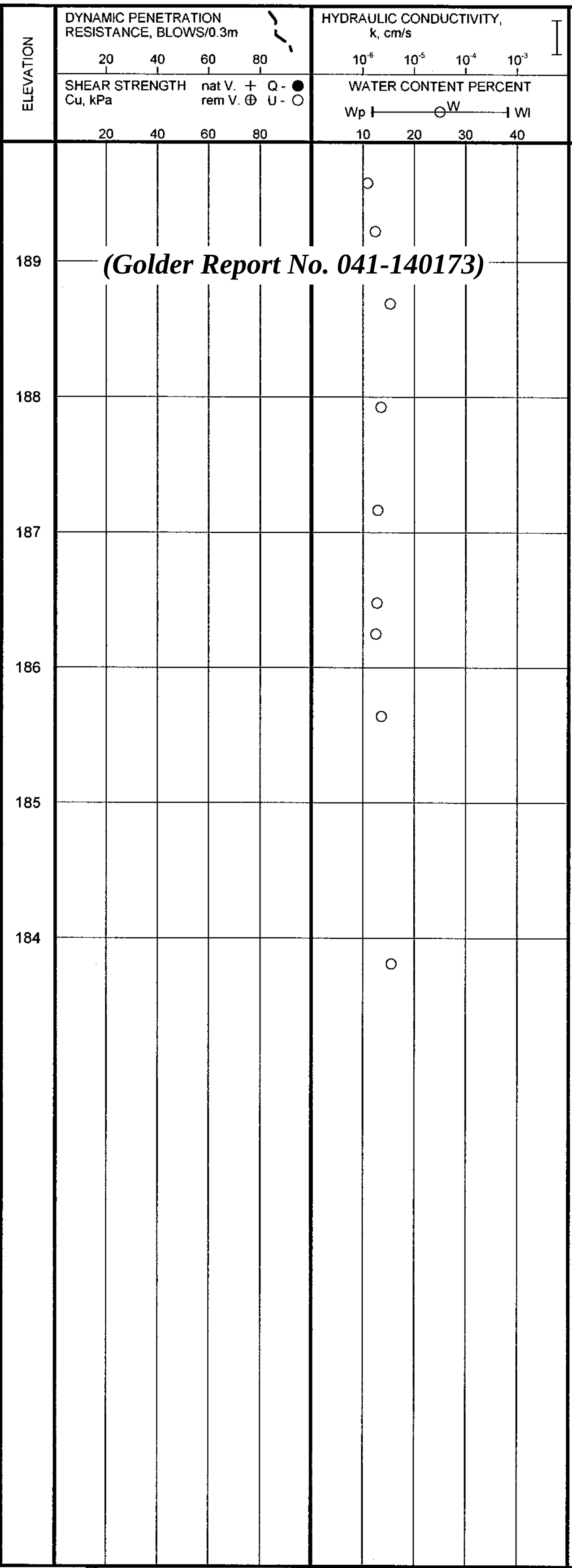
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

BORING METHOD: POWER AUGER, SOLID STEM

DEPTH SCALE METRES: 0–10

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	189.68			
Brown, silty **TOPSOIL**	0.00			
Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)	189.48 0.20	1	AS	-
		2	50 DO	11
Hard to very stiff, brown, **SILTY CLAY**, some sand, trace gravel, silt seams and pockets (**TILL**)	188.31 1.37	3	50 DO	31
		4	50 DO	44
Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	186.33 3.35	5	50 DO	28
		6	50 DO	27
		7	50 DO	15
END OF BOREHOLE	183.58 6.10			



(Golder Report No. 041-140173)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on August 24, 2004

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 4

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 24, 2004

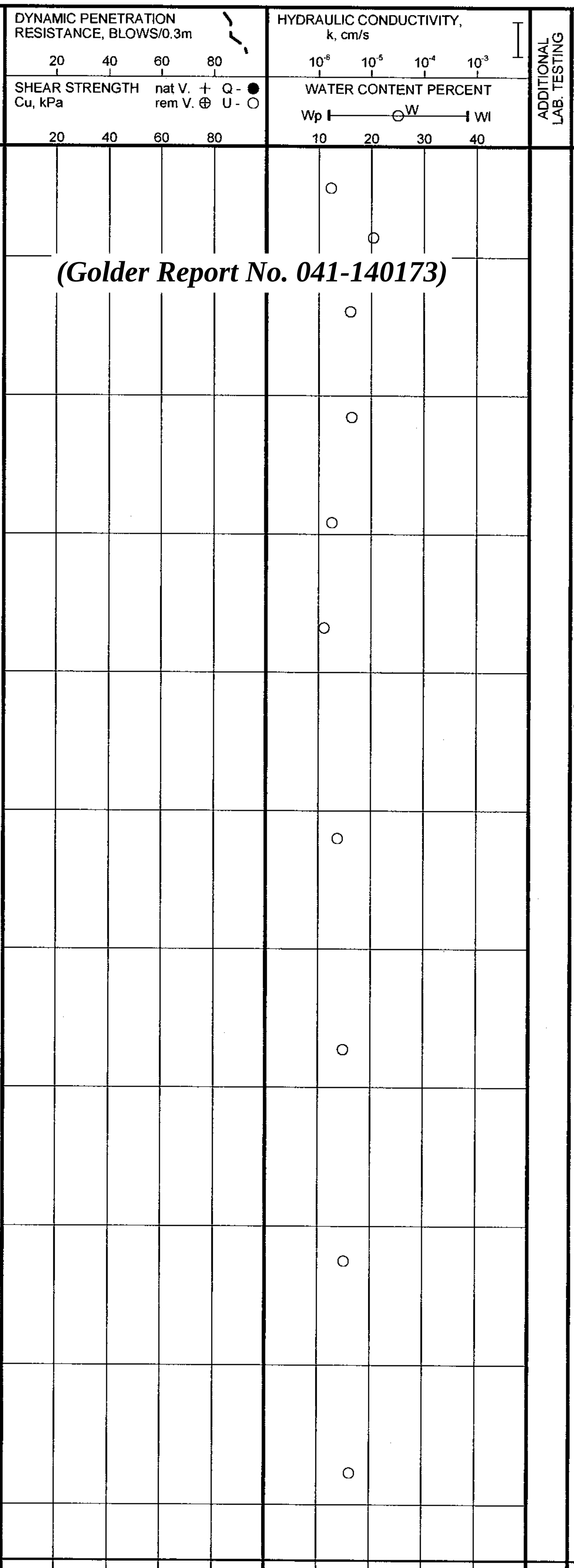
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	189.60				
		Brown, clayey **TOPSOIL**	0.00				
		Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)	189.40 0.20	1	AS	-	
1				2	50 DO	6	
		Very stiff to hard, brown, **SILTY CLAY**, some sand, trace gravel, silt seams and pockets (**TILL**)	188.23 1.37	3	50 DO	21	
2				4	50 DO	36	
3				5	50 DO	41	
4		Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	185.79 3.81				Borehole dry during drilling on August 24, 2004
5				6	50 DO	17	
6				7	50 DO	15	
8				8	50 DO	19	
9				9	50 DO	11	
10		--- CONTINUED NEXT PAGE ---					



DEPTH SCALE

1 : 50

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 4

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 24, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
10		*--- CONTINUED FROM PREVIOUS PAGE ---*										
	POWER AUGER SOLID STEM	Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)						179				
11				178.47 11.13	10	50 DO	14			○		
		END OF BOREHOLE										
12												
13												
14												
15												
16												
17												
18												
19												
20												

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 27, 2004

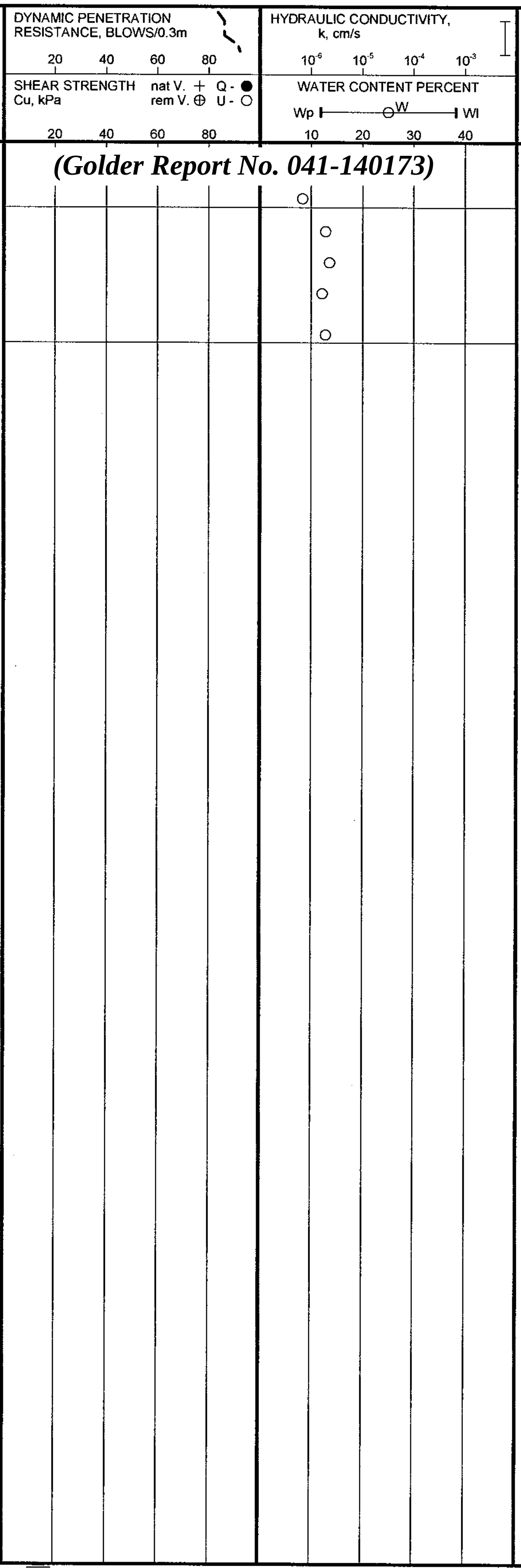
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m			
0		PAVEMENT SURFACE		190.28						
	POWER AUGER SOLID STEM	**ASPHALT**	■	0.00						
		Granular road base (**FILL**)	▨	0.15						
		Black, clayey topsoil, some sand (**FILL**)	▨	0.30	1	AS	-	190		
		Brown, silty clay, some sand and gravel, pockets of topsoil (**FILL**)	▨	189.67 0.61						Borehole dry during drilling on August 27, 2004
1		Compact, brown, **SILTY SAND**, trace clay		0.76	2	AS	18			
		Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		189.21 1.07	3	AS	25	189		
		END OF BOREHOLE		188.76 1.52						



DEPTH SCALE

1 : 50

LOGGED: A.B.

CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

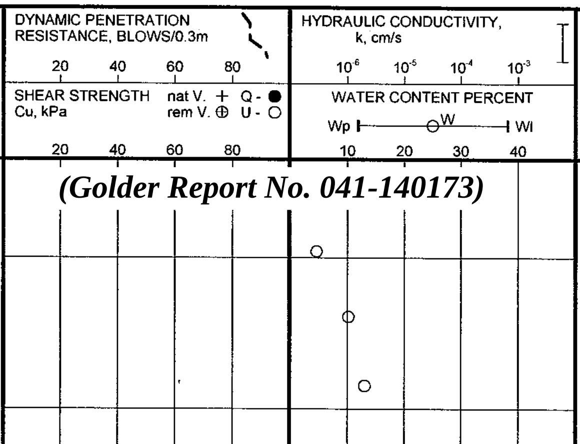
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SURFACE	190.45						
	POWER AUGER SOLID STEM	**ASPHALT**	0.00 190.25 0.20						
		Granular road base (**FILL**)	189.84 0.61	1	AS	-	190		
1		Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)		2	50 DO	16			Borehole dry during drilling on August 25, 2004
			188.93 1.52	3	50 DO	20	189		
		END OF BOREHOLE							



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 30, 2004

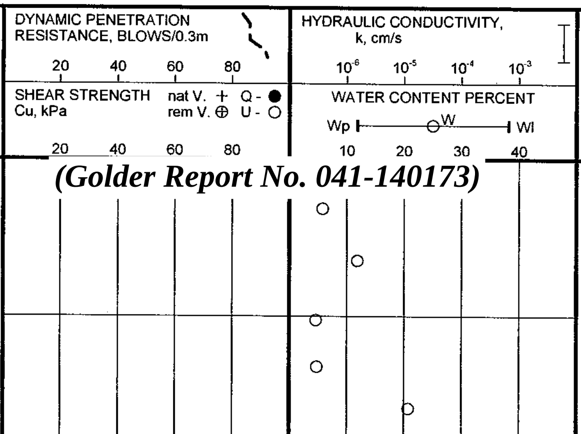
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
0	POWER AUGER SOLID STEM	PAVEMENT SHOULDER SURFACE	190.84				
		Brown sand and gravel **(FILL)**	0.00	1	AS	-	
		Brown, silty clay, some sand and gravel **(FILL)**	0.15	2	AS	-	
		Brown sand and gravel **(FILL)**	190.15 0.69	3	AS	-	190
1				4	AS	-	
		Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets **(TILL)**	189.54 1.30	5	AS	-	
		END OF BOREHOLE	189.32 1.52				
2							
3							
4							
5							
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Water seepage into borehole encountered at about elevation 189.49 m during drilling on August 30, 2004

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.B.
CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 8

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 27, 2004

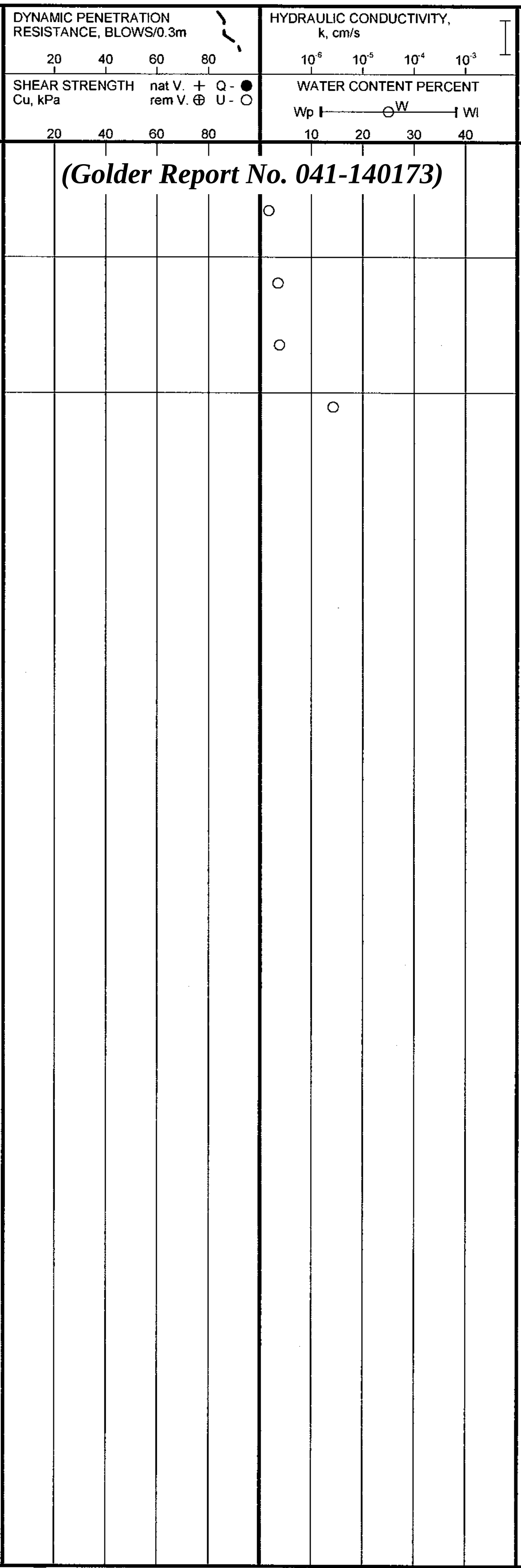
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SHOULDER SURFACE		190.65 0.00						
	POWER AUGER SOLID STEM	Dense to compact granular base **(FILL)**			1	AS	-			
1					2	50 DO	44	190		Borehole dry during drilling on August 25, 2004
				189.13 1.52	3	50 DO	23			
		Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**		188.67 1.98	4	50 DO	25	189		
2		END OF BORHOLE								
3										
4										
5										
6										
7										
8										
9										
10										



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

DATUM: GEODETIC

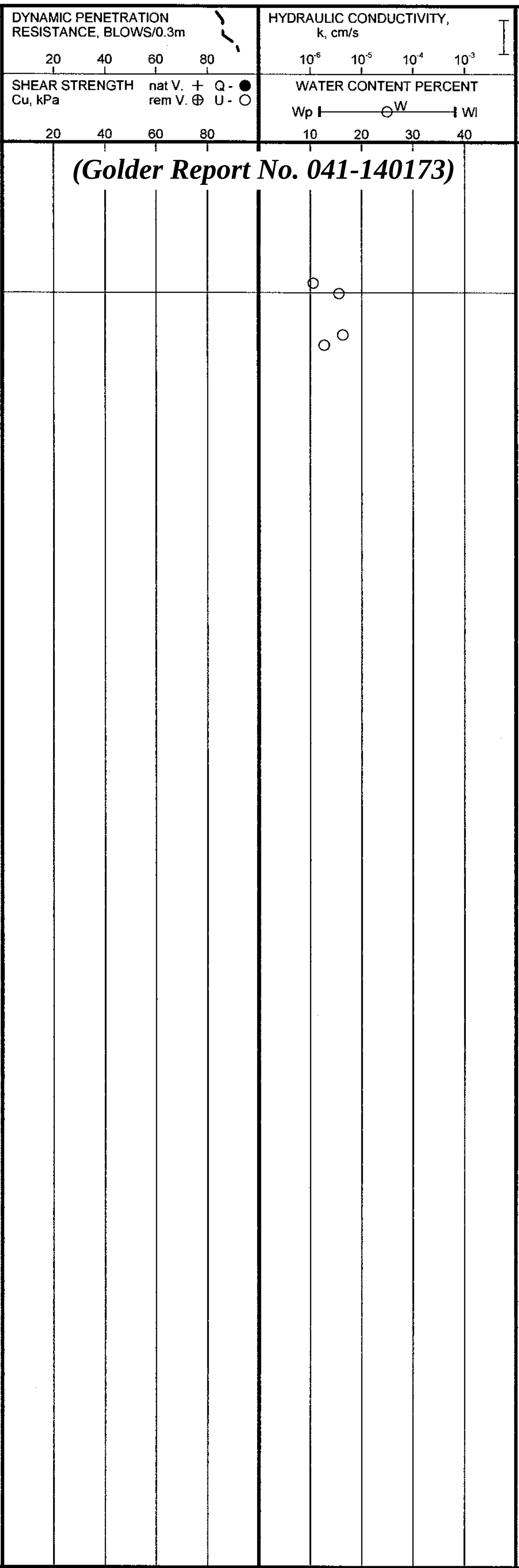
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		PAVEMENT SURFACE		190.91					
0	POWER AUGER SOLID STEM	**ASPHALT**	■	0.00					
		CONCRETE		0.15					
		Stiff, brown, silty clay, some sand and gravel, sand pockets (**FILL**)	▨	190.48 0.43	1	2" DO	15	190	Borehole dry during drilling on August 25, 2004
1		Black, clayey topsoil (**FILL**)	▨	190.00 0.91					
		Brown, sand and gravel, silty clay pockets and pieces of topsoil (**FILL**)	▨	1.07					
		Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		1.22	2	2" DO	19		
		END OF BOREHOLE		189.39 1.52					

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10



ADDITIONAL LAB. TESTING

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED:

PROJECT: 041-140173

RECORD OF BOREHOLE 10

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 26, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

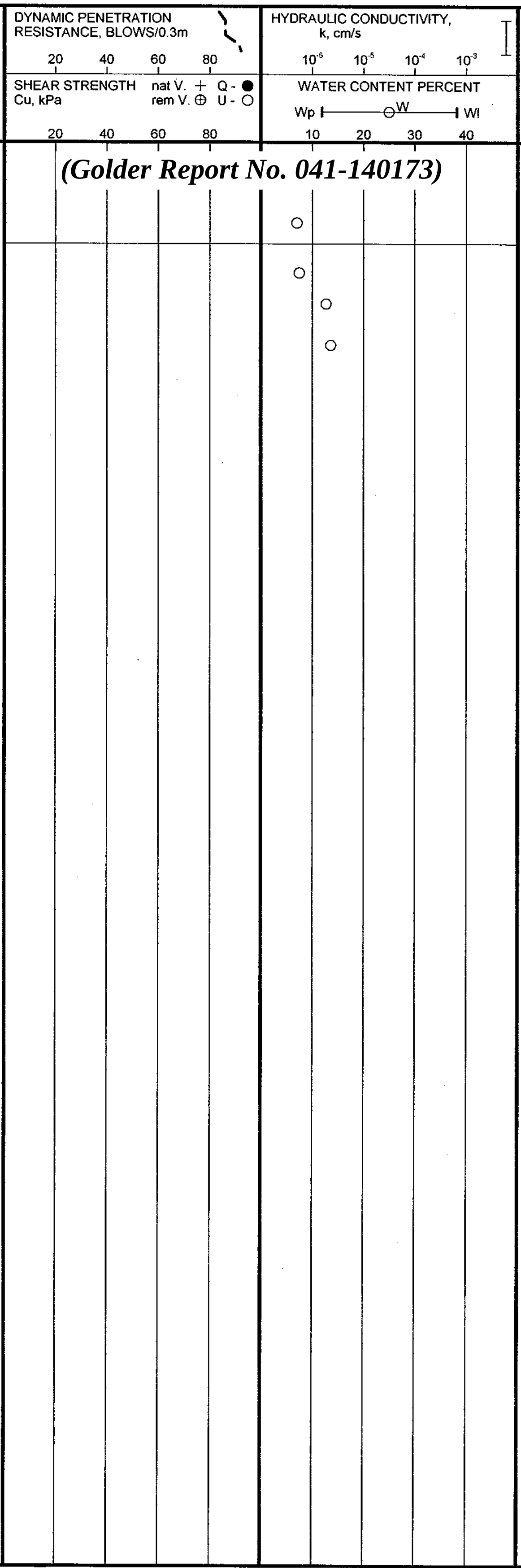
(Golder Report No. 041-140173)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
PAVEMENT SURFACE	190.55 0.00
ASPHALT	0.18
Granular road base (**FILL**)	189.64 0.91
Black, clayey topsoil, pockets of sand, clay and silt (**FILL**)	1.07
Hard, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)	189.03 1.52
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	50 DO	18
3	50 DO	31

ELEVATION: 190



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on August 26, 2004

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED:

PROJECT: 041-140173

RECORD OF BOREHOLE 11

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

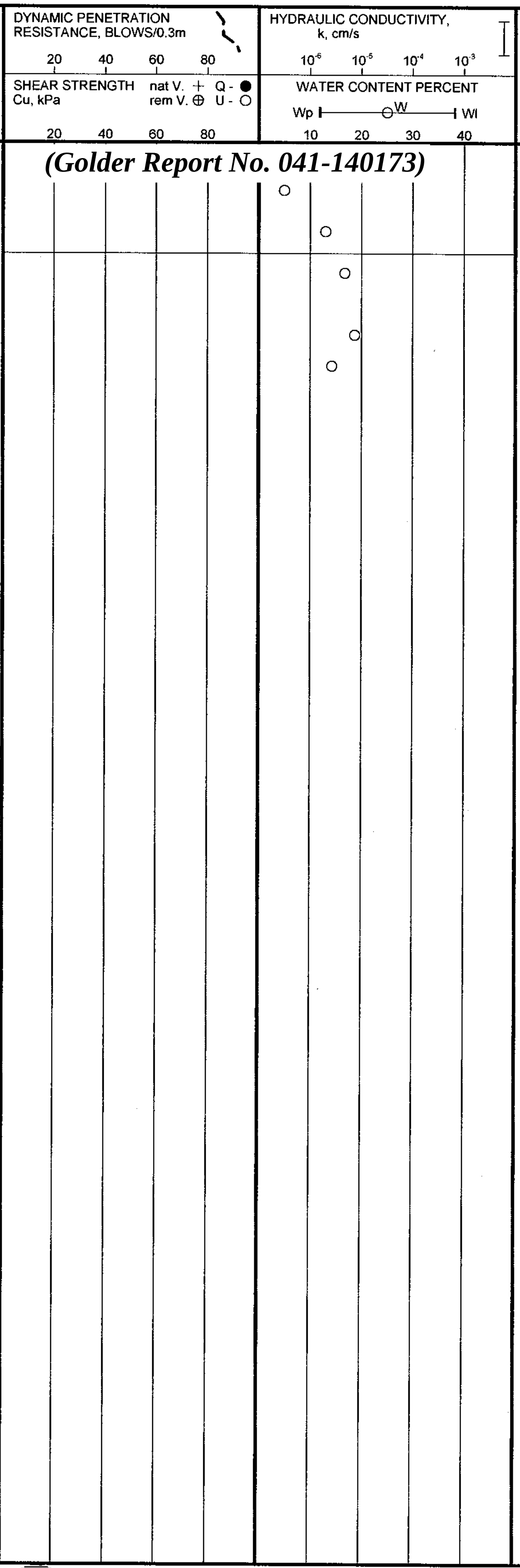
BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
PAVEMENT SHOULDER SURFACE	190.62 0.00
Granular base (**FILL**)	190.31 0.30
Brown to black, silty clay, some sand and gravel (**FILL**)	190.01 0.61
Black, clayey **TOPSOIL**, sand and gravel **(FILL)**	189.71 0.91
Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	189.25 1.37
Very stiff, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)	1.52
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	50 DO	11
3	50 DO	24

ELEVATION: 190

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10



(Golder Report No. 041-140173)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on August 25, 2004

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 12

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

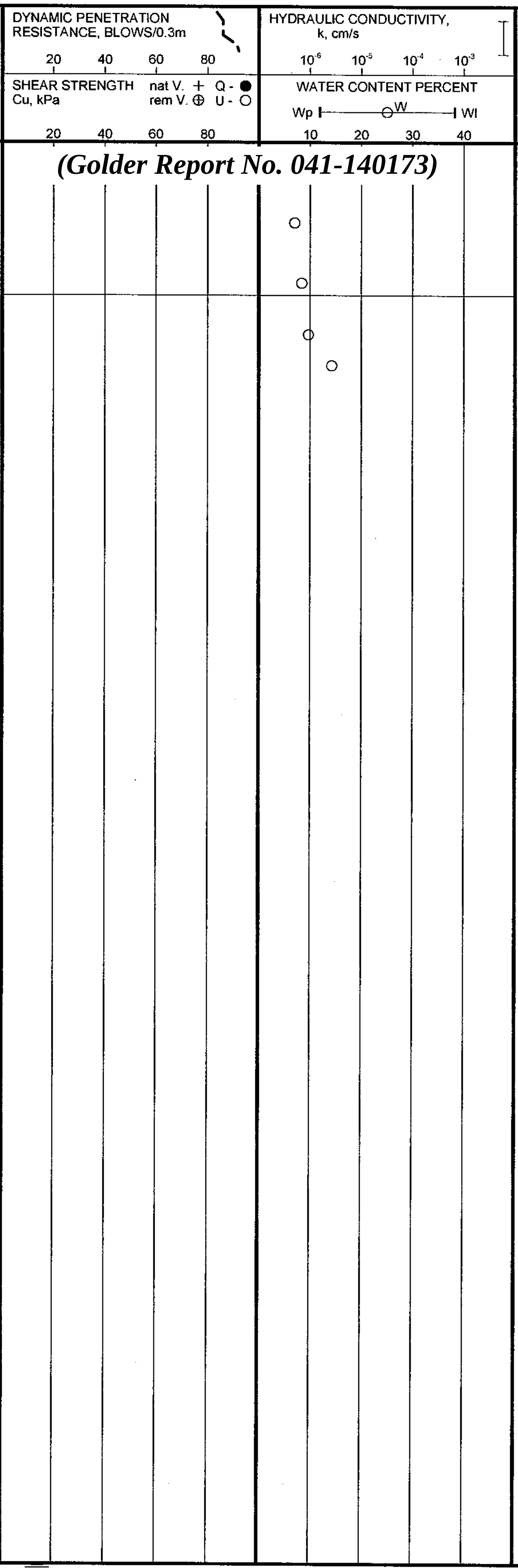
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SURFACE		190.93						
	POWER AUGER SOLID STEM	**ASPHALT**	■	0.00						
		Very dense, granular road base (**FILL**)	▨	0.18	1	AS	-			Borehole dry during drilling on August 25, 2004
1					2	50 DO	64	190		
				189.56 1.37	3	50 DO	27			
		Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		1.52						
		END OF BOREHOLE								
2										
3										
4										
5										
6										
7										
8										
9										
10										



LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.B.
CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 13

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

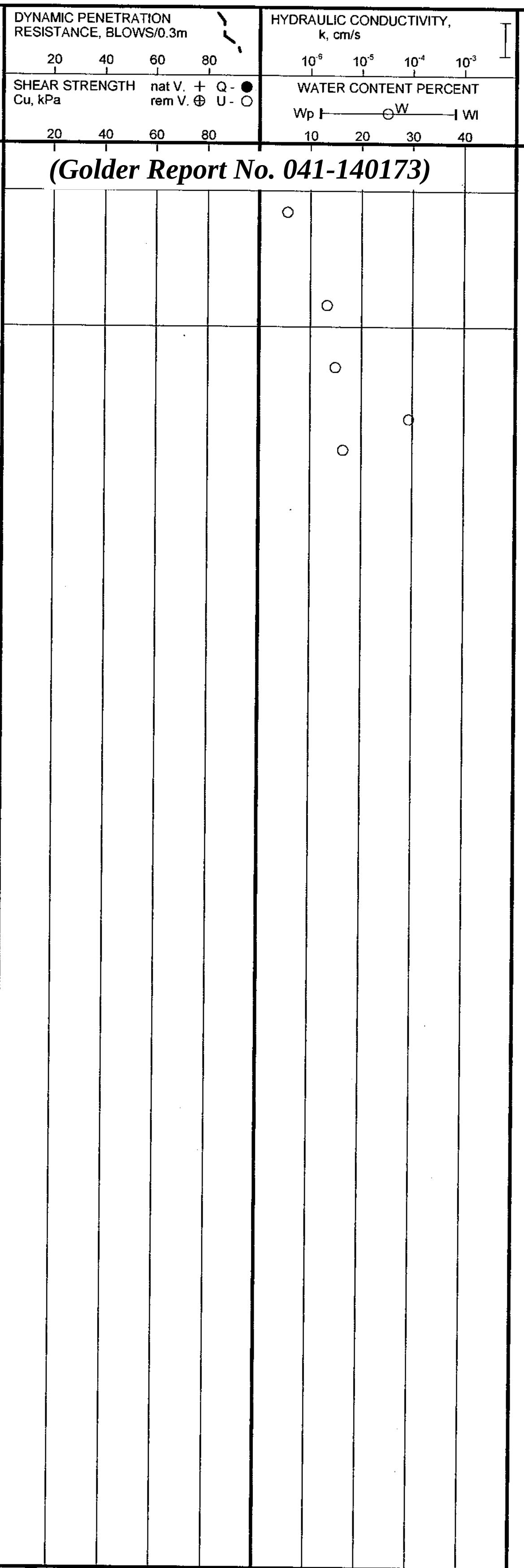
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SHOULDER SURFACE		191.15 0.00					
	POWER AUGER SOLID STEM	Granular base (**FILL**)			1	AS	-	191	
		CONCRETE		190.54 0.61					Borehole dry during drilling on August 25, 2004
1		Stiff, brown, silty clay, some sand and gravel, pockets of topsoil (**FILL**)		0.76	2	50 DO	11	190	
		Black, clayey topsoil, silty clay pockets, some sand and gravel (**FILL**)		189.93 1.22	3	50 DO	6		
		Black, organic **PEAT** material		189.47 1.68	4	50 DO	12		
2		Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		189.17 1.98					
		END OF BOREHOLE		2.13					
3									
4									
5									
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: A.B.

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 14

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

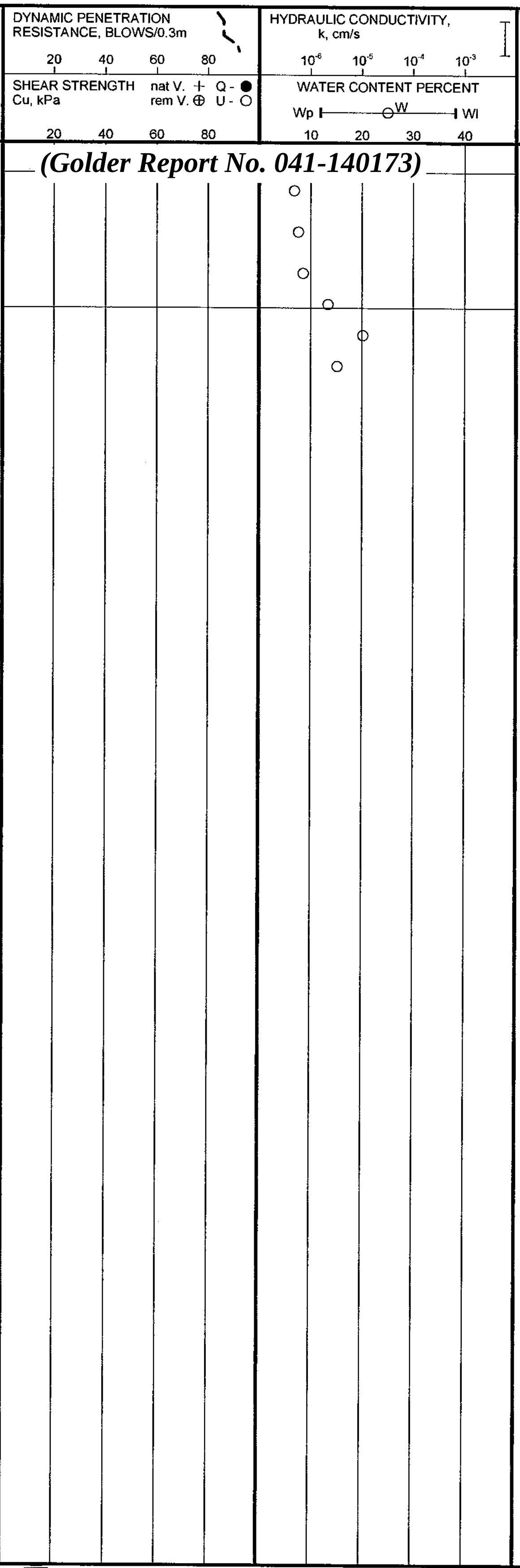
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		PAVEMENT SHOULDER SURFACE		191.02						
0	POWER AUGER SOLID STEM	Granular base (**FILL**)	▩	0.00	1	AS	-	191		Borehole dry during drilling on August 25, 2004
				190.11	2	50 DO	10			
1		Brown and grey, silty clay, pockets of sand (**FILL**)	▩	0.91				190		
		Black, clayey **TOPSOIL**		1.07	3	50 DO	8			
		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, pockets of sand (**TILL**)		189.65 1.37						
		END OF BOREHOLE		1.52						



DEPTH SCALE

1 : 50

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 15

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

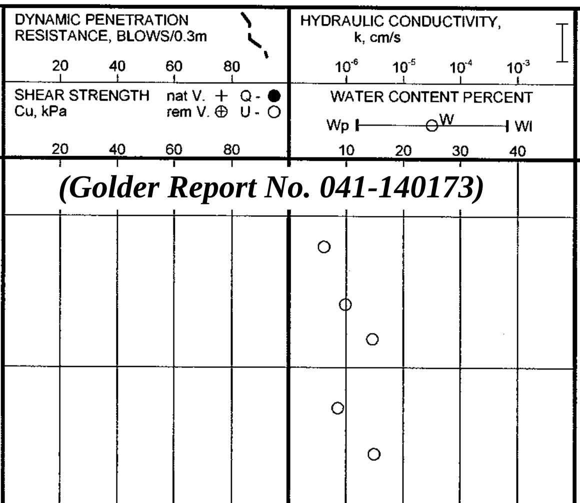
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		PAVEMENT SURFACE		191.18						
0	POWER AUGER SOLID STEM	**ASPHALT**		0.00				191		
		Granular road base (**FILL**)		0.18	1	AS	-			Borehole dry during drilling on August 25, 2004
					2	50 DO	14			
1		Stiff, brown and grey, silty clay, some sand and gravel (**FILL**)		190.27 0.91	3	50 DO	12	190		
		Black, clayey **TOPSOIL**		189.81 1.37						
		Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)		1.52	4	50 DO	10			
2		END OF BOREHOLE		189.20 1.98						
3										
4										
5										
6										
7										
8										
9										
10										



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED:

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

RECORD OF BOREHOLE 16

PROJECT: 041-140173

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5kg; DROP, 760mm

BORING DATE: AUGUST 25, 2004

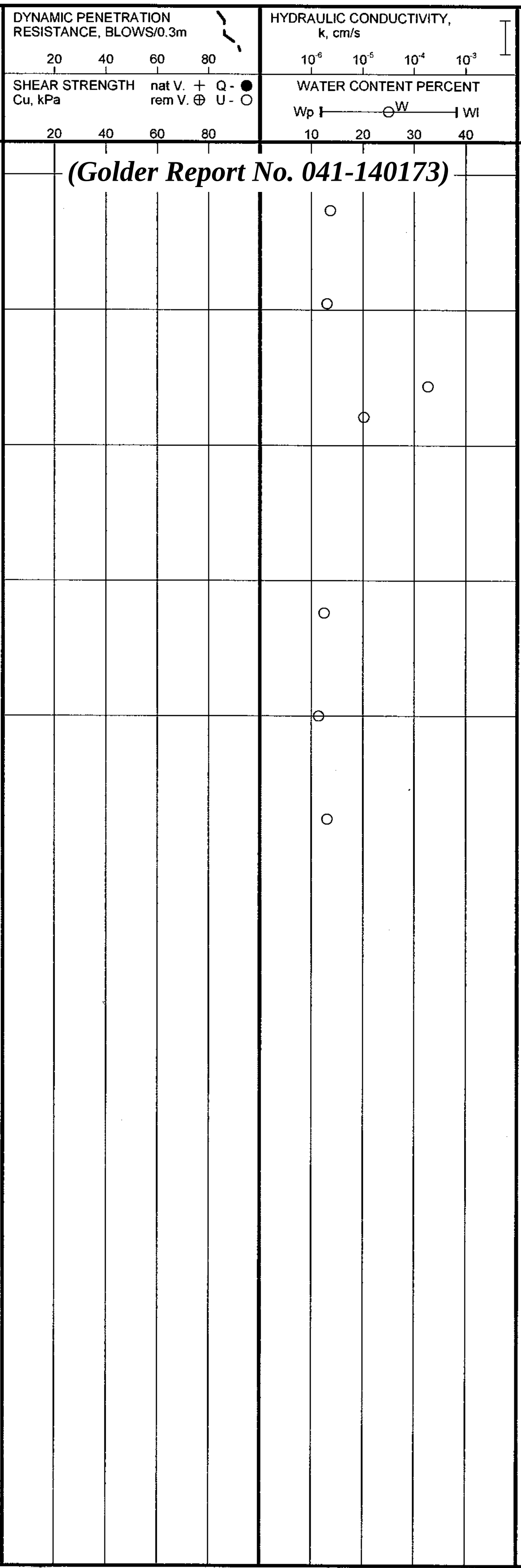
SHEET 1 OF 1

DATUM: GEODETIC

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SHOULDER SURFACE		191.04 0.00				191		
	POWER AUGER SOLID STEM	Brown sand and gravel, silty clay pockets (**FILL**)			1	AS	-			
1		Firm to stiff, brown and grey, silty clay, some sand and gravel, topsoil pockets (**FILL**)		190.28 0.76	2	50 DO	8	190		
		Black, clayey **TOPSOIL**		189.67 1.37						
2		Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		189.36 1.68	3	50 DO	5	189		
		Hard, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)		188.91 2.13	4	50 DO	36			Borehole dry during drilling on August 25, 2004
3					5	50 DO	39	188		
4		Hard, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		187.23 3.81	6	50 DO	39	187		
					7	50 DO	32			
5		END OF BOREHOLE		186.01 5.03						
6										
7										
8										
9										
10										



DEPTH SCALE

1 : 50

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 17

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 25, 2004

DATUM: GEODETIC

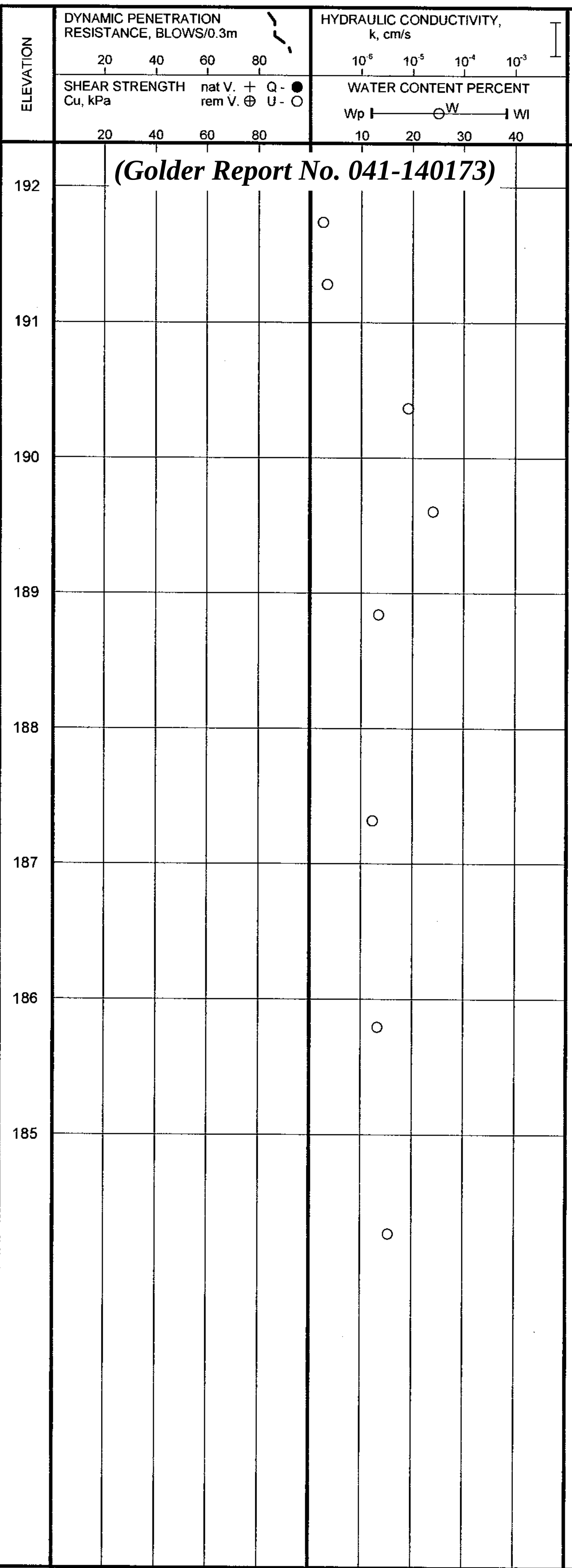
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES: 0 – 10

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m
PAVEMENT SURFACE	192.12			
ASPHALT	0.00			
Granular road base (**FILL**)	0.15	1 2	AS 50 DO	- -
CONCRETE	191.21 0.91			
Black, clayey topsoil, pockets of silty clay, pockets of sand, trace gravel (**FILL**)	1.07	3	50 DO	8
Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	190.14 1.98	4	50 DO	5
Very stiff to hard, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)	189.22 2.90	5	50 DO	30
Very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	188.31 3.81	6 7 8	50 DO 50 DO 50 DO	26 23 18
END OF BOREHOLE	184.04 8.08			



(Golder Report No. 041-140173)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on August 25, 2004

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 18

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 27, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

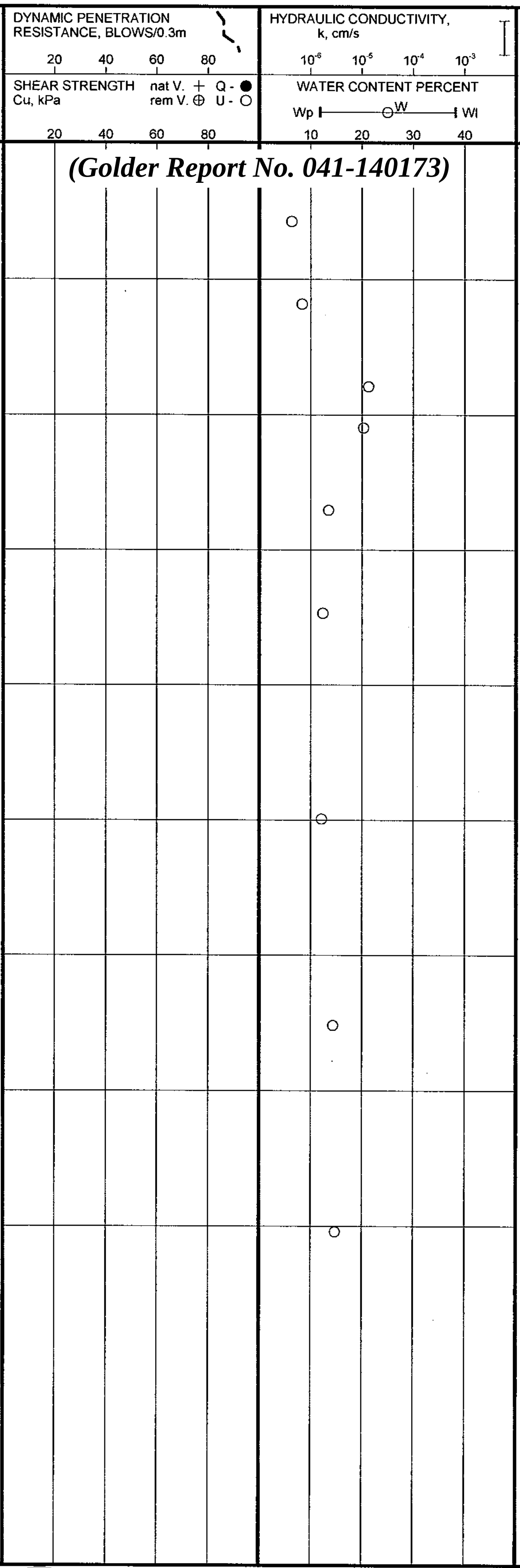
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
PAVEMENT SURFACE	191.81	
ASPHALT		0.00
Granular road base (**FILL**)		0.15
Black, clayey **TOPSOIL**	190.44	1.37
Firm to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	190.13	1.68
Hard, brown, **SILTY CLAY**, some sand, trace gravel, silt pockets (**TILL**)	188.91	2.90
Very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	187.70	4.11
END OF BOREHOLE	183.73	8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	50 DO	21
3	50 DO	5
4	50 DO	24
5	50 DO	46
6	50 DO	26
7	50 DO	23
8	50 DO	23



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on August 27, 2004

DEPTH SCALE 1 : 50

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 19

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 27, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		PAVEMENT SURFACE		191.90						
0	POWER AUGER SOLID STEM	**ASPHALT**	■	0.00						
		Granular road base (**FILL**)	▩	0.18 191.29	1	AS	-			
1		Compact, brown, sand and gravel subbase, silty clay pockets (**FILL**)	▩	0.61 190.53	2 3	50 DO 50 DO	17 18	191		Borehole dry during drilling on August 27, 2004
		Black, clayey **TOPSOIL**		1.37						
		Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		1.52 189.92	4	50 DO	14	190		
2		END OF BOREHOLE		1.98						
3										
4										
5										
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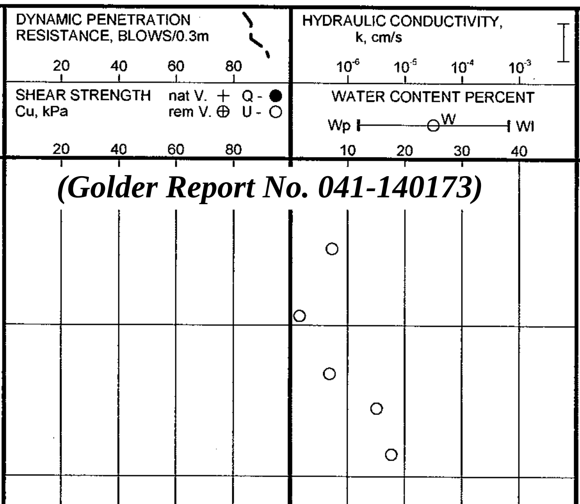
7										
8										
9										
10										



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 20

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 27, 2004

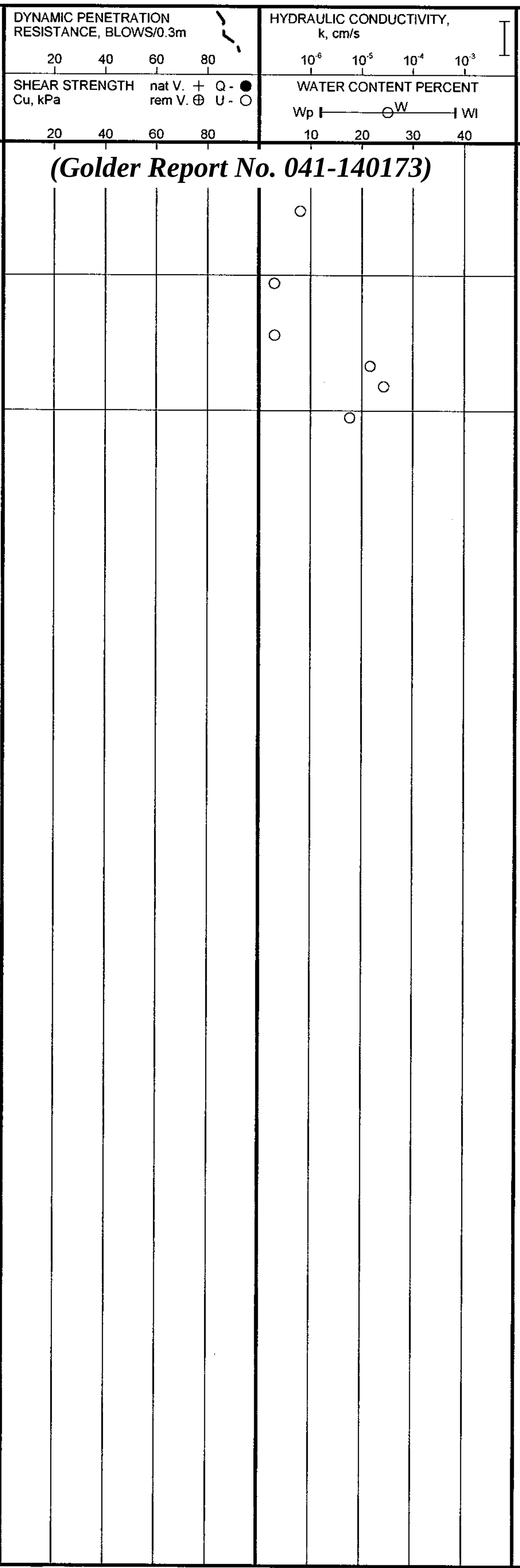
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SHOULDER SURFACE		191.78 0.00						
	POWER AUGER SOLID STEM	Sand and Gravel base (**FILL**)	▩		1	AS	-			Borehole dry during drilling on August 27, 2004
1					2	AS	9	191		
				190.41 1.37	3	AS	9			
		Stiff, brown, silty clay, some sand and gravel, topsoil pockets (**FILL**)	▩	190.10 1.68						
		Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		189.80 1.98	4	AS	7	190		
2		END OF BOREHOLE								
3										
4										
5										
6										
7										
8										
9										
10										



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED:

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 21

BORING DATE: AUGUST 26, 2004

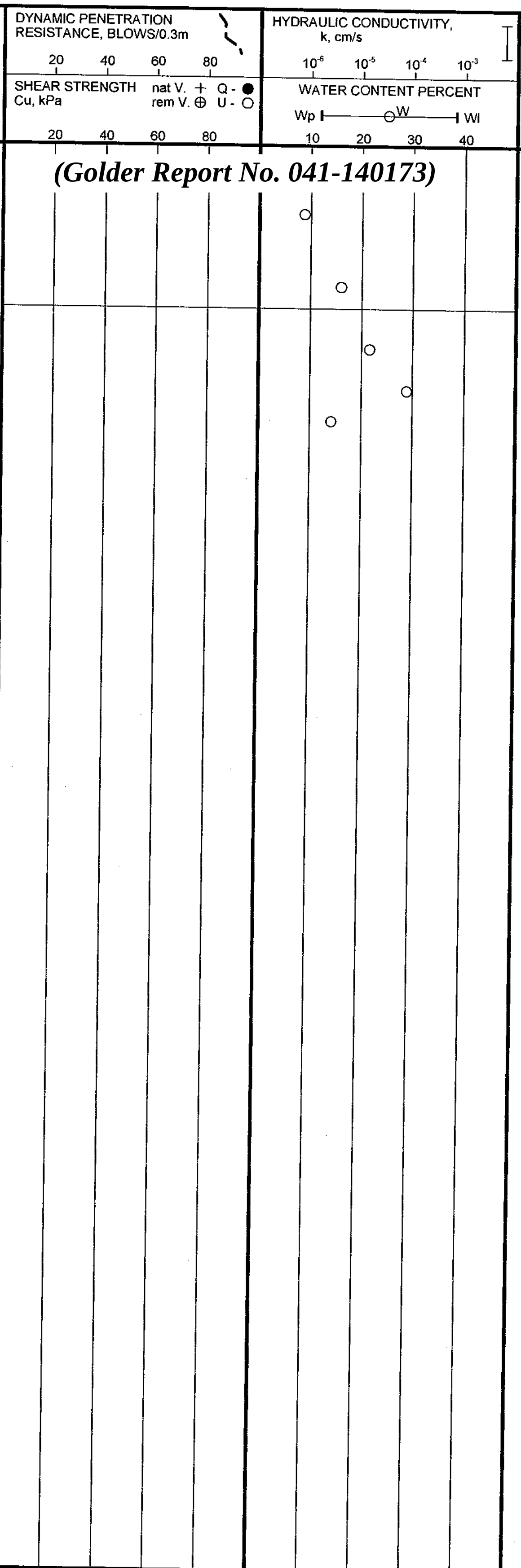
SHEET 1 OF 1

DATUM: GEODETIC

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		191.00						
	POWER AUGER SOLID STEM	Sand and gravel base, pockets of topsoil and clay (FILL)		0.00	1	AS	-			
1		Stiff, brown and grey, silty clay, some sand, trace gravel, topsoil pockets (FILL)		190.39 0.61	2	50 DO	13	190		Borehole dry during drilling on August 26, 2004
		Compact, brown sand and gravel, pieces of clay (FILL)		189.93 1.07	3	50 DO	16			
		Black, clayey topsoil (FILL)		189.48 1.52						
2		Very stiff, mottled brown and grey, silty clay, some sand, trace gravel (FILL)		1.68	4	50 DO	17			
		END OF BOREHOLE		189.02 1.98						
3										
4										
5										
6										
7										
8										
9										
10										



LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.B.

CHECKED: AB

PROJECT: 041-140173

RECORD OF BOREHOLE 22

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 26, 2004

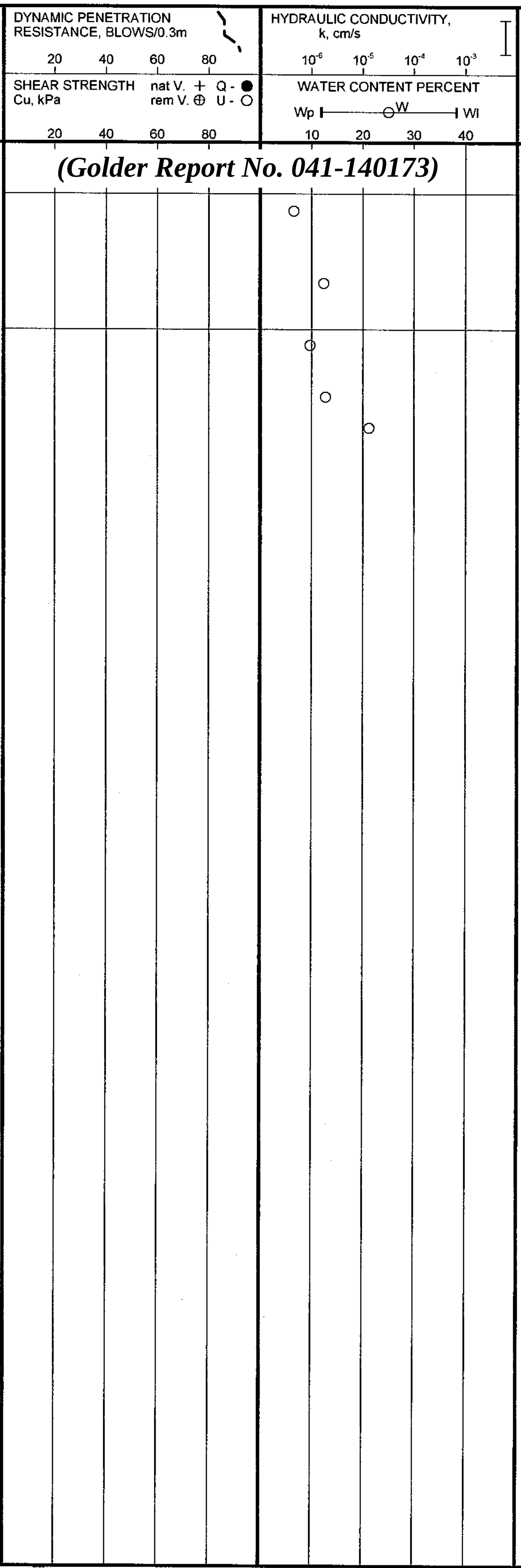
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SHOULDER SURFACE		191.18 0.00						
	POWER AUGER SOLID STEM	Black, sand and gravel base, some topsoil (**FILL**)	▨		1	AS	-	191		
		Hard to very stiff, brown and grey silty clay, sand and gravel, pockets of topsoil (**FILL**)	▨	190.57 0.61	2	50 DO	31			Borehole dry during drilling on August 26, 2004
1					3	50 DO	27	190		
					4	50 DO	10			
2		Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	▨	189.35 1.83						
		END OF BOREHOLE		1.98						
3										
4										
5										
6										
7										
8										
9										
10										



DEPTH SCALE

1 : 50

LOGGED: A.B.

CHECKED: AD

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 041-140173

RECORD OF BOREHOLE 23

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: AUGUST 26, 2004

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

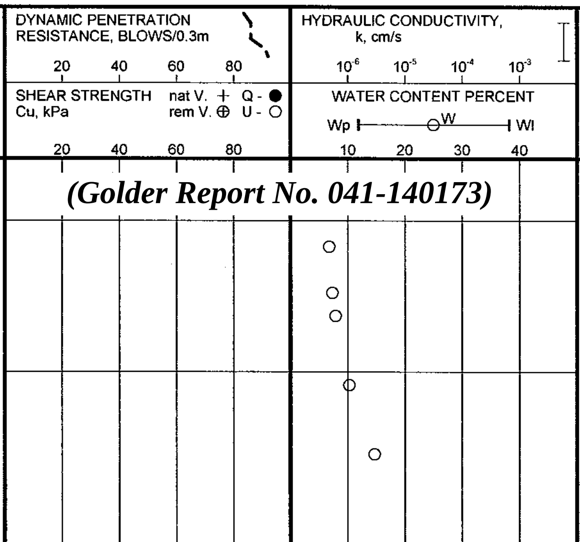
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0		PAVEMENT SURFACE	191.21
	POWER AUGER SOLID STEM	**ASPHALT**	0.00
1		Very dense to compact, Granular road base (**FILL**)	0.15
			189.69
		Hard, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, sand pockets (**TILL**)	1.52
2			189.23
		END OF BOREHOLE	1.98

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	50 DO	50
3	AS	-
4	50 DO	21
5	50 DO	37

ELEVATION: 191, 190



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Water level in borehole at about elevation 189.68 m upon completion of drilling on August 26, 2004

Depth scale: 0 1 2 3 4 5 6 7 8 9 10

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.B.
CHECKED:

PROJECT: 041-140173

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 24

BORING DATE: AUGUST 26, 2004

SHEET 1 OF 1

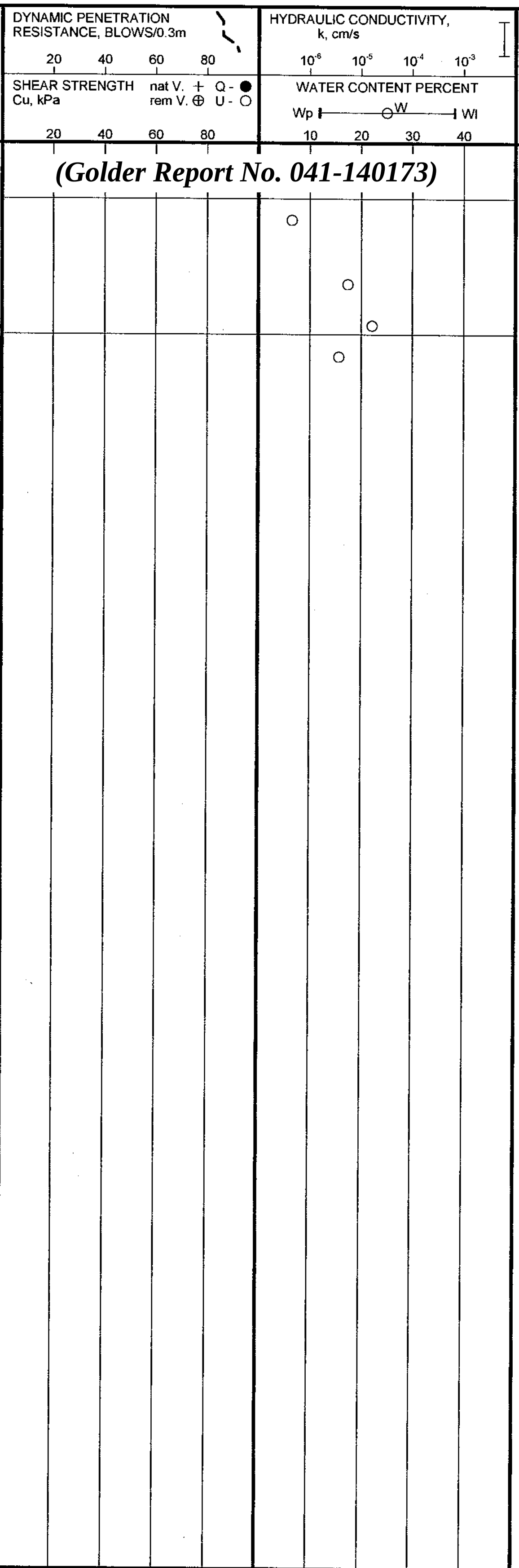
DATUM: GEODETIC

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 041-140173)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
PAVEMENT SURFACE		191.21					
ASPHALT	■	0.00					
Granular road base (**FILL**)	▨	0.13	1	AS	-	191	
Firm to stiff, brown and grey, silty clay, pockets of sand, silt and topsoil (**FILL**)	▨	190.60 0.61	2	50 DO	8		Borehole dry during drilling on August 26, 2004
Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		189.99 1.22	3	50 DO	13	190	
END OF BOREHOLE		189.69 1.52					



ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

LOGGED: A.B.

CHECKED: AB

LDN_BHS 041-140173.GPJ GLDR_CAN.GDT 10/4/04 DATA INPUT: Tony Mastroianni

PROJECT: 06-1140-021

RECORD OF BOREHOLE 1

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

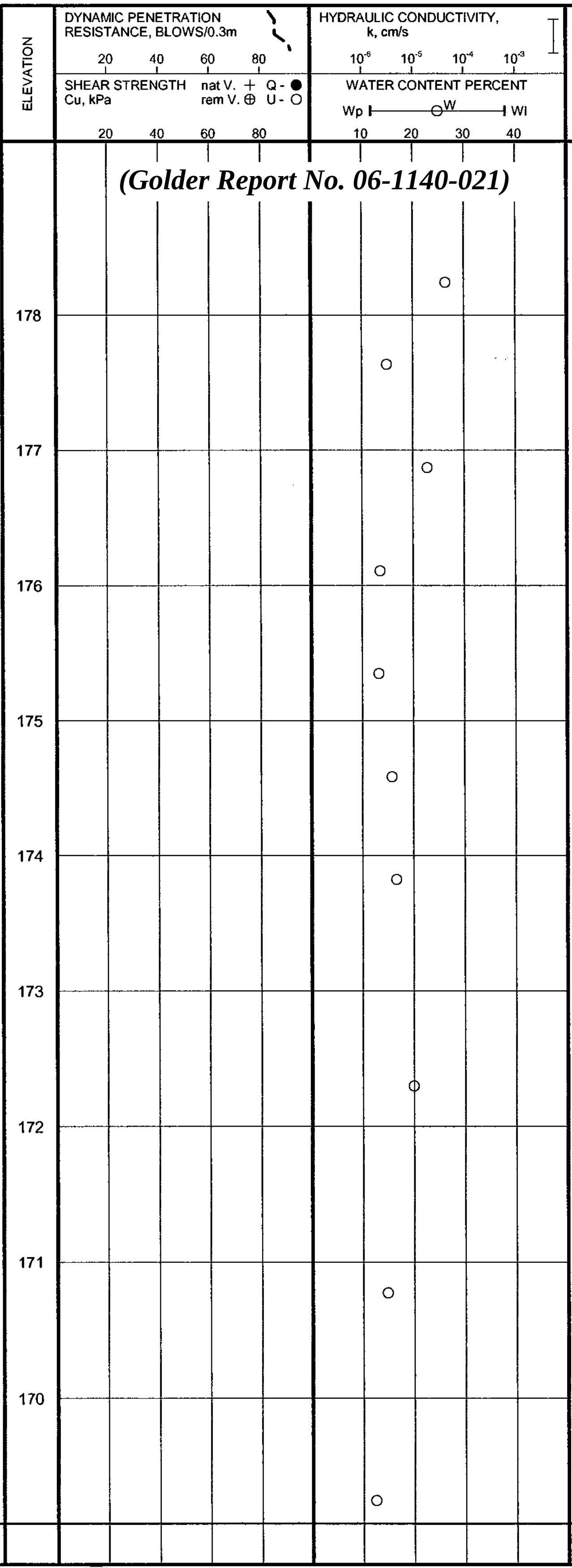
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		178.62 0.00
Brown, clayey topsoil (**FILL**)	▨	177.86 0.76
Brown, silty clay, some sand and gravel (**FILL**)	▨	177.25 1.37
Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		176.49 2.13
Very stiff to hard, brown, **SILTY CLAY**, some sand, trace gravel, fissured, occ. sand seams (**TILL**)		174.97 3.66
Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. sand pockets (**TILL**)		171.61 7.01
Hard, grey, **SILTY CLAY**, some sand, trace gravel, numerous silt seams and sand pockets (**TILL**)		170.09 8.53
Hard, grey, **CLAYEY SILT**, some sand, trace gravel, numerous sand pockets (**TILL**)		
— CONTINUED NEXT PAGE —		

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	18
3	SS	10
4	SS	35
5	SS	29
6	SS	17
7	SS	16
8	SS	13
9	SS	38
10	SS	58



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

∇

Water level in borehole at about elevation 171.62m upon completion of drilling on February 13, 2006

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

PROJECT: 06-1140-021

RECORD OF BOREHOLE 1

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —										
10	POWER AUGER SOLID STEM	Hard, grey, **CLAYEY SILT**, some sand, trace gravel, numerous sand pockets (TILL)		168.57 10.06				169				
11		Very dense, grey, **SILTY SAND**, some gravel, occ. clay pockets (**TILL**)		167.50 11.13	11	SS	55	168		○		
		END OF BOREHOLE										
12												
13												
14												
15												
16												
17												
18												
19												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.A.
CHECKED: A

PROJECT: 06-1140-021

RECORD OF BOREHOLE 2

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

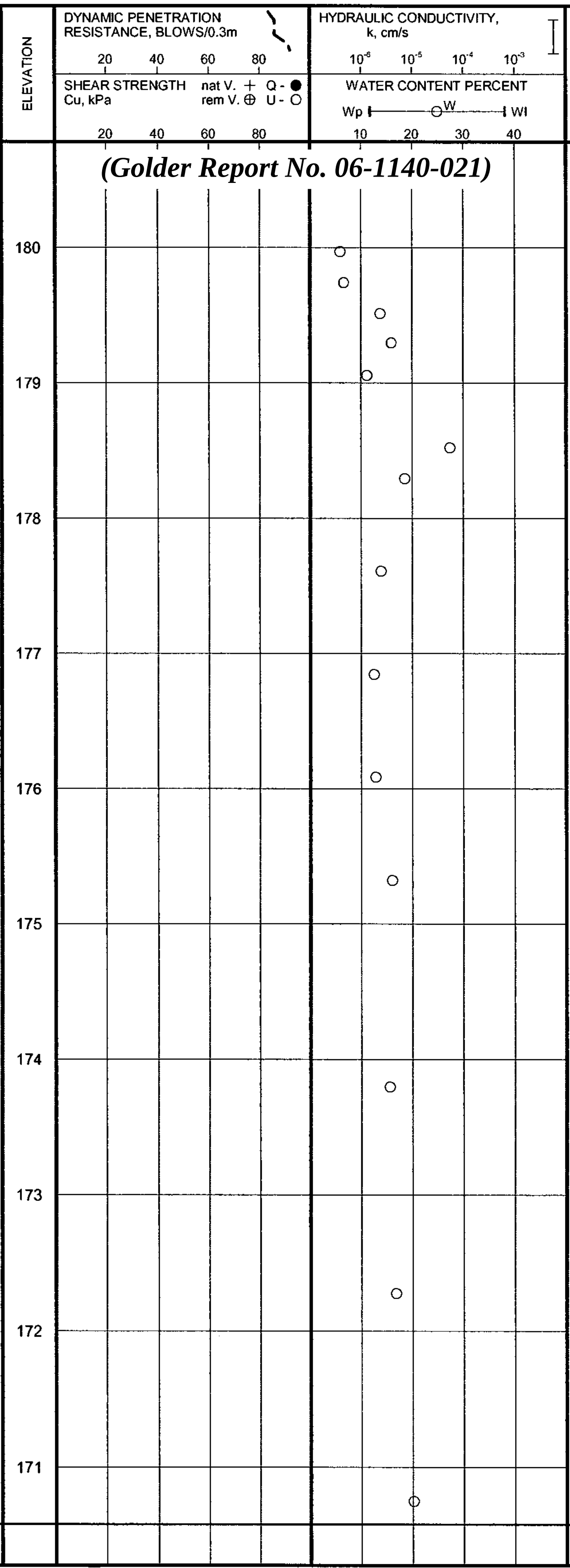
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.12 0.00
Grey, crushed granular base (**FILL**)	
Very stiff, brown, silty clay, some sand and gravel, trace organics (**FILL**)	179.67 0.46
Very stiff, black, clayey **TOPSOIL**	178.75 1.37
Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. sand seams (**TILL**)	178.45 1.68
Hard, brown, **CLAYEY SILT** to **SILTY CLAY**, some sand, trace gravel, occ. sand seams/ pockets (**TILL**)	177.23 2.90
Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	174.64 5.49

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	19
3	SS	28
4	SS	20
5	SS	16
6	SS	44
7	SS	37
8	SS	34
9	SS	14
10	SS	10
11	SS	15



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on February 15, 2006

— CONTINUED NEXT PAGE —

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

PROJECT: 06-1140-021

RECORD OF BOREHOLE 2

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —										
10	POWER AUGER SOLID STEM	Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)						170				
11					12	SS	13			○		
		END OF BOREHOLE		169.00 11.13				169				
12												
13												
14												
15												
16												
17												
18												
19												

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

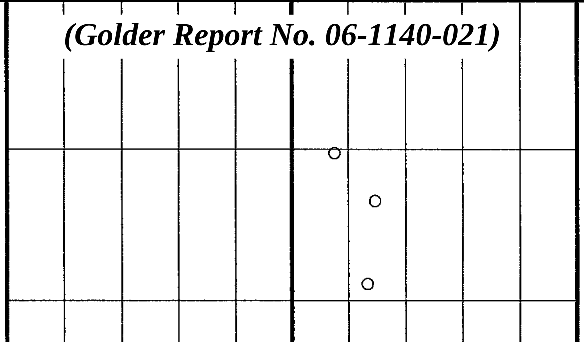
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	PAVEMENT SURFACE		180.33 0.00						
		CONCRETE		180.05 0.28						
		Brown, sand and gravel road base (**FILL**)		0.41	1	AS	-	180		
		Very stiff, brown, silty clay, some sand and gravel (**FILL**)			2	SS	16			Borehole dry during drilling on February 15, 2006
1				178.81 1.52	3	SS	18	179		
		END OF BOREHOLE								



Depth scale marks: 2, 3, 4, 5, 6, 7, 8, 9

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 4

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

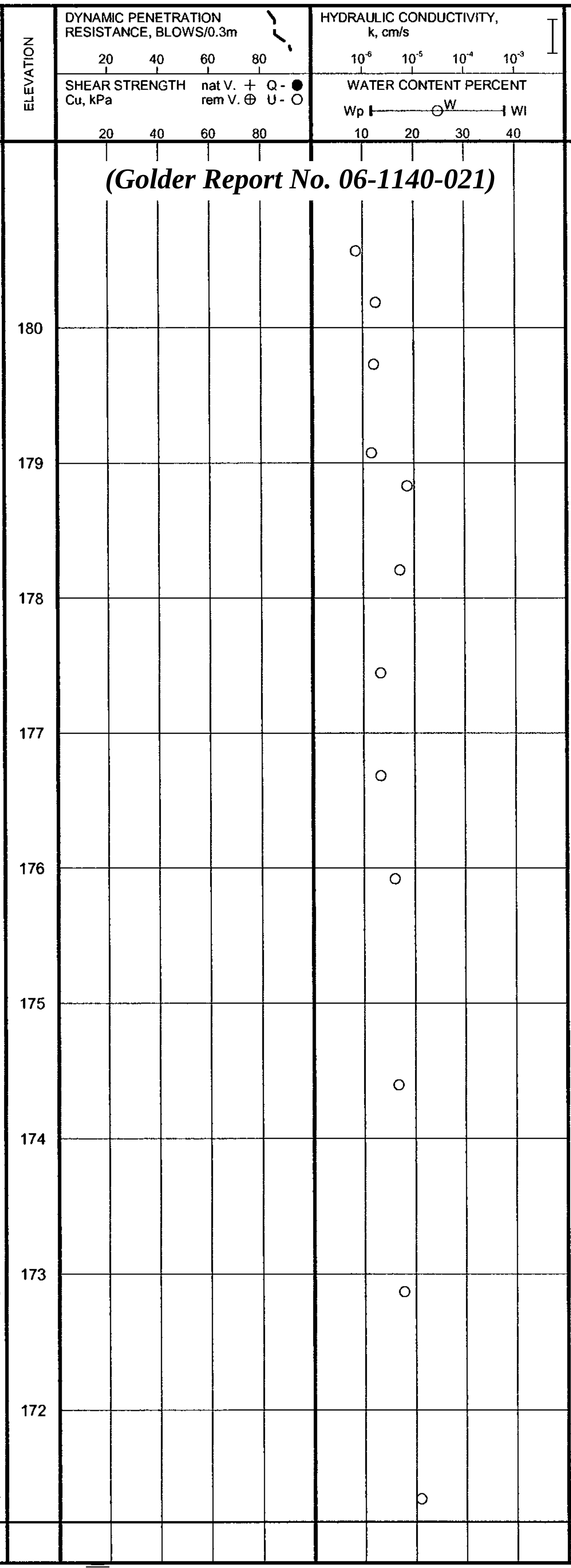
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.72 0.00
Grey, crushed granular base (**FILL**)	180.42 0.30
Very stiff, brown, silty clay, some sand and gravel (**FILL**)	178.95 1.77
Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	177.83 2.90
Hard, brown, **CLAYEY SILT** to **SILTY CLAY**, some sand, trace gravel, fissured, occ. sand pockets (**TILL**)	176.30 4.42
Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	19
3	SS	34
4	SS	21
5	SS	16
6	SS	32
7	SS	40
8	SS	15
9	SS	12
10	SS	13
11	SS	14



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on February 15, 2006

— CONTINUED NEXT PAGE —

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.A.
CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 4

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

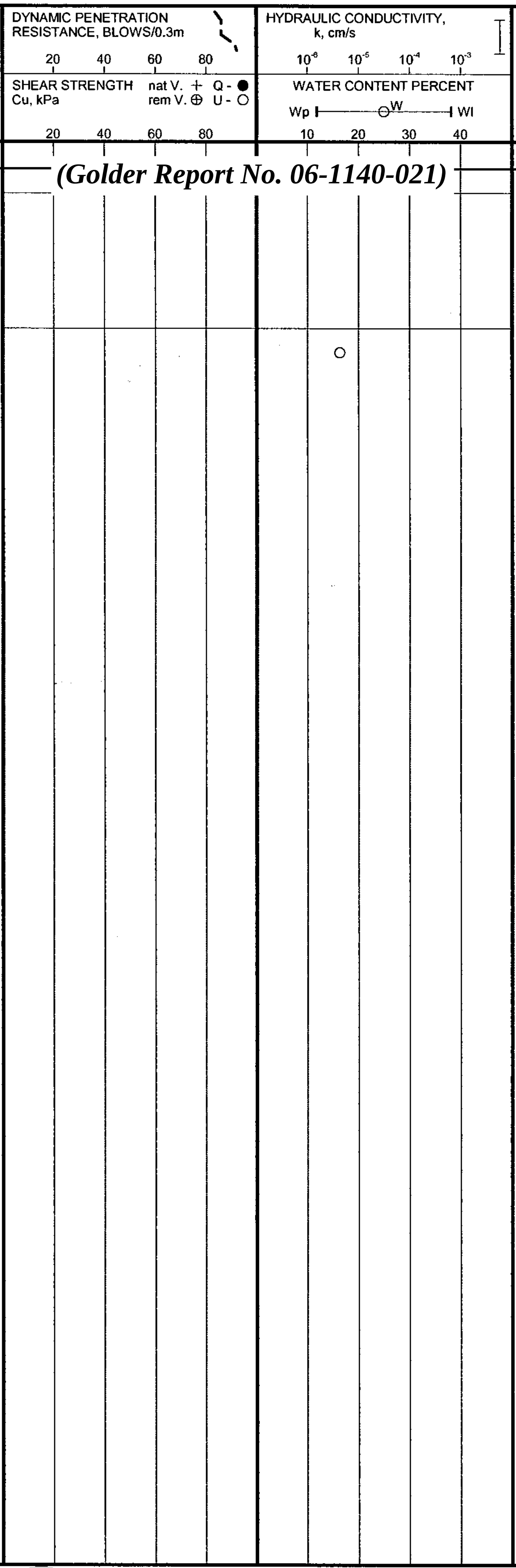
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —							
10	POWER AUGER SOLID STEM	Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	170.66 10.06				171		
11		Hard, grey, **SILTY CLAY**, some sand, trace gravel, stratified with silt and sand seams (**TILL**)	169.60 11.13	12	SS	38	170		
		END OF BOREHOLE							
12									
13									
14									
15									
16									
17									
18									
19									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED: Jr

PROJECT: 06-1140-021

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

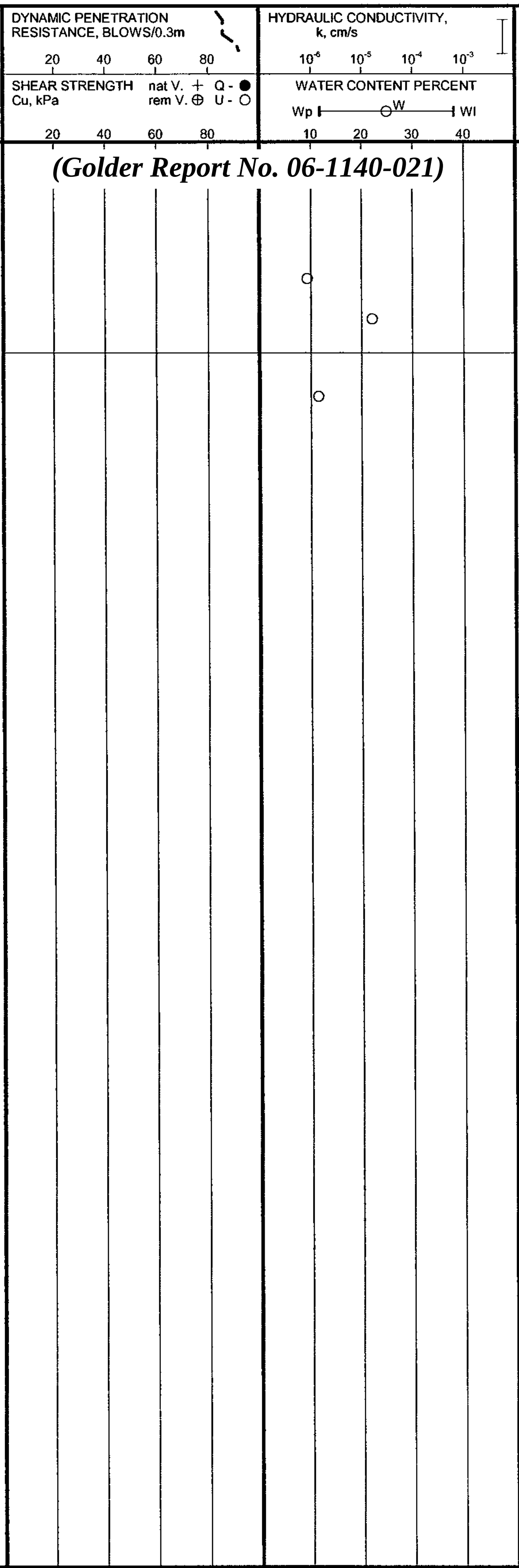
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	PAVEMENT SURFACE		180.90 0.00						
		CONCRETE		180.63 0.27	1	AS	-			
		Granular road base (**FILL**)		0.30						
		Brown, sand and gravel (**FILL**)		0.38	2	SS	13			Borehole dry during drilling on February 15, 2006
1		Stiff to very stiff, brown to grey, silty clay, some sand and gravel (**FILL**)			3	SS	23	180		
				179.38 1.52						
		END OF BOREHOLE								
2										
3										
4										
5										
6										
7										
8										
9										



LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 6

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

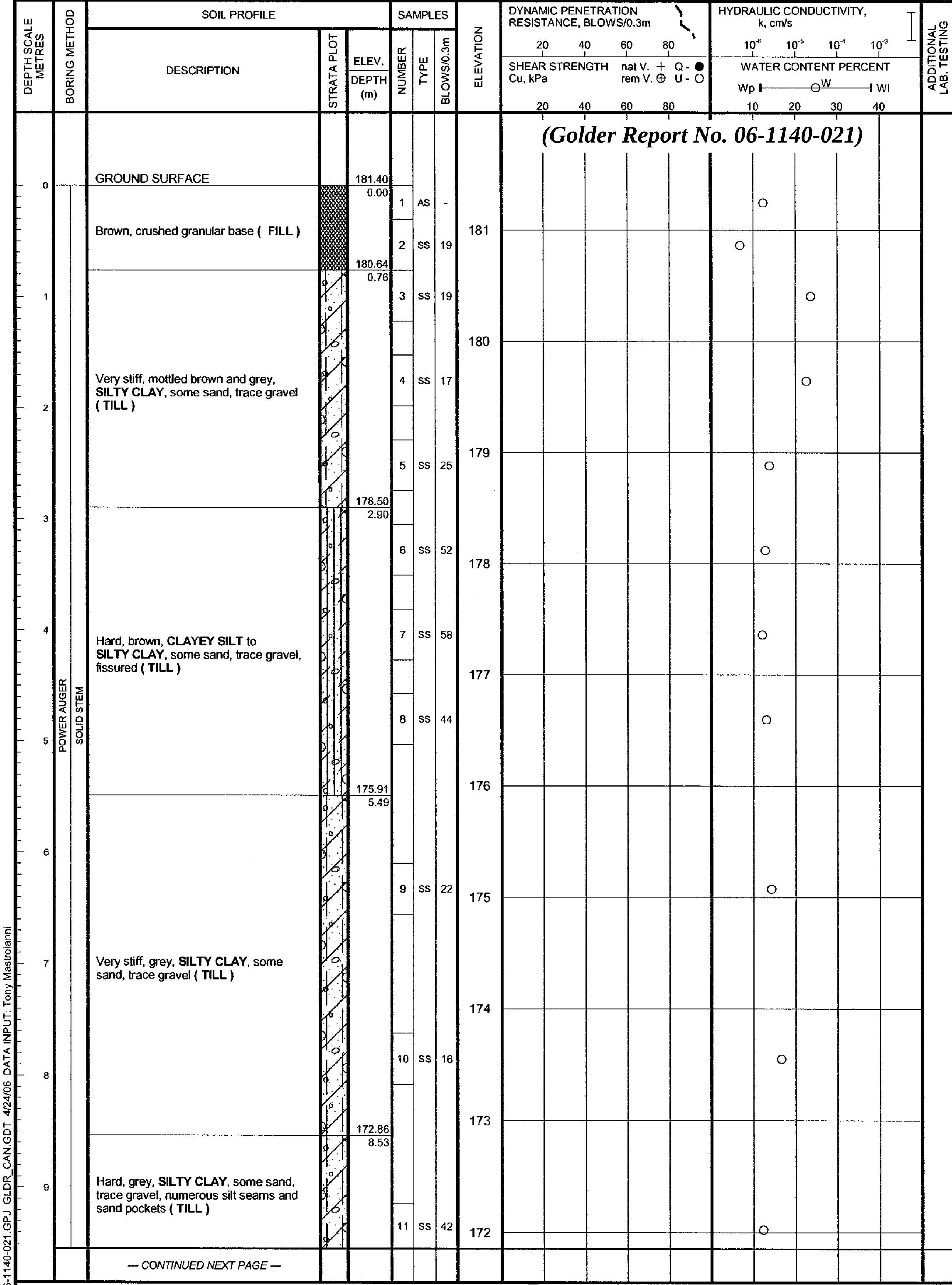
(Golder Report No. 06-1140-021)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.40 0.00
Brown, crushed granular base (FILL)	180.64 0.76
Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (TILL)	178.50 2.90
Hard, brown, **CLAYEY SILT** to **SILTY CLAY**, some sand, trace gravel, fissured (TILL)	175.91 5.49
Very stiff, grey, **SILTY CLAY**, some sand, trace gravel (TILL)	172.86 8.53
Hard, grey, **SILTY CLAY**, some sand, trace gravel, numerous silt seams and sand pockets (TILL)	

— CONTINUED NEXT PAGE —

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	19
3	SS	19
4	SS	17
5	SS	25
6	SS	52
7	SS	58
8	SS	44
9	SS	22
10	SS	16
11	SS	42



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on February 15, 2006

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.A.
CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 6

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ├──○W──┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —										
10	POWER AUGER SOLID STEM	Hard, grey, **SILTY CLAY**, some sand, trace gravel, numerous silt seams and sand pockets (**TILL**)		171.34 10.06								
		Very dense, grey, **SANDY SILT**, some clay, trace gravel (**TILL**)						171				
11				170.27 11.13	12	SS	60			○		
		END OF BOREHOLE										
12												
13												
14												
15												
16												
17												
18												
19												

(Golder Report No. 06-1140-021)

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED: 9

PROJECT: 06-1140-021

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

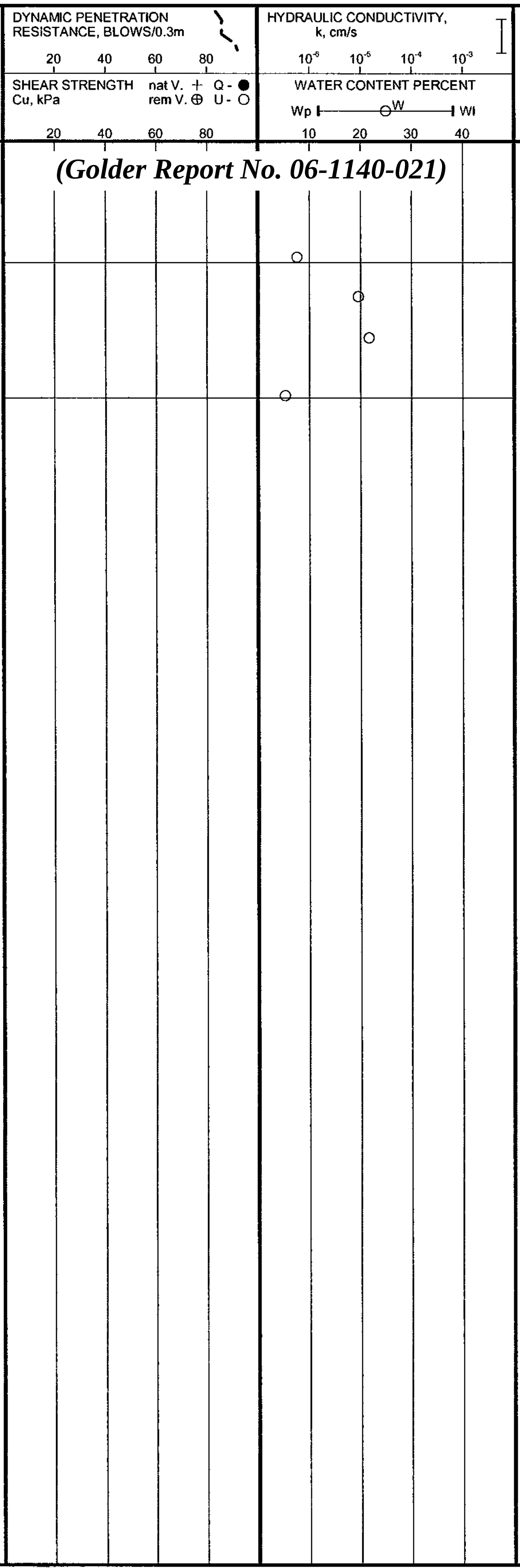
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	PAVEMENT SURFACE		182.24						
		ASPHALT	■	0.00 0.09						
		Grey, crushed granular road base (FILL)	▩	181.58 0.66	1	AS	-	182		
					2	SS	35			Borehole dry during drilling on February 15, 2006
1		Very stiff, brown, silty clay, some sand and gravel, trace organics (FILL)	▩	180.71 1.52	3	SS	16	181		
		END OF BOREHOLE								
2										
3										
4										
5										
6										
7										
8										
9										



LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 8

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

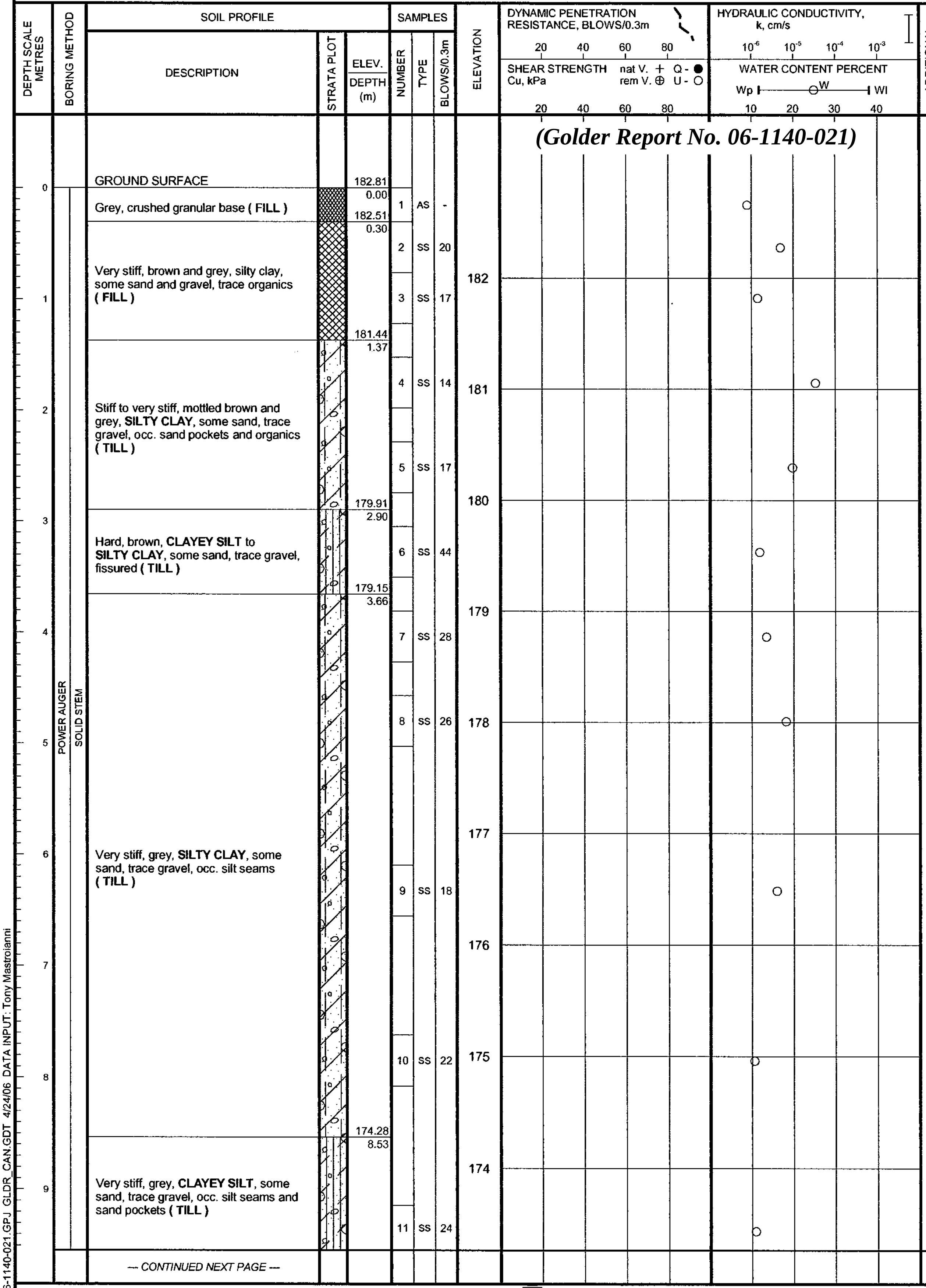
(Golder Report No. 06-1140-021)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	182.81 0.00
Grey, crushed granular base (**FILL**)	182.51 0.30
Very stiff, brown and grey, silty clay, some sand and gravel, trace organics (**FILL**)	181.44 1.37
Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. sand pockets and organics (**TILL**)	179.91 2.90
Hard, brown, **CLAYEY SILT** to **SILTY CLAY**, some sand, trace gravel, fissured (**TILL**)	179.15 3.66
Very stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. silt seams (**TILL**)	174.28 8.53
Very stiff, grey, **CLAYEY SILT**, some sand, trace gravel, occ. silt seams and sand pockets (**TILL**)	

— CONTINUED NEXT PAGE —

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	20
3	SS	17
4	SS	14
5	SS	17
6	SS	44
7	SS	28
8	SS	26
9	SS	18
10	SS	22
11	SS	24



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on February 15, 2006

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.A.
CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 8

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —										
								173				
10	POWER AUGER SOLID STEM	Very stiff, grey, **CLAYEY SILT**, some sand, trace gravel, occ. silt seams and sand pockets (**TILL**)										
								172				
					12	SS	26			○		
11				171.68 11.13								
		END OF BOREHOLE										
12												
13												
14												
15												
16												
17												
18												
19												

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED: Q

PROJECT: 06-1140-021

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

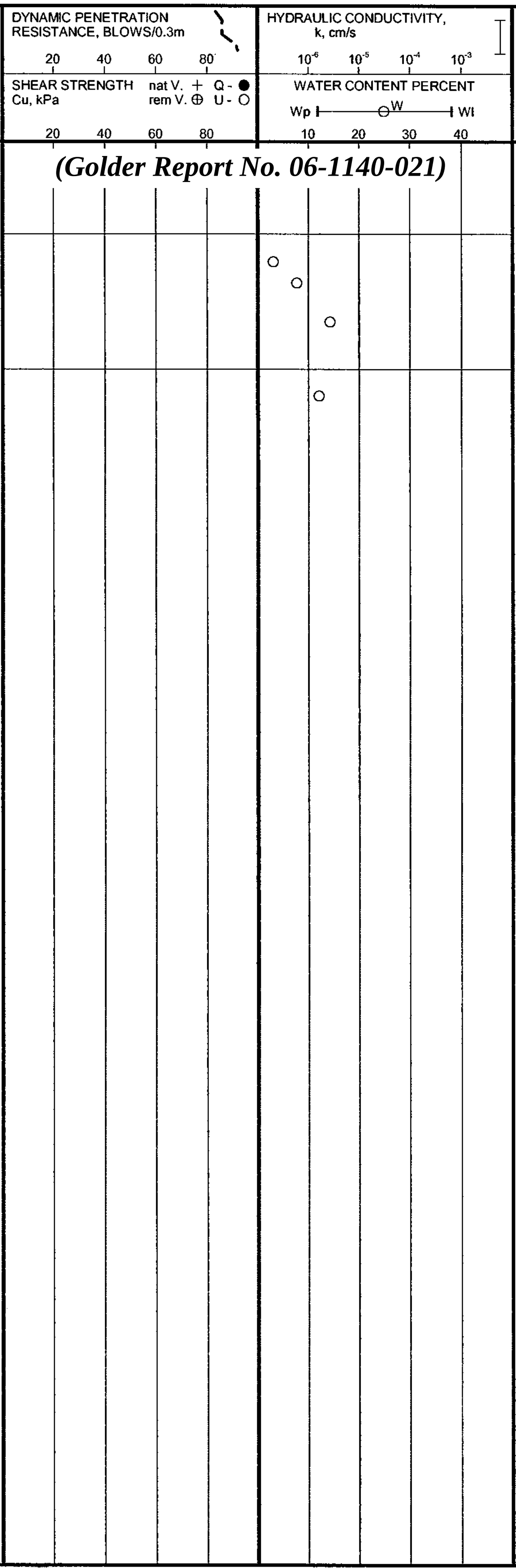
BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		PAVEMENT SURFACE		183.02				183		
	POWER AUGER SOLID STEM	**ASPHALT**	■	0.00						
		Grey, sand and gravel, road base **(FILL)**	▨	0.16 182.54	1	AS	-			
		Very stiff, brown, silty clay, some sand and gravel **(FILL)**	▨	0.48	2	SS	26			Borehole dry during drilling on February 15, 2006
1					3	SS	17	182		
				181.50						
		END OF BOREHOLE		1.52						
2										
3										
4										
5										
6										
7										
8										
9										



(Golder Report No. 06-1140-021)

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 10

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

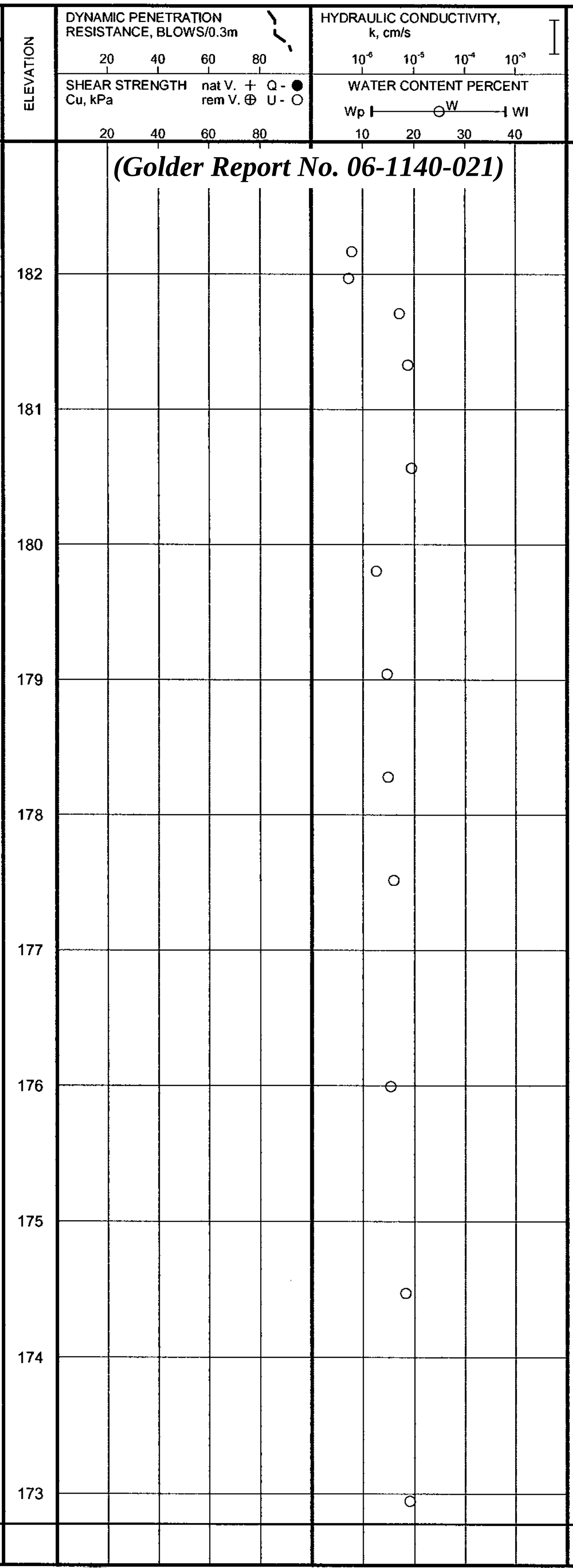
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
0	POWER AUGER SOLID STEM	GROUND SURFACE	182.32 0.00			
		Grey, crushed granular base (**FILL**)		1	AS	-
		Stiff, brown, silty clay, trace gravel, numerous sand pockets (**FILL**)	181.91 0.41	2	SS	15
1–2		Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	181.56 0.76	3 4	SS SS	12 21
2–3		Hard, brown, **CLAYEY SILT**, some sand, trace gravel, fissured, occ. sand seams (**TILL**)	180.19 2.13	5 6	SS SS	57 51
4–9		Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	178.66 3.66	7 8 9 10 11	SS SS SS SS SS	22 16 14 15 14

— CONTINUED NEXT PAGE —



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.A.
CHECKED: Q

PROJECT: 06-1140-021

RECORD OF BOREHOLE 10

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —										
10	POWER AUGER SOLID STEM	Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		172.26 10.06								
		Stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)						172				
11				171.19 11.13	12	SS	14			○		
		END OF BOREHOLE										
12												
13												
14												
15												
16												
17												
18												
19												

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED: Qy

PROJECT: 06-1140-021

RECORD OF BOREHOLE 11

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
POWER AUGER SOLID STEM	PAVEMENT SURFACE	182.44				
	ASPHALT	0.00				
	Grey, crushed granular road base (**FILL**)	0.16	1	AS	-	
	Very stiff, brown and grey, silty clay, occ. topsoil pockets (**FILL**)	181.93 0.51	2	SS	20	Borehole dry during drilling on February 15, 2006
	Very stiff, black, clayey **TOPSOIL**	181.53 0.91				
	Very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	1.07	3	SS	16	
	END OF BOREHOLE	180.92 1.52				

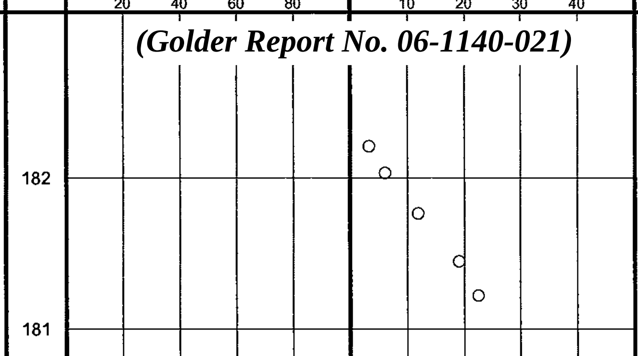
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl ; 10 20 30 40

ADDITIONAL LAB. TESTING



DEPTH SCALE 1 : 50

LOGGED: A.A.

CHECKED: Q

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

PROJECT: 06-1140-021

RECORD OF BOREHOLE 12

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

BORING METHOD: POWER AUGER, SOLID STEM

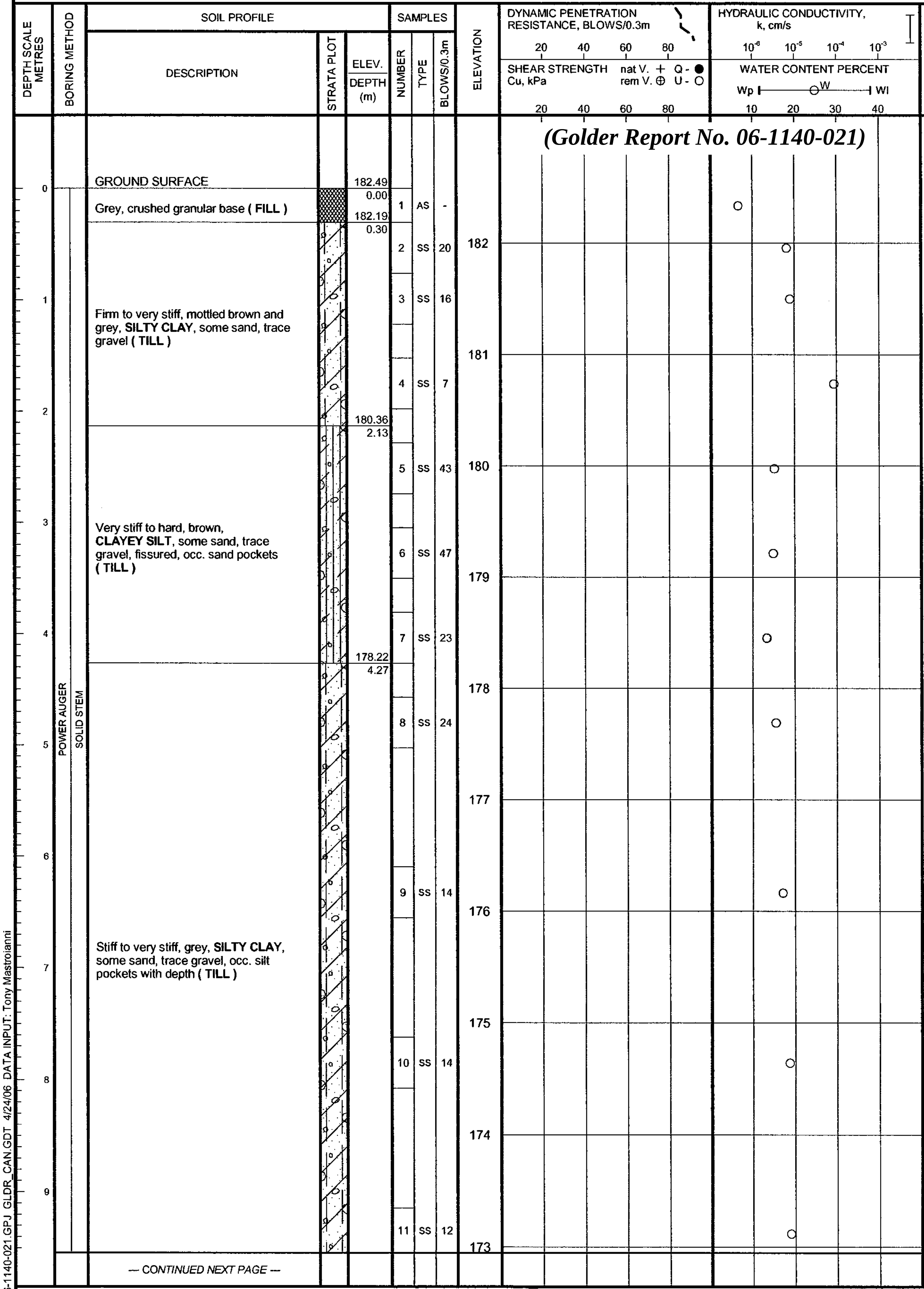
SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	182.49
Grey, crushed granular base (**FILL**)	0.00
Firm to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	182.19 0.30
Very stiff to hard, brown, **CLAYEY SILT**, some sand, trace gravel, fissured, occ. sand pockets (**TILL**)	180.36 2.13
Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. silt pockets with depth (**TILL**)	178.22 4.27

— CONTINUED NEXT PAGE —

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	20
3	SS	16
4	SS	7
5	SS	43
6	SS	47
7	SS	23
8	SS	24
9	SS	14
10	SS	14
11	SS	12



INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on February 15, 2006

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-021

RECORD OF BOREHOLE 12

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: FEBRUARY 13, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-021)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10⁻⁶ 10⁻⁵ 10⁻⁴ 10⁻³); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		— CONTINUED FROM PREVIOUS PAGE —										
10	POWER AUGER SOLID STEM	Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. silt pockets with depth (**TILL**)		172.43 10.06								
		Hard, grey, **SILTY CLAY**, some sand, trace gravel, occ. cobbles (**TILL**)						172				
11				171.37 11.13	12	SS	81			○		
		END OF BOREHOLE										
12												
13												
14												
15												
16												
17												
18												
19												

LDN_BHS 06-1140-021.GPJ GLDR_CAN.GDT 4/24/06 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: A.A.

CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: NOVEMBER 29, 2006

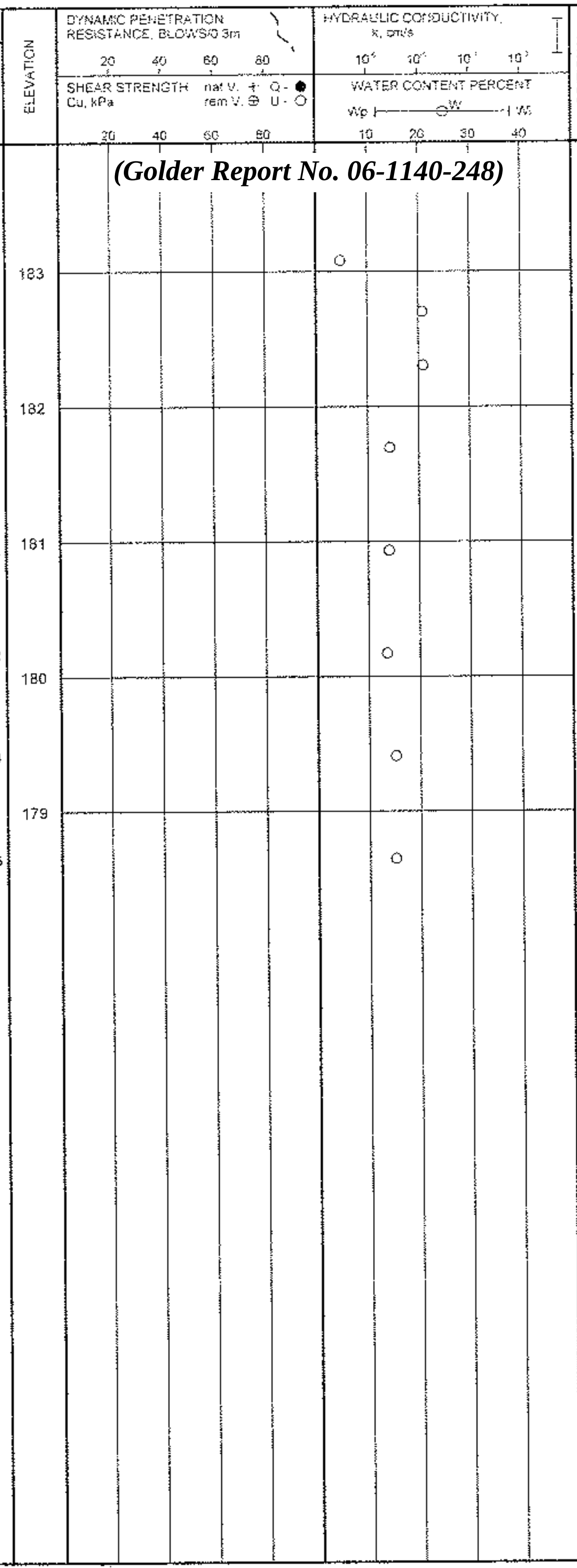
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
		PAVEMENT SURFACE	183.45				
0	POWER AUGER SOLID STEM	**ASPHALT**	0.00				
		Brown, granular road base (**FILL**)	0.18 182.89	1	AS	-	
		Firm, dark brown, silty clay, some sand, trace gravel (**FILL**)	182.38 1.07	2	SS	7	
1		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	181.32 2.13	3	SS	14	
2		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. silt seams (**TILL**)		4	SS	23	Borehole dry during drilling on November 29, 2006
3				5	SS	22	
4			178.88 4.57	6	SS	24	
		Very stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	178.42	7	SS	15	
5		END OF BOREHOLE	5.03				
6							
7							
8							
9							



LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.R.

CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: NOVEMBER 29, 2006

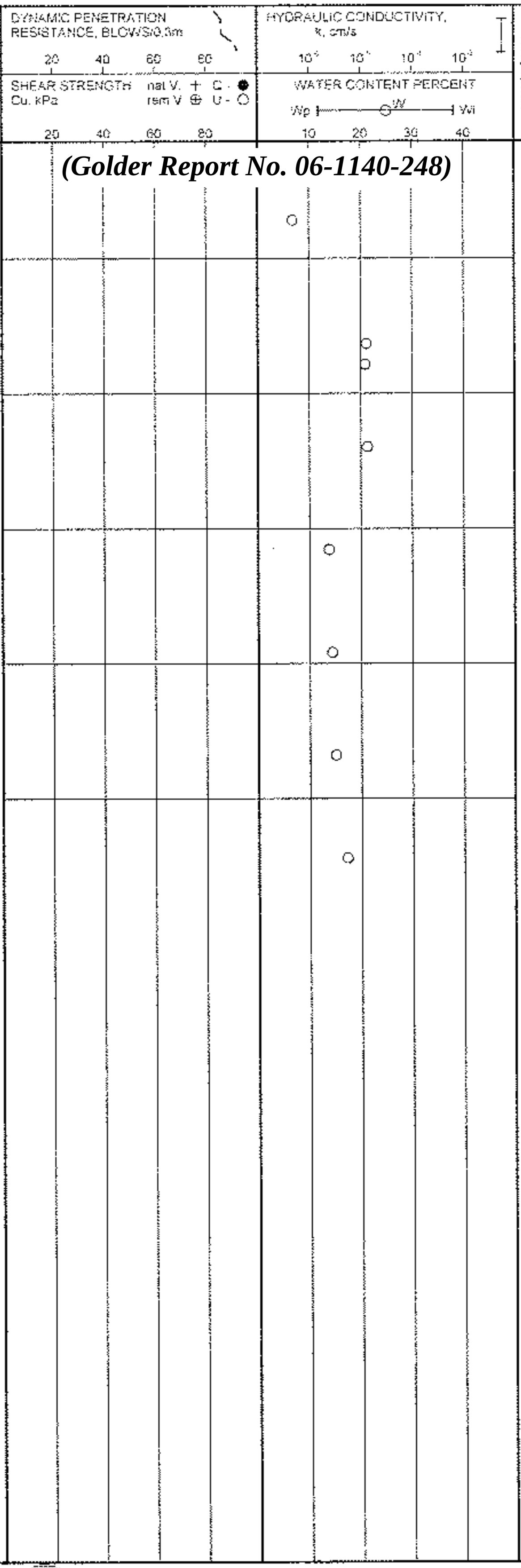
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
		PAVEMENT SHOULDER SURFACE					
0	POWER AUGER SOLID STEM	Brown, granular road base (**FILL**)	183.36 0.00				
		Black, clayey **TOPSOIL**	183.06 0.30	1 2	AS SS	- 7	183
1		Firm, mottled brown and grey. **SILTY CLAY**, some sand, trace gravel (**TILL**)	182.29 1.07	3	SS	7	182
2 3		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)	181.36 1.98	4 5	SS SS	21 26	181 180
4		Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	179.55 3.81	6 7	SS SS	19 13	179
5		END OF BOREHOLE	178.33 5.03				
6 7 8 9							



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

▽

Water seepage into borehole encountered at about elevation 181.3m during drilling

Borehole dry upon completion of drilling on November 29, 2006

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.R.
CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: NOVEMBER 29, 2006

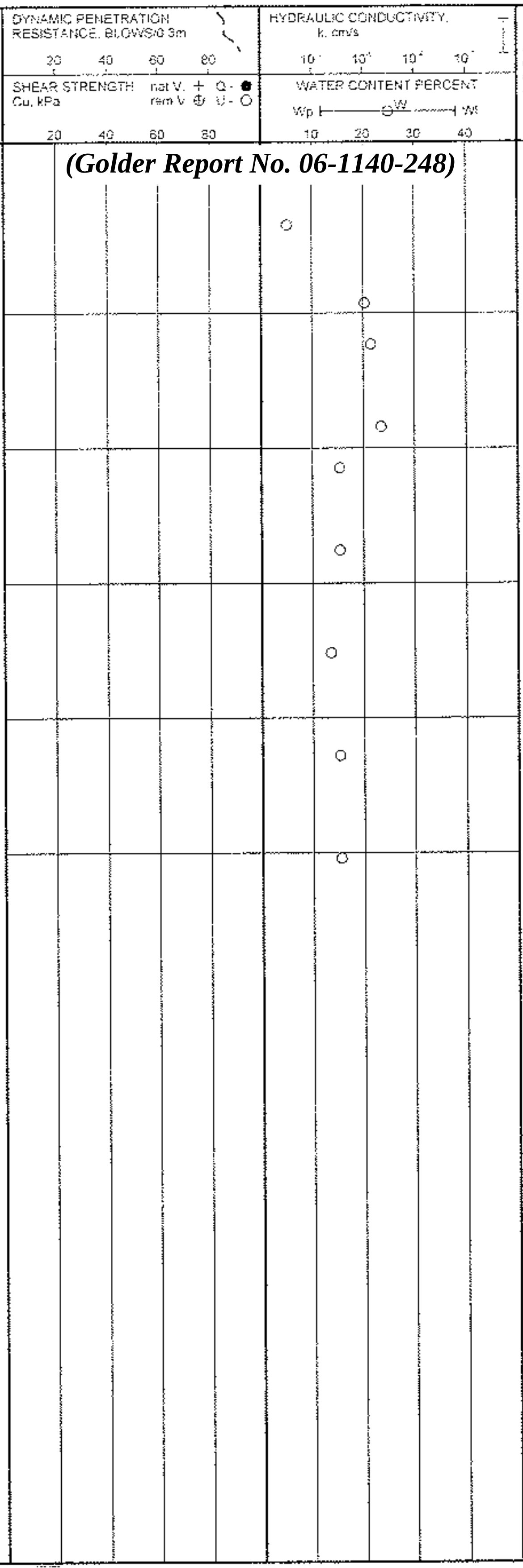
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
		PAVEMENT SURFACE	182.76				
0	POWER AUGER SOLID STEM	**TAR and CHIP**	0.04				
		Brown, granular road base (**FILL**)	182.43 0.33	1	AS	-	
		Black, clayey **TOPSOIL**	182.00 0.76				182
1		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	181.08 1.68	2	SS	6	
2		Stiff to very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. silt seams, oxidized and fissured(**TILL**)	179.10 3.66	3	SS	10	181
				4	SS	24	180
3				5	SS	26	
4		Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	177.73 5.03	6	SS	16	179
				7	SS	11	178
5		END OF BOREHOLE					
6							
7							
8							
9							



ADDITIONAL LAB TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on November 29, 2006

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NR

CHECKED:

PROJECT: 06-1140-248

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 4

BORING DATE: NOVEMBER 29, 2006

SHEET 1 OF 1

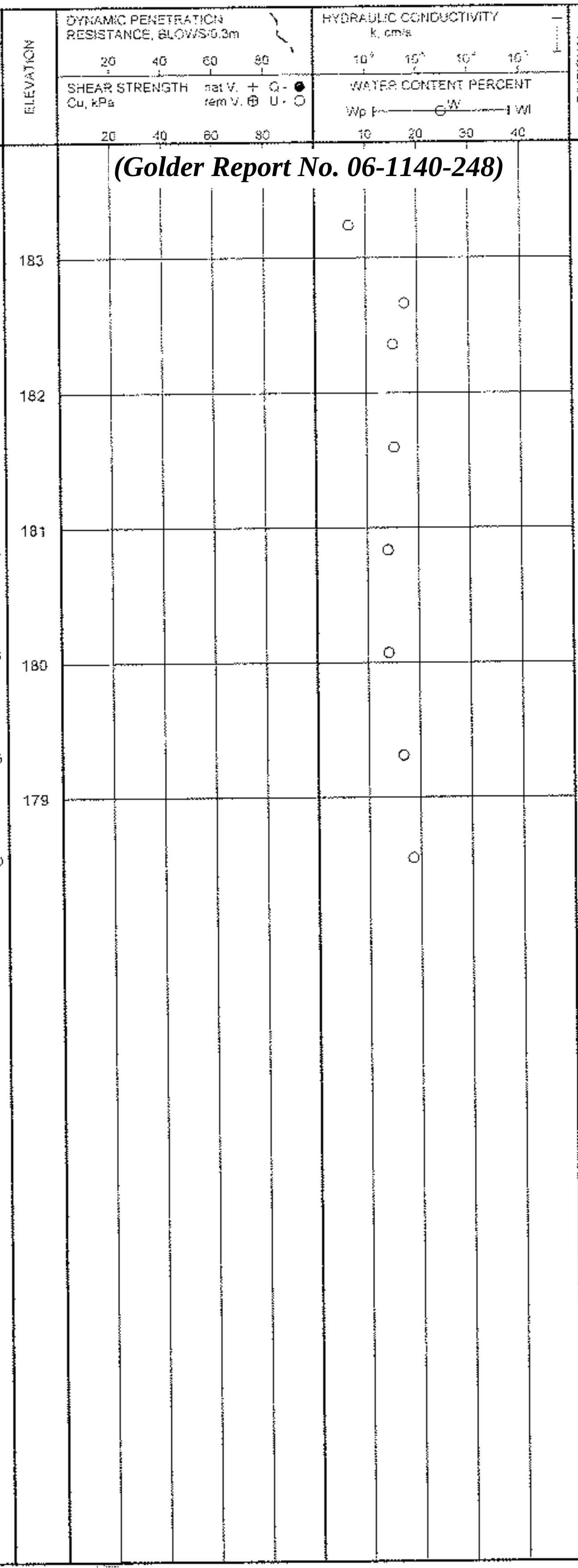
DATUM: GEODETIC

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV DEPTH (m)
		PAVEMENT SURFACE		183.35
0	POWER AUGER SOLID STEM	**TAR and CHIP**		0.04
		Brown, granular road base (**FILL**)		183.10 0.25
		Brown, silty clay, some sand, trace gravel, mixed with topsoil (**FILL**)		182.44 0.91
1		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		181.22 2.13
2–3		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. oxidized and fissured (**TILL**)		179.54 3.81
4		Stiff, grey, **SILTY CLAY**, some sand, trace gravel, oxidized and fissured (**TILL**)		178.32 5.03
5		END OF BOREHOLE		

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	6
3	SS	12
4	SS	28
5	SS	26
6	SS	15
7	SS	10



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

∇

Water seepage into borehole encountered at about elevation 178.8m during drilling

Borehole dry upon completion of drilling on November 29, 2006

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.R.

CHECKED:

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

PROJECT: 06-1140-248

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: NOVEMBER 29, 2006

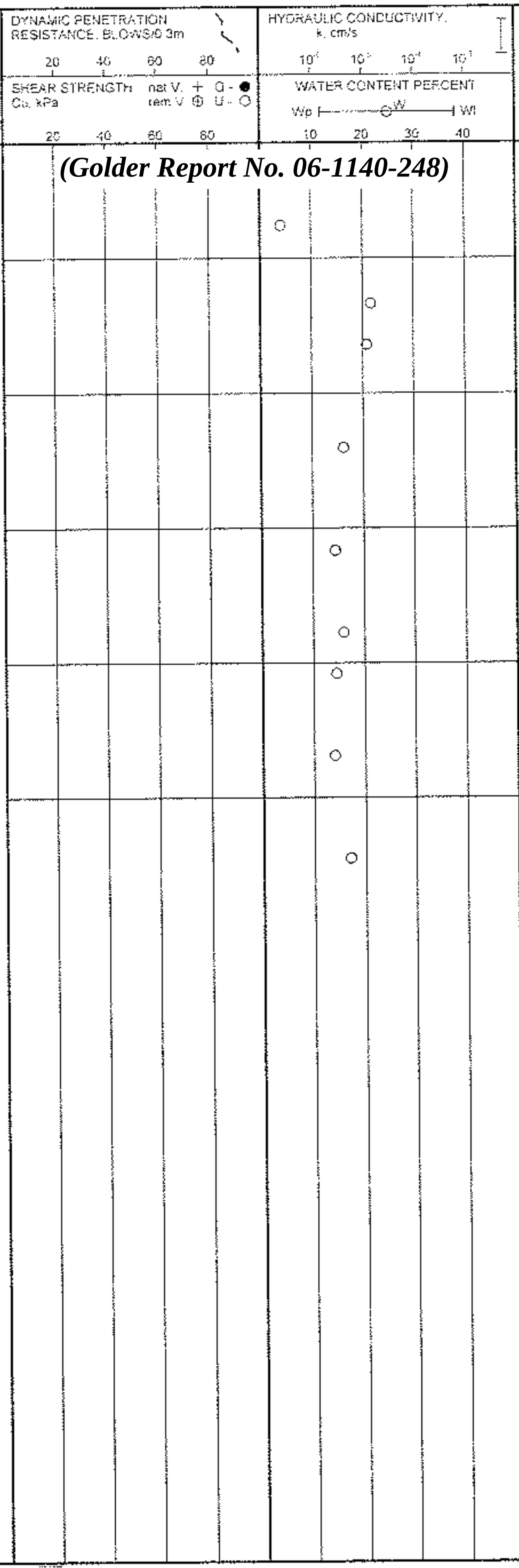
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	PAVEMENT SURFACE		183.35					
		TAR and CHIP		0.04					
		Brown, granular road base (FILL)							
		Black, clayey **TOPSOIL**		183.05 0.30	1	AS	-	183	
1		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (TILL)		182.44 0.91	2 3	SS SS	5 9	182	
2		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. oxidized, fissured, silt seams (**TILL**)		181.37 1.98	4 5	SS SS	26 28	181	Borehole dry during drilling on November 29, 2006
3		Very stiff to firm, grey, **SILTY CLAY**, some sand, trace gravel (TILL)		180.00 3.35	6 7	SS SS	9 7	180 179	
5		END OF BOREHOLE		178.52 5.03					



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MR

CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION. SEE LOCATION PLAN

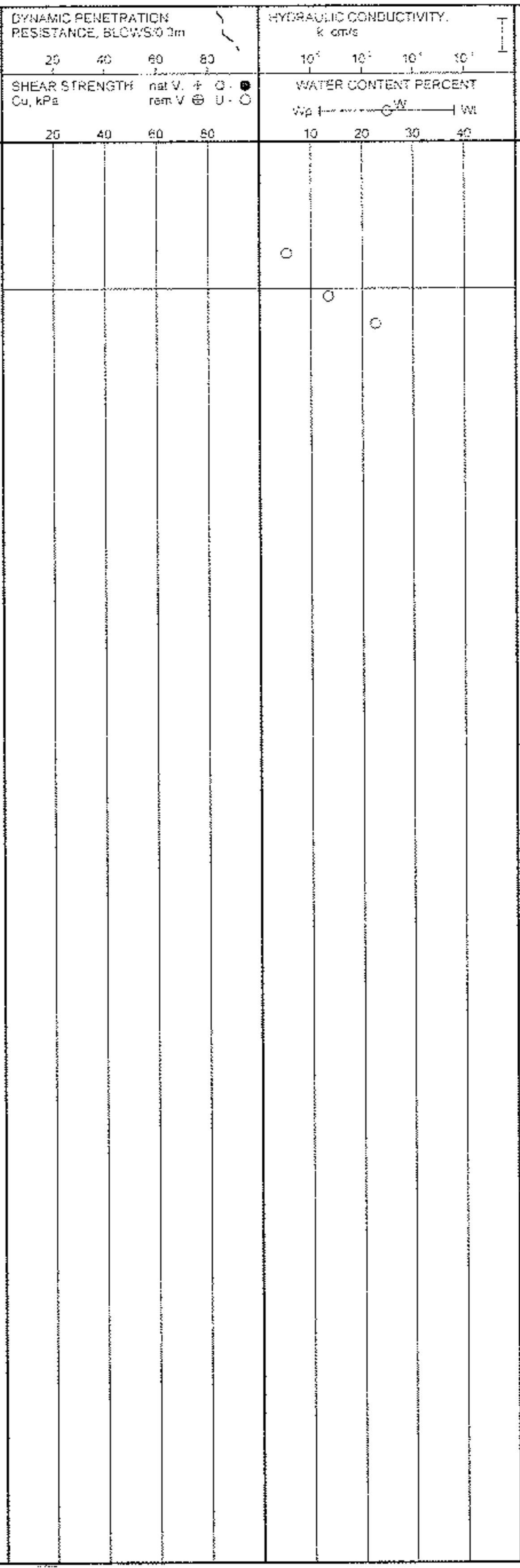
BORING DATE: DECEMBER 5, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	PAVEMENT SURFACE		183.56 0.00						
		ASPHALT	▇	0.13						
		Brown, granular road base (**FILL**)	▨	183.07 0.51	1	AS	-			
		Brown, sand, trace silt and clay (**FILL**)	▨	182.82 0.76	2	AS	-	183		Borehole dry during drilling on December 5, 2006
		Brown, silty clay, some sand, trace gravel, mixed with topsoil (**FILL**)	▨	0.91	3	AS	-			
1		END OF BOREHOLE								



LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.R.

CHECKED: Ok

PROJECT: 06-1140-248

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 5, 2006

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

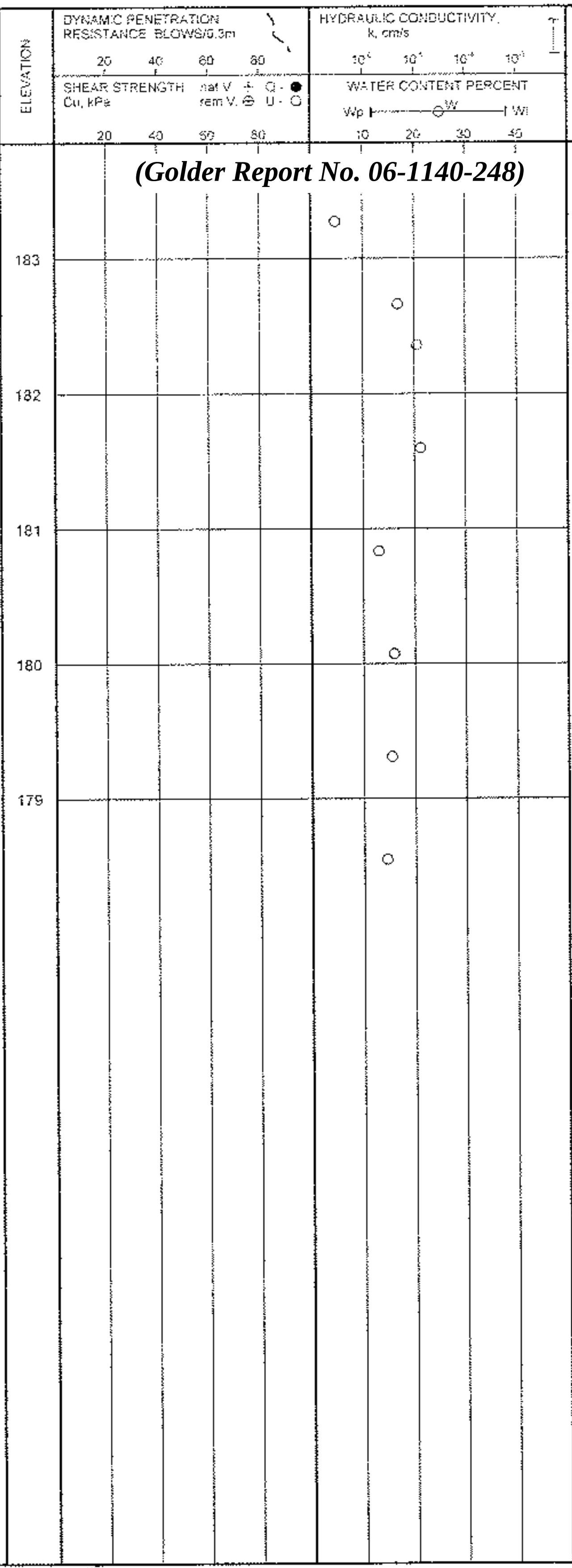
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV DEPTH (m)
PAVEMENT SHOULDER SURFACE	183.35 0.00
Brown, granular road base (**FILL**)	183.12 0.23
Black, clayey **TOPSOIL**	182.59 0.76
Stiff to firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	181.22 2.13
Very stiff, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)	180.45 2.90
Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. sand seams, oxidized and fissured (**TILL**)	178.32 5.03
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	9
3	SS	7
4	SS	25
5	SS	21
6	SS	12
7	SS	8



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

∇

Water seepage into borehole encountered at about elevation 181.1m during drilling

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.R.

CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 8

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 5, 2006

DATUM: GEODETIC

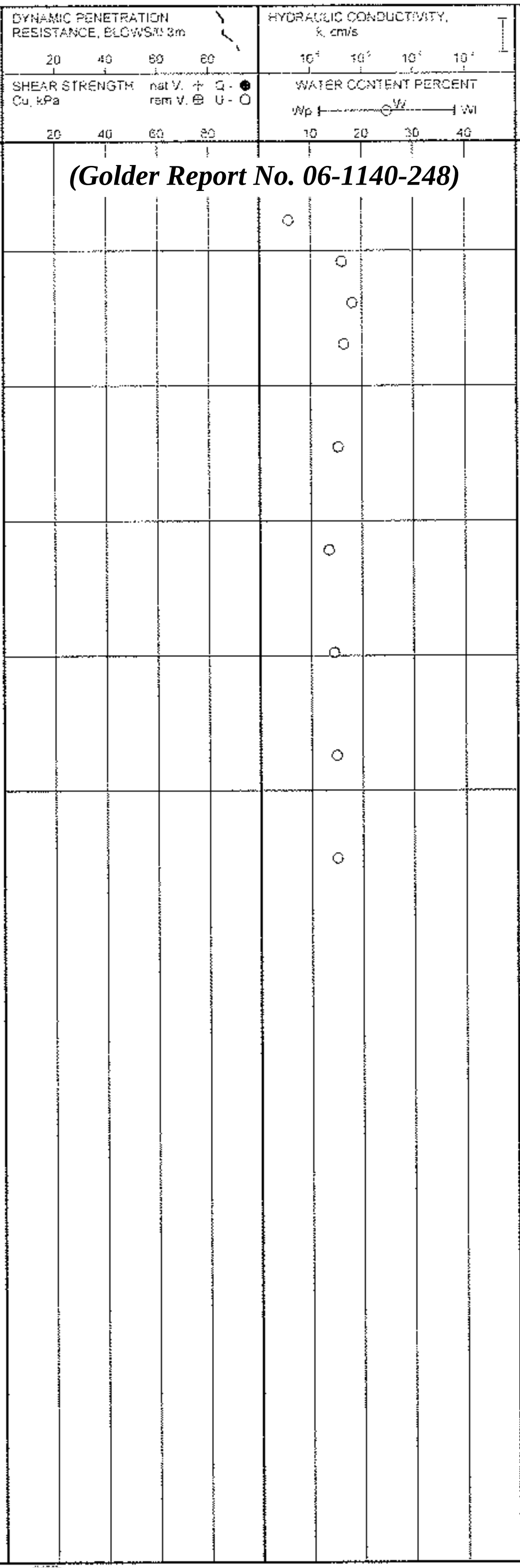
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
PAVEMENT SHOULDER SURFACE	183.30			
Brown, granular road base (**FILL**)	0.00			
Black, clayey topsoil (**FILL**)	0.10	1	AS	-
Mottled brown and grey, silty clay, some sand, trace gravel, mixed with topsoil (**FILL**)	182.89 0.41			
Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	182.54 0.76	2	SS	10
Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. silt seams, oxidized and fissured (**TILL**)	181.78 1.52	3	SS	18
		4	SS	26
		5	SS	30
Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	179.64 3.66	6	SS	15
		7	SS	13
END OF BOREHOLE	178.27 5.03			



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on December 5, 2006

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.R.
CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 5, 2006

DATUM: GEODETIC

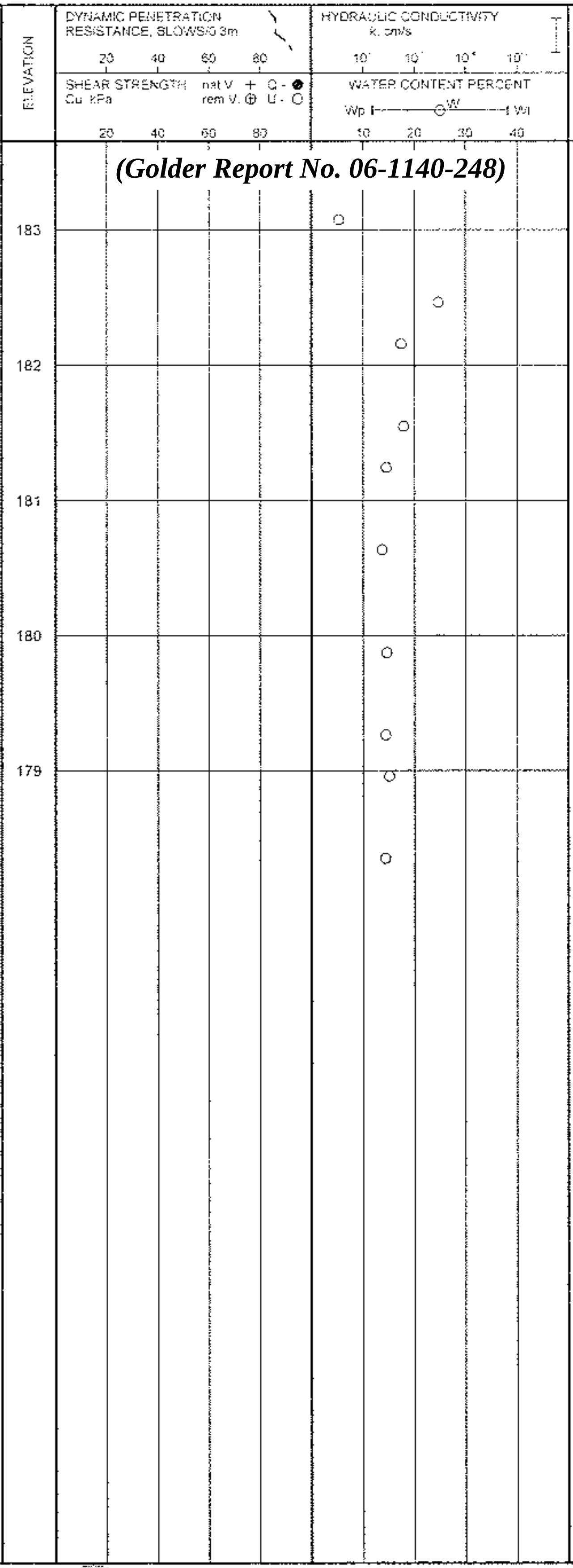
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

BORING METHOD: POWER AUGER SOLID STEM

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	PAVEMENT SHOULDER SURFACE	183.15			
0	Brown, granular road base (**FILL**)	0.00			
	Black, clayey topsoil (**FILL**)	0.10	1	AS	-
	Mottled brown and grey, silty clay, some sand, trace gravel, mixed with topsoil (**FILL**)	182.69 0.46			
1	Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	182.39 0.76	2	SS	9
2	Stiff to very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. sand seams, oxidized and fissured (**TILL**)	181.47 1.68	3	SS	10
			4	SS	28
3			5	SS	27
4	Very stiff to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	179.11 4.04	6	SS	22
			7	SS	12
5	END OF BOREHOLE	178.12 5.03			
6					
7					
8					
9					



ADDITIONAL LAB TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on December 5, 2006

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.R.

CHECKED:

PROJECT: 06-1140-248

RECORD OF BOREHOLE 10

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 5, 2006

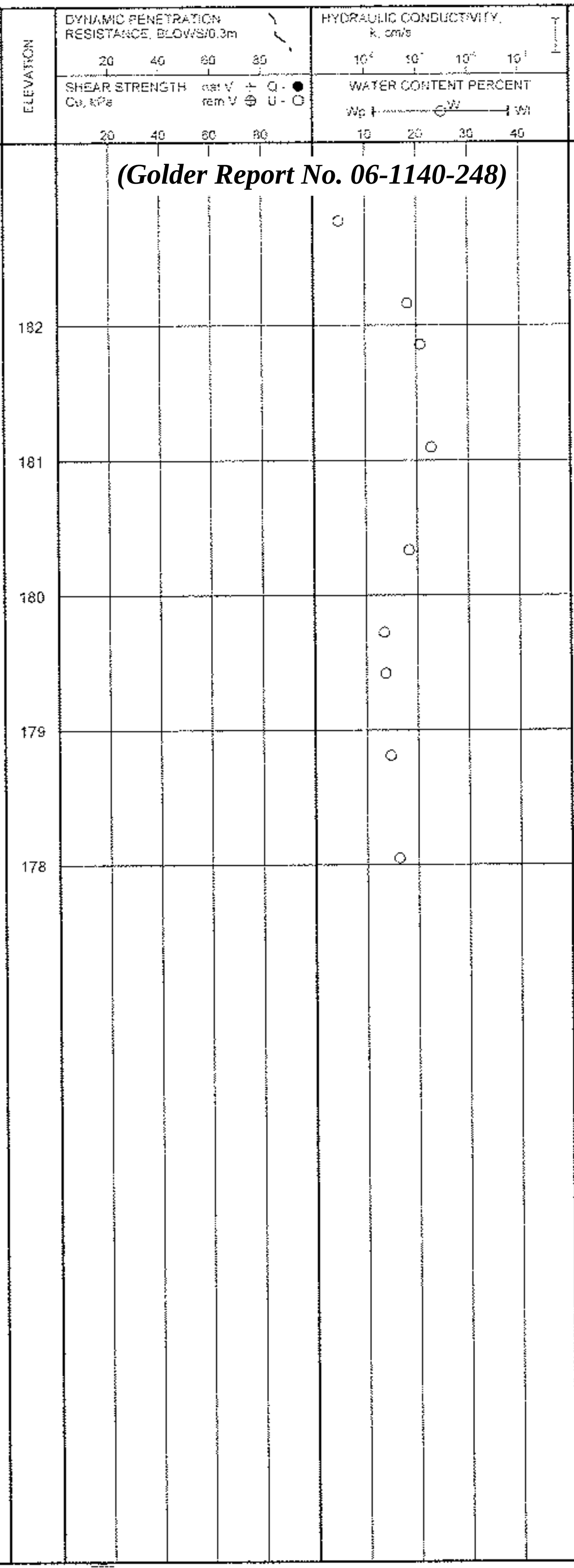
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		PAVEMENT SHOULDER SURFACE	182.85			
0	POWER AUGER SOLID STEM	Brown, granular road base (**FILL**)	0.00			
		Brown, silty clay, some sand, trace gravel, mixed with topsoil (**FILL**)	0.15 182.09	1	AS	-
1		Stiff, mottled brown and grey. **SILTY CLAY**, some sand, trace gravel (**TILL**)	0.76 180.72	2 3	SS SS	11 8
2 3 4		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)	2.13 178.43	4 5 6	SS SS SS	24 26 22
		Stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	4.42 177.82	7	SS	12
5		END OF BOREHOLE	5.03			
6 7 8 9						



ADDITIONAL LAB TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on December 5, 2006

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.R.

CHECKED:

PROJECT: 06-1140-248

LOCATION: SEE LOCATION PLAN

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 11

BORING DATE: DECEMBER 4, 2006

SHEET 1 OF 2

DATUM: GEODETIC

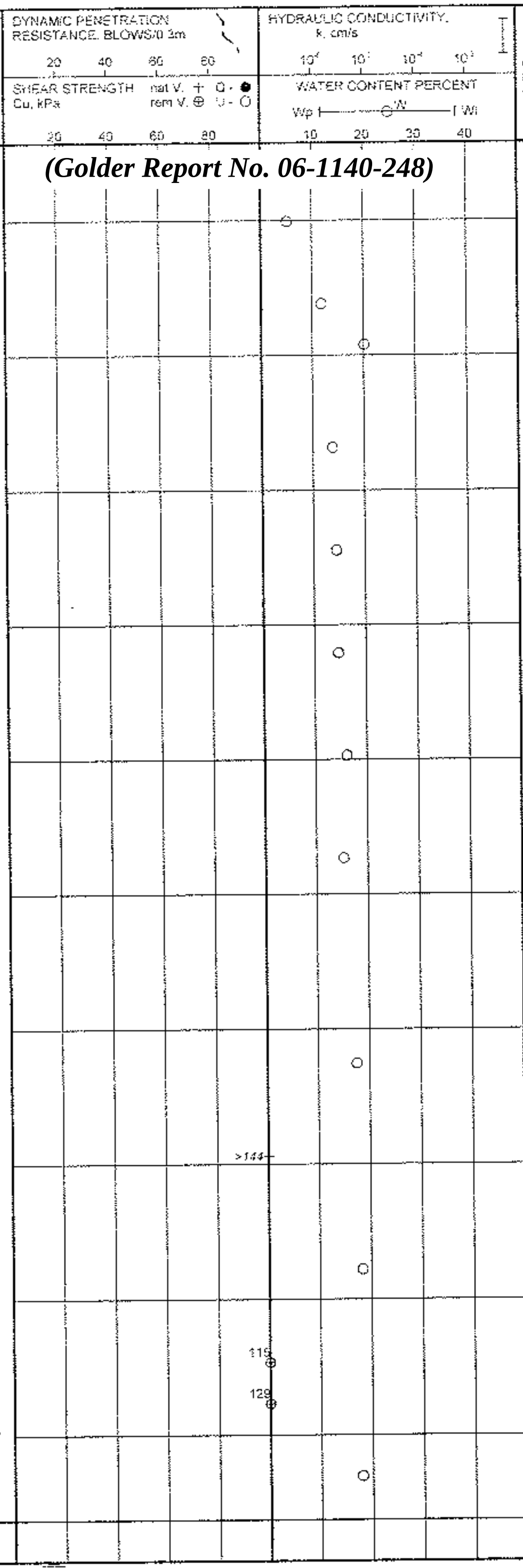
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV DEPTH (m)
PAVEMENT SHOULDER SURFACE	186.07
Brown, granular road base (FILL)	0.00
Dark brown, silty fine sand, trace gravel mixed with topsoil (FILL)	185.87 0.20
Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	185.31 0.76
Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. silt seams (**TILL**)	184.55 1.52
Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. sand, seams (**TILL**)	181.80 4.27

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	12
3	SS	20
4	SS	26
5	SS	22
6	SS	22
7	SS	12
8	SS	11
9	SS	7
10	SS	7



ADDITIONAL LAB TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

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LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.R.
CHECKED: Ok

PROJECT: 06-1140-248

RECORD OF BOREHOLE 11

SHEET 2 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 4, 2006

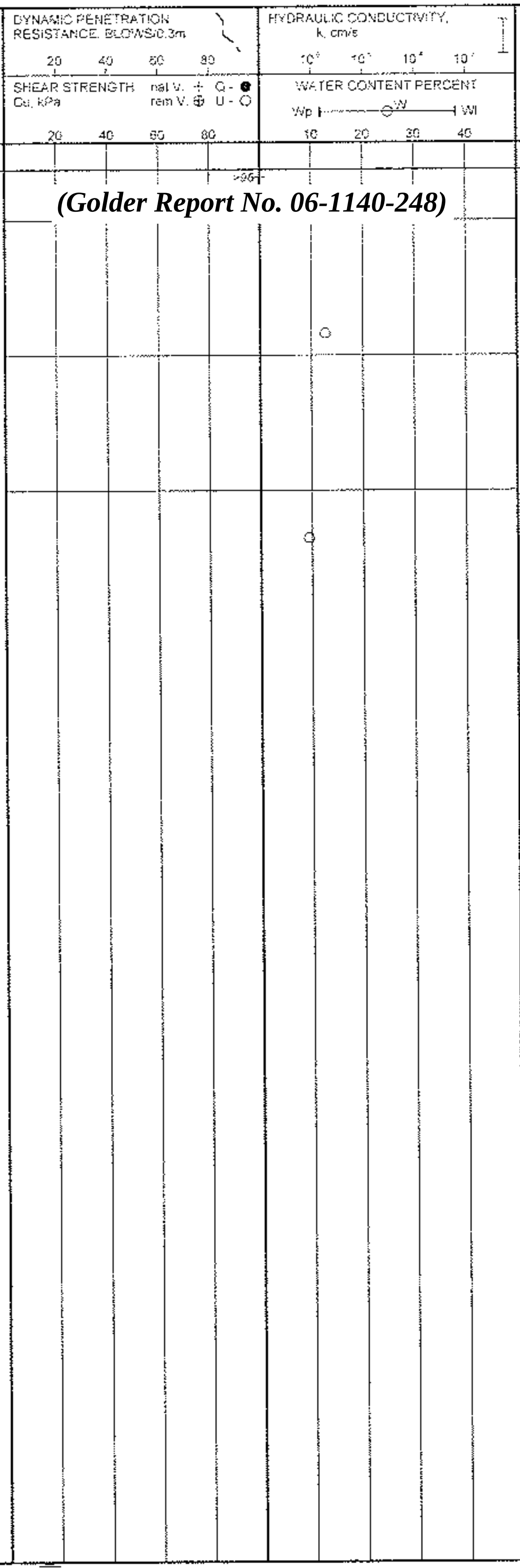
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---							
10	POWER AUGER SOLID STEM	Compact, grey, SANDY SILT, trace clay and gravel (TILL)	176.32 9.75				176		
11				11	SS	18	175		▽
12				12	SS	17	174		Water seepage into borehole encountered at about elevation 171.5m during drilling
		END OF BOREHOLE	173.42 12.65						
13									
14									
15									
16									
17									
18									
19									



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.R.
CHECKED:

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mostroianni

PROJECT: 06-1140-248

RECORD OF BOREHOLE 12

SHEET 1 OF 2

LOCATION: SEE LOCATION PLAN

BORING DATE: DECEMBER 11, 2006

DATUM: GEODETIC

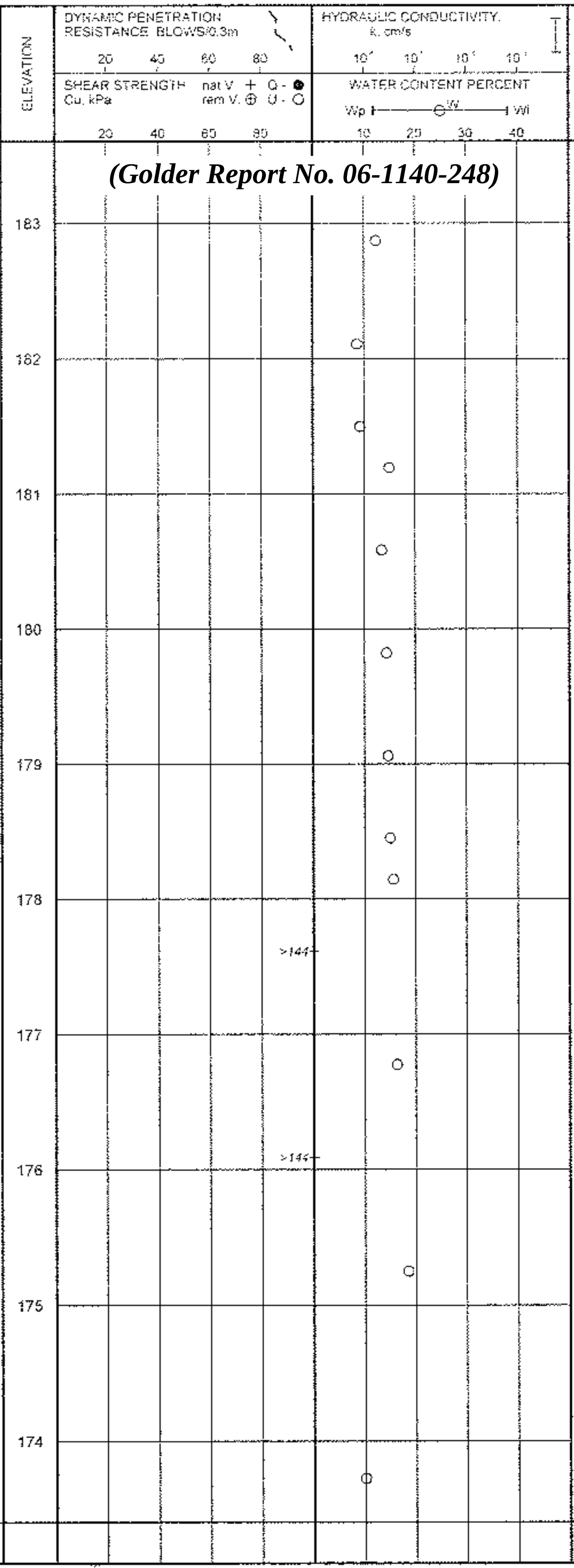
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 06-1140-248)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
PAVEMENT SHOULDER SURFACE	183.10 / 0.00			
Compact, brown, granular road base (**FILL**)		1	SS	16
Loose, brown, sand & gravel, some clay (**FILL**)	182.14 / 0.96	2	SS	5
Compact, brown, sand & gravel (**FILL**)	181.73 / 1.37			
Stiff, mottled brown nd grey, **SILTY CLAY**, some sand, trace gravel, silt seams (**TILL**)	181.35 / 1.75	3	SS	10
Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. oxidized and fissured (**TILL**)	180.81 / 2.29	4	SS	18
		5	SS	18
		6	SS	19
Stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. oxidized (**TILL**)	178.68 / 4.42	7	SS	9
		8	SS	10
		9	SS	10
		10	SS	12



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on December 11, 2006

— CONTINUED NEXT PAGE —

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.R.
CHECKED:

LDN_BHS 06-1140-248.GPJ GLDR_CAN.GDT 5/7/07 DATA INPUT: Tony Mastroianni

TABLE I
RECORD OF BOREHOLES
VARIOUS STREETS
CITY OF WINDSOR

(Golder Report No. 07-1140-0030)

Street Name: North Service Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
~~1~~	~~0 - 80~~	~~**ASPHALT**~~	~~Borehole dry upon completion~~
	~~80 - 380~~	~~**CONCRETE**~~	
	~~380 - 430~~	~~Grey Granular Road Base **(FILL)**~~	
	~~430 - 640~~	~~Brown Silty Clay, some Sand, trace Gravel **(FILL)**~~	
	~~640 - 1220~~	~~Green to Black Silty Clay, trace Sand **(FILL)**~~	
~~2~~	~~0 - 130~~	~~**ASPHALT**~~	
	~~at 130~~	~~**CONCRETE**~~	
~~3~~	~~0 - 130~~	~~**ASPHALT**~~	
	~~at 130~~	~~**CONCRETE**~~	
~~4~~	~~0 - 100~~	~~**ASPHALT**~~	
	~~at 100~~	~~**CONCRETE**~~	
~~5~~	~~0 - 100~~	~~**ASPHALT**~~	~~Borehole dry upon completion~~
	~~100 - 460~~	~~**CONCRETE**~~	
	~~460 - 1220~~	~~Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**~~	
~~6~~	~~0 - 80~~	~~**ASPHALT**~~	
	~~at 80~~	~~**CONCRETE**~~	
7	0 - 130	**ASPHALT**	
	at 130	**CONCRETE**	

Prepared By: BG
Checked By: HD

TABLE I
RECORD OF BOREHOLES
VARIOUS STREETS
CITY OF WINDSOR

(Golder Report No. 07-1140-0030)

Street Name: North Service Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
8	0 - 100	**ASPHALT**	Borehole dry upon completion
	100 - 280	**CONCRETE**	
	280 - 300	**ASPHALT**	
	300 - 430	**CONCRETE**	
	430 - 660	Brown Silty Clay, some Sand, trace Gravel **(FILL)**	
	660 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**	

(Golder Report No. 07-1140-0030)

Street Name: 7th Concession Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
1	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 360	Brown Sand, some Gravel, trace Clay **(FILL)**	
	360 - 760	Black Clayey **TOPSOIL**	
	760 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**	
2	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 380	Brown Sand, some Gravel, trace Clay **(FILL)**	
	380 - 890	Greenish Brown Silty Clay, trace Sand and Gravel **(FILL)**	
	890 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, numerous Organic Pockets **(TILL)**	
3	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 300	Brown Sand, some Gravel, trace Clay **(FILL)**	
	300 - 1220	Black Clayey **TOPSOIL**	
4	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 380	Brown Sand, some Gravel, trace Clay **(FILL)**	
	380 - 1220	Black Clayey **TOPSOIL**	
5	0 - 200	**ASPHALT**	Borehole dry upon completion
	200 - 1220	Black Clayey **TOPSOIL**	
6	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 380	Brown Silty Clay, some Sand, trace Gravel **(FILL)**	
	380 - 1220	Black Clayey **TOPSOIL**	

Prepared By: BG
Checked By: HD

TABLE I
RECORD OF BOREHOLES
VARIOUS STREETS
CITY OF WINDSOR

(Golder Report No. 07-1140-0030)

Street Name: Baseline Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
1	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 130	Grey Granular Road Base **(FILL)**	
	130 - 180	**Bituminous Surface Treatment**	
	180 - 230	Grey Granular Road Base **(FILL)**	
	230 - 380	Brown Sand, some Gravel **(FILL)**	
	380 - 740	Black Sandy **TOPSOIL**	
	740 - 1220	Greenish, Mottled Brown and Grey **CLAYEY SILT**, some Sand, occ. Organic pockets	
2	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 130	Grey Granular Road Base **(FILL)**	
	130 - 180	**Bituminous Surface Treatment**	
	180 - 300	Grey Granular Road Base **(FILL)**	
	300 - 810	Black Clayey **TOPSOIL,** some Sand	
	810 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **(TILL)**	
3	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 130	Grey Granular Road Base **(FILL)**	
	130 - 150	**Bituminous Surface Treatment**	
	150 - 250	Grey Granular Road Base **(FILL)**	
	250 - 900	Black Clayey **TOPSOIL**	
	900 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **(TILL)**	
4	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 150	Grey Granular Road Base **(FILL)**	
	150 - 180	**Bituminous Surface Treatment**	
	180 - 250	Grey Granular Road Base **(FILL)**	
	250 - 1220	Black Clayey **TOPSOIL**, some Sand and Silt	

Prepared By: BG
Checked By: HD

TABLE I
RECORD OF BOREHOLES
VARIOUS STREETS
CITY OF WINDSOR

(Golder Report No. 07-1140-0030)

Street Name: Baseline Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
5	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 180	Grey Granular Road Base **(FILL)**	
	180 - 200	**Bituminous Surface Treatment**	
	200 - 280	Grey Granular Road Base **(FILL)**	
	280 - 380	Brown Sand, some Gravel **(FILL)**	
	380 - 1220	Black Clayey **TOPSOIL**, trace Sand	
6	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 100	Grey Granular Road Base **(FILL)**	
	100 - 150	**Bituminous Surface Treatment**	
	150 - 280	Grey Granular Road Base **(FILL)**	
	280 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**	
7	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 150	Grey Granular Road Base **(FILL)**	
	150 - 200	**Bituminous Surface Treatment**	
	200 - 230	Grey Granular Road Base **(FILL)**	
	230 - 300	Brown Sand, some Gravel **(FILL)**	
	300 - 530	Black Clayey **TOPSOIL,** trace Sand	
	530 - 1220	Brown to Grey **SILTY FINE SAND**	
8	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 250	Grey Granular Road Base **(FILL)**	
	250 - 460	Brown Sand, trace Gravel **(FILL)**	
	460 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**	

Prepared By: BG
Checked By: HD

TABLE I
RECORD OF BOREHOLES
VARIOUS STREETS
CITY OF WINDSOR

(Golder Report No. 07-1140-0030)

Street Name: Baseline Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
9	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 300	Grey Granular Road Base **(FILL)**	
	300 - 380	Brown Sand, some Gravel, trace Clay **(FILL)**	
	380 - 1220	Brown Silty Clay, some Sand **(FILL)**	
10	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 330	Grey Granular Road Base **(FILL)**	
	330 - 580	Black Clayey **TOPSOIL**	
	580 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**	
11	0 - 30	**Bituminous Surface Treatment**	Borehole dry upon completion
	30 - 300	Grey Granular Road Base **(FILL)**	
	300 - 410	Brown Silty Clay, some Sand, trace Gravel **(FILL)**	
	410 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, numerous Organic Pockets **(TILL)**	
12	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 410	Grey Granular Road Base **(FILL)**	
	410 - 1220	Black Clayey **TOPSOIL**	
13	0 - 30	**Bituminous Surface Treatment**	Borehole dry upon completion
	30 - 280	Grey Granular Road Base **(FILL)**	
	280 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, occ. Organic Pockets **(TILL)**	
14	0 - 50	**Bituminous Surface Treatment**	Borehole dry upon completion
	50 - 300	Grey Granular Road Base **(FILL)**	
	300 - 380	Brown Sand, some Gravel **(FILL)**	
	380 - 1220	Black Clayey **TOPSOIL**	

(Golder Report No. 07-1140-0030)

Street Name: Division Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
1	0 - 180	**ASPHALT**	
	at 180	**CONCRETE**	
2	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 360	**CONCRETE**	
	360 - 1220	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel, numerous Organic Pockets **(TILL)**	
3	0 - 180	**ASPHALT**	
	at 180	**CONCRETE**	
4	0 - 180	**ASPHALT**	
	at 180	**CONCRETE**	
5	0 - 200	**ASPHALT**	
	at 200	**CONCRETE**	
6	0 - 180	**ASPHALT**	
	at 180	**CONCRETE**	
7	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 330	**CONCRETE**	
	330 - 1220	Black Clayey **TOPSOIL**	
8	0 - 200	**ASPHALT**	
	at 200	**CONCRETE**	
9	0 - 130	**ASPHALT**	
	at 130	**CONCRETE**	

Prepared By: BG
Checked By: HD

TABLE I
RECORDS OF BOREHOLES
VARIOUS STREETS
CITY OF WINDSOR

(Golder Report No. 07-1140-0030)

Street Name: Division Road

BOREHOLE	APPROXIMATE DEPTH (mm)	STRATIGRAPHY	REMARKS
10	0 - 200	**ASPHALT**	
	at 200	**CONCRETE**	
11	0 - 150	**ASPHALT**	
	at 150	**CONCRETE**	
12	0 - 200	**ASPHALT**	Borehole dry upon completion
	200 - 430	**CONCRETE**	
	430 - 1220	Black Clayey **TOPSOIL,** trace Sand	
13	0 - 150	**ASPHALT**	
	at 150	**CONCRETE**	
14	0 - 250	**ASPHALT**	
	at 250	**CONCRETE**	
15	0 - 180	**ASPHALT**	
	at 180	**CONCRETE**	
16	0 - 180	**ASPHALT**	
	at 180	**CONCRETE**	
17	0 - 180	**ASPHALT**	Borehole dry upon completion
	180 - 360	**CONCRETE**	
	360 - 860	Black Clayey **TOPSOIL,** some sandy silt inclusions	
	860 - 1220	Mottled Brown and Grey **CLAYEY SILT**, numerous Sand Seams, occ. Organic Pockets	

Prepared By: BG
Checked By: HD

PROJECT: 07-1140-0031

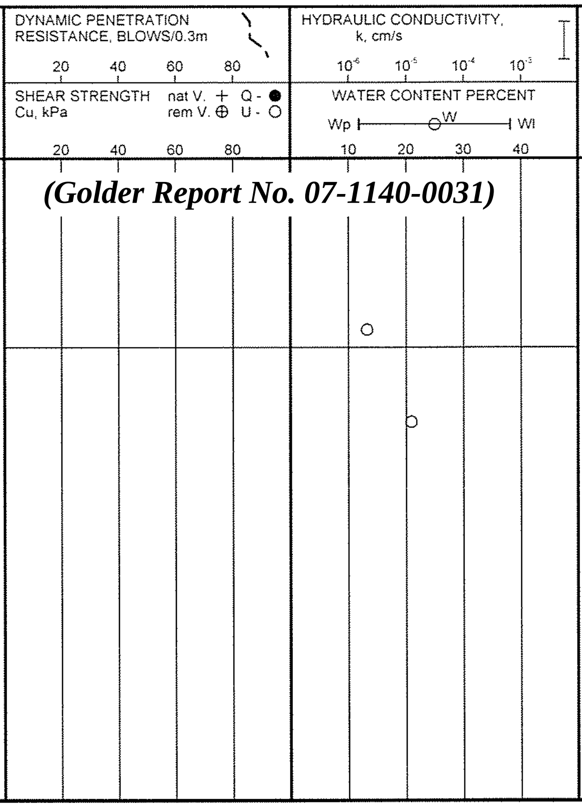
RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN
BORING DATE: MARCH 7, 2007
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		178.50						
0	POWER AUGER SOLID STEM	Brown, sand and gravel, trace clay and organics (**FILL**)	▨	0.00	1	AS	-	178		Borehole dry during drilling on March 7, 2007
		Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. organic pockets (**TILL**)		177.73 0.76	2	SS	4			
1		END OF BOREHOLE		177.28 1.22						
2										
3										



(Golder Report No. 07-1140-0031)

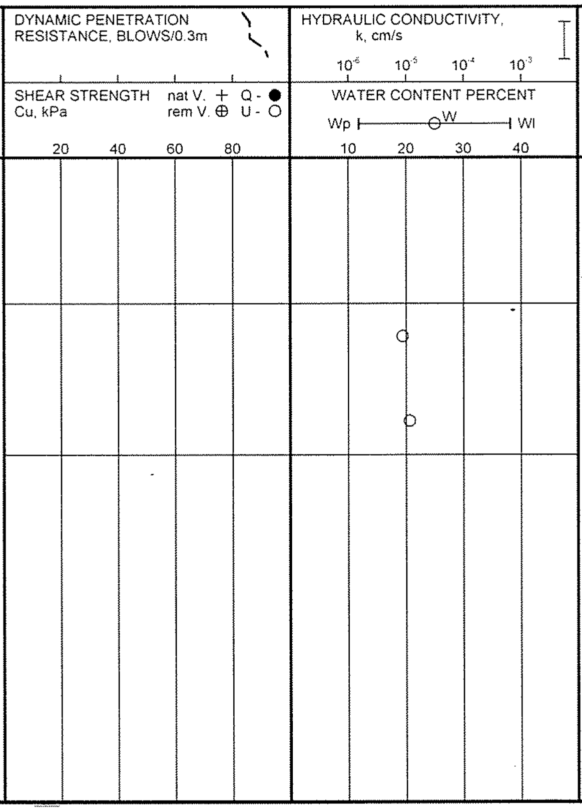
PROJECT: 07-1140-0031

RECORD OF BOREHOLE 2

LOCATION: SEE LOCATION PLAN
BORING DATE: MARCH 7, 2007
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		178.22						
0	POWER AUGER SOLID STEM	Black, clayey **TOPSOIL**		0.00						
		Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. organic pockets (**TILL**)		0.10	1	AS	-	178		Borehole dry during drilling on March 7, 2007
1					2	SS	6			
		END OF BOREHOLE		177.00 1.22				177		
2										
3										



LDN_DBL 07-1140-0031.GPJ GLDR_LDN.GDT 3/4/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.G.
CHECKED: BG

PROJECT: 07-1140-0031

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 7, 2007

DATUM: GEODETIC

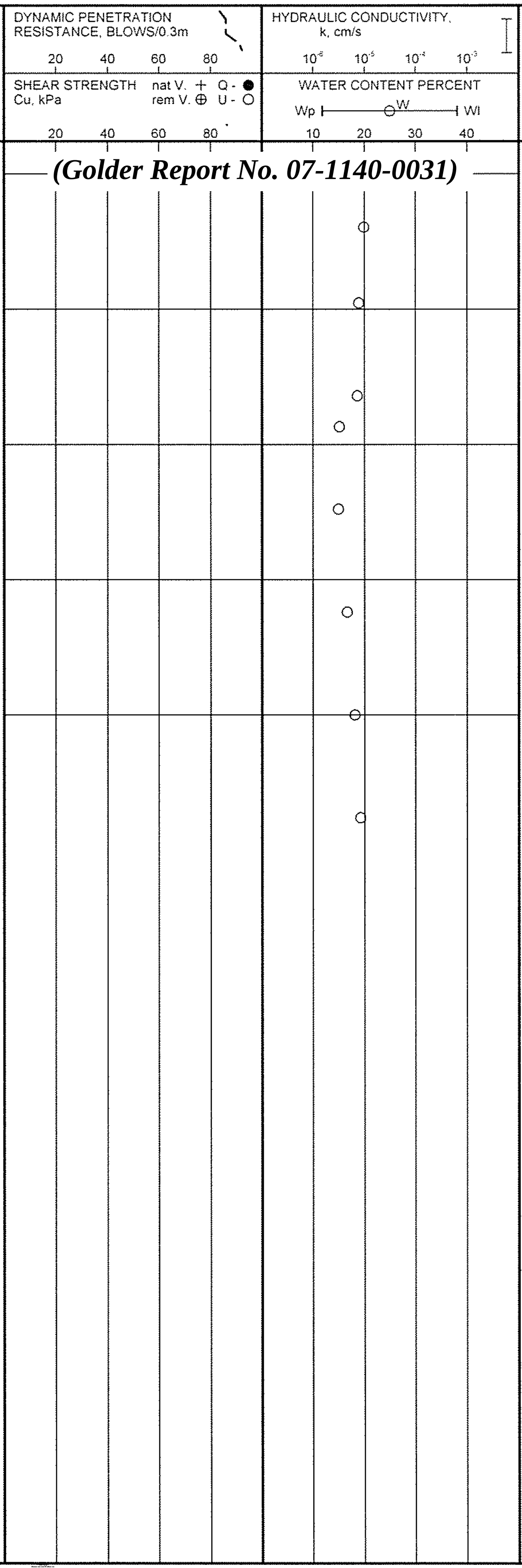
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	178.04
Black, clayey **TOPSOIL**	0.00
Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. organic pockets (**TILL**)	0.10
Stiff to very stiff, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)	176.21 1.83
Firm to stiff, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	175.14 2.90
END OF BOREHOLE	173.01 5.03

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	-
2	SS	8
3	SS	11
4	SS	20
5	SS	11
6	SS	5
7	SS	10



(Golder Report No. 07-1140-0031)

INSTALLATION AND GROUNDWATER OBSERVATIONS

Water seepage into borehole encountered at about elevation 177.13m during drilling on March 7, 2007

LDN_BHS 07-1140-0031.GPJ GLDR_CAN.GDT 3/4/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.G.

CHECKED: BG

PROJECT: 07-1140-0031

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 7, 2007

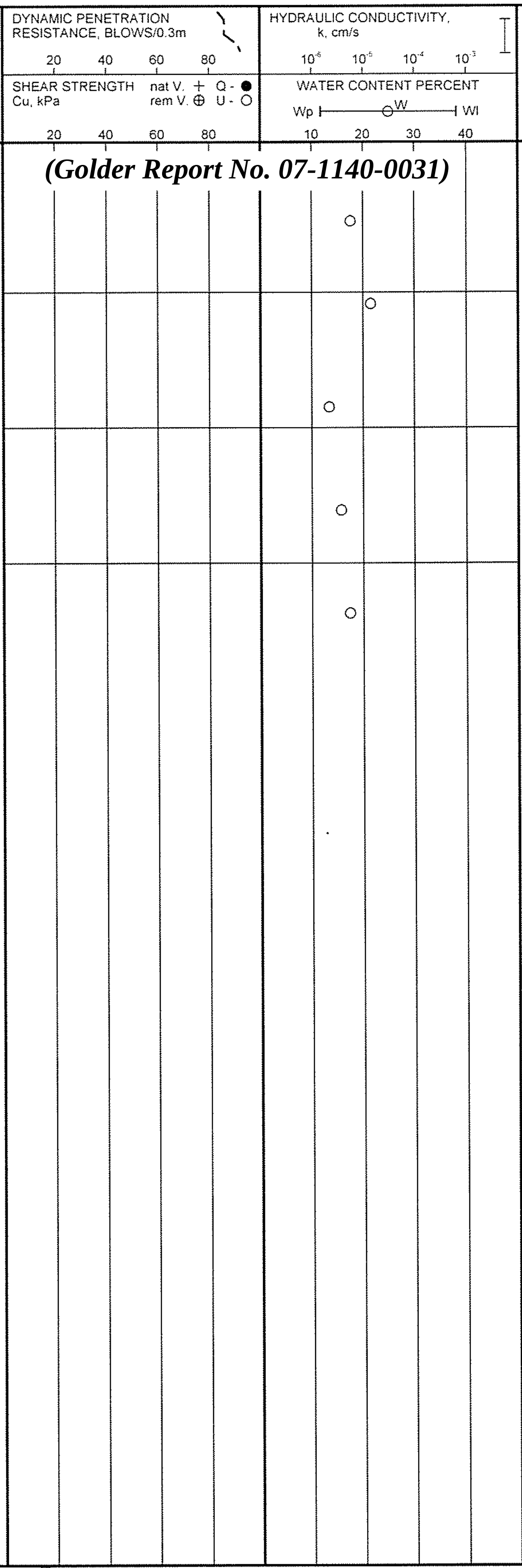
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0031)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	177.91					
	POWER AUGER SOLID STEM	Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. organic pockets **(TILL)**	0.00	1	AS	-		
1				2	SS	5	177	
			176.53 1.37					
		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. sand and silt seams/pockets with depth **(TILL)**		3	SS	27		Borehole dry during drilling on March 7, 2007
2							176	
				4	SS	15		
3							175	
				5	SS	16		
		END OF BOREHOLE	174.40 3.51					
4								
5								
6								
7								
8								
9								
10								



LDN_BHS 07-1140-0031.GPJ GLDR_CAN.GDT 3/4/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.G.

CHECKED: BG

PROJECT: 07-1140-0031

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 7, 2007

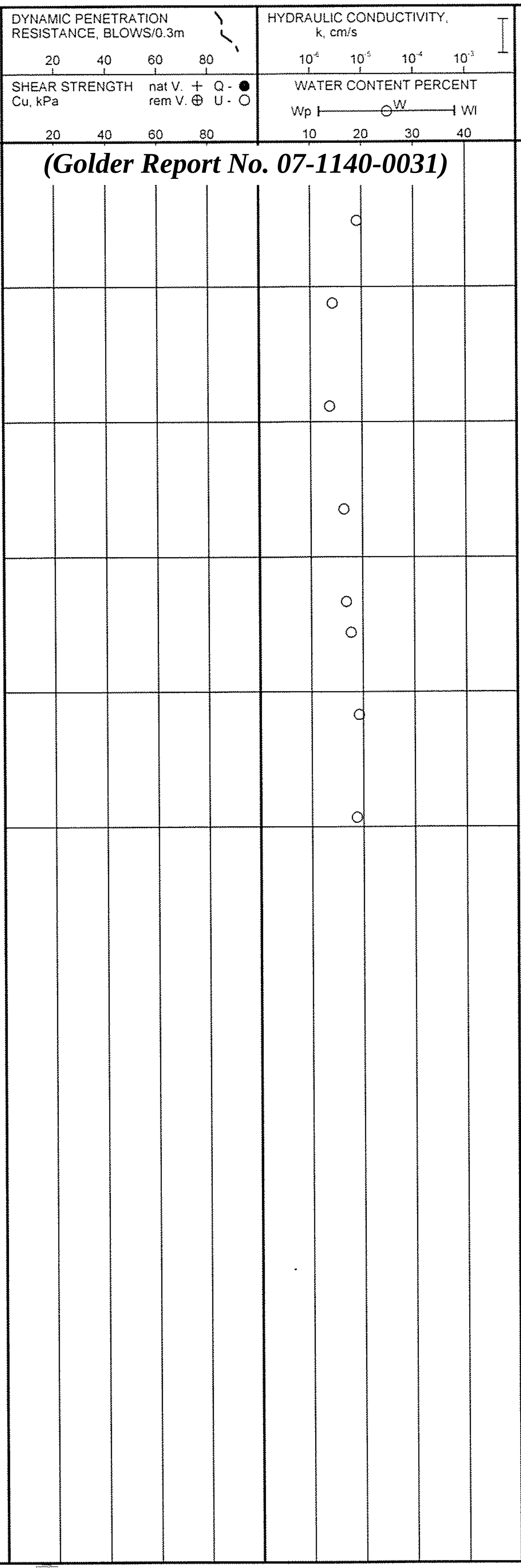
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0031)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
0		GROUND SURFACE	177.87 0.00				
	POWER AUGER SOLID STEM	Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (TILL)		1	AS	-	
1			176.50 1.37	2	SS	9	177
		Very stiff to stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. sand and silt seams with depth (TILL)		3	SS	26	176
2				4	SS	18	
3			174.52 3.35	5	SS	10	175
4		Stiff to firm, grey, **SILTY CLAY**, some sand, trace gravel (TILL)		6	SS	6	174
			172.84	7	SS	6	173
5		END OF BOREHOLE	5.03				
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during drilling on March 7, 2007

LDN_BHS 07-1140-0031.GPJ GLDR_CAN.GDT 3/4/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.G.
CHECKED: BG

PROJECT: 07-1140-0031

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

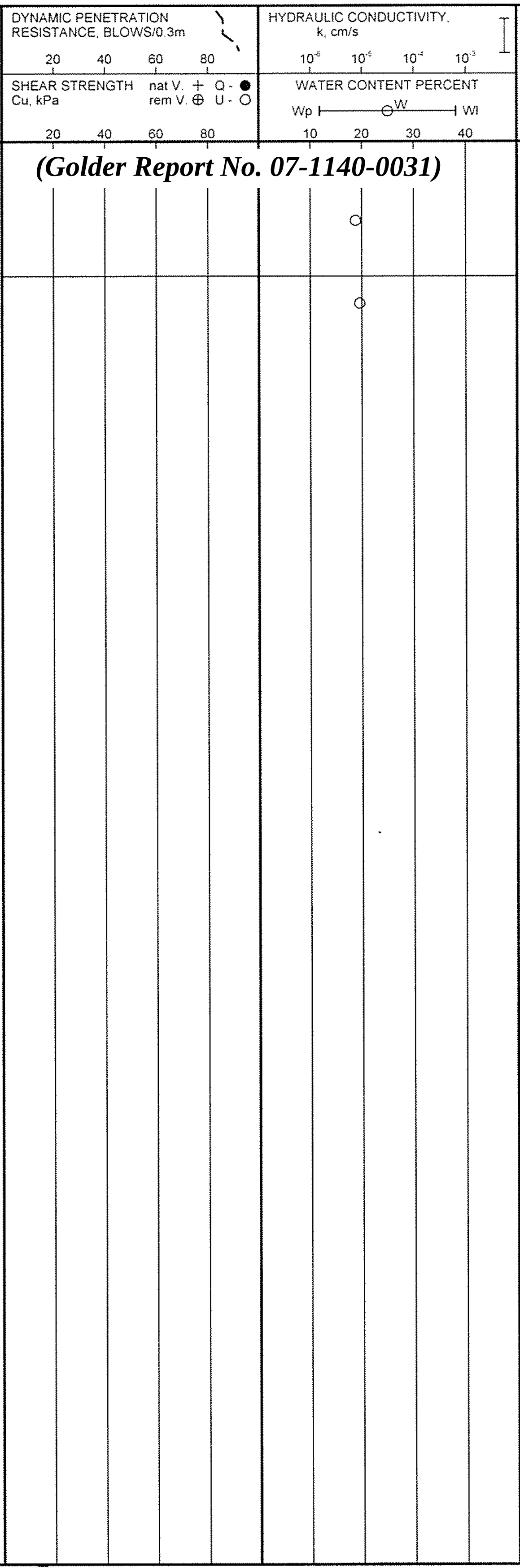
BORING DATE: MARCH 7, 2007

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		177.79						
	POWER AUGER SOLID STEM	Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (TILL)		0.00	1	AS	-			
					2	SS	7	177		▽ Water seepage into borehole encountered at about elevation 176.88m during drilling on March 7, 2007
1		END OF BOREHOLE		176.57 1.22						
2										
3										
4										
5										
6										
7										
8										
9										
10										



(Golder Report No. 07-1140-0031)

LDN_BHS 07-1140-0031.GPJ GLDR_CAN.GDT 3/4/07 DATA INPUT: Tony Mastroianni

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.G.

CHECKED: BG

PROJECT: 07-1140-0031

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 7, 2007

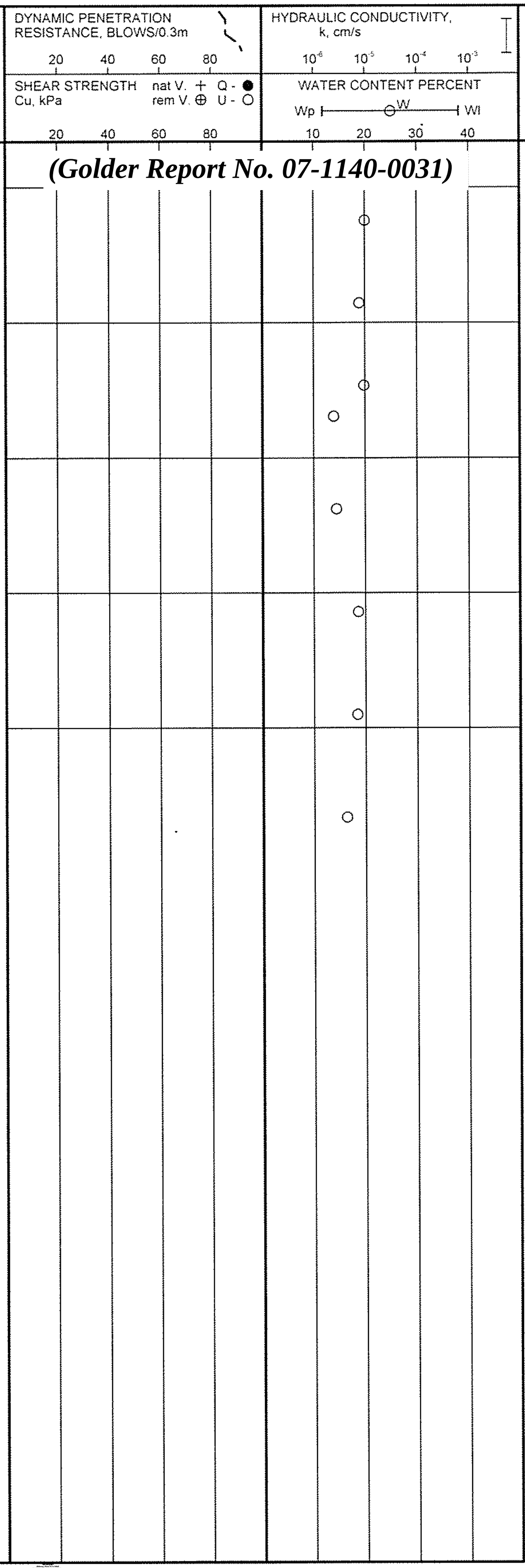
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0031)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		178.14 0.00				178		
	POWER AUGER SOLID STEM	Stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. organic pockets (**TILL**)			1	AS	-			
1					2	SS	8	177		
		Stiff to very stiff, brown, **SILTY CLAY**, some sand, trace gravel (**TILL**)		176.46 1.68	3	SS	12			Borehole dry during drilling on March 7, 2007
2					4	SS	17	176		
3					5	SS	14	175		
		Firm to stiff, grey, **SILTY CLAY**, some sand, trace gravel , occ. sand and silt seams/pockets (**TILL**)		174.48 3.66						
4					6	SS	6	174		
					7	SS	8			
5		END OF BOREHOLE		173.11 5.03						
6										
7										
8										
9										
10										



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: N.G.
CHECKED: BG

PROJECT: 07-1140-0031

RECORD OF BOREHOLE 8

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MARCH 7, 2007

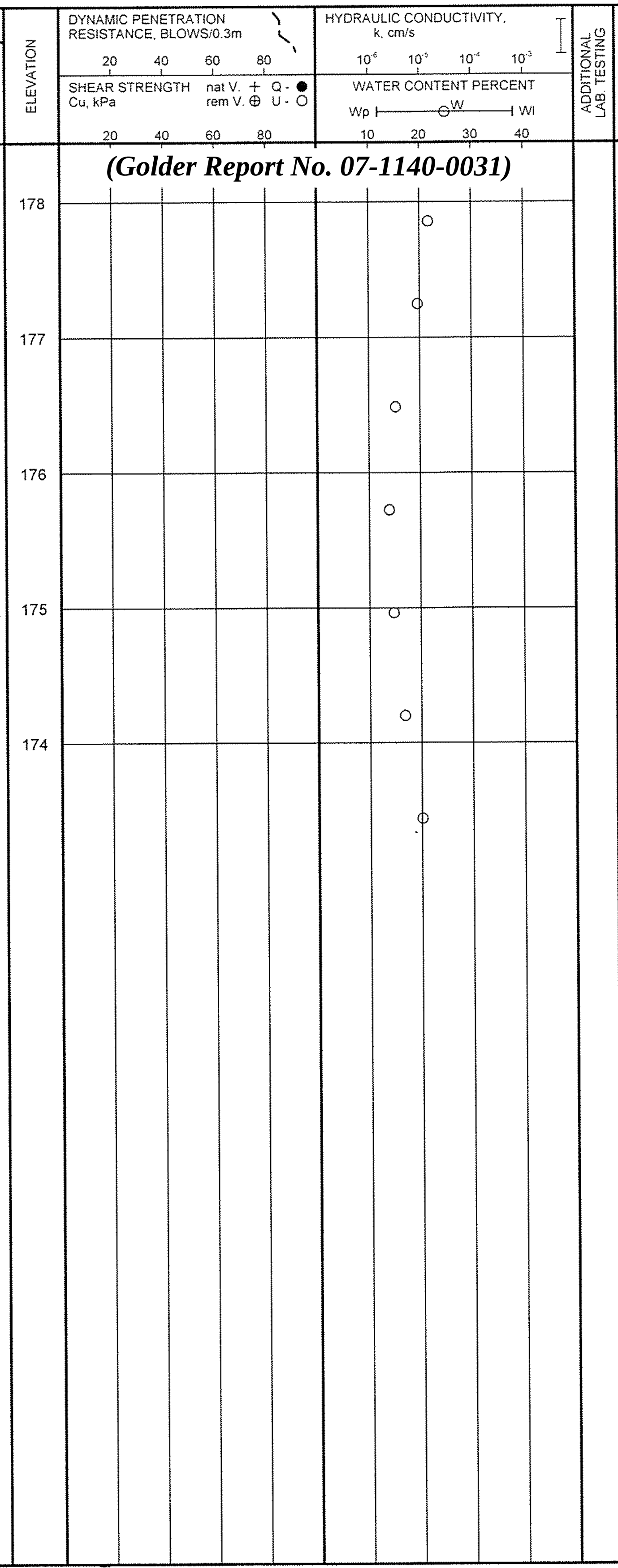
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0031)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	178.24 0.00				
		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. organic pockets (**TILL**)		1	AS	-	
1				2	SS	7	
			176.47 1.77	3	SS	15	Borehole dry during drilling on March 7, 2007
2		Very stiff to stiff, brown, **SILTY CLAY**, some sand, trace gravel, occ. silt partings (**TILL**)		4	SS	23	
3				5	SS	14	
			174.58 3.66				
4		Firm, grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)		6	SS	6	
				7	SS	5	
5		END OF BOREHOLE	173.21 5.03				
6							
7							
8							
9							
10							



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: N.G.

CHECKED: BG

PROJECT: 07-1140-0178

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: OCTOBER 4, 2007

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

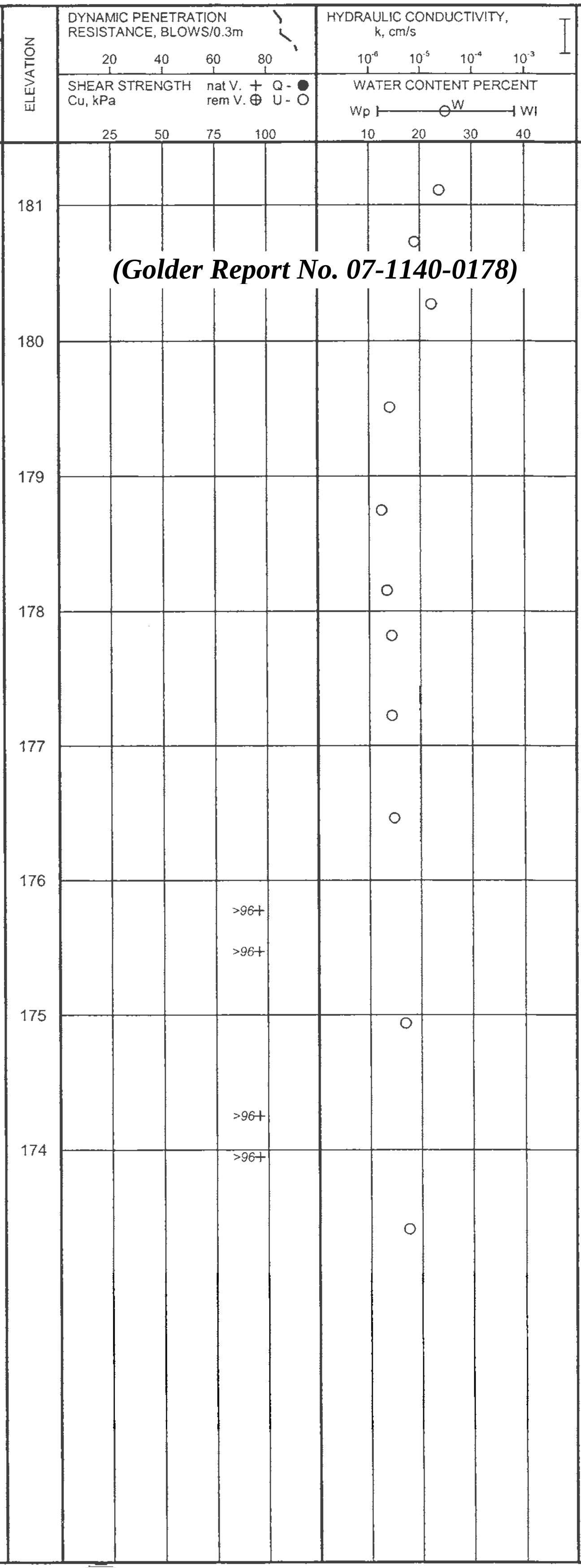
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0178)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.26 0.00
Black, clayey, **TOPSOIL**	180.96 0.30
Firm to stiff, brown and grey, **SILTY CLAY**, some sand, trace gravel, silt partings **(TILL)**	178.98 2.29
Hard, brown, **SILTY CLAY**, some sand, trace gravel **(TILL)**	178.06 3.20
Very stiff, grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	173.18 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	CS	
2	SS	5
3	SS	6
4	SS	8
5	SS	39
6	SS	18
7	SS	10
8	SS	9
9	SS	8
10	SS	12



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 4, 2007

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: S.M.
CHECKED:

LDN_BHS 07-1140-0178.GPJ GLDR_CAN.GDT 10/23/07 DATA INPUT: Jason Scott

PROJECT: 07-1140-0178

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

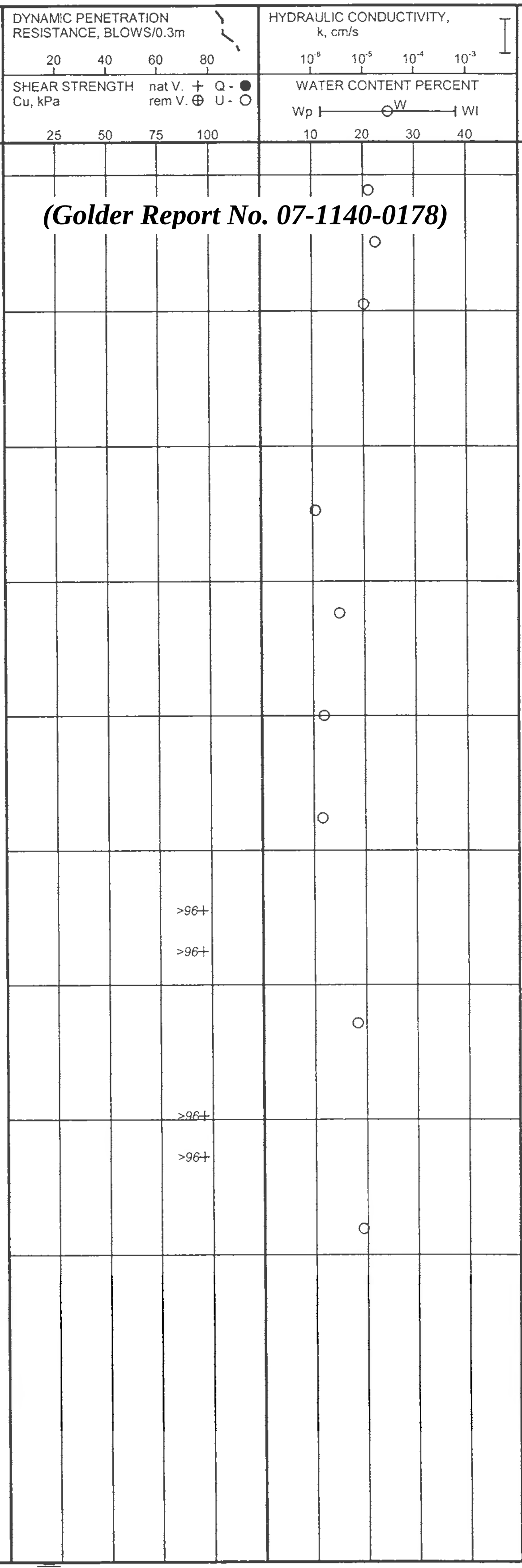
BORING DATE: OCTOBER 4, 2007

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
0		GROUND SURFACE		181.04				181
	POWER AUGER SOLID STEM	Black, clayey, **TOPSOIL**		0.00	1	CS		
				180.73 0.30	2	SS	5	
1		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**			3	SS	4	180
				179.21 1.83	4	SS	14	
2								179
					5	SS	30	
3		Stiff to hard, brown, **SILTY CLAY**, some sand, trace gravel, silt partings **(TILL)**						178
					6	SS	24	
				177.23 3.81				
4					7	SS	9	177
					8	SS	9	
5								176
6		Very stiff, grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**						175
					9	SS	8	
7								174
					10	SS	7	
8				172.96 8.08				173
		END OF BOREHOLE						
9								
10								



(Golder Report No. 07-1140-0178)

ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
	Borehole dry upon completion of drilling on October 4, 2007
	▽
	Water level in borehole at about elevation 175.62 m on October 5, 2007

LDN_BHS 07-1140-0178.GPJ GLDR_CAN.GDT 10/23/07 DATA INPUT: Jason Scott

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: S.M.

CHECKED:

RECORD OF BOREHOLE 3

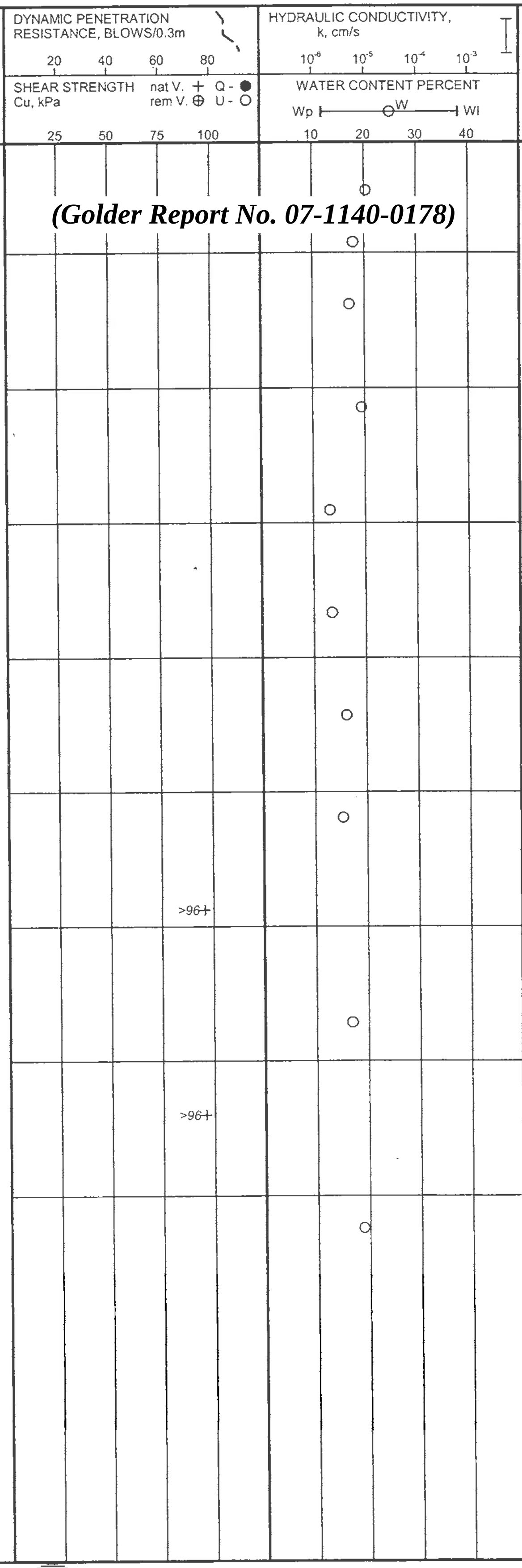
PROJECT: 07-1140-0178
LOCATION: SEE LOCATION PLAN
SAMPLER HAMMER, 63.5kg; DROP, 760mm

BORING DATE: OCTOBER 5, 2007

SHEET 1 OF 1
DATUM: GEODETIC
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0178)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION
		GROUND SURFACE	181.61				
0	POWER AUGER SOLID STEM	Brown, clayey, **TOPSOIL**, trace organics	0.00	1	CS		
		Stiff, mottled brown and grey, **SILTY CLAY** to **CLAYEY SILT**, some sand, trace gravel **(TILL)**	181.34 0.27	2	SS	8	181
1				3	SS	7	180
				4	SS	13	
2		Very stiff, brown, **SILTY CLAY**, some sand, occ. gravel **(TILL)**	179.78 1.83	5	SS	24	179
3				6	SS	24	178
4		Very stiff, grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	177.80 3.81	7	SS	8	177
5				8	SS	8	176
6				9	SS	8	175
7							174
8				10	SS	9	
		END OF BOREHOLE	173.53 8.08				
9							
10							



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on October 5, 2007

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: S.M.
CHECKED: Q

LDN_BHS 07-1140-0178.GPJ GLDR_CAN.GDT 10/23/07 DATA INPUT: Jason Scott

PROJECT: 07-1140-0178

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: OCTOBER 5, 2007

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

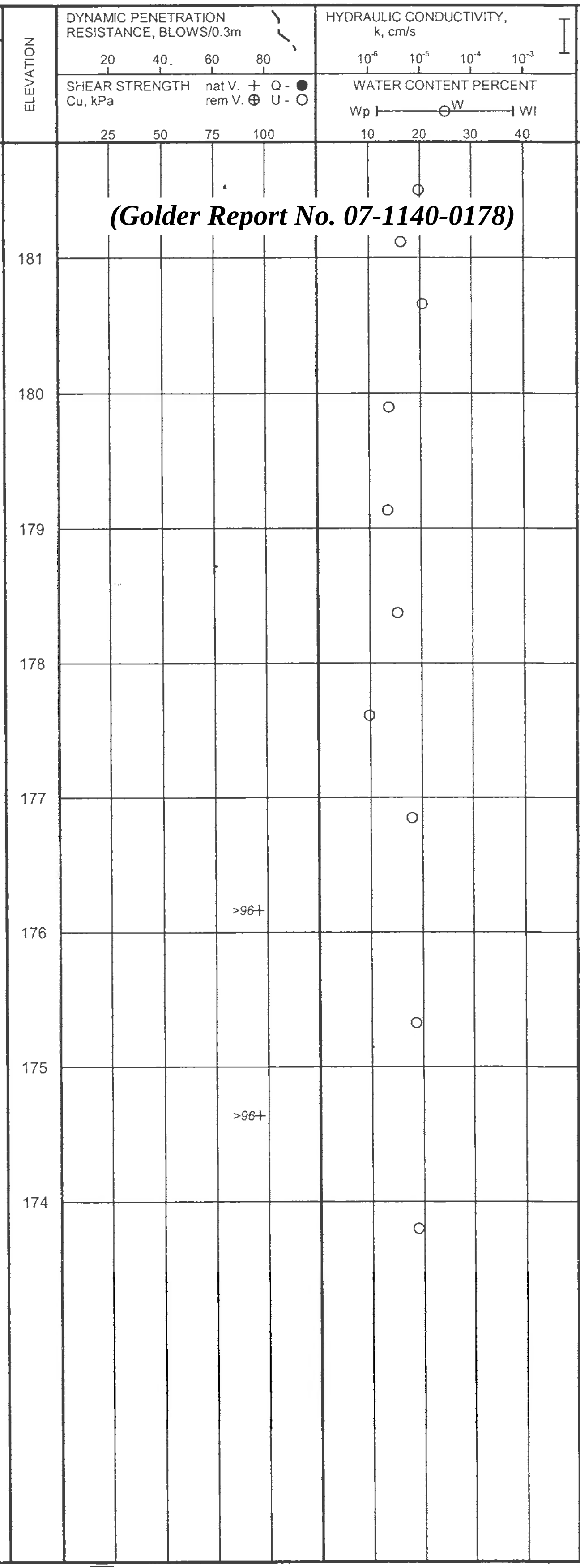
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0178)

Depth scale (metres): 0 – 10

Boring method: POWER AUGER, SOLID STEM

Soil profile: description	Elev. / Depth (m)	Sample number	Type	Blows/0.3m
GROUND SURFACE	181.65 0.00			
Dark brown, clayey, **TOPSOIL**		1	CS	
Stiff, brown and grey, **SILTY CLAY** to **CLAYEY SILT**, some sand, trace gravel, occ. silt partings **(TILL)**	181.34 0.30	2 3	SS SS	9 12
Very stiff, brown, **CLAYEY SILT**, some sand, occ. silt pocket or parting **(TILL)**	180.12 1.52	4	SS	14
Very stiff, brown, **SILTY CLAY**, some sand, occ. gravel **(TILL)**	179.52 2.13	5 6	SS SS	22 20
Very stiff, grey, **SILTY CLAY**, occ. brown sand parting, some sand, occ. gravel **(TILL)**	177.84 3.81	7 8 9 10	SS SS SS SS	25 6 11 7
END OF BOREHOLE	173.57 8.08			



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 5, 2007

LDN_BHS 07-1140-0178.GPJ GLDR_CAN.GDT 10/23/07 DATA INPUT: Jason Scott

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: S.M.
CHECKED:

PROJECT: 07-1140-0178

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: OCTOBER 5, 2007

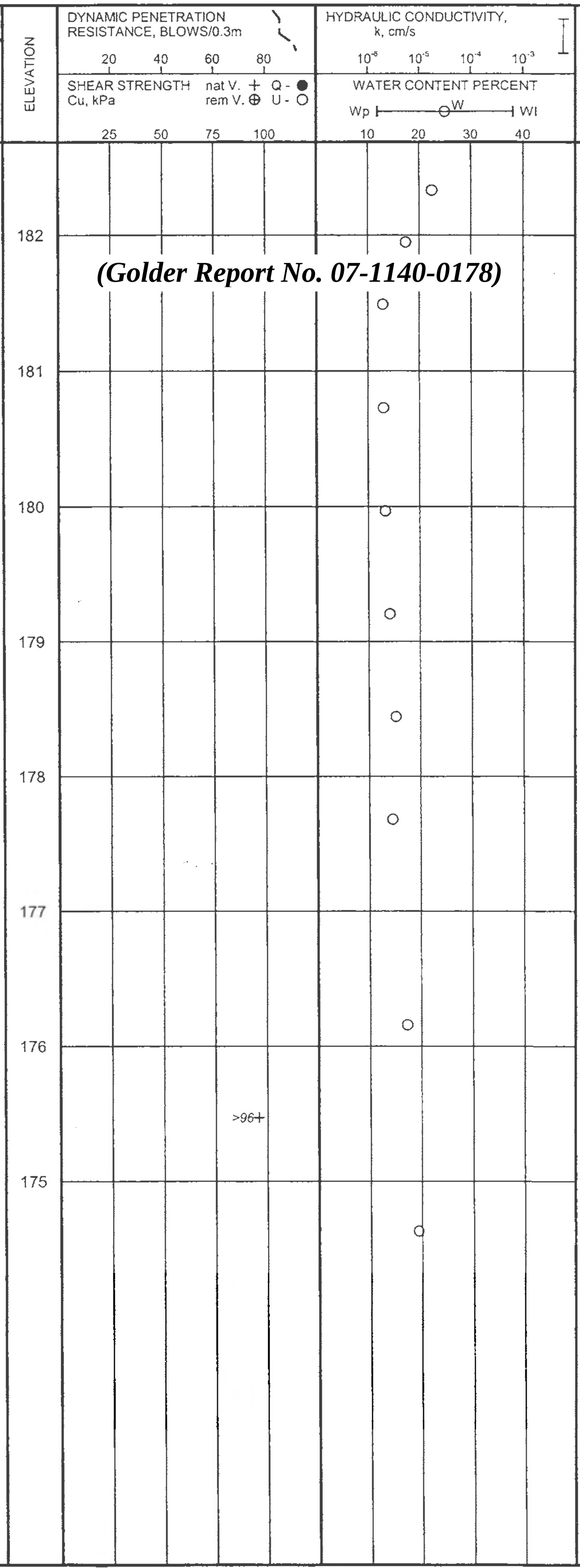
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE		SAMPLES		
DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	182.48			
Brown, clayey, **TOPSOIL**	0.00 182.25 0.23	1	CS	
Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel, occ. silt pocket **(TILL)**		2	SS	8
		3	SS	12
	180.65 1.83	4	SS	17
Very stiff, brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**		5	SS	28
	178.67 3.81	6	SS	22
Very stiff, grey, **SILTY CLAY**, some sand, trace gravel, occ. silt partings **(TILL)**		7	SS	13
		8	SS	8
		9	SS	9
	174.40 8.08	10	SS	7
END OF BOREHOLE				



(Golder Report No. 07-1140-0178)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on October 5, 2007

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: S.M.
CHECKED: a

LDN_BHS 07-1140-0178.GPJ GLDR_CAN.GDT 10/23/07 DATA INPUT: Jason Scott

PROJECT: 07-1140-0178

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: OCTOBER 5, 2007

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

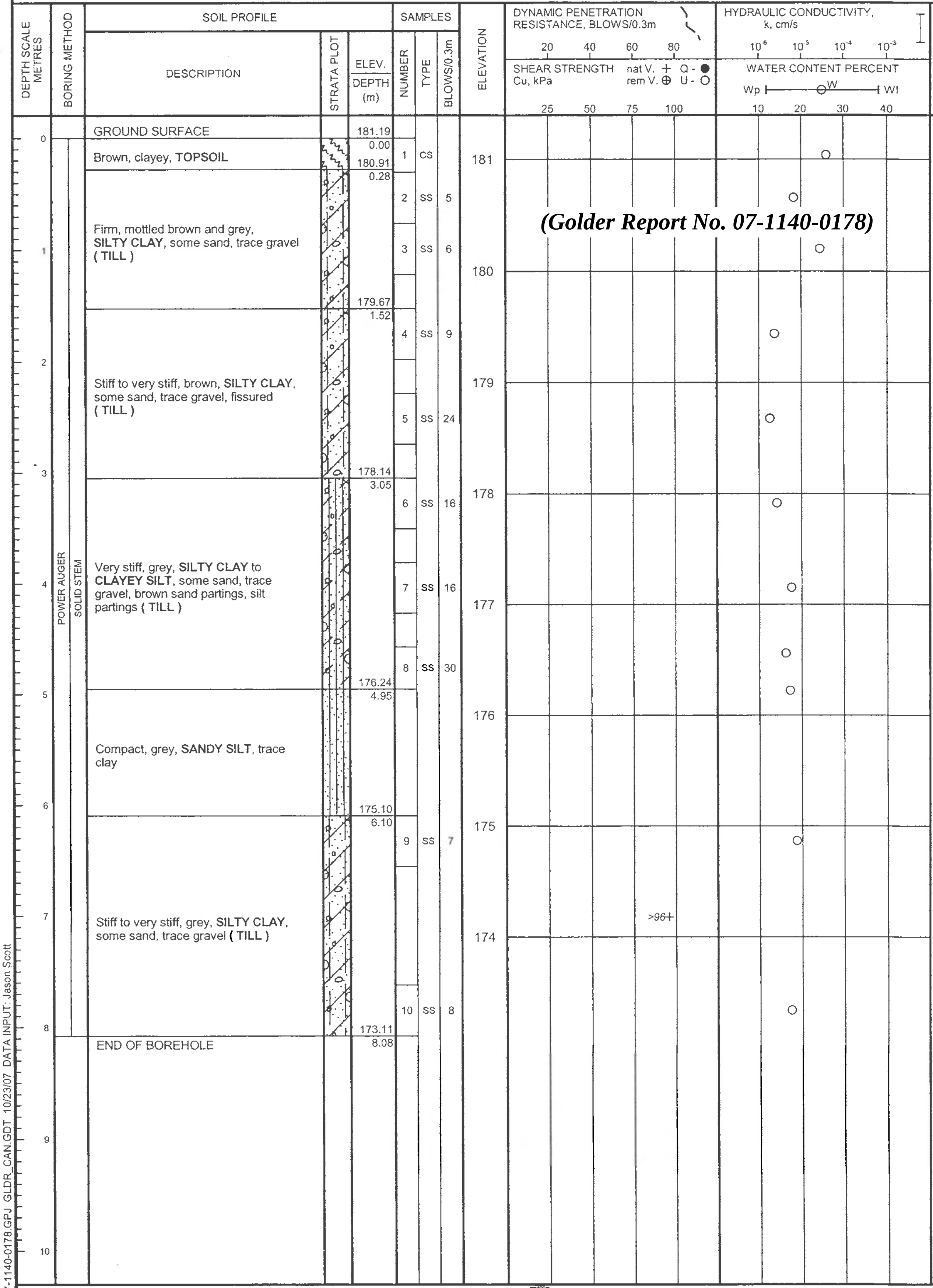
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 07-1140-0178)

BORING METHOD: POWER AUGER, SOLID STEM

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.19 0.00
Brown, clayey, **TOPSOIL**	180.91 0.28
Firm, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	179.67 1.52
Stiff to very stiff, brown, **SILTY CLAY**, some sand, trace gravel, fissured **(TILL)**	178.14 3.05
Very stiff, grey, **SILTY CLAY** to **CLAYEY SILT**, some sand, trace gravel, brown sand partings, silt partings **(TILL)**	176.24 4.95
Compact, grey, **SANDY SILT**, trace clay	175.10 6.10
Stiff to very stiff, grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	173.11 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	CS	
2	SS	5
3	SS	6
4	SS	9
5	SS	24
6	SS	16
7	SS	16
8	SS	30
9	SS	7
10	SS	8



INSTALLATION AND GROUNDWATER OBSERVATIONS

Water seepage into borehole at about elevation 177.38 m during drilling on October 5, 2007

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: S.M.

CHECKED: CK

LDN_BHS 07-1140-0178.GPJ GLDR_CAN.GDT 10/23/07 DATA INPUT: Jason Scott

PROJECT: 08-1140-W041

RECORD OF TEST PIT 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

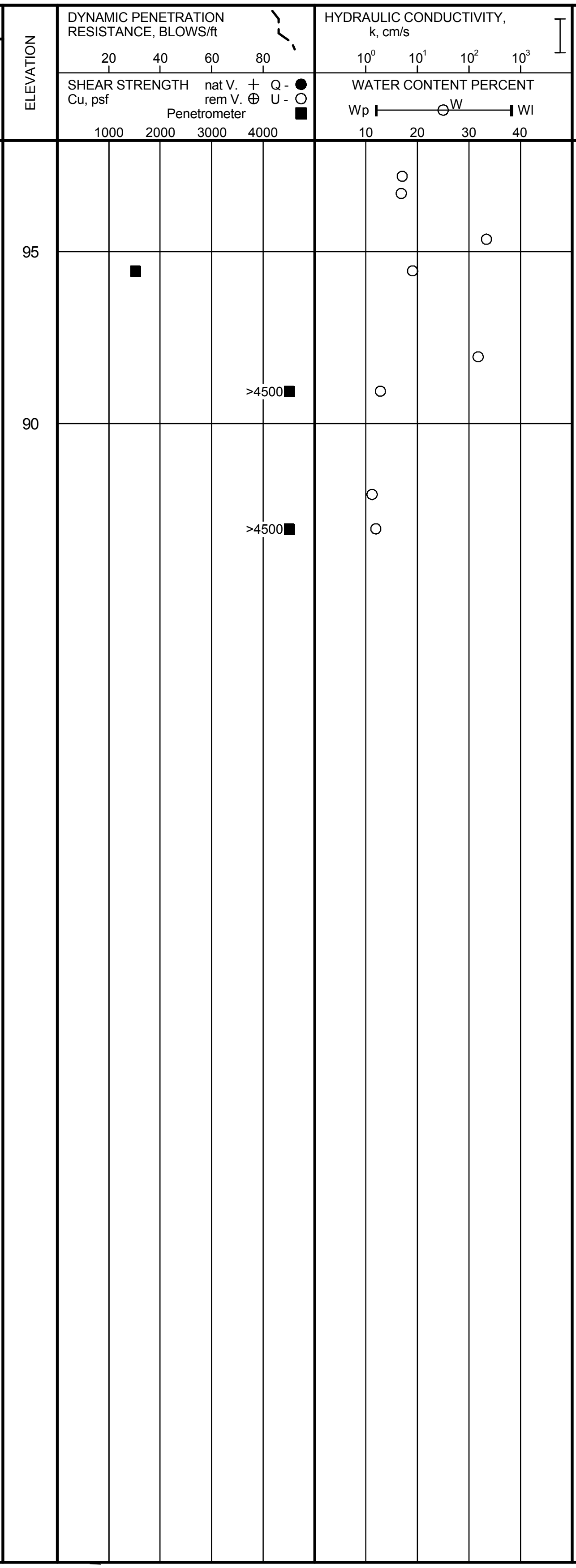
EXCAVATION DATE: APRIL 14, 2008

DATUM: LOCAL

(Golder Report No. 08-1140-W041)

METHOD: BACKHOE

DESCRIPTION	ELEV. DEPTH (ft)	NUMBER	TYPE
GROUND SURFACE	97.4		
Dark brown, clayey topsoil, occ. rootlets (**FILL**)	0.0	1	CS
Brown, silty clay, some sand, trace gravel, occ. topsoil pockets (**FILL**)	0.5	2	CS
Black, clayey **TOPSOIL**	95.8 1.7	3	CS
Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel (**TILL**)	94.9 2.5	4 5	CS CS
Hard, brown, **CLAYEY SILT**, some sand, trace gravel (**TILL**)	91.4 6.0	6	CS
Hard, grey, **CLAYEY SILT**, some sand, trace gravel, fissured (**TILL**)	87.9 9.5	7 8	CS CS
END OF TEST PIT	85.4 12.0		



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

▽

Water seepage into test pit at about elevation 91.4ft during excavating on April 14, 2008

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35

DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: S.M.

CHECKED:

LDN_BHS 08-1140-W041.GPJ GLDR_CAN.GDT 4/25/08 DATA INPUT: Jason Scott

PROJECT: 08-1140-W041

LOCATION: SEE LOCATION PLAN

RECORD OF TEST PIT 2

EXCAVATION DATE: APRIL 14, 2008

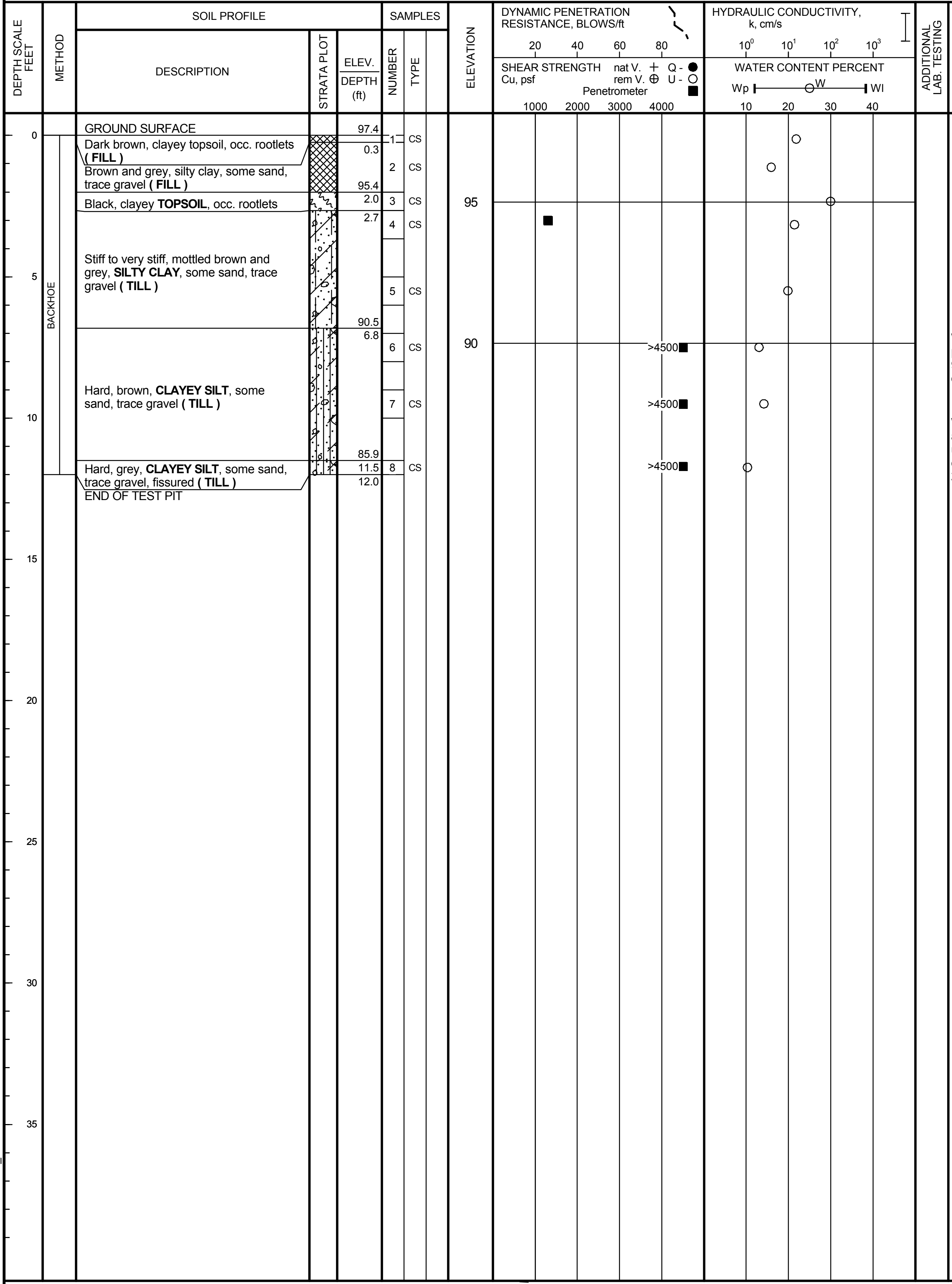
SHEET 1 OF 1

DATUM: LOCAL

(Golder Report No. 08-1140-W041)

METHOD: BACKHOE

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLE NUMBER	TYPE
GROUND SURFACE	97.4		
Dark brown, clayey topsoil, occ. rootlets **(FILL)**	0.3	1	CS
Brown and grey, silty clay, some sand, trace gravel **(FILL)**	95.4 2.0	2	CS
Black, clayey **TOPSOIL**, occ. rootlets	2.7	3	CS
Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	90.5 6.8	4 5	CS CS
Hard, brown, **CLAYEY SILT**, some sand, trace gravel **(TILL)**	85.9 11.5	6 7	CS CS
Hard, grey, **CLAYEY SILT**, some sand, trace gravel, fissured **(TILL)**	12.0	8	CS
END OF TEST PIT			



INSTALLATION AND GROUNDWATER OBSERVATIONS

Water seepage into test pit at about elevation 90.9ft during excavating on April 14, 2008

Water level in test pit at about elevation 91.1ft upon completion of excavating on April 14, 2008

DEPTH SCALE

1 inch to 5 feet

LOGGED: S.M.

CHECKED:

LDN_BHS 08-1140-W041.GPJ GLDR_CAN.GDT 4/25/08 DATA INPUT: Jason Scott

PROJECT: 08-1140-W041

RECORD OF TEST PIT 3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: APRIL 14, 2008

DATUM: LOCAL

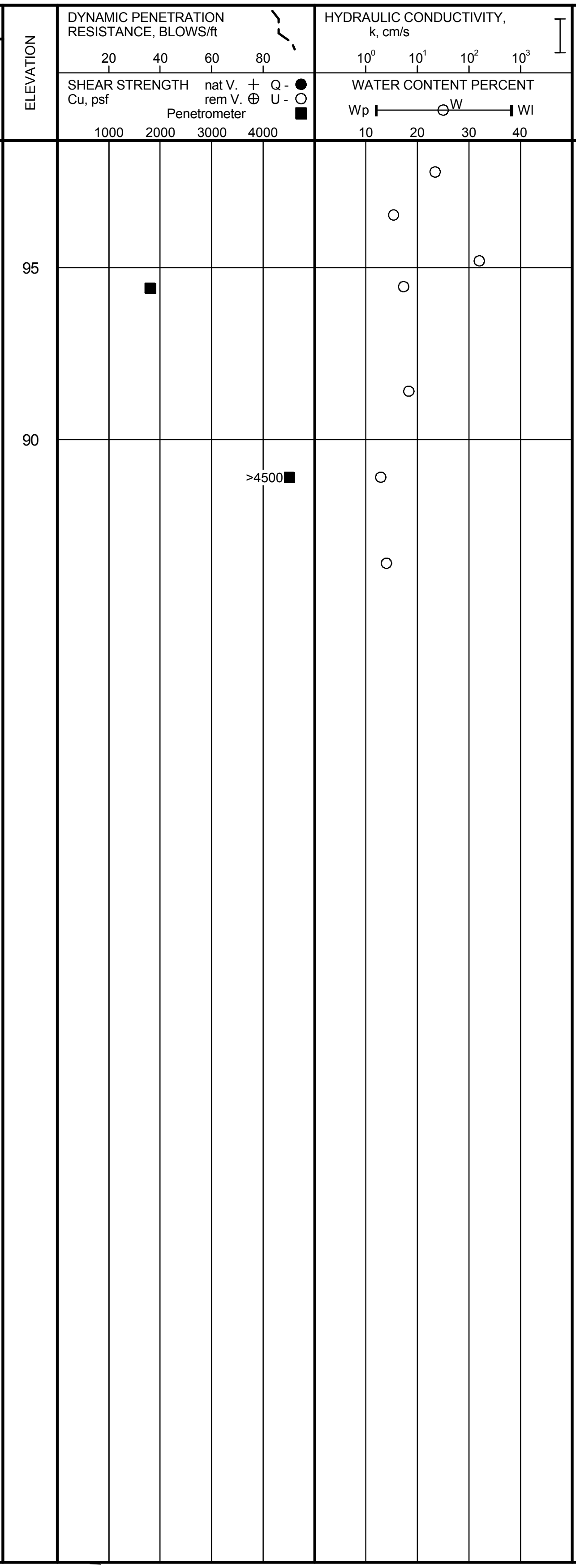
(Golder Report No. 08-1140-W041)

DEPTH SCALE FEET: 0, 5, 10, 15, 20, 25, 30, 35

METHOD: BACKHOE

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)
GROUND SURFACE	97.9
Dark brown, clayey topsoil, trace gravel, occ. rootlets **(FILL)**	0.3
Brown and grey, silty clay, some sand, trace gravel, occ. rootlets **(FILL)**	95.4 2.5
Black, clayey **TOPSOIL**	2.9
Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	89.9 8.0
Hard, brown, **CLAYEY SILT**, some sand, trace gravel **(TILL)**	87.4 10.5
Hard, brown to grey, **CLAYEY SILT**, some sand, trace gravel, fissured **(TILL)**	85.9 12.0
END OF TEST PIT	

SAMPLES NUMBER	TYPE
1	CS
2	CS
3	CS
4	CS
5	CS
6	CS
7	CS



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Minor water seepage into test pit at about elevation 95.4ft during excavating on April 14, 2008

Water seepage into test pit at about elevation 90.9ft during excavating on April 14, 2008

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: S.M.
CHECKED:

LDN_BHS 08-1140-W041.GPJ GLDR_CAN.GDT 4/25/08 DATA INPUT: Jason Scott

PROJECT: 08-1140-W041

RECORD OF TEST PIT 4

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

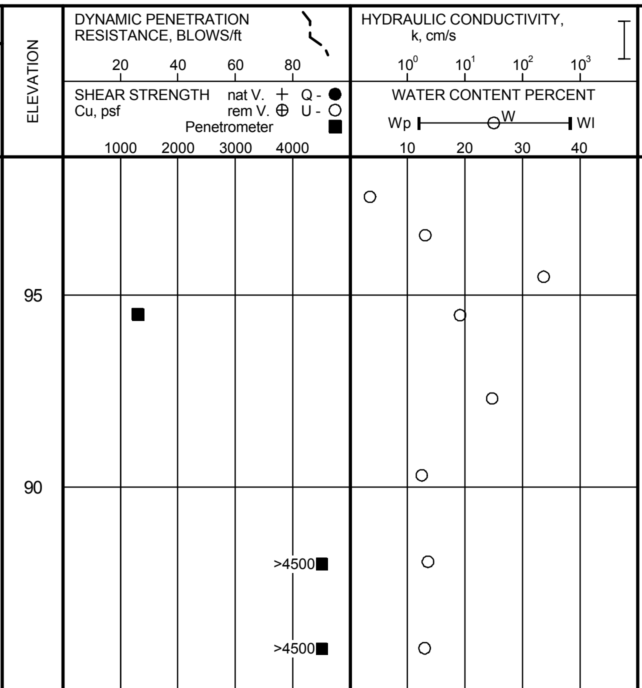
EXCAVATION DATE: APRIL 14, 2008

DATUM: LOCAL

(Golder Report No. 08-1140-W041)

METHOD: BACKHOE

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (ft)	SAMPLE NUMBER	TYPE
GROUND SURFACE	97.8		
Grey, crushed granular material **(FILL)**	0.0	1	CS
Brown, silty clay, some sand, trace gravel, occ. asphalt fragments **(FILL)**	0.5	2	CS
Black, clayey **TOPSOIL**	95.8 2.0	3	CS
Stiff to very stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	2.7	4 5	CS CS
Hard, brown, **CLAYEY SILT**, some sand, trace gravel **(TILL)**	91.1 6.8	6	CS
Hard, grey, **CLAYEY SILT**, some sand, trace gravel, fissured **(TILL)**	87.8 10.0	7 8	CS CS
END OF TEST PIT	85.3 12.5		



INSTALLATION AND GROUNDWATER OBSERVATIONS

Minor water seepage into test pit at about elevation 95.3ft during excavating on April 14, 2008

Water seepage into test pit at about elevation 91.8ft during excavating on April 14, 2008

DEPTH SCALE

1 inch to 5 feet

LOGGED: S.M.

CHECKED:

PROJECT: 08-1140-W044

RECORD OF BOREHOLE 1A

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MAY 1, 2008

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

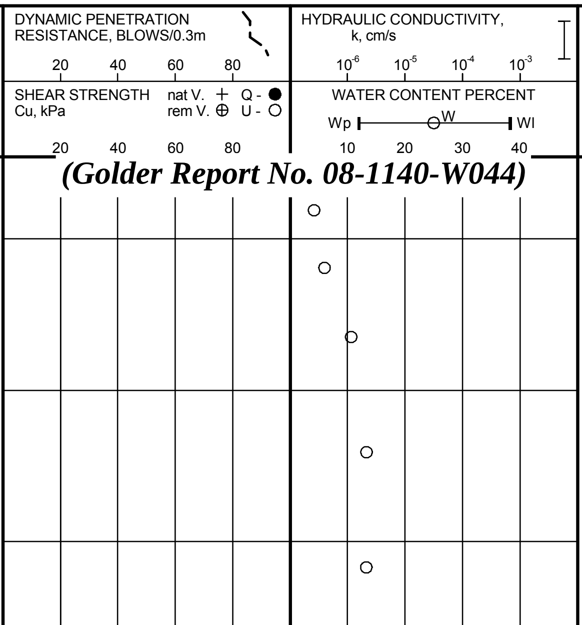
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 08-1140-W044)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		185.34 0.00
Grey, crushed granular material **(FILL)**	▨	184.58 0.76
Grey, crushed granular material, mixed with clayey silt **(FILL)**	▨	183.21 2.13
Soft, brown, silty clay, some sand, trace gravel, occ. sand pockets and wood fragments **(FILL)**	▨	182.60 2.74
END OF BOREHOLE		

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	CS	
2	SS	10
3	AS	6
4	SS	1
5	SS	3



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Water seepage into borehole at about elevation 184.58m during drilling on May 1, 2008

Water level in borehole at about elevation 184.43m upon completion of drilling on May 1, 2008

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

LDN_BHS 08-1140-W044.GPJ GLDR_CAN.GDT 5/16/08 DATA INPUT: Jason Scott

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: S.M.
CHECKED:

PROJECT: 08-1140-W044

RECORD OF BOREHOLE 1B

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: MAY 1, 2008

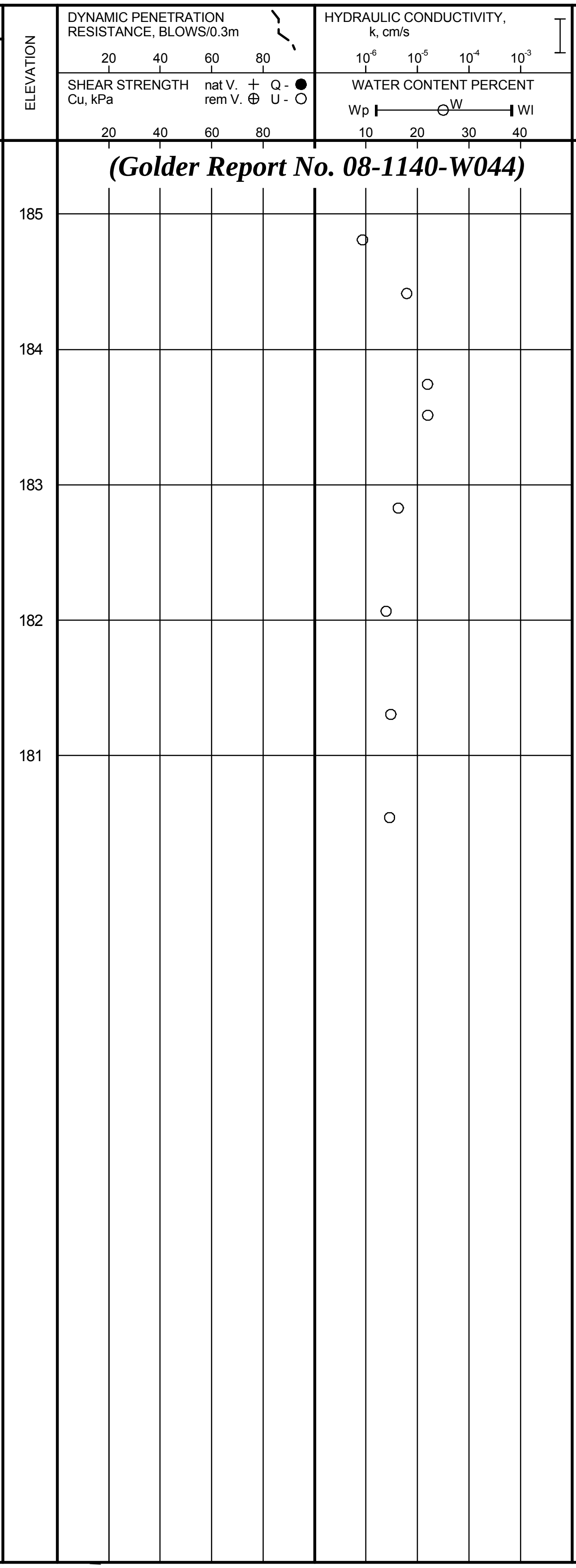
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 08-1140-W044)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	185.34					
0	POWER AUGER HOLLOW STEM	Grey, crushed granular material **(FILL)**	0.00	1	CS			
		Brown, sand, some gravel **(FILL)**	185.04 0.30	2	CS			
1		Greenish brown, clayey silt, some sand, trace gravel **(FILL)**	184.58 0.76	3	CS			
2		Mottled brown and grey, **CLAYEY SILT**, some sand, occ. gravel, some organic pockets **(TILL)**	184.25 1.10	4 5	CS SS	 4		
		Firm to stiff, mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	183.21 2.13	6	SS	11		Borehole dry during drilling on May 1, 2008
3 4		Very stiff, brown, **SILTY CLAY**, some sand, trace gravel **(TILL)**	182.45 2.90	7 8 9	SS SS SS	25 26 22		
5		END OF BOREHOLE	180.31 5.03					
6								
7								
8								
9								
10								



DEPTH SCALE

1 : 50

LOGGED: S.M.

CHECKED:

PROJECT: 08-1140-W125

RECORD OF BOREHOLE BH-1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: August 29, 2008

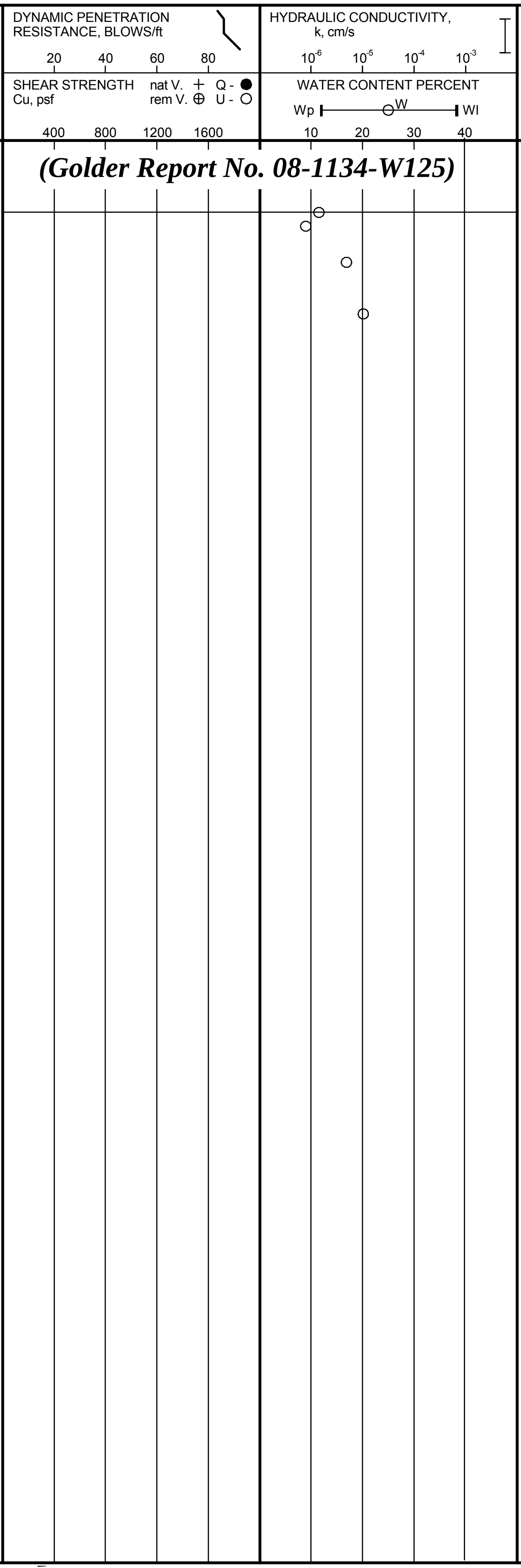
DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 08-1134-W125)

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/FT	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	600.3						
	POWER AUGER SOLID STEM	Dark brown clayey **TOPSOIL**, trace gravel	0.0 599.6 0.8	1	AS		600		
		Stiff to very stiff mottled brown/grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings **(TILL)**		2	SS	11			Borehole dry during drilling on August 29, 2008.
			596.3 4.0	3	SS	20			
		END OF BOREHOLE							
5									
10									
15									
20									
25									
30									
35									



DEPTH SCALE

1 inch to 5 feet

Golder Associates

LOGGED: BG

CHECKED:

PROJECT: 08-1140-W125

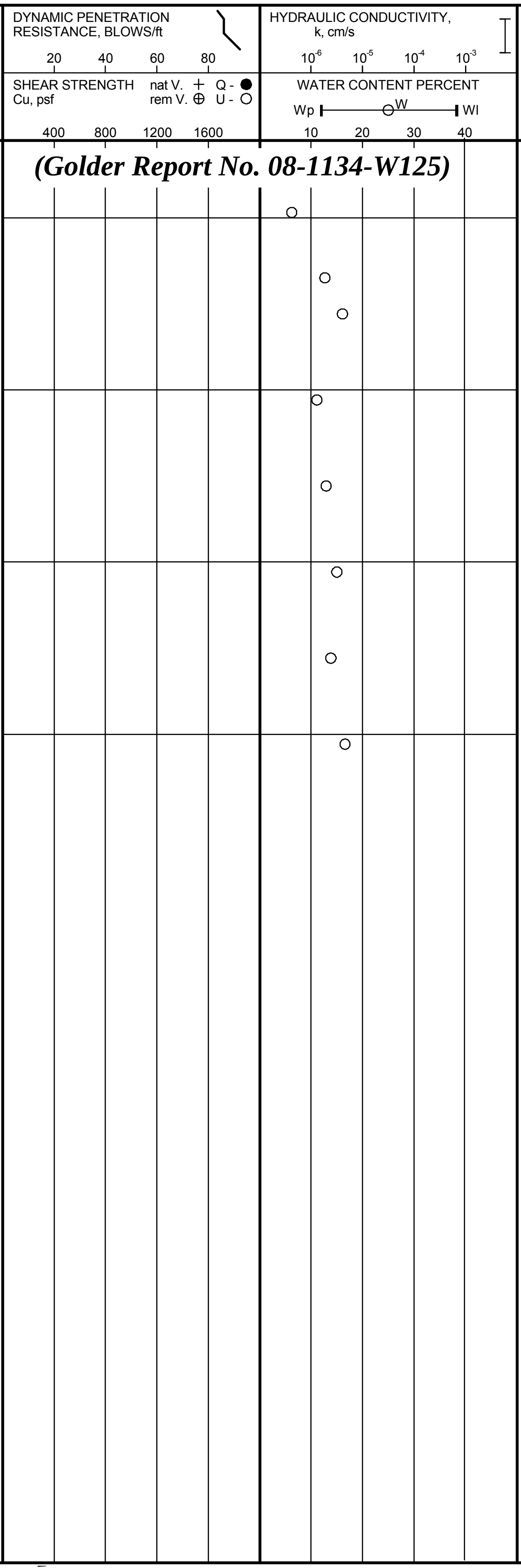
RECORD OF BOREHOLE BH-2

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN
BORING DATE: August 29, 2008
DATUM: GEODETIC

SAMPLER HAMMER, 140lb; DROP, 30in
PENETRATION TEST HAMMER, 140lb; DROP, 30in

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/FT	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER SOLID STEM	GROUND SURFACE	600.5					
		Dark brown to black clayey **TOPSOIL**, occasional rootlets	0.0				600	
		Firm to stiff mottled brown/grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings **(TILL)**	0.7	1	AS			Borehole dry during drilling on August 29, 2008.
				2	SS	11		
5		Very stiff to hard brown **SILTY CLAY**, some sand and gravel, occasional fissures **(TILL)**	596.0 4.5	3	SS	20	595	
				4	SS	36		
10		Very stiff to stiff grey **SILTY CLAY**, trace to some sand and gravel **(TILL)**	591.0 9.5	5	SS	20	590	
				6	SS	10		
15				7	SS	9	585	
		END OF BOREHOLE	584.0 16.5					
20								
25								
30								
35								



(Golder Report No. 08-1134-W125)

ADDITIONAL LAB. TESTING

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: BG
CHECKED:

PROJECT: 08-1140-W125

RECORD OF BOREHOLE BH-3

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

BORING DATE: August 29, 2008

DATUM: GEODETIC

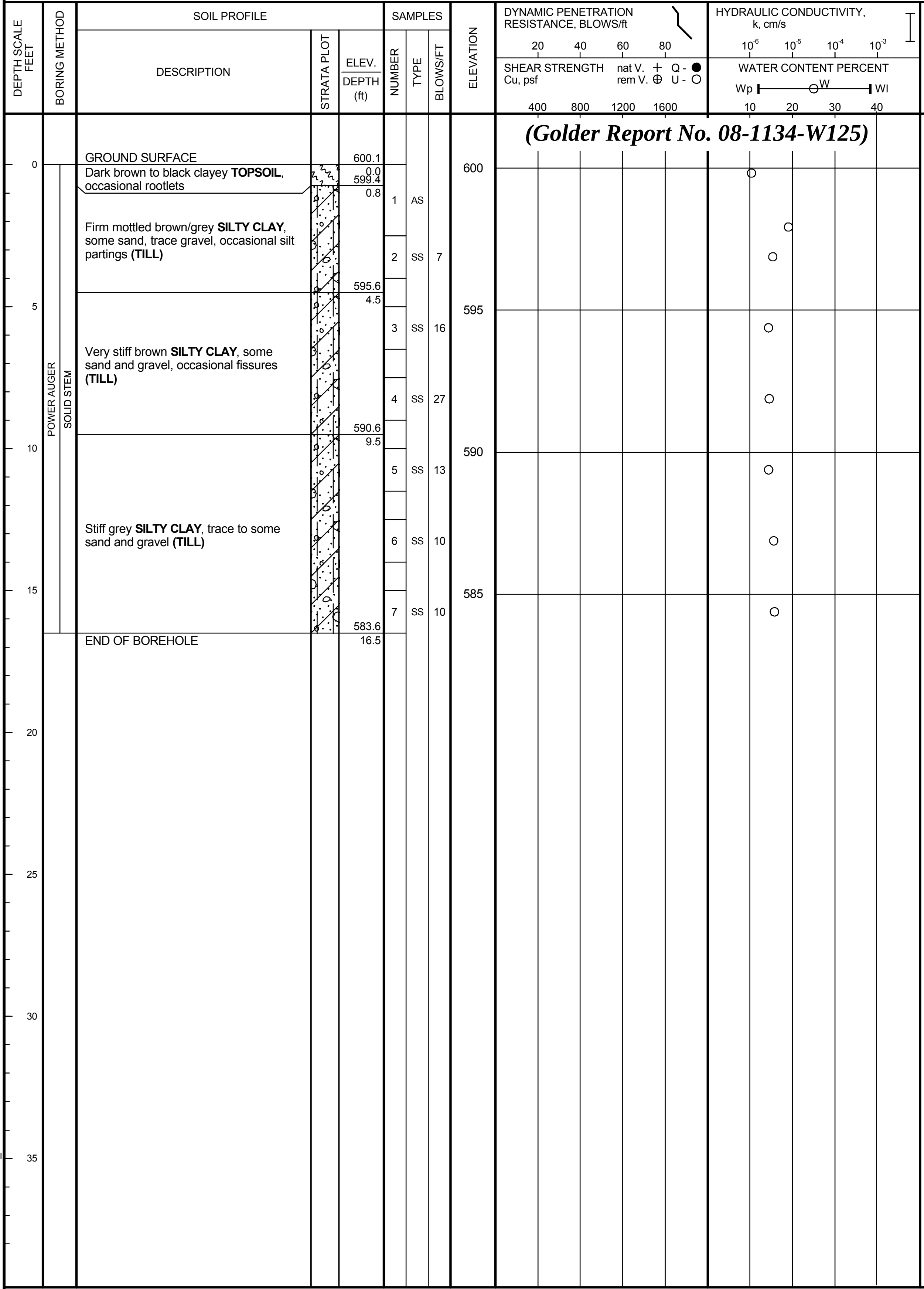
SAMPLER HAMMER, 140lb; DROP, 30in

PENETRATION TEST HAMMER, 140lb; DROP, 30in

(Golder Report No. 08-1134-W125)

BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS/FT
GROUND SURFACE	600.1 0.0			
Dark brown to black clayey **TOPSOIL**, occasional rootlets	599.4 0.8			
Firm mottled brown/grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings **(TILL)**		1	AS	
		2	SS	7
	595.6 4.5			
Very stiff brown **SILTY CLAY**, some sand and gravel, occasional fissures **(TILL)**		3	SS	16
		4	SS	27
	590.6 9.5			
Stiff grey **SILTY CLAY**, trace to some sand and gravel **(TILL)**		5	SS	13
		6	SS	10
		7	SS	10
END OF BOREHOLE	583.6 16.5			



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on August 29, 2008.

DEPTH SCALE
1 inch to 5 feet

Golder Associates

LOGGED: BG
CHECKED:

LDN_BHS_02 081140W125.GPJ GLDR_LON.GDT 12/9/08 DATA INPUT: SJL

PROJECT: 09-1140-1122

RECORD OF TEST PIT 1

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

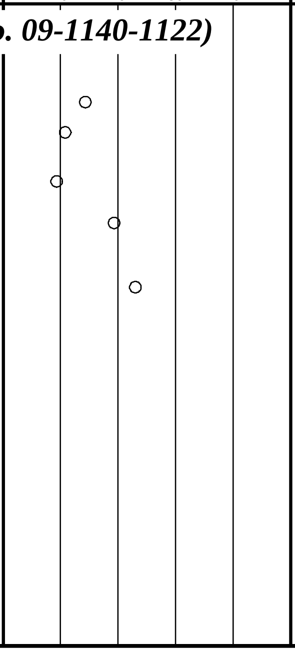
(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE				
	BACKHOE	Brown silty clay, some sand **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
		Brown silty sand with topsoil pockets **(FILL)**	0.30	2	CS	
		Grey crushed gravel **(FILL)**	0.50	3	CS	
1		Black **CLAYEY TOPSOIL**, some sand with roots	0.75	4	CS	
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel with silt pockets and fissures **(TILL)**	1.30	5	CS	
		BOTTOM OF TEST PIT	1.55			
2		Large cable at a depth of about 1.3m.				
3						

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



ADDITIONAL LAB. TESTING

PROJECT: 09-1140-1122

RECORD OF TEST PIT 2

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

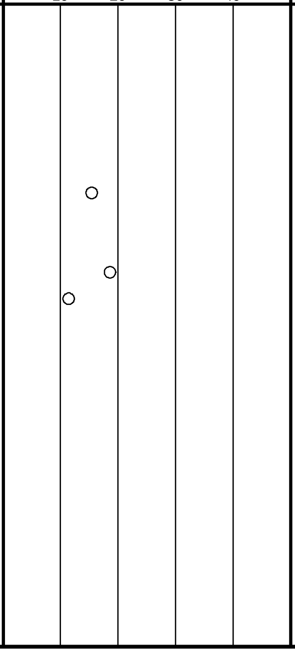
DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE				
1	BACKHOE 1.9m x 2.8m	Brown silty clay with topsoil pockets, trace sandy gravel, pieces of brick and chainlink fencing **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
		Black **CLAYEY TOPSOIL** with organic fibres	1.25	2	CS	
		Brown **SILTY SAND**, trace gravel with clay inclusions	1.40	3	CS	
		BOTTOM OF TEST PIT	1.60			
2						
3						

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 3

SHEET 1 OF 1

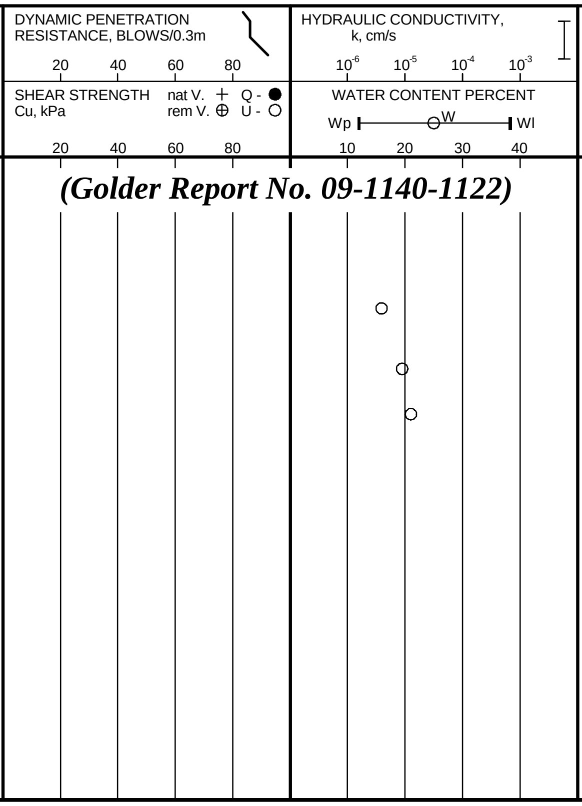
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	BACKHOE 0.7m x 2.7m	GROUND SURFACE							
		Mottled brown and grey silty clay with topsoil pockets **(FILL)**	▨	0.00	1	CS			Test pit dry upon completion of excavation on January 27, 2010.
1		Black **CLAYEY TOPSOIL** with organic fibres		0.80	2	CS			
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.10	3	CS			
		BOTTOM OF TEST PIT		1.35					
2									
3									

(Golder Report No. 09-1140-1122)



PROJECT: 09-1140-1122

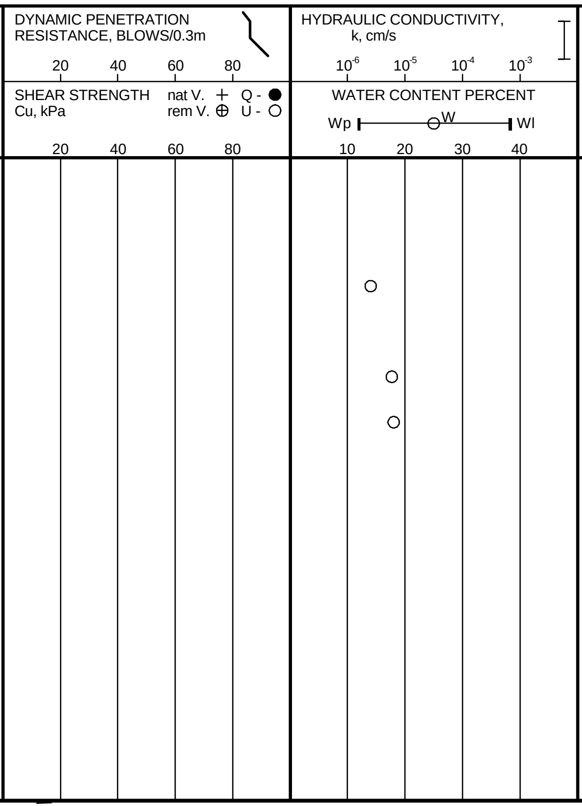
RECORD OF TEST PIT 4

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	BACKHOE 0.7 m x 2.8m	GROUND SURFACE							
		Brown silty clay, some sand and gravel with topsoil pockets **(FILL)**	▨	0.00	1	CS			Test pit dry upon completion of excavation on January 27, 2010.
1		Black clayey **TOPSOIL**		0.95	2	CS			
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.20	3	CS			
		BOTTOM OF TEST PIT		1.50					
2									
3									



LDN_BHS_06 0911401122.GPJ GLDR_LDN.GDT 5/19/10 DATA INPUT: DMB/SJL

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 5

SHEET 1 OF 1

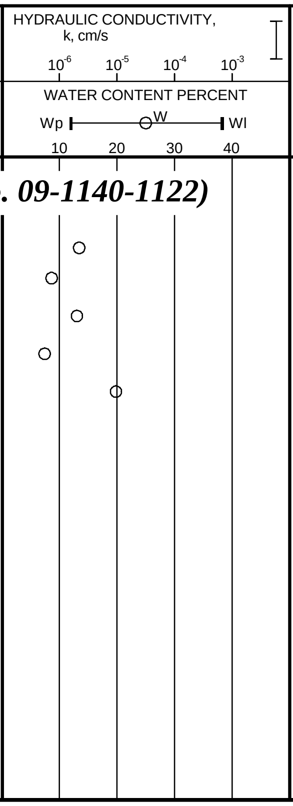
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES	METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE				
	BACKHOE 0.7m x 2.6m	Brown silty clay, some sand, trace gravel **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
		Brown sand and gravel with silty clay and crushed gravel **(FILL)**	0.25	2	CS	
		Black **SANDY TOPSOIL**, trace gravel	0.50	3	CS	
		Brown **SILTY SAND**, trace gravel	0.70	4	CS	
1		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	0.95	5	CS	
		BOTTOM OF TEST PIT	1.30			
2						
3						



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80

ELEVATION

ADDITIONAL LAB. TESTING

PROJECT: 09-1140-1122

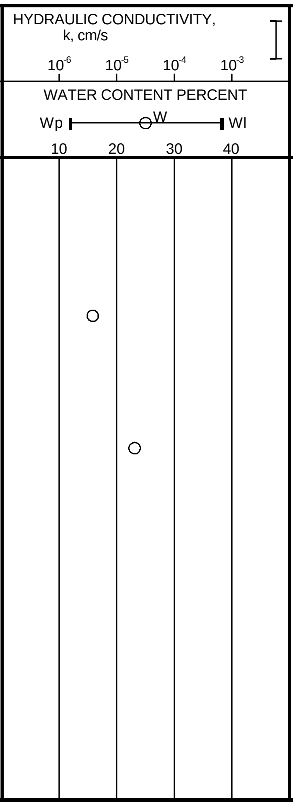
RECORD OF TEST PIT 6

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE				
	BACKHOE 0.7m x 2.4m	Brown silty clay and topsoil, trace gravel, pieces of asphalt, brick and field tile **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.40	2	CS	
		BOTTOM OF TEST PIT	1.55			
2						
3						



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80

ELEVATION

ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

LDN_BHS_06 0911401122.GPJ GLDR_LDN.GDT 5/19/10 DATA INPUT: DMB/SJL

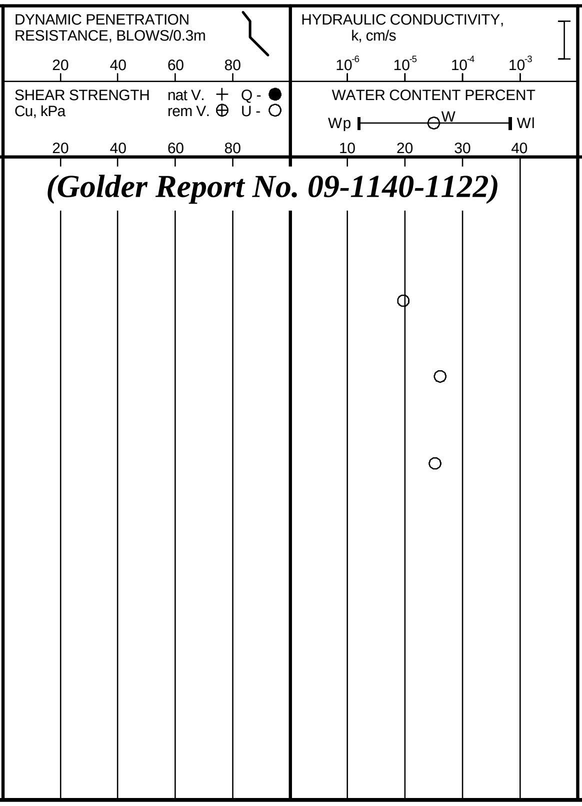
RECORD OF TEST PIT 7

PROJECT: 09-1140-1122
LOCATION: SEE LOCATION PLAN
EXCAVATION DATE: January 27, 2010
SHEET 1 OF 1
DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

METHOD: BACKHOE 0.7m x 2.4m

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	GROUND SURFACE				
	Brown silty clay, some sand, trace gravel with topsoil pockets and brick fragments, pieces of concrete and metal **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1	Black clayey topsoil, 4" dia. tree root, trace gravel **(FILL)**	0.80	2	CS	
	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel, with topsoil pockets **(TILL)**	1.50	3	CS	
2	BOTTOM OF TEST PIT	1.65			
3					

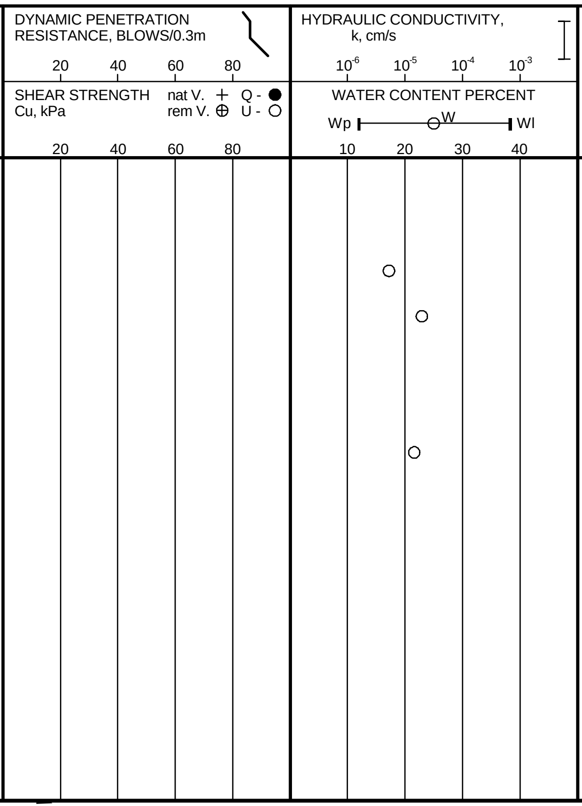


RECORD OF TEST PIT 8

PROJECT: 09-1140-1122
LOCATION: SEE LOCATION PLAN
EXCAVATION DATE: January 27, 2010
DATUM: NOT SURVEYED

METHOD: BACKHOE 0.7m x 2.3m

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	GROUND SURFACE				
	Brown silty clay, some sand, trace gravel with topsoil pockets, pieces of concrete and red brick **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1	Brown clayey topsoil **(FILL)**	0.45	2	CS	
	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.35	3	CS	
2	BOTTOM OF TEST PIT	1.60			
3					



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NG
CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 9

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES	METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	BACKHOE 0.7m x 2.0m	GROUND SURFACE				
		Brown silty clay, some sand, trace gravel **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1		Grey silty clay, some sand, trace gravel **(FILL)**	0.80	2	CS	
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.40	3	CS	
		BOTTOM OF TEST PIT	1.65			
2						
3						

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

ELEVATION

ADDITIONAL LAB. TESTING

PROJECT: 09-1140-1122

RECORD OF TEST PIT 10

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	BACKHOE 0.7m x 2.4m	GROUND SURFACE				
1		Brown and grey silty clay, some sand, trace gravel with pockets of topsoil, red brick and wood **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.40	2	CS	
		BOTTOM OF TEST PIT	1.55			
2						
3						

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

ELEVATION

ADDITIONAL LAB. TESTING

LDN_BHS_06 0911401122.GPJ GLDR_LDN.GDT 5/19/10 DATA INPUT: DMB/SJL

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 11

SHEET 1 OF 1

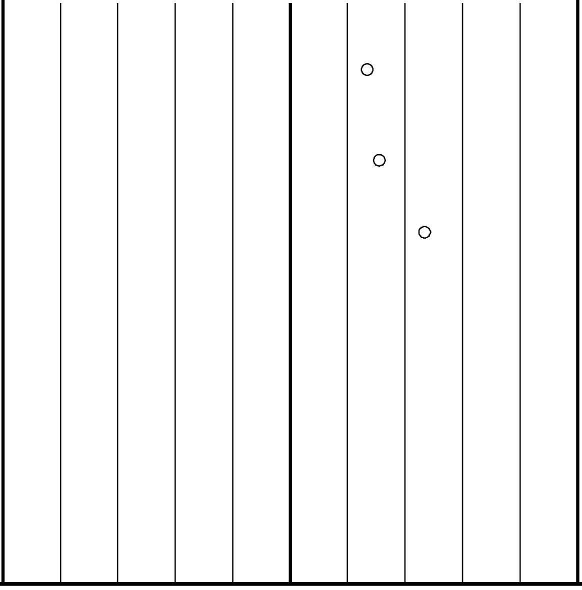
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE					
	BACKHOE 0.7m x 2.1m	Brown silty clay, some sand, trace gravel, field tile and asphalt fragments **(FILL)**	▨	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1		Black organic clayey topsoil with pockets of brown silty clay, some sand, trace gravel and pieces of plastic and metal **(FILL)**	▨	0.80	2	CS	
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.40	3	CS	
		BOTTOM OF TEST PIT		1.55			
2							
3							



PROJECT: 09-1140-1122

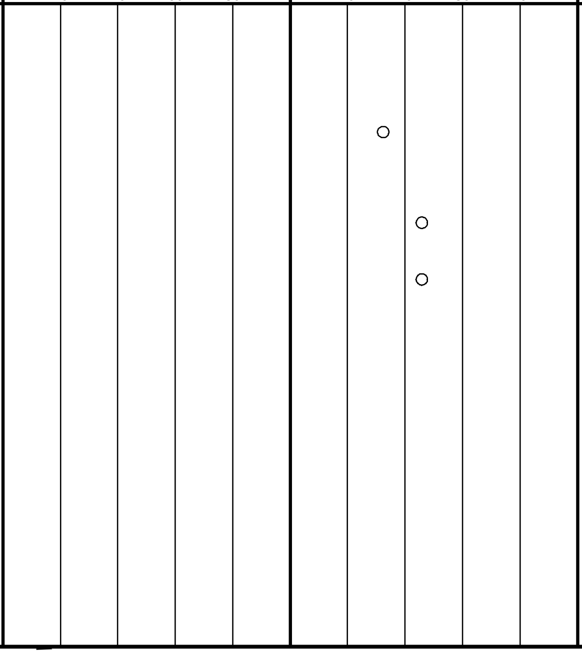
RECORD OF TEST PIT 12

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE					
	BACKHOE 0.7m x 2.5m	Brown silty clay, some sand, trace gravel, occasional field tile and concrete pieces, occasional topsoil pockets **(FILL)**	▨	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1		Mottled brown and grey silty clay, some sand, trace gravel with topsoil pockets and occasional field tile, wood, and organic fragments **(FILL)**	▨	0.80	2	CS	
		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.30	3	CS	
		BOTTOM OF TEST PIT		1.45			
2							
3							



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 13

SHEET 1 OF 1

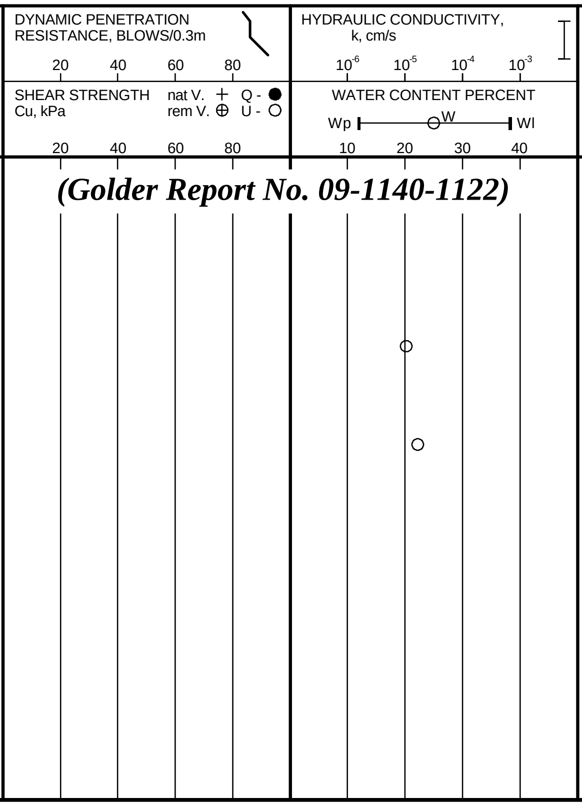
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		0.00					
	BACKHOE 0.7m x 2.5m	Mottled brown and grey silty clay, some sand, trace gravel with asphalt, concrete, metal and plastic fragments, topsoil pockets **(FILL)**	☒		1	CS			Test pit dry upon completion of excavation on January 27, 2010.
1		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.40	2	CS			
		BOTTOM OF TEST PIT		1.50					
2									
3									



PROJECT: 09-1140-1122

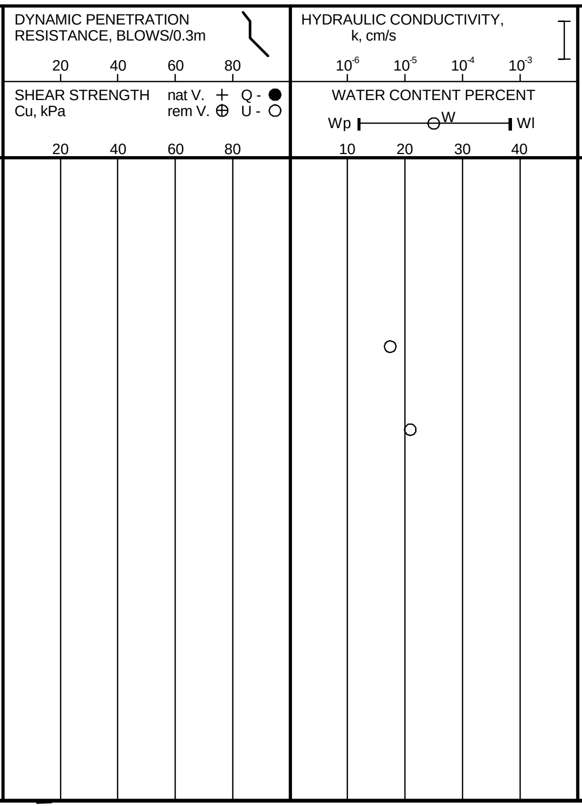
RECORD OF TEST PIT 14

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		0.00					
	BACKHOE 0.7m x 2.6m	Brown silty clay, some sand, trace gravel, some topsoil pockets, field tile fragments **(FILL)**	☒		1	CS			Test pit dry upon completion of excavation on January 27, 2010.
1		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.20	2	CS			
		BOTTOM OF TEST PIT		1.45					
2									
3									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 15

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

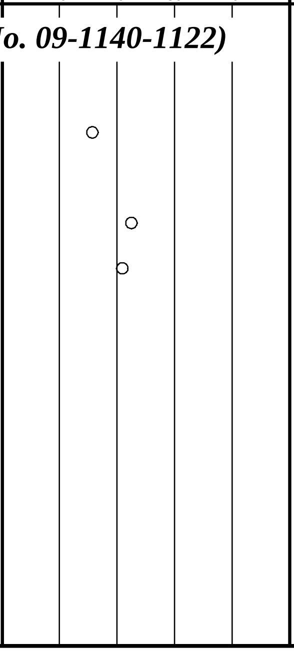
EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

METHOD: BACKHOE 0.7m x 2.3m

DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
GROUND SURFACE				
Brown silty clay mixed with sand and gravel **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
Brown and grey silty clay, some sand and gravel, pieces of concrete and field tile with topsoil pockets **(FILL)**	0.75	2	CS	
Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.20	3	CS	
BOTTOM OF TEST PIT	1.40			



DEPTH SCALE METRES: 0, 1, 2, 3

PROJECT: 09-1140-1122

RECORD OF TEST PIT 16

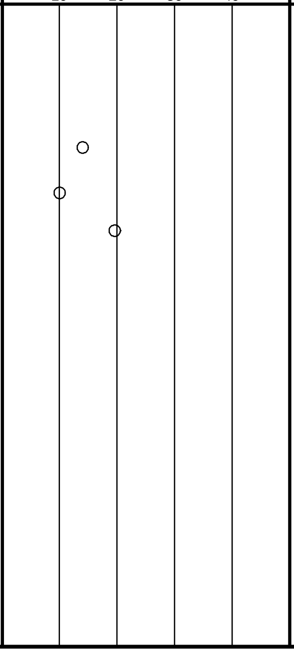
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

METHOD: BACKHOE 0.7m x 2.5m

DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
GROUND SURFACE				
Brown silty clay, some sand, trace gravel with pockets of grey silty clay and topsoil **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
Grey crushed sand and gravel **(FILL)**	0.70	2	CS	
Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	0.95	3	CS	
BOTTOM OF BOREHOLE	1.35			



DEPTH SCALE METRES: 0, 1, 2, 3

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 17

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

METHOD: BACKHOE, 0.7m x 2.35m

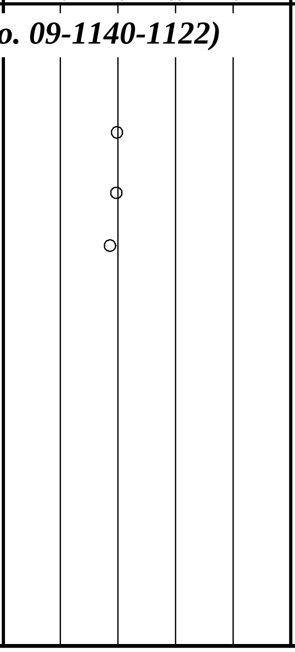
DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	GROUND SURFACE				
	Brown silty clay mixed with sand and gravel, topsoil, trace organics **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
	Brown silty clay and topsoil mixed with pockets of sand and gravel, copper wire **(FILL)**	0.60	2	CS	
1	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.00	3	CS	
	BOTTOM OF TEST PIT	1.35			
2					
3					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 10 20 30 40



ADDITIONAL LAB. TESTING

PROJECT: 09-1140-1122

RECORD OF TEST PIT 18

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

METHOD: BACKHOE, 0.7m x 2.2m

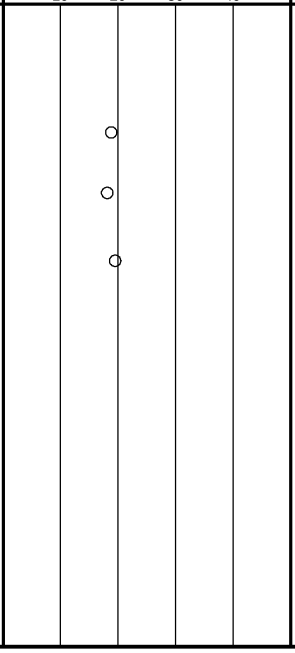
DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	GROUND SURFACE				
	Brown and grey silty clay, some sand, trace gravel, occasional pieces of concrete **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
1	Grey to mottled brown and grey silty clay, some sand and gravel, occasional topsoil pockets **(FILL)**	0.60	2	CS	
	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.10	3	CS	
	BOTTOM OF TEST PIT	1.45			
2					
3					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 10 20 30 40



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 19

SHEET 1 OF 1

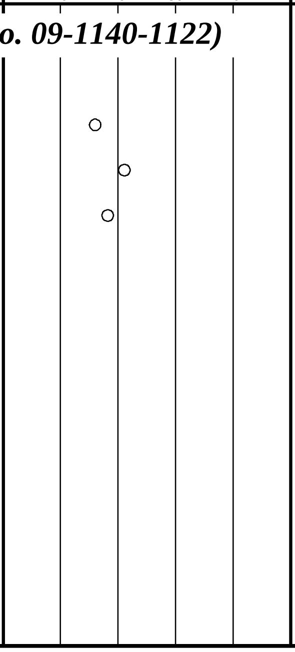
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									
	BACKHOE 0.7m x 2.3m	Brown silty clay, some sand, trace gravel with topsoil pockets, occasional pieces of field tile **(FILL)**		0.00	1	CS					Test pit dry upon completion of excavation on January 27, 2010.
		Black clayey topsoil, some sand with organic fibres **(FILL)**		0.50	2	CS					
1		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel with topsoil pockets **(TILL)**		0.80	3	CS					
		BOTTOM OF TEST PIT		1.35							
2											
3											



PROJECT: 09-1140-1122

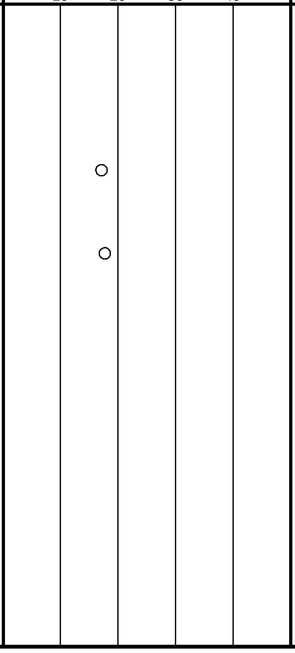
RECORD OF TEST PIT 20

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES	METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									
	BACKHOE 0.7m x 2.7m	Brown silty clay, some sand, trace gravel with pieces of brick **(FILL)**		0.00	1	CS					Test pit dry upon completion of excavation on January 27, 2010.
1		Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		1.15	2	CS					
		BOTTOM OF TEST PIT		1.25							
2											
3											



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NG

CHECKED:

RECORD OF TEST PIT 21

PROJECT: 09-1140-1122

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

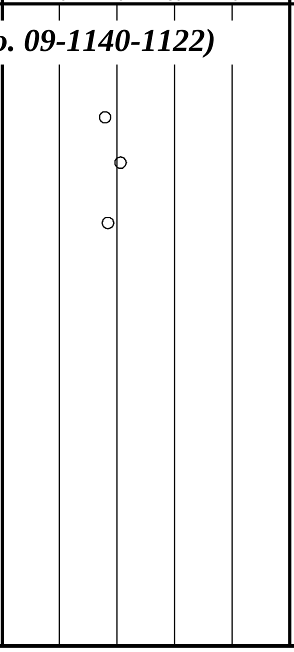
EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

METHOD: BACKHOE, 0.7m x 2.4m

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE
GROUND SURFACE			
Brown silty clay, some sand and gravel with large pieces of plastic pipe, occasional concrete and topsoil pockets **(FILL)**	0.00	1	CS
Black clayey topsoil mixed with black sandy topsoil, trace gravel with organic fibres **(FILL)**	0.45	2	CS
Mottled brown and grey silty clay, some sand, trace gravel, occasional pieces of crushed gravel, wood, topsoil pockets **(FILL)**	0.70	3	CS
BOTTOM OF TEST PIT	1.40		



INSTALLATION AND GROUNDWATER OBSERVATIONS: Test pit dry upon completion of excavation on January 27, 2010.

RECORD OF TEST PIT 22

PROJECT: 09-1140-1122

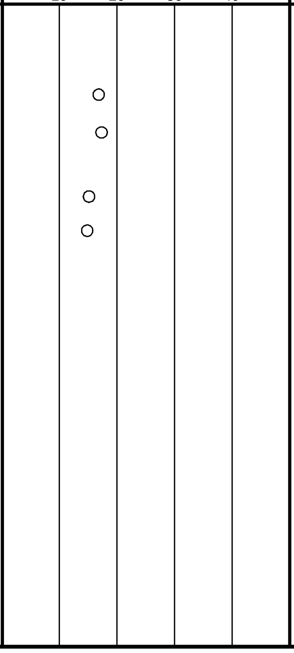
LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

METHOD: BACKHOE

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE
GROUND SURFACE			
Brown silty sand, trace gravel with pockets of silty clay, some sand, trace gravel and concrete fragments **(FILL)**	0.00	1	CS
Mottled brown and grey silty clay, some sand and gravel, occasional gravel and topsoil pockets **(FILL)**	0.25	2	CS
Brown to black **SANDY TOPSOIL**, occasional brown silty clay pockets	0.60	3	CS
Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	0.90	4	CS
BOTTOM OF TEST PIT	1.15		



INSTALLATION AND GROUNDWATER OBSERVATIONS: Test pit dry upon completion of excavation on January 27, 2010.

DEPTH SCALE 1 : 50

LOGGED: NG

CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 23

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

EXCAVATION DATE: January 27, 2010

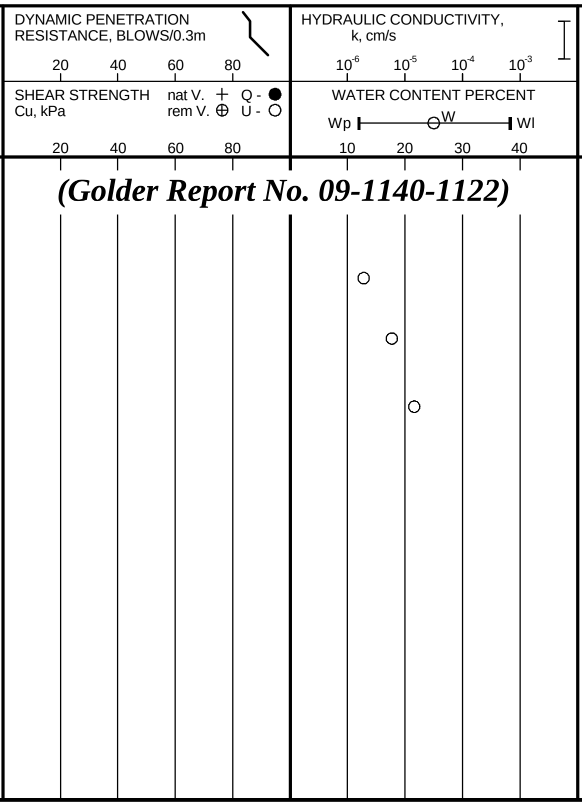
DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

DEPTH SCALE METRES: 0, 1, 2, 3

METHOD: BACKHOE

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
GROUND SURFACE				
Brown silty clay and clayey topsoil, some sand, trace gravel with pieces of asphalt, concrete, metal and plastic **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
Brown and grey silty clay, some sand and gravel, occasional topsoil pockets **(FILL)**	0.50	2	CS	
Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	1.05	3	CS	
BOTTOM OF TEST PIT	1.30			



PROJECT: 09-1140-1122

RECORD OF TEST PIT 24

LOCATION: SEE LOCATION PLAN

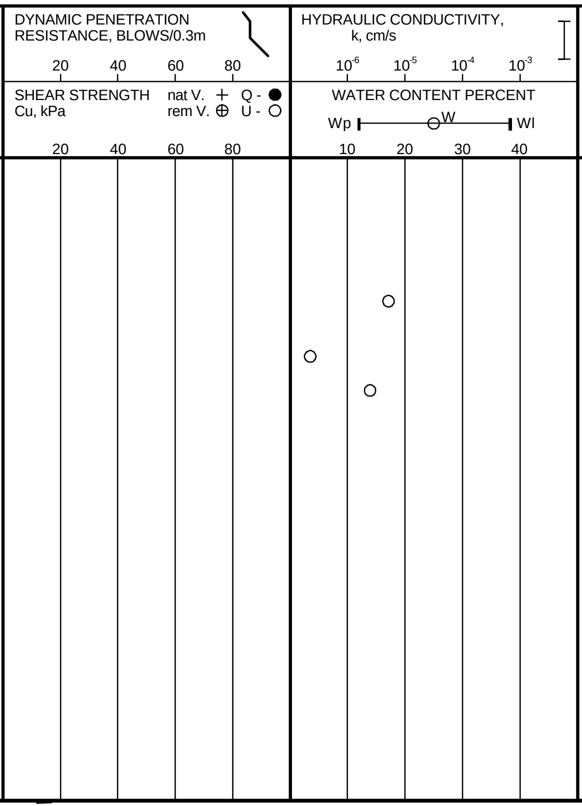
EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

DEPTH SCALE METRES: 0, 1, 2, 3

METHOD: BACKHOE 0.7m x 2.6m

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	INSTALLATION AND GROUNDWATER OBSERVATIONS
GROUND SURFACE				
Brown silty clay, some sand, trace gravel with pockets of sand and gravel, topsoil and concrete fragments **(FILL)**	0.00	1	CS	Test pit dry upon completion of excavation on January 27, 2010.
Grey crushed gravel **(FILL)**		2	CS	
Brown **CLAYEY TOPSOIL** mixed with gravel	0.90	3	CS	
Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	0.98	4	CS	
BOTTOM OF TEST PIT	1.40			



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NG
CHECKED:

PROJECT: 09-1140-1122

RECORD OF TEST PIT 25

SHEET 1 OF 1

LOCATION: SEE LOCATION PLAN

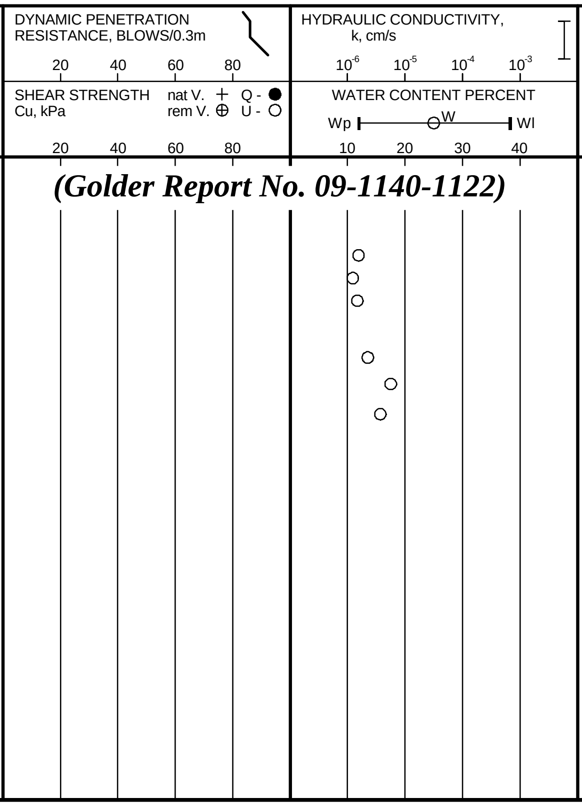
EXCAVATION DATE: January 27, 2010

DATUM: NOT SURVEYED

(Golder Report No. 09-1140-1122)

METHOD: BACKHOE, 0.7m x 2.7m

DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE
GROUND SURFACE	0.00		
Brown and grey silty clay, some sand and gravel with rootlets **(FILL)**	0.30	1	CS
Grey silty clay, some sand, trace gravel, numerous rootlets **(FILL)**	0.40	2	CS
Brown silty clay, some sand, trace gravel with rootlets **(FILL)**	0.60	3	CS
Grey crushed gravel with concrete and asphalt fragments **(FILL)**	0.75	4	CS
Brown silty clay, some sand, trace gravel **(FILL)**	1.00	5	CS
Black clayey topsoil with brown and grey silty clay, some sand, trace gravel, pockets **(FILL)**	1.10	6	CS
Mottled brown and grey **SILTY CLAY**, some sand, trace gravel with topsoil pockets **(TILL)**	1.40	7	CS
BOTTOM OF TEST PIT			



ELEVATION: —

ADDITIONAL LAB. TESTING: —

INSTALLATION AND GROUNDWATER OBSERVATIONS: Test pit dry upon completion of excavation on January 27, 2010.

DEPTH SCALE METRES: 0, 1, 2, 3

DEPTH SCALE 1 : 50

LOGGED: NG

CHECKED:

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 1

SHEET 1 OF 2

LOCATION: UTM 4678982.0 N, 339373.0 E

BORING DATE: October 7, 2010 & October 30, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

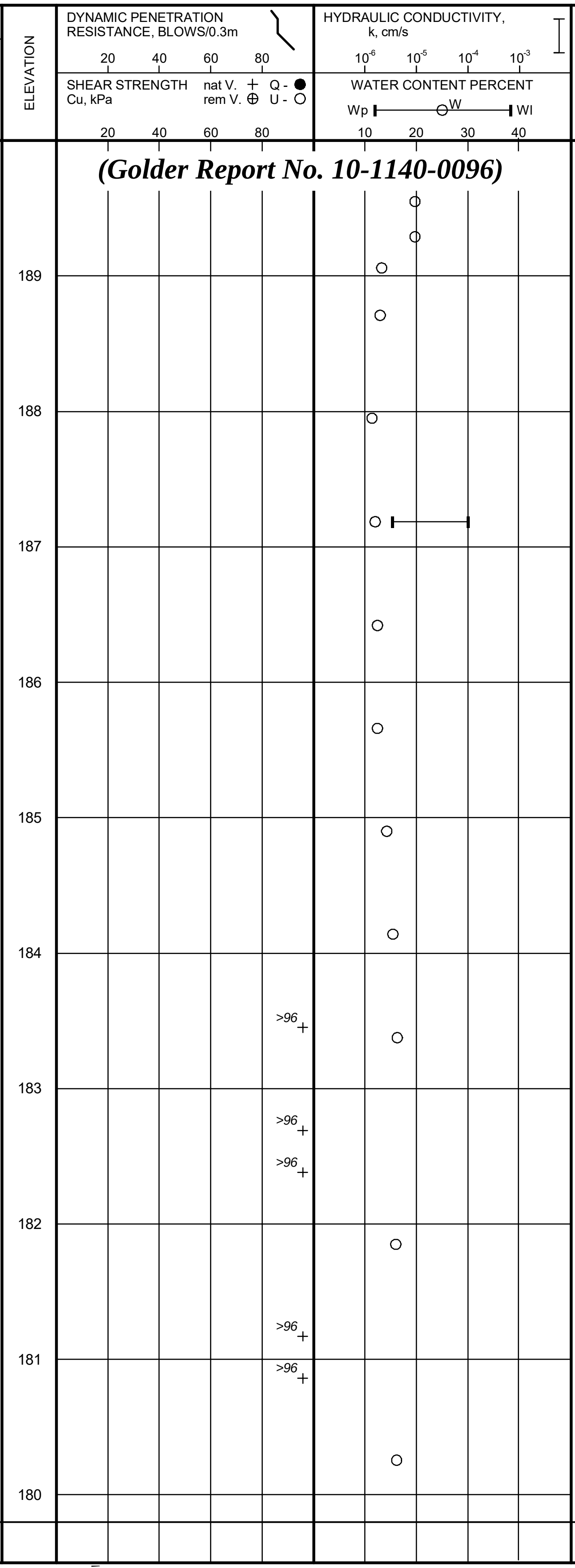
BORING METHOD: POWER AUGER, SOLID STEM

DEPTH SCALE METRES: 0 – 9

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	189.70
Stiff, brown clayey topsoil with brick fragments **(FILL)**	0.00
Stiff to hard, brown and grey silty clay, some sand, trace gravel with topsoil pockets **(FILL)**	189.19 0.51
Very stiff to hard, brown **SILTY CLAY**, some sand, trace gravel, some silt partings with oxidized fissures **(TILL)**	188.33 1.37
Very stiff, grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings **(TILL)**	186.04 3.66

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	13	
3	SS	34	
4	SS	38	
5	SS	29	MH
6	SS	31	
7	SS	21	
8	SS	13	
9	SS	10	
10	SS	8	
11	SS	8	
12	SS	9	

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on October 7, 2010.



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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TA
CHECKED:

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 1

SHEET 2 OF 2

LOCATION: UTM 4678982.0 N, 339373.0 E

BORING DATE: October 7, 2010 & October 30, 2010

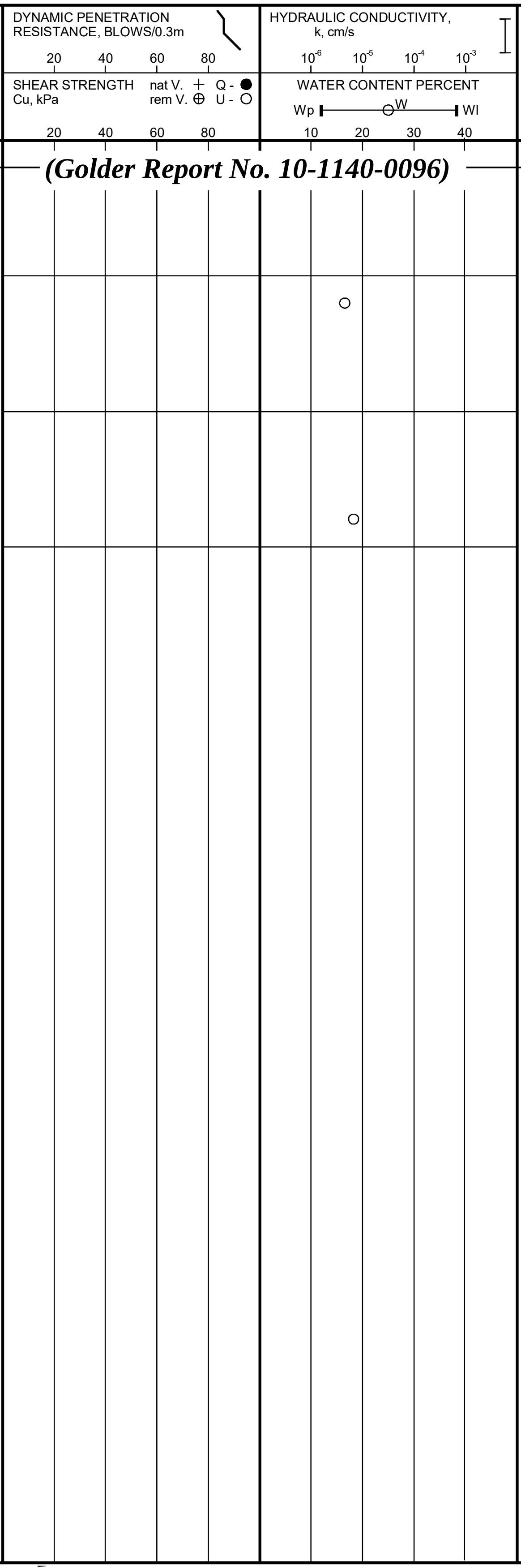
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---								
10	POWER AUGER SOLID STEM	Very stiff, grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings **(TILL)**								
								179		
11					13	SS	12			
								178		
12					14	SS	16			
				176.90 12.80				177		
13		END OF BOREHOLE								
14										
15										
16										
17										
18										
19										



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TA
CHECKED:

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 2

SHEET 1 OF 2

LOCATION: UTM 4678948.2 N, 339380.5 E

BORING DATE: October 8, 2010 & October 30, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

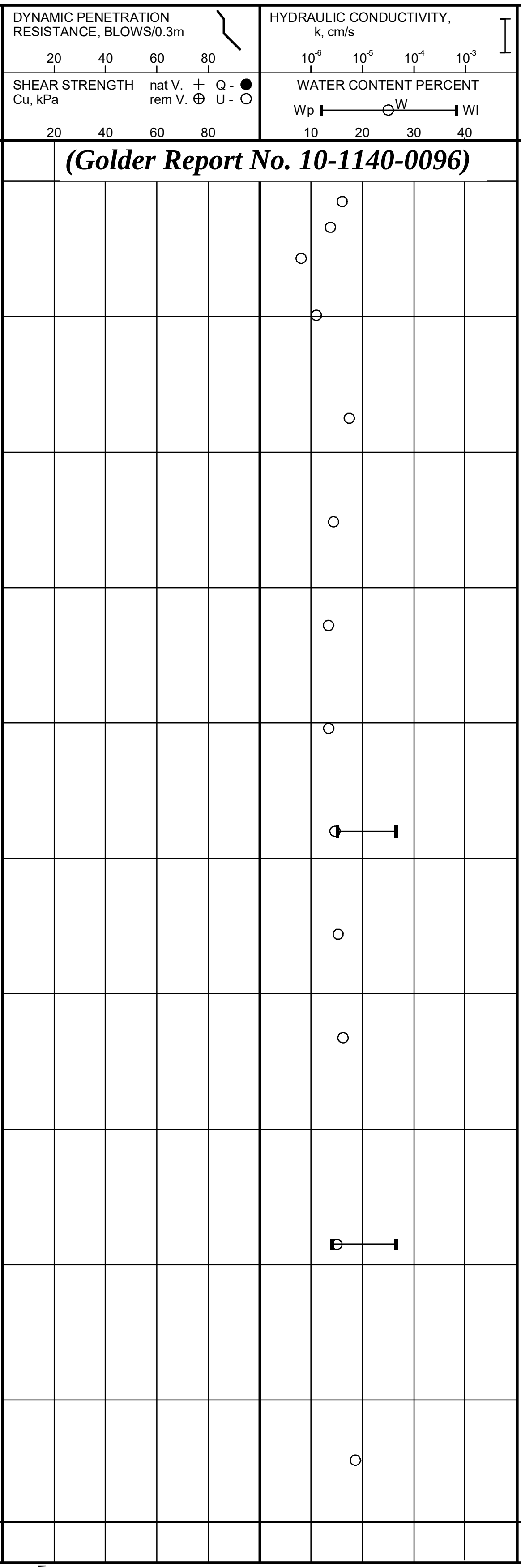
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	190.00
Stiff, brown clayey topsoil **(FILL)**	0.00
Compact to loose, brown silty sand, trace to some gravel **(FILL)**	189.62 0.38
Stiff, brown and grey **SILTY CLAY**, some sand, trace gravel, fissures **(TILL)**	188.63 1.37
Hard, brown **SILTY CLAY**, some sand, trace gravel, occasional silt partings with oxidized fissures **(TILL)**	188.02 1.98
Very stiff to stiff, grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings **(TILL)**	186.34 3.66
	180.25 9.75

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	11	
3	SS	4	
4	SS	10	
5	SS	38	
6	SS	40	
7	SS	24	
8	SS	16	MH
9	SS	19	
10	SS	15	
11	SS	13	MH
12	SS	10	



INSTALLATION AND GROUNDWATER OBSERVATIONS

Seepage Oct. 8/10 ∇

Groundwater seepage into borehole at about elevation 188.3m during drilling on October 8, 2010.

--- CONTINUED NEXT PAGE ---

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TA

CHECKED:

LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 2

SHEET 2 OF 2

LOCATION: UTM 4678948.2 N, 339380.5 E

BORING DATE: October 8, 2010 & October 30, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---						
10	POWER AUGER SOLID STEM	Stiff to very stiff, grey **SILTY CLAY**, some sand, trace gravel, occasional silt partings, occasional sand and gravel pockets **(TILL)**					180	
11				13	SS	18	179	
12							178	Seepage Oct. 30/10 ▽
			177.20 12.80	14	SS	14		Minor groundwater seepage into borehole at about elevation 177.5m during drilling on October 30, 2010.
13		END OF BOREHOLE						
14								
15								
16								
17								
18								
19								

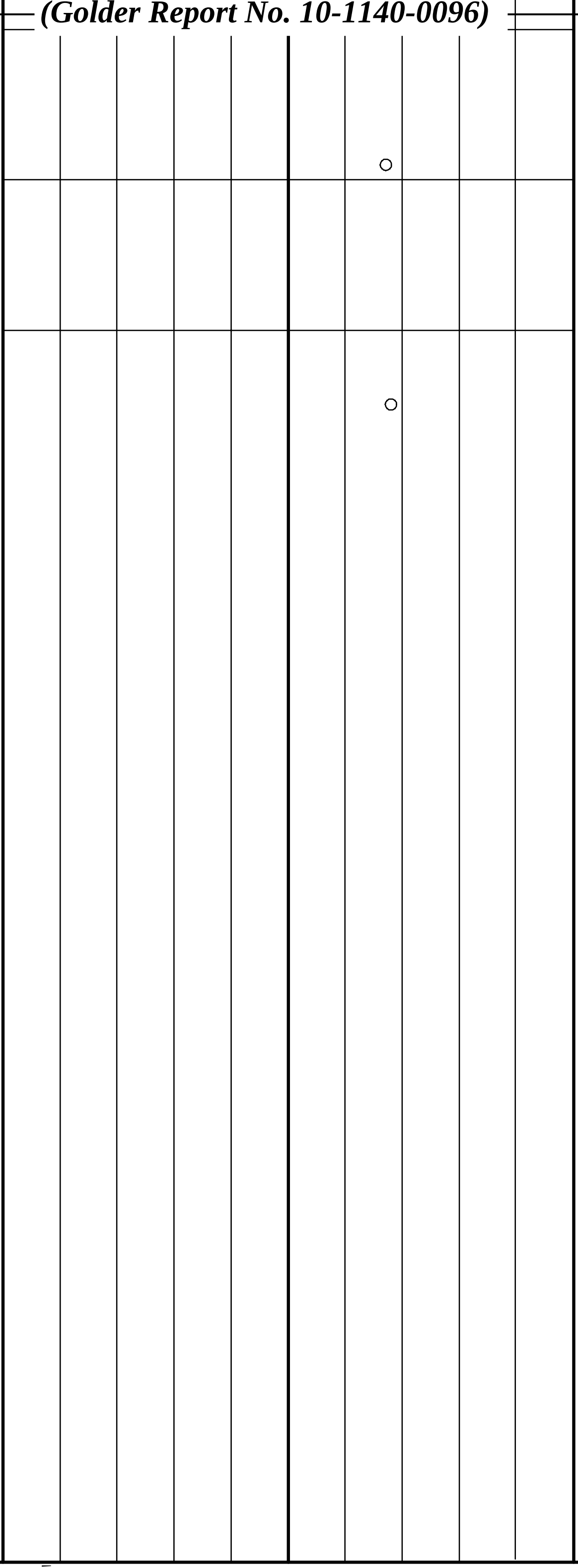
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING



LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TA

CHECKED:

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 3

SHEET 1 OF 2

LOCATION: UTM 4678893.2 N, 339376.8 E

BORING DATE: October 7, 2010 & October 30, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

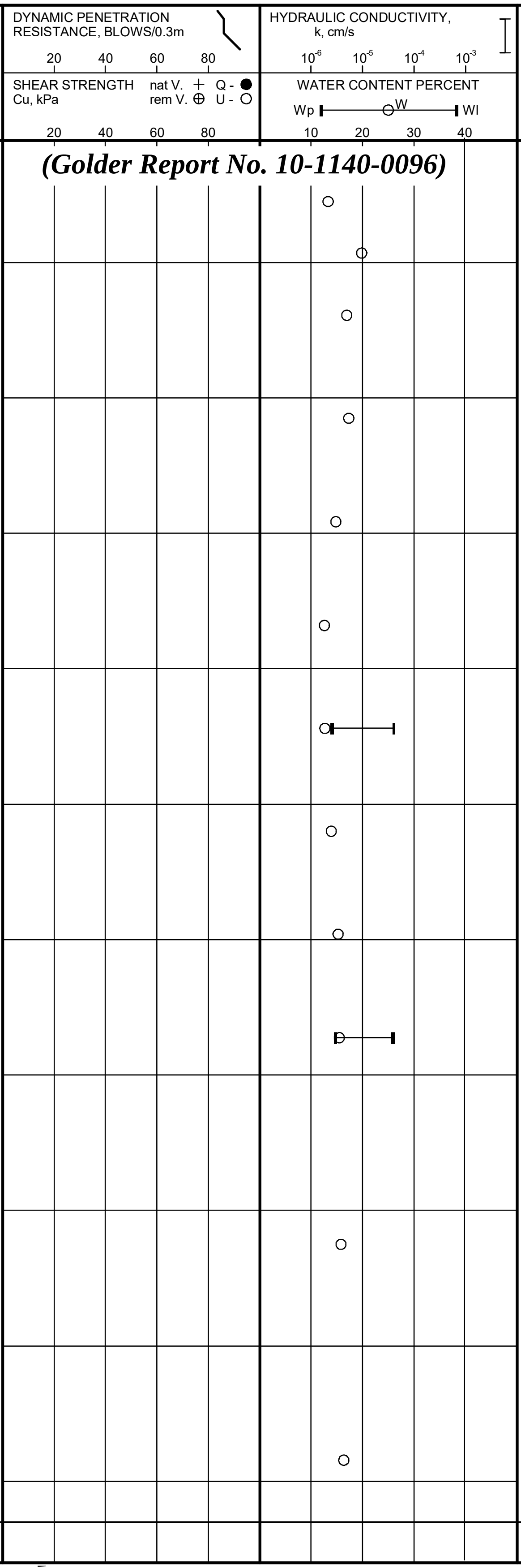
BORING METHOD: POWER AUGER, SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	189.60	0.00
Firm brown to black clayey topsoil **(FILL)**	188.84	0.76
Compact, brown **SILTY SAND**, trace gravel	188.23	1.37
Stiff to hard, brown **SILTY CLAY**, some sand, trace gravel, occasional silt partings to thin layers, thin sand layers, fissures **(TILL)**	186.70	2.90
Very stiff, grey **SILTY CLAY**, some sand, trace gravel, some silt partings **(TILL)** *(Coarse sand layer at a depth of about 10.8m)*		

--- CONTINUED NEXT PAGE ---

SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	6	
3	SS	14	
4	SS	12	
5	SS	30	
6	SS	17	
7	SS	21	MH
8	SS	21	
9	SS	17	
10	SS	19	MH
11	SS	21	
12	SS	15	

(Golder Report No. 10-1140-0096)



INSTALLATION AND GROUNDWATER OBSERVATIONS

WL Oct. 8/10 ∇

Seepage Oct. 7/10 ∇

Groundwater seepage encountered at about elevation 188.2m during drilling on October 7, 2010.

Borehole dry upon completion of drilling on October 7, 2010.

Water level in open borehole at about elevation 188.5m on October 8, 2010.

DEPTH SCALE

1 : 50

LOGGED: TA

CHECKED:

LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 3

SHEET 2 OF 2

LOCATION: UTM 4678893.2 N, 339376.8 E

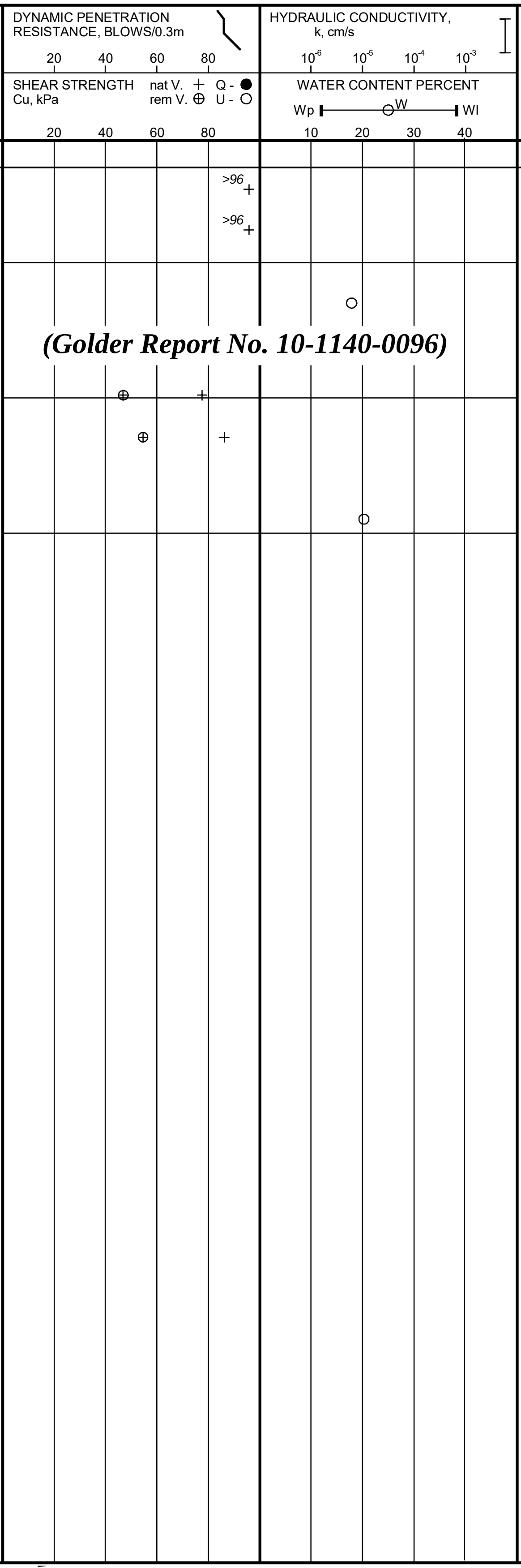
BORING DATE: October 7, 2010 & October 30, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---								
10		Very stiff, grey **SILTY CLAY**, some sand, trace gravel, some silt partings **(TILL)** *(Coarse sand layer at a depth of about 10.8m)*		178.78 10.82				179		*Seepage Oct. 30/10* ▽
11					13	SS	9			Groundwater seepage encountered at about elevation 178.9m during drilling on October 30, 2010.
		Stiff, grey **SILTY CLAY**, some sand, trace gravel, occasional silty sand layers **(TILL)**						178		
12					14	SS	5	177		
		END OF BOREHOLE		176.80 12.80						
13										
14										
15										
16										
17										
18										
19										



(Golder Report No. 10-1140-0096)

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TA

CHECKED:

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 4

SHEET 1 OF 2

LOCATION: UTM 4678874.1 N, 339374.9 E

BORING DATE: October 7, 2010 & October 30, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

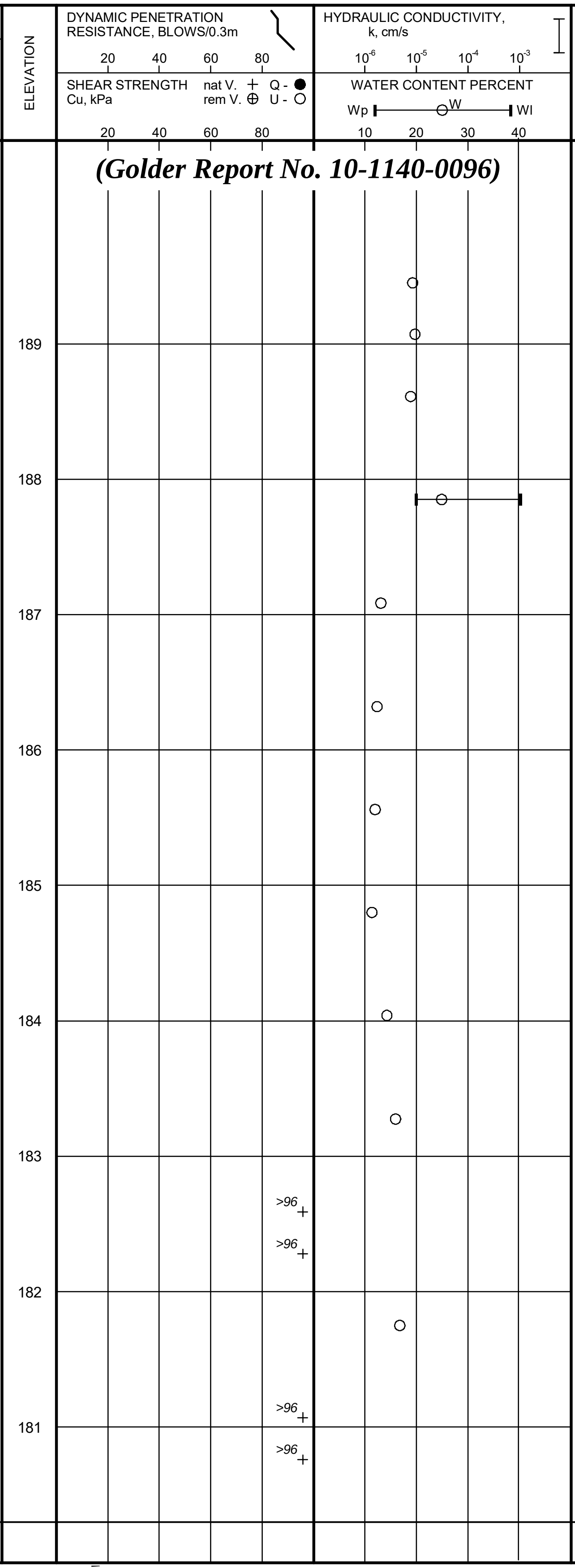
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

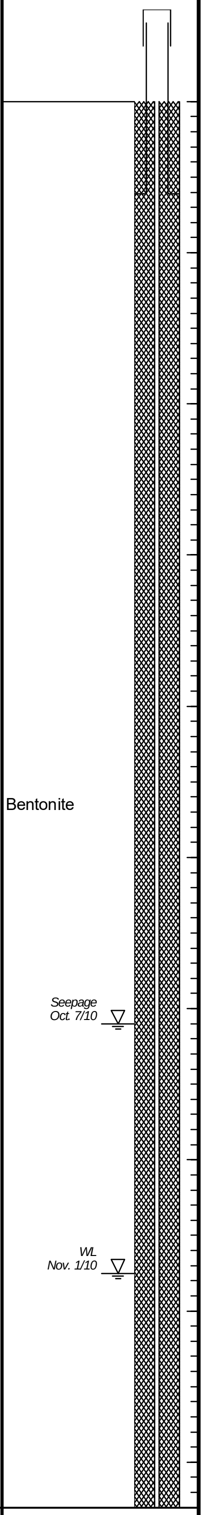
BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	189.60 0.00
Stiff, brown clayey topsoil mixed with brown silty clay and organic fibres **(FILL)**	
Stiff to firm, mottled brown and grey **SILTY CLAY**, some sand, trace gravel, fissures **(TILL)**	188.84 0.76
Hard, brown **SILTY CLAY**, some sand, trace gravel, some silt partings and fissures **(TILL)**	187.47 2.13
Very stiff to stiff, grey **SILTY CLAY**, some sand, trace gravel, some silt partings **(TILL)**	185.94 3.66
--- CONTINUED NEXT PAGE ---	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	9	
3	SS	10	
4	SS	6	MH
5	SS	42	
6	SS	48	
7	SS	23	
8	SS	17	
9	SS	16	
10	SS	11	
11	SS	13	
12	SS	8	



INSTALLATION AND GROUNDWATER OBSERVATIONS



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: TA
CHECKED:

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 4

SHEET 2 OF 2

LOCATION: UTM 4678874.1 N, 339374.9 E

BORING DATE: October 7, 2010 & October 30, 2010

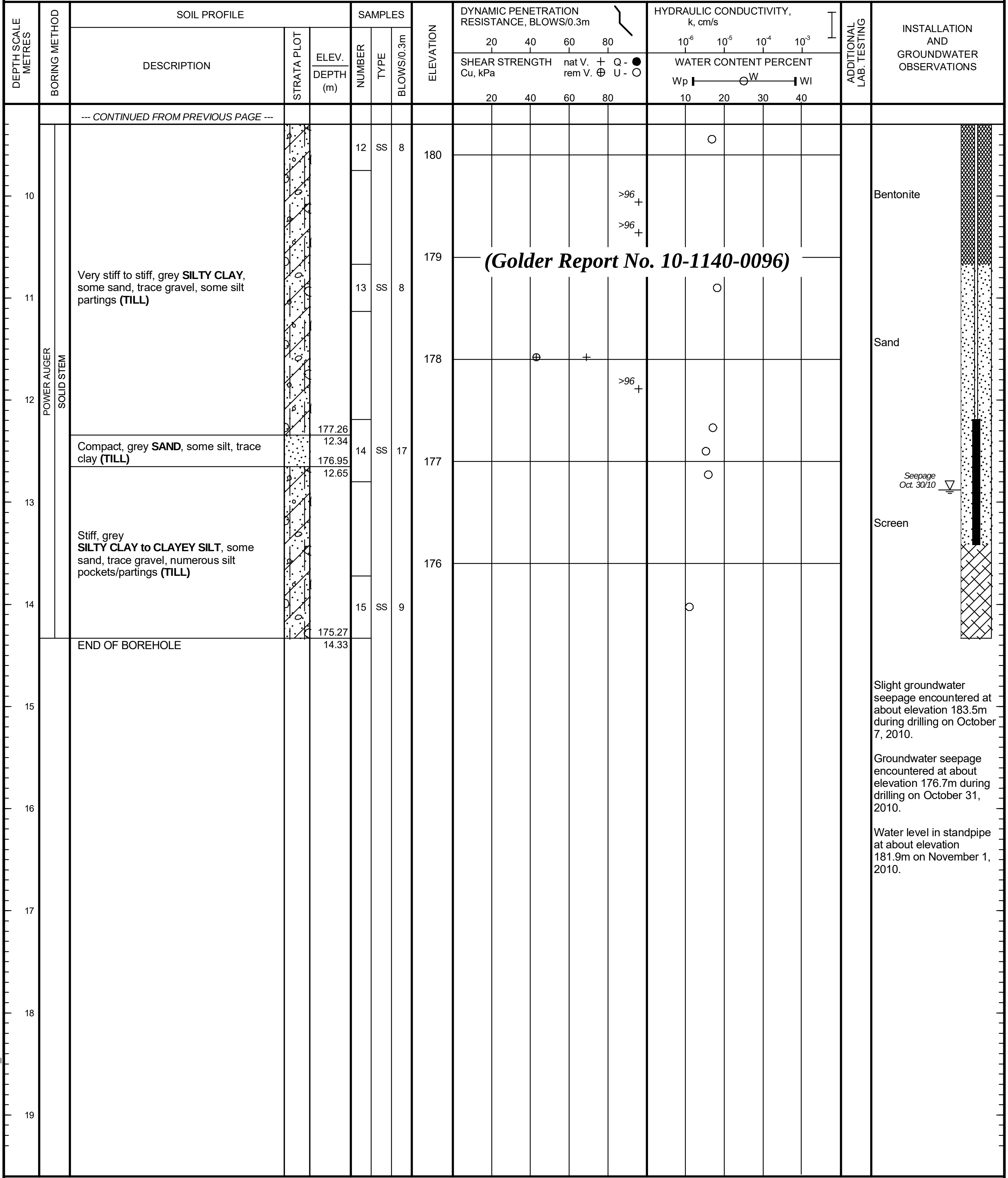
DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
POWER AUGER SOLID STEM	Very stiff to stiff, grey **SILTY CLAY**, some sand, trace gravel, some silt partings **(TILL)**	177.26 12.34	12	SS	8
			13	SS	8
	Compact, grey **SAND**, some silt, trace clay **(TILL)**	176.95 12.65	14	SS	17
	Stiff, grey **SILTY CLAY to CLAYEY SILT**, some sand, trace gravel, numerous silt pockets/partings **(TILL)**	175.27 14.33	15	SS	9
	END OF BOREHOLE				



(Golder Report No. 10-1140-0096)

Slight groundwater seepage encountered at about elevation 183.5m during drilling on October 7, 2010.

Groundwater seepage encountered at about elevation 176.7m during drilling on October 31, 2010.

Water level in standpipe at about elevation 181.9m on November 1, 2010.

LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TA

CHECKED:

RECORD OF BOREHOLE 5

PROJECT: 10-1140-0096

SHEET 1 OF 1

LOCATION: UTM 4678691.5 N, 339373.8 E

BORING DATE: October 7, 2010

DATUM: GEODETIC

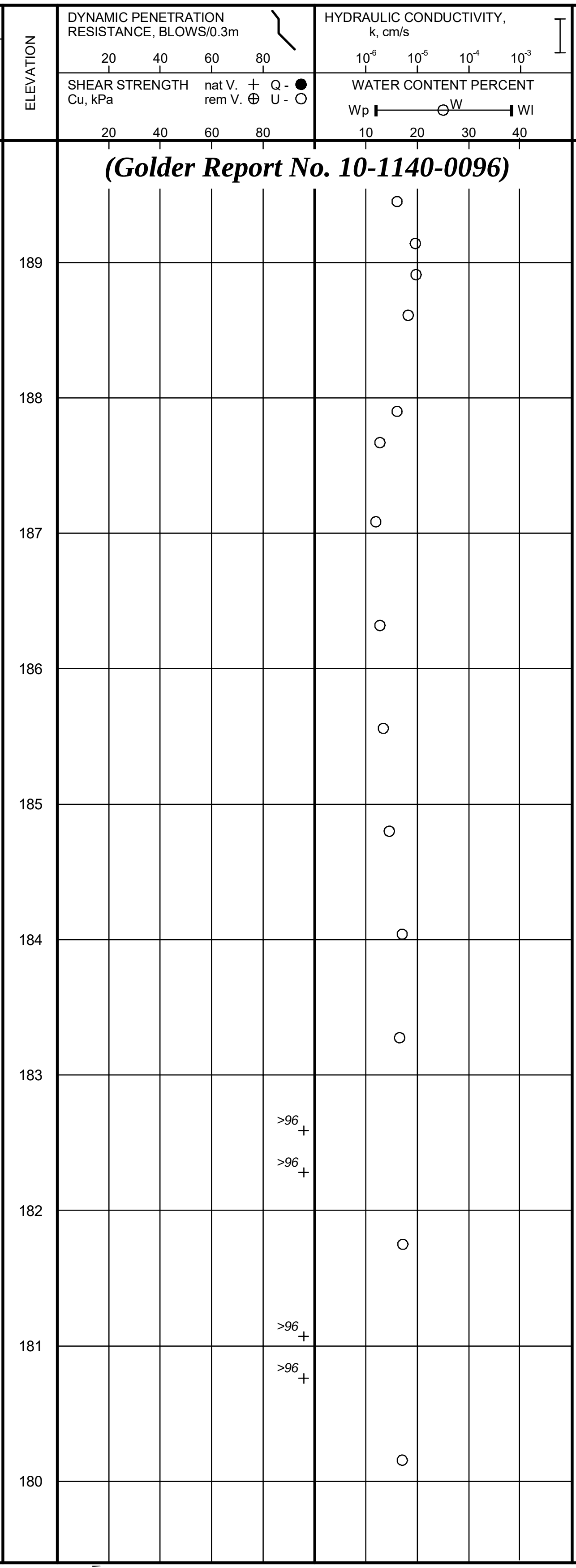
SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

BORING METHOD: POWER AUGER SOLID STEM

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
0	GROUND SURFACE	189.60			
	Stiff, brown clayey topsoil **(FILL)**	0.00	1	AS	
			2	SS	10
	Stiff to very stiff, mottled brown and grey **SILTY CLAY**, some sand, trace gravel, fissures **(TILL)**	188.99 0.61	3	SS	10
			4	SS	20
	Very stiff to hard, brown **SILTY CLAY**, some sand, trace gravel, some silt partings and fissures **(TILL)**	187.72 1.88	5	SS	37
			6	SS	36
	Very stiff, grey **SILTY CLAY**, some sand, trace gravel, some silt partings and fissures **(TILL)**	185.94 3.66	7	SS	24
			8	SS	16
			9	SS	13
			10	SS	9
			11	SS	8
			12	SS	6
	END OF BOREHOLE	179.85 9.75			



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Seepage ∇

Slight groundwater seepage encountered at about elevation 184.3m during drilling on October 7, 2010.

DEPTH SCALE
1 : 50

LOGGED: TA

CHECKED:

LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: UTM 4678552.0 N, 339370.0 E

BORING DATE: October 8, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

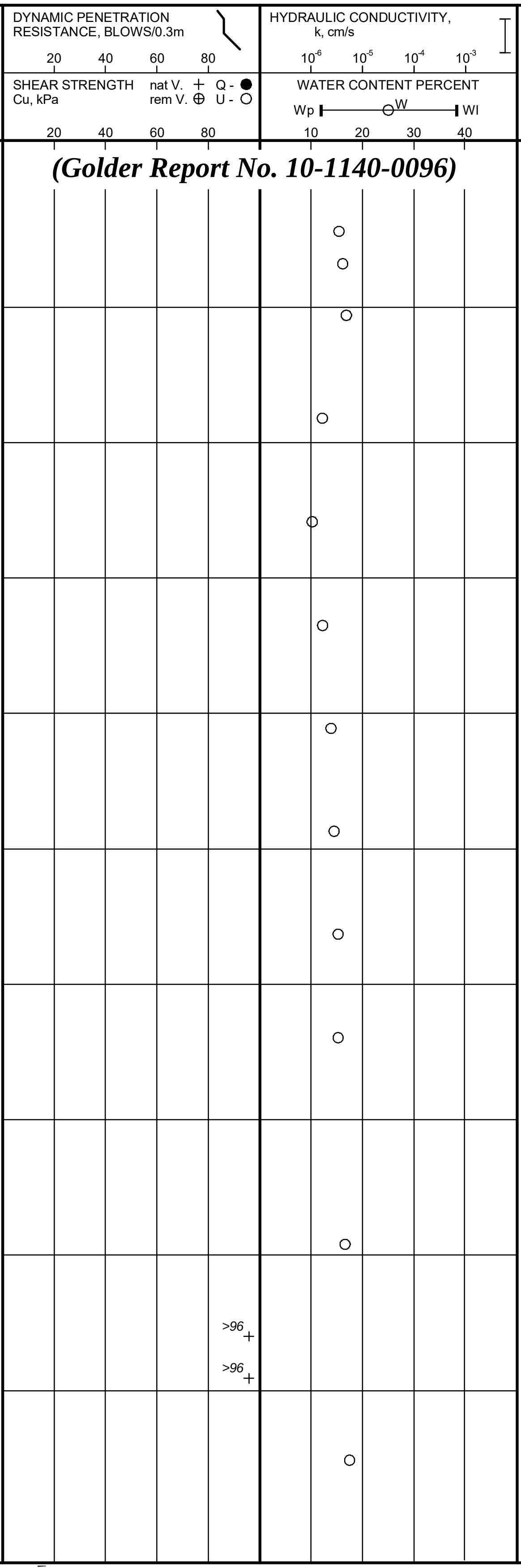
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
PAVEMENT SURFACE	189.93 0.00
ASPHALT	189.75 0.18
CONCRETE	0.28
Grey, crushed granular material **(FILL)**	189.47 0.46
Stiff, mottled brown and grey **SILTY CLAY**, some sand, trace gravel, fissures **(TILL)**	188.56 1.37
Hard, brown **SILTY CLAY**, some sand, trace gravel with silt partings and fissures **(TILL)**	185.51 4.42
Very stiff, grey **SILTY CLAY**, some sand, trace gravel with silt partings and fissures **(TILL)**	180.18 9.75
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	8
3	SS	32
4	SS	41
5	SS	37
6	SS	36
7	SS	17
8	SS	15
9	SS	13
10	SS	11
11	SS	8



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on October 8, 2010.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: TA

CHECKED:

LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

PROJECT: 10-1140-0096

RECORD OF BOREHOLE 7

SHEET 1 OF 1

LOCATION: UTM 4678390.3 N, 339367.6 E

BORING DATE: October 8, 2010

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

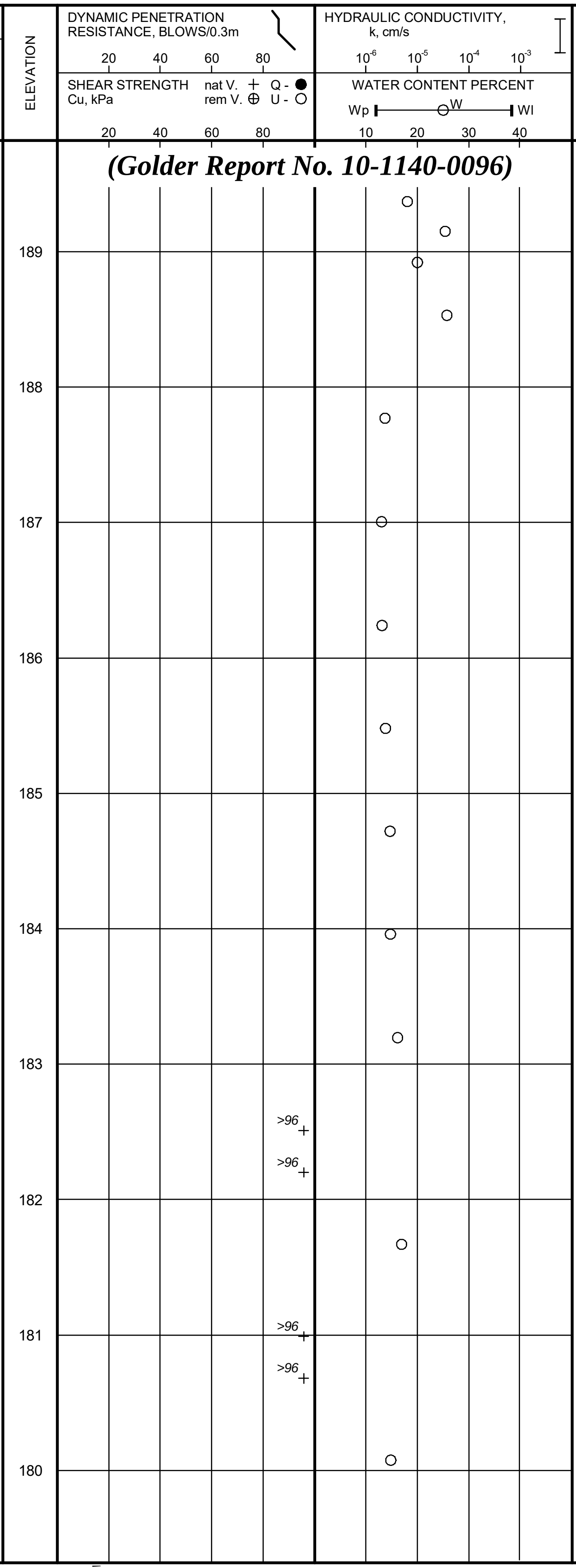
PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

(Golder Report No. 10-1140-0096)

BORING METHOD: POWER AUGER SOLID STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	189.52 0.00
Loose, brown sandy topsoil **(FILL)**	189.09 0.43
Firm, mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	188.15 1.37
Stiff to hard, brown **SILTY CLAY**, some sand, trace gravel, some silt partings and fissures **(TILL)**	185.10 4.42
Very stiff, grey **SILTY CLAY**, some sand, trace gravel, some silt partings and fissures **(TILL)**	179.77 9.75
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	7
3	SS	7
4	SS	13
5	SS	38
6	SS	39
7	SS	32
8	SS	15
9	SS	15
10	SS	9
11	SS	8
12	SS	8



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during drilling on October 8, 2010.

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: TA

CHECKED:

LDN_BHS_02 1011400096.GPJ GLDR_LON.GDT 12/2/10 DATA INPUT: SJL

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
1	0 - 250	**ASPHALT**		Dry during drilling.
	250 - 610	Grey crushed granular material **(FILL)**		
	610 - 860	Brown silty clay, some sand, trace gravel **(FILL)**	16	
	860 - 1370	Brown sand and gravel, trace clay **(FILL)**		
	1370 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, some organic pockets **(TILL)**		
		***		
3	0 - 100	Black Clayey **TOPSOIL**		Dry during drilling.
	100 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel, occasional organic pockets **(TILL)**		
		***		
4	0 - 250	**ASPHALT**		Dry during drilling.
	250 - 480	Grey crushed granular material **(FILL)**		
	480 - 760	Brown fine sand, trace gravel **(FILL)**	5	
	760 - 1520	Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**	17	
		***		
5	0 - 230	**ASPHALT**		Dry during drilling.
	230 - 360	Grey crushed granular material **(FILL)**		
	360 - 810	Brown sand, some gravel **(FILL)**		
	810 - 1170	Grey silty clay, some sand, trace gravel, numerous organic pockets **(FILL)**	17	
	1170 - 1520	Mottled brown and grey **SILTY CLAY,** some sand, trace gravel **(TILL)**		

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
6	0 - 250	**ASPHALT**		Dry during drilling.
	250 - 430	Grey crushed granular material **(FILL)**		
	430 - 710	Brown silty sand, trace gravel, trace clay **(FILL)**	11	
	710 - 810	Black Clayey **TOPSOIL**	15	
	810 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, occasional organic pockets **(TILL)**	17	
		***		
7	0 - 230	**ASPHALT**		Dry during drilling.
	230 - 410	**CONCRETE**		
	410 - 960	Black Clayey **TOPSOIL**	23	
	960 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		
		***		
8	0 - 70	**ASPHALT**		Dry during drilling.
	70 - 250	Grey crushed granular material **(FILL)**		
	250 - 1520	Grey clear stone **(FILL)**		
		***		
9	0 - 100	**ASPHALT**		Dry during drilling.
	100 - 200	Brown sand, some gravel **(FILL)**		
	200 - 300	Grey crushed granular material **(FILL)**		
	300 - 1220	Brown fine sand, trace silt and gravel **(FILL)**		
	1220 - 1520	Brown silty clay, some sand, trace gravel **(FILL)**	13	

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
10	0 - 250	**ASPHALT**		Dry during drilling.
	250 - 430	**CONCRETE**		
	430 - 510	Grey crushed granular material **(FILL)**		
	510 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, some organic pockets **(TILL)**	23 18	
		***		
11	0 - 200	**ASPHALT**		Hole collapsed at a depth of about 810mm.
	200 - 910	Grey crushed granular material **(FILL)**		
	910 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		
		***		
12	0 - 150	**ASPHALT**		Dry during drilling.
	150 - 300	Grey crushed granular material **(FILL)**		
	300 - 690	Brown sand, some gravel **(FILL)**	7	
	690 - 1120	Brown and grey silty clay, some sand, trace gravel **(FILL)**	17	
	1120 - 1520	Black Clayey **TOPSOIL**	25	
		***		
13	0 - 230	**ASPHALT**		Dry during drilling.
	230 - 430	**CONCRETE**		
	430 - 530	Black Clayey **TOPSOIL**		
	530 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	15	

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
14	0 - 50	**ASPHALT**		Dry during drilling.
	50 - 330	Grey crushed granular material **(FILL)**		
	330 - 1520	Brown sand, some gravel, some clay pockets **(FILL)**	8	
		***		
15	0 - 50	**ASPHALT**		Dry during drilling.
	50 - 150	Grey crushed granular material **(FILL)**		
	150 - 250	Brown sand, some gravel **(FILL)**		
	250 - 300	Grey crushed granular material **(FILL)**		
	300 - 760	Brown sand, some gravel **(FILL)**		
	760 - 1520	Brown to grey silty clay, some sand and gravel **(FILL)**	15	
		***		
16	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 330	**CONCRETE**		
	330 - 460	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, numerous organic pockets **(TILL)**	20	
	460 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	17	
		***		
17	0 -200	**ASPHALT**		Dry during drilling.
	200 - 560	Grey crushed granular material **(FILL)**		
	560 - 810	Brown fine sand, trace gravel **(FILL)**		
	810 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
18	0 - 150	**ASPHALT**		Dry during drilling.
	150 - 380	Grey crushed granular material **(FILL)**		
	380 - 630	Brown sand, some gravel **(FILL)**	7	
	630 - 960	Black Clayey **TOPSOIL**	17	
	960 - 1520	Greenish mottled brown and grey **SILTY CLAY**, some sand, trace gravel, numerous organic pockets **(TILL)**	24 17	
		***		
19	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 430	**CONCRETE**		
	430 - 860	Brown silty clay, some sand, trace gravel **(FILL)**		
	860 - 1020	Black clayey topsoil, some clay **(FILL)**		
	1020 - 1520	Brown clayey silt, trace gravel, some sand pockets **(FILL)**	15	
		***		
20	0 - 50	**ASPHALT**		Dry during drilling.
	50 - 250	Brown sand, some gravel **(FILL)**		
	250 - 410	Grey crushed granular material **(FILL)**		
	410 - 1370	Brown sand, some gravel **(FILL)**	7	
	1370 - 1520	Brown **CLAYEY SILT**, some sand, trace gravel, some sand and organic seams **(TILL)**	16	
		***		
21	0 - 50	**ASPHALT**		
	50 - 300	Grey crushed granular material **(FILL)**		
	300 - 810	Brown sand, some gravel **(FILL)**		
	810 - 1520	Black clayey topsoil, some grey clay seams, trace gravel **(FILL)**		

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
22	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 380	**CONCRETE**		
	380 - 430	Grey crushed granular material **(FILL)**		
	430 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, occasional organic seams **(TILL)**	17 19	
		***		
23	0 - 180	**ASPHALT**		Dry during drilling.
	180 - 380	Grey crushed granular material **(FILL)**		
	380 - 640	Brown sand, some gravel **(FILL)**		
	640 - 990	Brown silty clay, some sand, trace gravel **(FILL)**	16	
	990 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		
		***		
24	0 - 150	**ASPHALT**		Dry during drilling.
	150 - 330	Grey crushed granular material **(FILL)**		
	330 - 640	Brown sand, some gravel **(FILL)**	7	
	640 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, some organic pockets **(TILL)**	16 19	
		***		
25	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 410	**CONCRETE**		
	410 - 640	Brown silty clay, some sand, trace gravel **(FILL)**		
	640 - 810	Black Clayey **TOPSOIL,** trace fibrous pockets	26	
	810 - 1520	Mottled brown and grey, **SILTY CLAY**, some sand, trace gravel **(TILL)**		

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
26	0 - 1520	Grey crushed granular material **(FILL)**		Dry during drilling.
		***		
27	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 430	**CONCRETE**		
	430 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, some to trace organic pockets **(TILL)**		
		***		
28	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 300	Grey crushed granular material **(FILL)**		
	300 - 860	Brown sand, some gravel **(FILL)**	5	
	860 - 910	Brown silty clay, some sand and gravel **(FILL)**	13	
	910 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	20	
		***		
29	0 - 150	**ASPHALT**		Dry during drilling.
	150 - 300	Grey crushed granular material **(FILL)**		
	300 - 640	Brown sand, some gravel **(FILL)**		
	640 - 740	Black clayey topsoil, trace gravel **(FILL)**		
	740 - 1520	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, some organic pockets **(TILL)**		

TABLE I
RECORDS OF BOREHOLES
WALKER ROAD RECONSTRUCTION
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	WATER CONTENT (%)	REMARKS
30	0 - 230	**ASPHALT**		Dry during drilling.
	230 - 410	**CONCRETE**		
	410 - 510	Black Clayey **TOPSOIL**	27	
	510 - 1520	Mottled greenish brown and grey **SILTY CLAY,** some sand, trace gravel, some to trace organic pockets **(TILL)**	22 21	
		***		
31	0 - 100	Black sandy topsoil **(FILL)**		Dry during drilling.
	100 - 300	Brown sand, trace gravel **(FILL)**		
	300 - 410	Grey crushed granular material **(FILL)**		
	410 - 1170	Brown silty sand, trace gravel **(FILL)**	10	
	1170 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		
		***		
32	0 - 230	**ASPHALT**		Dry during drilling.
	230 - 410	**CONCRETE**		
	410 - 460	Grey crushed granular material **(FILL)**		
	460 - 910	Mottled greenish brown and grey **SILTY CLAY**, some sand, trace gravel, some organic pockets **(TILL)**	23 19	
	910 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**	18	
		***		
33	0 - 200	**ASPHALT**		Dry during drilling.
	200 - 300	Grey crushed granular material **(FILL)**		
	300 - 910	Brown sand, trace gravel **(FILL)**		
	910 - 1520	Mottled brown and grey **SILTY CLAY**, some sand, trace gravel **(TILL)**		

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RECORD OF BOREHOLES
WALKER ROAD WIDENING AND RECONSTRUCTION, PHASE 3
DIVISION ROAD TO LEGACY PARK DRIVE
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	REMARKS
1	0 -145	Asphalt	Water Contents(%):
	145 - 420	Granular Road Base Materials **(FILL)**	9.5
	420 - 560	Concrete	
	560 - 1070	Stiff, Black Clayey **TOPSOIL**	25.3
	1070 -- 1520	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **(TILL)**	23.3 Dry During Drilling
		***	
2	0 - 155	Asphalt	Water contents (%):
	155 - 405	Granular Road Base Materials **(FILL)**	7.2
	405 - 580	Concrete	
	580 - 1070	Stiff, Black, Silty topsoil **(FILL)**	16.0
	1070 - 1480	Stiff, Black, Clayey **TOPSOIL**	27.6
	1480 - 1520	Stiff, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **(TILL)**	23.1 Dry during drilling.
		***	
3	0 - 125	Asphalt	Water contents (%):
	125 - 420	Granular Road Base Materials **(FILL)**	5.7
	420 - 600	Concrete	
	600 - 1070	Stiff, Black, Clayey **TOPSOIL**	22.9
	1070 - 1520	Stiff, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	20.5 Dry during drilling.
		***	
4	0 - 155	Asphalt	Water contents (%):
	125 - 690	Granular Road Base Materials **(FILL)**	4.3, 8.6
	690 - 760	Stiff, Black, Clayey **TOPSOIL**	20.7
	760 - 1370	Stiff, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	16.0 Dry during drilling.
		***	

(Golder Report No. 011-4121)

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RECORD OF BOREHOLES
WALKER ROAD WIDENING AND RECONSTRUCTION, PHASE 3
DIVISION ROAD TO LEGACY PARK DRIVE
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	REMARKS
5	0 - 165	Asphalt	Water contents (%):
	165 - 410	Granular Road Base Materials **(FILL)**	2.9
	410 - 585	Concrete	
	585 - 1070	Stiff, Black, Clayey Topsoil **(FILL)**	11.4
	1070 - 1270	Firm, Black Clayey **TOPSOIL**	15.7
	1270 - 1370	Firm, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	14.0 Dry during drilling.
		***	
6	0 - 160	Asphalt	Water contents (%):
	160 - 320	Granular Road Base Materials **(FILL)**	3.0
	320 - 530	Concrete	
	520 - 990	Stiff, Black Sandy **TOPSOIL**	20.6
	990 - 1600	Stiff, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	14.8 Dry during drilling.
		***	
7	0 - 150	Asphalt	Water contents (%):
	150 - 345	Granular Road Base Materials **(FILL)**	3.0
	345 - 540	Concrete	
	540 - 990	Stiff, Black Clayey topsoil **(FILL)**	15.5
	990 - 1600	Stiff, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	14.1 Dry during drilling.
		***	
8	0 - 190	Asphalt	Water contents (%):
	190 - 385	Granular Road Base Materials **(FILL)**	6.5
	385 - 585	Concrete	
	585 - 1070	Stiff, Black Clayey topsoil **(FILL)**	21.9
	1070 - 1220	Stiff, Black Clayey **TOPSOIL**	
	1220 - 1680	Stiff, Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	18.6 Dry during drilling.
		***	
			Water contents (%):

(Golder Report No. 011-4121)

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RECORD OF BOREHOLES
WALKER ROAD WIDENING AND RECONSTRUCTION, PHASE 3
DIVISION ROAD TO LEGACY PARK DRIVE
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	REMARKS
9	0 - 100	Brown Sand and Gravel **(FILL)**	2.8, 6.2
	100 - 710	Compact, Granular Road Base Materials **(FILL)**	7.9
	710 - 1070	Stiff, Brown Silty Clay **(FILL)**	15.2
	1070 - 1680	Stiff, Black Clayey **TOPSOIL**	20.1
			Dry during drilling.
		***	
			Water contents (%):
10	0 - 760	Compact, Granular Road Base Materials **(FILL)**	4.9, 7.6
	760 -1040	Very Stiff, Brown silty clay with topsoil pockets **(FILL)**	
	1040 - 1140	Very Stiff, Black Clayey **TOPSOIL**	23.1
			24.9
	1140 - 1520	Very Stiff Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	27.7
			Dry during drilling.
		***	
			Water contents (%):
11	0 - 690	Compact, Granular Road Base Materials **(FILL)**	3.8, 8.0
	690 -990	Stiff, black clayey topsoil with brown silty clay layers **(FILL)**	15.6
	990 - 1600	Very Stiff Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	21.8
			Dry during drilling.
		***	
			Water contents (%):
12	0 - 540	Compact, Granular Road Base Materials **(FILL)**	6.8, 9.8
	540 -760	Stiff, black clayey topsoil with brown silty clay layers **(FILL)**	18.1
	910 - 1520	Very Stiff Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	15.0
			Dry during drilling.

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RECORD OF BOREHOLES
WALKER ROAD WIDENING AND RECONSTRUCTION, PHASE 3
DIVISION ROAD TO LEGACY PARK DRIVE
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	REMARKS
			Water contents (%):
13	0 - 305	Granular Road Base Materials **(FILL)**	5.7
	305 - 760	Compact , Brown Silty Sand and Gravel with brown silty clay pockets **(FILL)**	7.8
	760 - 910	Stiff, Brown Silty Clay **(FILL)**	17.1, 15.3
	910 - 1520	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	Dry during drilling.
		***	
			Water contents (%):
14	0 - 310	Granular Road Base Materials **(FILL)**	6.5
	310 - 1220	Stiff, black clayey topsoil with brown silty clay layers **(FILL)**	26.4
	1220 - 1520	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	20.9 Dry during drilling.
		***	
			Water contents (%):
15	0 - 130	Black, Organic Silty Sand **(FILL)**	38.3
	125 - 510	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	20.9
	510 - 920	Brown **SILTY CLAY**, some Sand, trace Gravel **TILL**	21.4, 21.9 Inflow of standing in the ditch water during drilling
		***	
			Water contents (%):
16	0 - 180	Black, Organic Silt	43.0
	180 - 560	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	18.2
	560 - 910	Brown **SILTY CLAY**, some Sand, trace Gravel **TILL**	13.5, 16.2 Inflow of standing in the ditch water during drilling

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RECORD OF BOREHOLES
WALKER ROAD WIDENING AND RECONSTRUCTION, PHASE 3
DIVISION ROAD TO LEGACY PARK DRIVE
WINDSOR, ONTARIO

BOREHOLE	DEPTH (mm)	STRATIGRAPHY	REMARKS
			Water contents (%):
17	0 - 50	Black, Organic Silt (**FILL**)	96.9
	50 - 180	Black, Clayey **TOPSOIL** with roots	33.9
	180 - 580	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	22.7
	580 - 910	Brown **SILTY CLAY**, some Sand, trace Gravel **TILL**	18.5
			Inflow of standing in the ditch water during drilling
		***	
			Water contents (%):
18	0 - 310	Black, Organic Silty Sand (**FILL**)	24.1
	305 - 380	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	18.9
	380 -910	Brown **SILTY CLAY**, some Sand, trace Gravel **TILL**	16.4, 19.2
			Inflow of standing in the ditch water during drilling
		***	
			Water contents (%):
19	0 - 310	Black, Organic Silt (**FILL**)	193.4
	305 - 460	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	24.7, 22.5
	460 -910	Brown **SILTY CLAY**, some Sand, trace Gravel **TILL**	14.5
			Inflow of standing in the ditch water during drilling
		***	
			Water contents (%):
20	0 - 310	Black, Organic Silt (**FILL**)	39.6
	305 - 460	Mottled Brown and Grey **SILTY CLAY**, some Sand, trace Gravel **TILL**	31.0, 19.3
	460 -910	Brown **SILTY CLAY**, some Sand, trace Gravel **TILL**	15.6
			Inflow of standing in the ditch water during drilling
		***	

PROJECT: 12-1140-0094

RECORD OF BOREHOLE 1

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: November 07, 2012

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

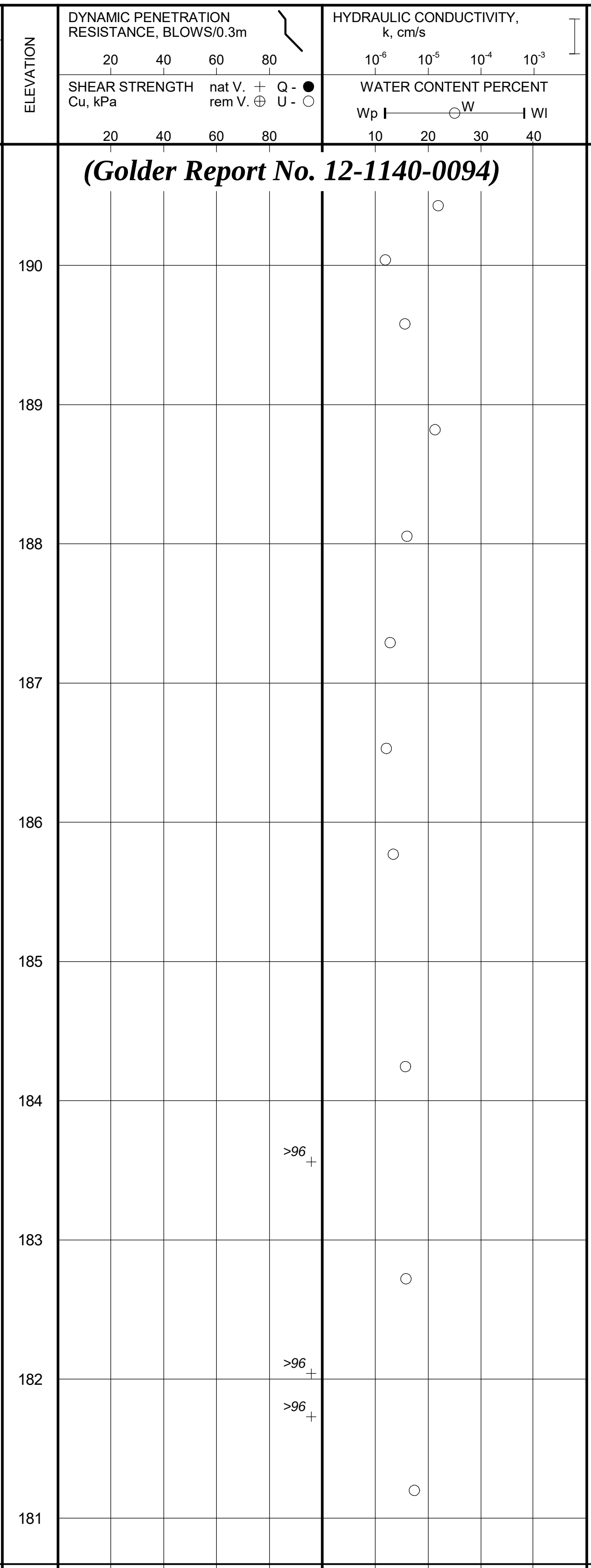
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0094)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	190.57
(CL) CLAYEY SILT, some sand; dark brown, **(TOPSOIL)**; moist.	0.00
(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, organic pockets, **(TILL)**; cohesive, w~PL, stiff to firm.	190.29 0.28
(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, **(TILL)**; cohesive, w<PL, stiff to hard.	188.44 2.13
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff to stiff.	186.15 4.42

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	9
3	SS	11
4	SS	7
5	SS	13
6	SS	32
7	SS	33
8	SS	20
9	SS	9
10	SS	7
11	SS	6



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during and upon completion of drilling on November 7, 2012.

--- CONTINUED NEXT PAGE ---

LDN_BHS_02 1211400094.GPJ 23/11/12 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: LS
CHECKED:

PROJECT: 12-1140-0094

RECORD OF BOREHOLE 1

SHEET 2 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: November 07, 2012

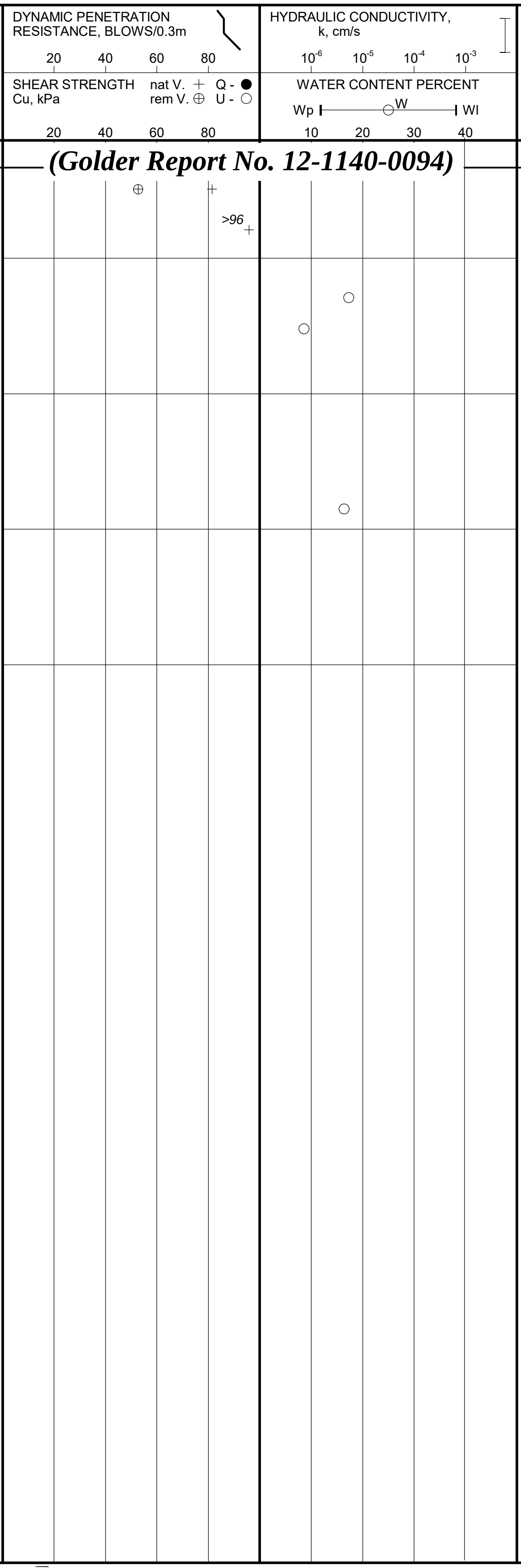
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0094)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
		--- *CONTINUED FROM PREVIOUS PAGE* ---						
10	POWER AUGER 83mm ID HOLLOW STEM	(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff to stiff.		179.52 11.05	12	SS	9	180
11		(ML) sandy **CLAYEY SILT**, trace gravel; grey, **(TILL)**; cohesive, w<PL, stiff.		178.99 11.58				179
12		(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, firm.		177.92 12.65	13	SS	4	178
		END OF BOREHOLE						
13								177
14								
15								
16								
17								
18								
19								



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

LDN_BHS_02 1211400094.GPJ 23/11/12 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 12-1140-0094

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: November 07, 2012

DATUM: GEODETIC

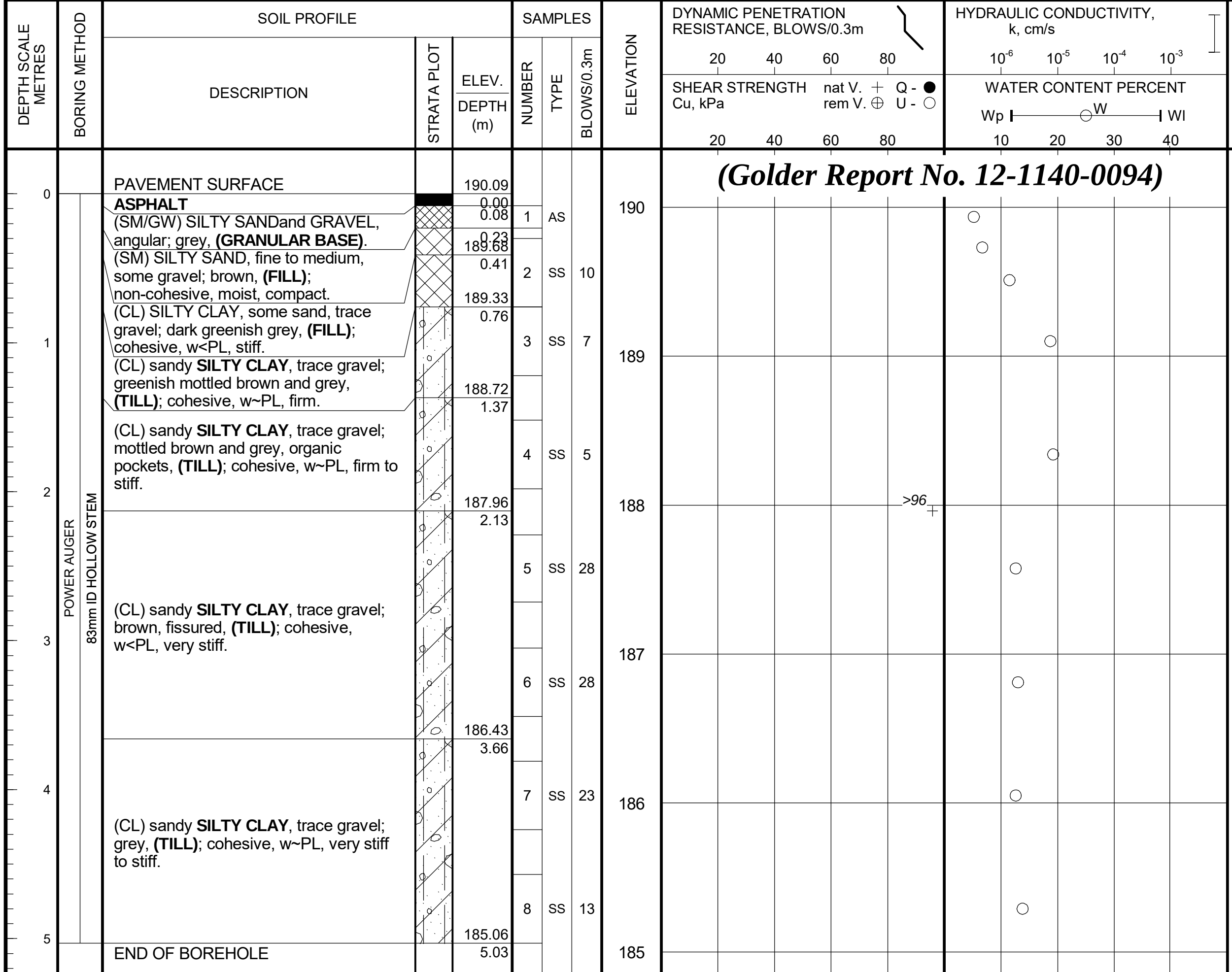
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0094)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	PAVEMENT SURFACE	190.09 0.00
POWER AUGER 83mm ID HOLLOW STEM	**ASPHALT**	0.08
	(SM/GW) SILTY SANDand GRAVEL, angular; grey, **(GRANULAR BASE)**.	189.68 0.23
	(SM) SILTY SAND, fine to medium, some gravel; brown, **(FILL)**; non-cohesive, moist, compact.	0.41 189.33
	(CL) SILTY CLAY, some sand, trace gravel; dark greenish grey, **(FILL)**; cohesive, w<PL, stiff.	0.76
	(CL) sandy **SILTY CLAY**, trace gravel; greenish mottled brown and grey, **(TILL)**; cohesive, w~PL, firm.	188.72
	(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, organic pockets, **(TILL)**; cohesive, w~PL, firm to stiff.	1.37 187.96
	(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, **(TILL)**; cohesive, w<PL, very stiff.	2.13 186.43
	(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff to stiff.	3.66 185.06
	END OF BOREHOLE	5.03

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	10
3	SS	7
4	SS	5
5	SS	28
6	SS	28
7	SS	23
8	SS	13



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during and upon completion of drilling on November 7, 2012.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: LS

CHECKED:

LDN_BHS_02 1211400094.GPJ 23/11/12 DATA INPUT: DMB

PROJECT: 12-1140-0094

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: November 07, 2012

DATUM: GEODETIC

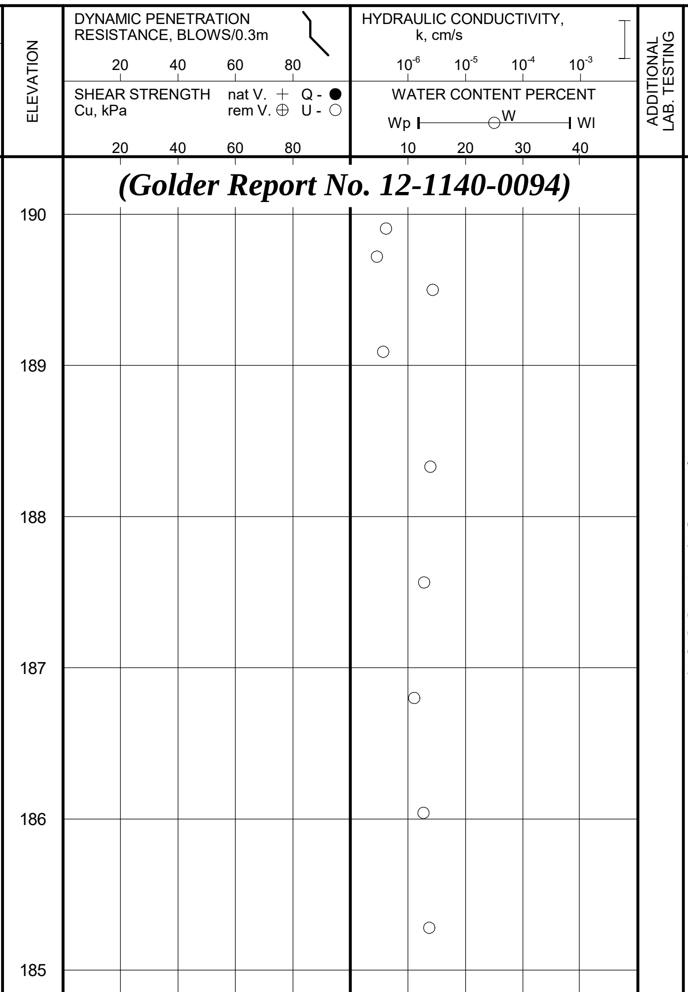
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0094)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0		PAVEMENT SURFACE	190.08
	POWER AUGER 83mm ID HOLLOW STEM	**ASPHALT**	0.00
		(SM/GW) SILTY SAND and GRAVEL, angular; grey, **(GRANULAR BASE)**.	0.10
		(SM) SILTY SAND, fine to medium, trace gravel; brown, **(FILL)**; non-cohesive, moist, compact.	189.78 0.30
1		(CL) SILTY CLAY, some sand, some gravel; dark greenish grey, organic pockets, **(FILL)**; cohesive, w<PL, stiff.	0.41
2		(SW) SAND, fine to coarse, some silt, some gravel; brown, **(FILL)**; non-cohesive, moist to wet, loose to very loose.	189.32 0.76
3		(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, **(TILL)**; cohesive, w<PL, very stiff to hard.	187.74 2.34
4		(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff to stiff.	186.42 3.66
5		END OF BOREHOLE	185.05 5.03
6			
7			
8			
9			

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	11
3	SS	8
4	SS	2
5	SS	29
6	SS	32
7	SS	18
8	SS	12



INSTALLATION AND GROUNDWATER OBSERVATIONS

Nov. 7/12 ▼

Seepage ▽

Water level in borehole measured at elev. 188.8m upon completion of drilling on November 7, 2012.

Groundwater seepage into borehole encountered at about elev. 188.6m during drilling on November 7, 2012.

LDN_BHS_02 1211400094.GPJ 23/11/12 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 12-1140-0094

RECORD OF BOREHOLE 4

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: November 07, 2012

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

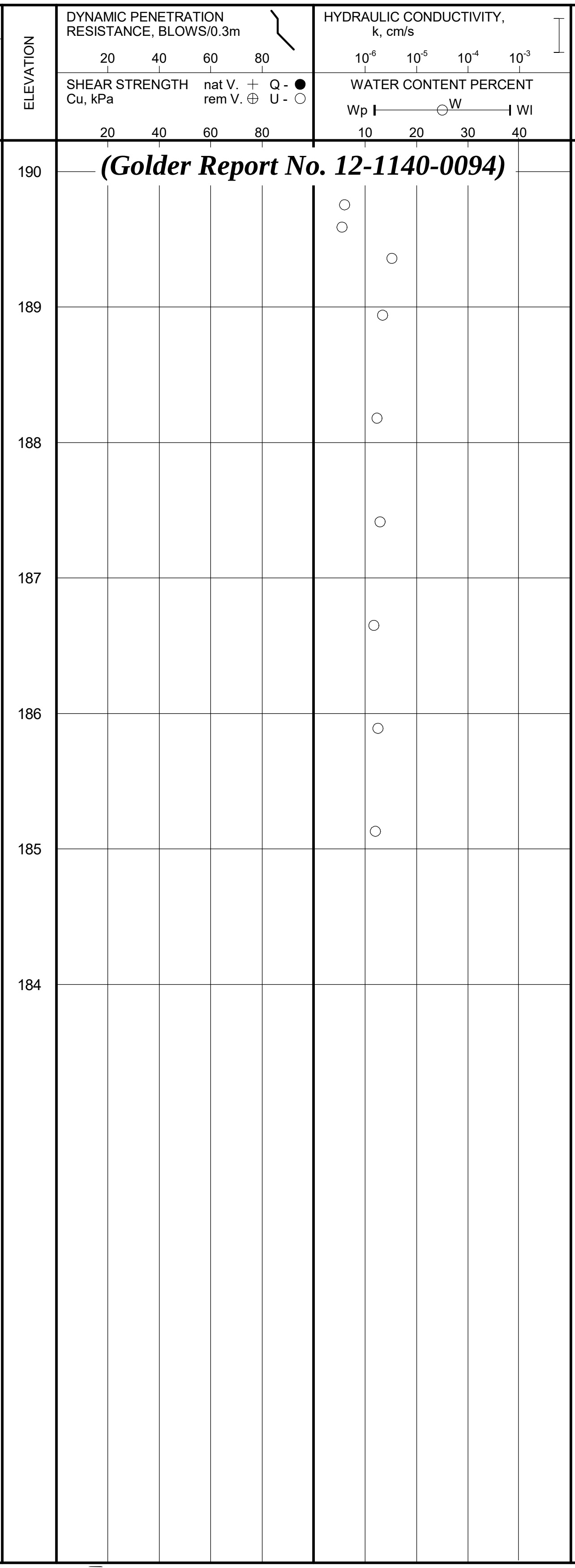
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0094)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM (0 to 5.03 m)

ELEV. / DEPTH (m)	SOIL PROFILE – DESCRIPTION
189.93	PAVEMENT SURFACE
0.00	**ASPHALT**
0.10	(SM/GW) SAND and GRAVEL, angular; grey, **(GRANULAR BASE)**.
0.25	(SM) SILTY SAND, fine to coarse, trace gravel; brown, **(FILL)**; non-cohesive, moist, loose.
0.38	(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, organic pockets, **(TILL)**; cohesive, w~PL, stiff.
188.56 1.37	(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, **(TILL)**; cohesive, w<PL, very stiff.
186.65 3.28	(CL) sandy **SILTY CLAY**, trace gravel; grey, silt partings, **(TILL)**; cohesive, w<PL, very stiff to stiff.
184.90 5.03	END OF BOREHOLE

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	9
3	SS	11
4	SS	22
5	SS	29
6	SS	26
7	SS	16
8	SS	14



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry during and upon completion of drilling on November 7, 2012.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 12-1140-0207

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 04, 2012

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

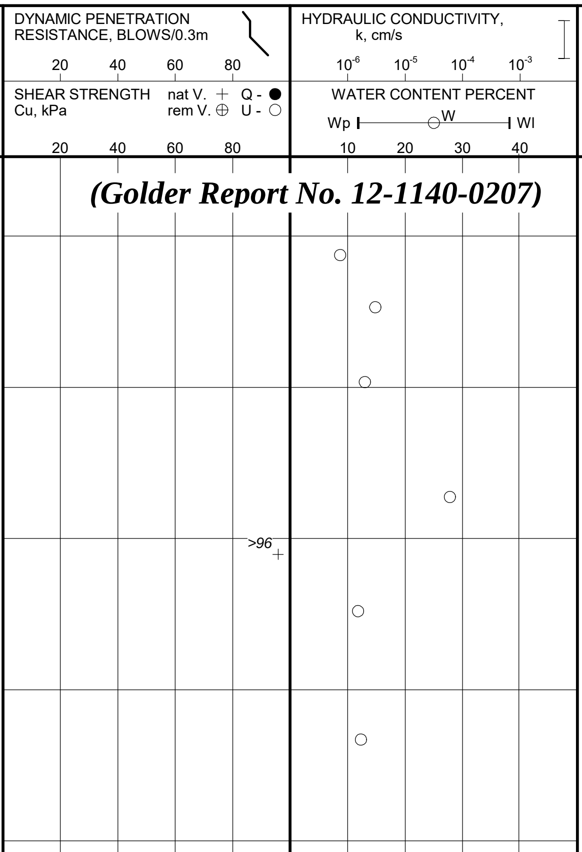
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0207)

BORING METHOD: POWER AUGER 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	189.03
(CL/SP) SILTY CLAY and SAND, trace gravel; brown, some organic material, **(FILL)**; dry.	0.00 188.73
(CL) SILTY CLAY, some sand, trace gravel; brown, **(FILL)**; cohesive, w<PL, stiff.	0.30 188.34
(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w<PL, stiff to very stiff.	0.69 186.90
(CL) sandy **SILTY CLAY**, trace gravel; brown, oxidized, **(TILL)**; cohesive, w<PL, very stiff to hard.	2.13 185.37
END OF BOREHOLE	3.66

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	8
3	SS	8
4	SS	5
5	SS	28
6	SS	32



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

ELEVATION: 189 188 187 186 185

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during and upon completion of drilling on October 4, 2012.

DEPTH SCALE

1 : 50

LOGGED: LS

CHECKED:

LDN_BHS_02 1211400207.GPJ 24/10/12 DATA INPUT: DMB

PROJECT: 12-1140-0207

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 04, 2012

DATUM: GEODETIC

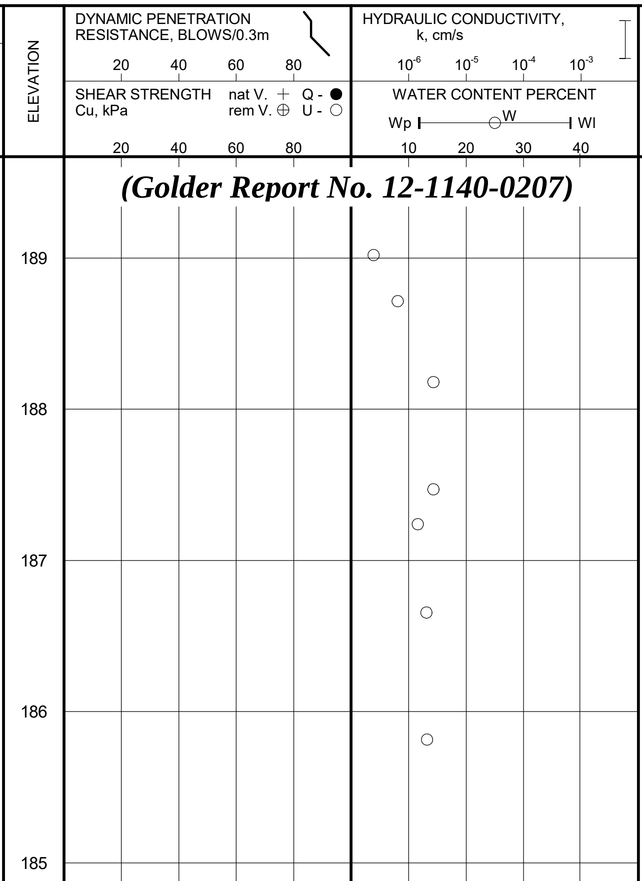
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 12-1140-0207)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	189.17			
(SM) SILTY SAND, some gravel, angular; grey, **(GRANULAR BASE)**; dry, compact.	0.00	1 2	AS SS	 21
(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, black organic nodules, with cobbles, **(TILL)**; cohesive, w<PL, stiff.	188.56 0.61	3 4	SS SS	8 10
(CL) sandy **SILTY CLAY**, some gravel; brown, oxidized, grey fissures, with cobbles, **(TILL)**; cohesive, w<PL, stiff to very stiff.	187.29 1.88	5 6	SS SS	23 24
END OF BOREHOLE	185.51 3.66			



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry during and upon completion of drilling on October 4, 2012.

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 13-1140-0110

RECORD OF BOREHOLE BH-101

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN, FIGURE 1

BORING DATE: July 11, 2013

DATUM: LOCAL

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

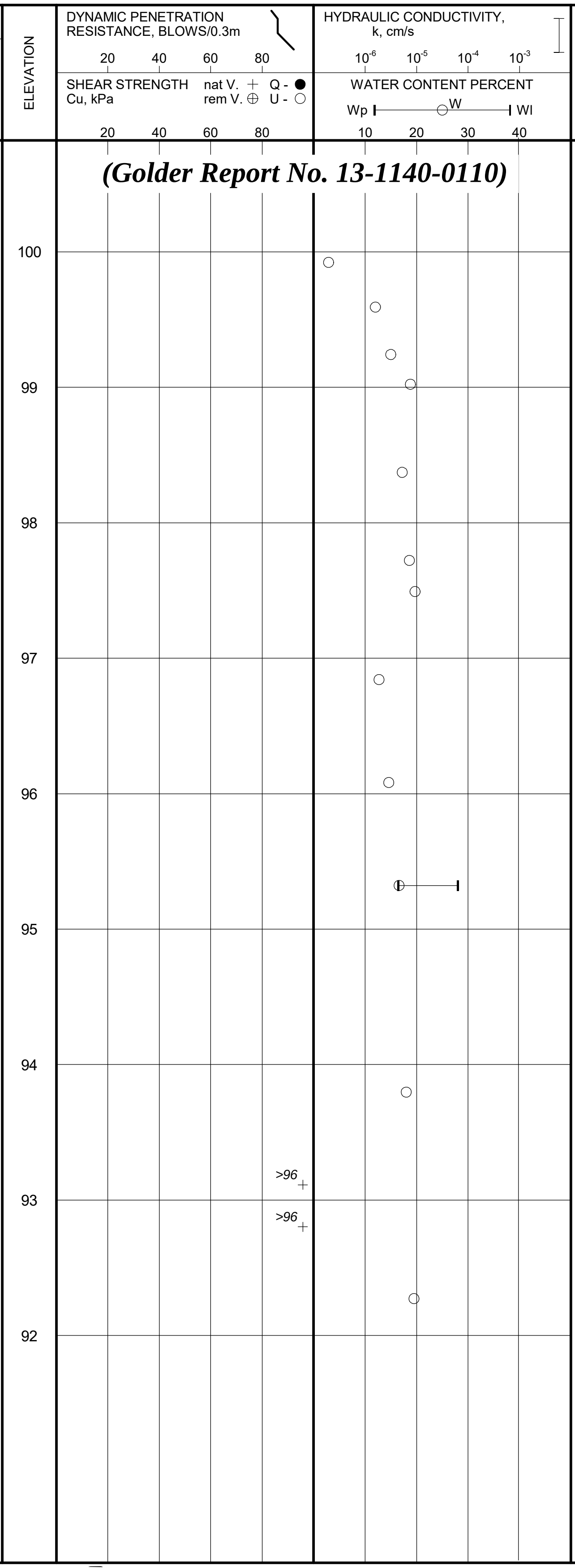
(Golder Report No. 13-1140-0110)

DEPTH SCALE METRES: 0 – 9

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROAD SURFACE	100.12
ASPHALT	0.00
FILL - (SP/GP) SAND and GRAVEL, angular; grey, (ROADBASE); non-cohesive, dry	0.10 99.82 0.30
FILL - (CL-ML) sandy SILTY CLAY to CLAYEY SILT, some gravel; brown, with topsoil, sand pockets, and cobbles; cohesive, w<PL, stiff to very soft	97.99 2.13
FILL - (SP) SAND, fine to medium, trace gravel, trace clay; brown; non-cohesive, moist, loose	97.61 2.51
(CL) sandy **SILTY CLAY**, trace gravel; brown, with sand seams, **(TILL)**; cohesive, w>PL, firm	97.22 2.90
(ML) sandy **CLAYEY SILT**, trace gravel; grey, with silt seams; cohesive, w~PL, very stiff to stiff	95.85 4.27
(CL) sandy **SILTY CLAY**, trace gravel; grey, laminated, with silt seams, **(TILL)**; cohesive, w<PL, very stiff to firm	92.04 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	10	
3	SS	6	
4	SS	2	
5	SS	6	
6	SS	18	
7	SS	13	
8	SS	12	MH
9	SS	9	
10	SS	7	



INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on July 11, 2013.

DEPTH SCALE

1 : 50

LOGGED: LS

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-101

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

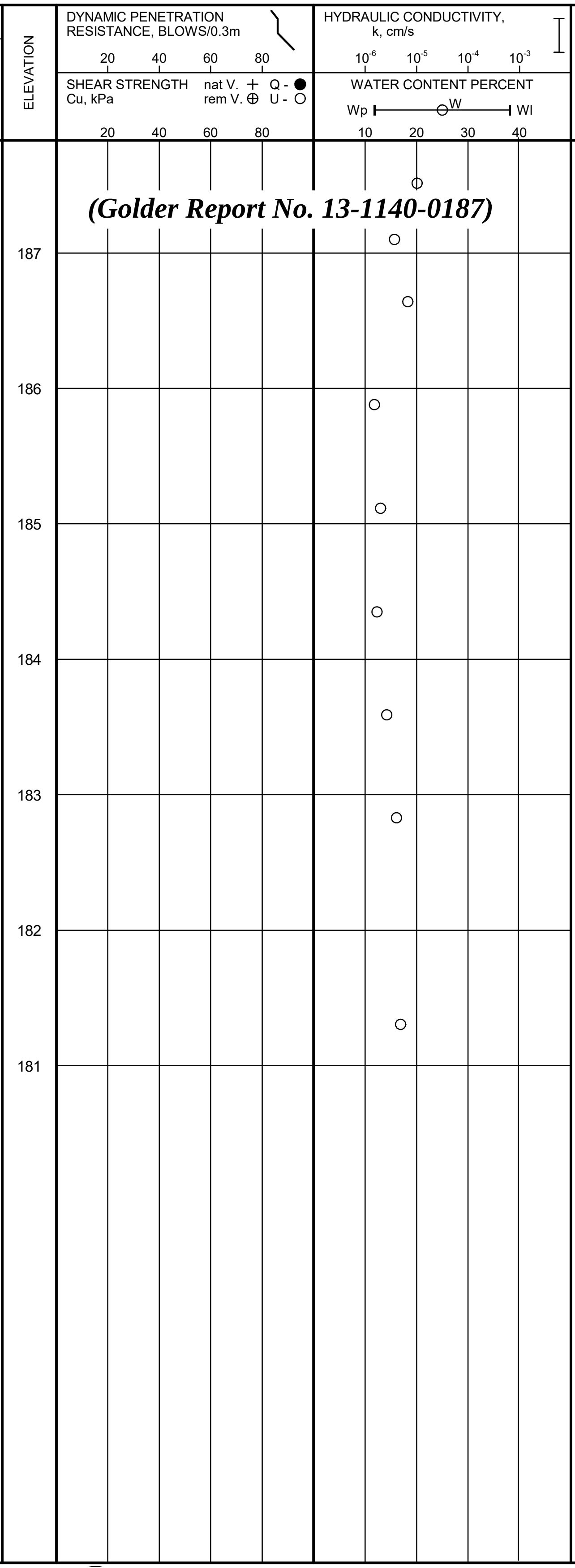
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER 83mm ID HOLLOW STEM	GROUND SURFACE	187.63				
		TOPSOIL - (ML) CLAYEY SILT; brown, moist	0.00 187.40 0.23	1	AS		Borehole dry upon completion of drilling on October 16, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets and layers, **(TILL)**; cohesive, w~PL, stiff to firm	186.26 1.37	2	SS	8	
1				3	SS	6	
2		(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	184.73 2.90	4	SS	21	
				5	SS	27	
3		(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w<PL to w>PL, very stiff to firm	181.08 6.55	6	SS	20	
4				7	SS	13	
5				8	SS	9	
6				9	SS	6	
		END OF BOREHOLE					
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

DEPTH SCALE
1 : 50

LOGGED: SM
CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-102

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

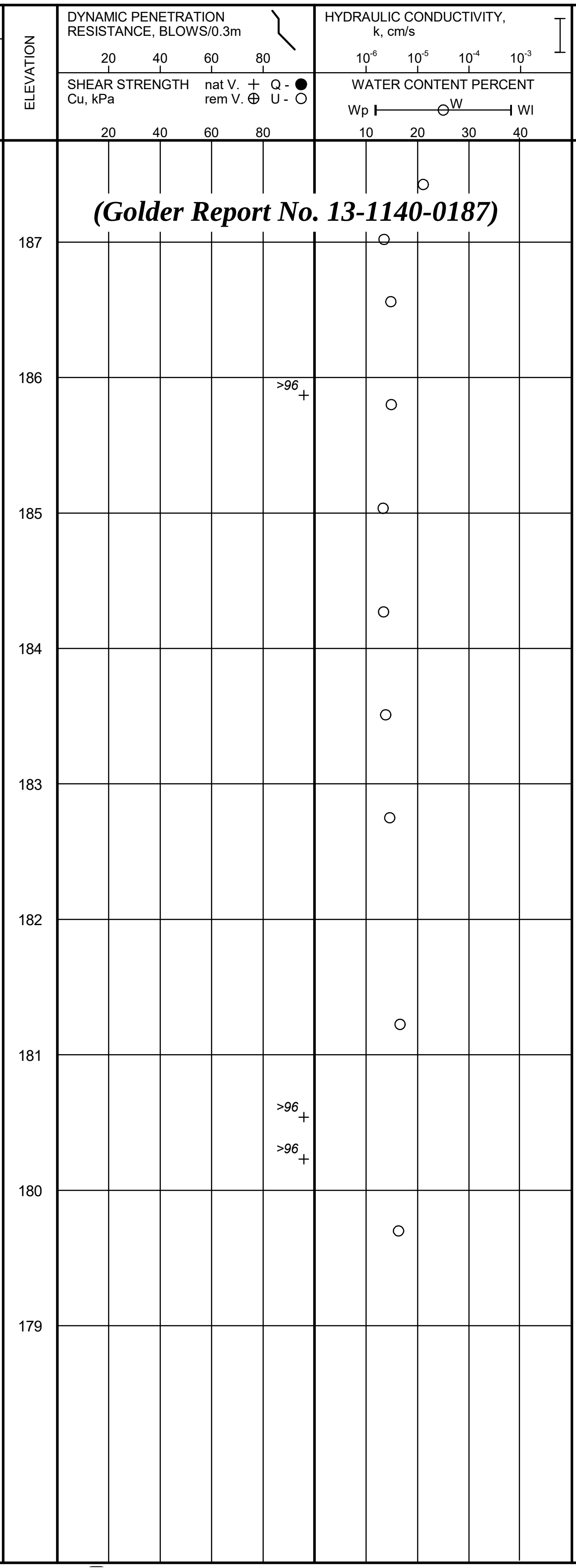
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.55
TOPSOIL - (ML) CLAYEY SILT; brown, moist	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w~PL, firm	187.30 0.25
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand layers and pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	186.18 1.37
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	184.65 2.90
END OF BOREHOLE	179.47 8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	6
3	SS	6
4	SS	11
5	SS	21
6	SS	15
7	SS	12
8	SS	10
9	SS	6
10	SS	4



(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-103

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

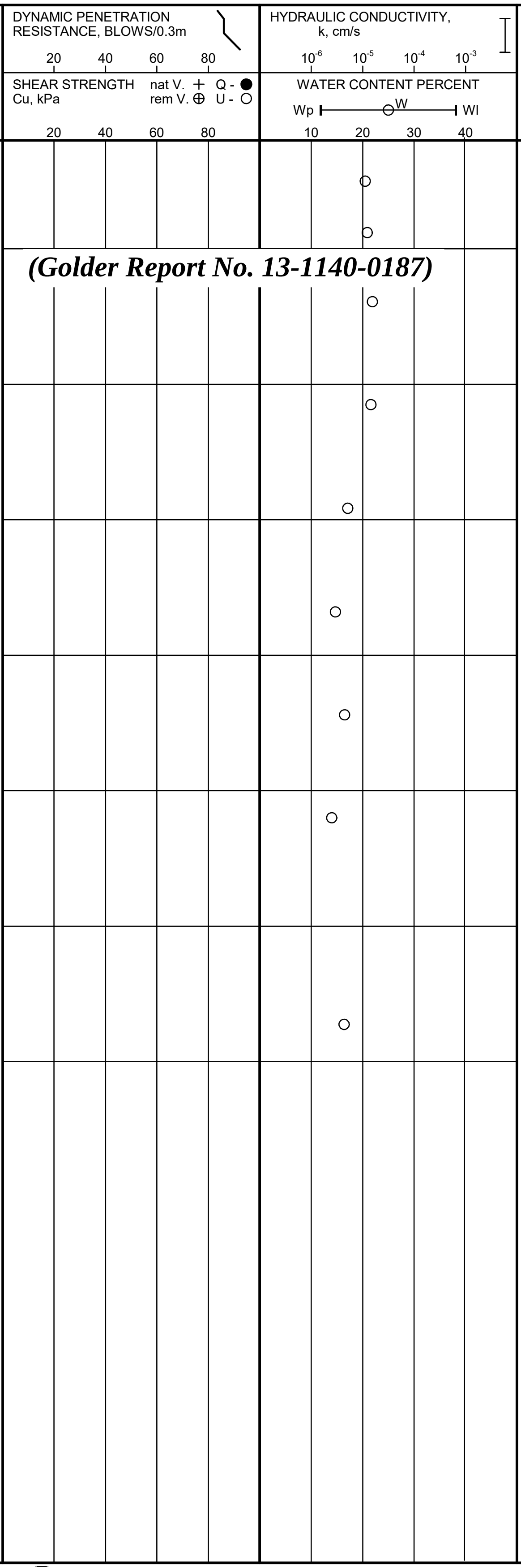
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.60
TOPSOIL - (ML) CLAYEY SILT; brown, moist	0.00 187.40 0.20
(ML-CL) sandy **CLAYEY SILT** to **SILTY CLAY**, trace gravel; mottled brown and grey, with sand and topsoil pockets, **(TILL)**; cohesive, w>PL, stiff to firm	185.47 2.13
(ML-CL) sandy **CLAYEY SILT** to **SILTY CLAY**, trace gravel; brown, with sand layers and pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	183.94 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, thinly laminated, **(TILL)**; cohesive, w~PL, stiff to firm	181.05 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	8
3	SS	6
4	SS	7
5	SS	16
6	SS	17
7	SS	11
8	SS	10
9	SS	7



(Golder Report No. 13-1140-0187)

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE
1 : 50

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-104

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

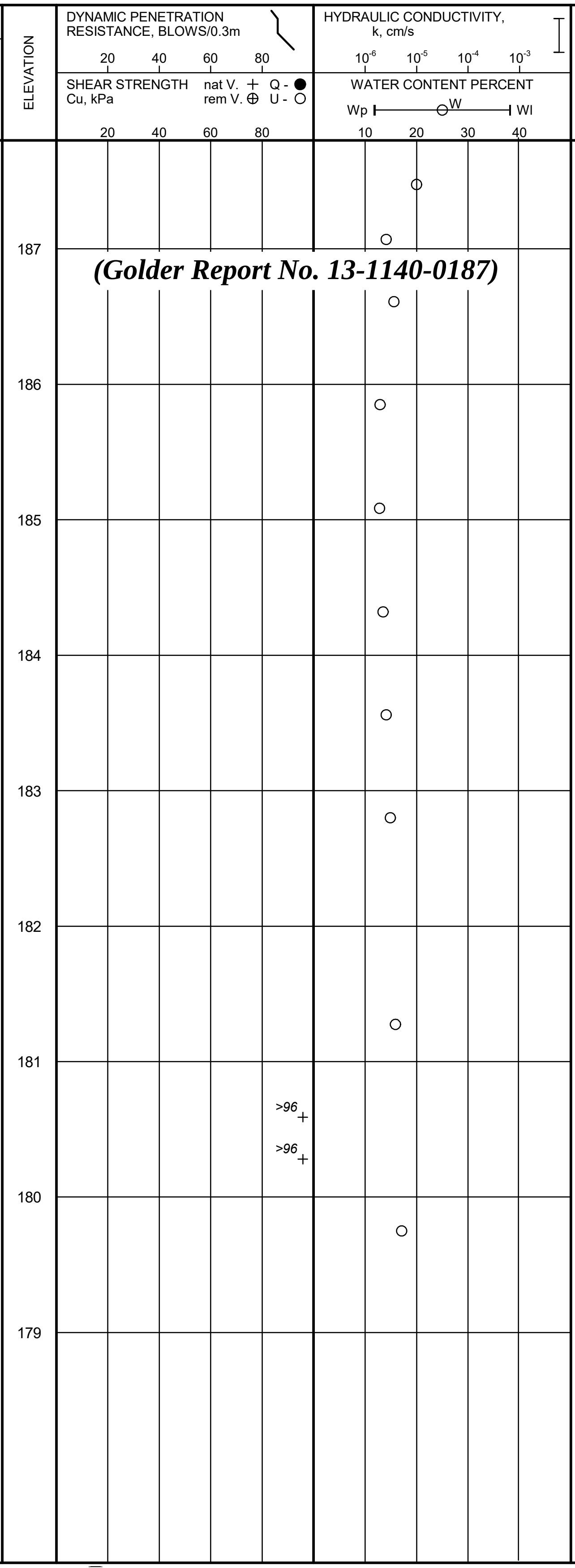
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.60 0.00
TOPSOIL - (ML) CLAYEY SILT; brown, moist	187.30 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets and layers, **(TILL)**; cohesive, w~PL, firm	186.23 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	184.70 2.90
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	179.52 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	7
3	SS	6
4	SS	17
5	SS	24
6	SS	16
7	SS	9
8	SS	9
9	SS	7
10	SS	7



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE
1 : 50

LOGGED: SM
CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-105

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

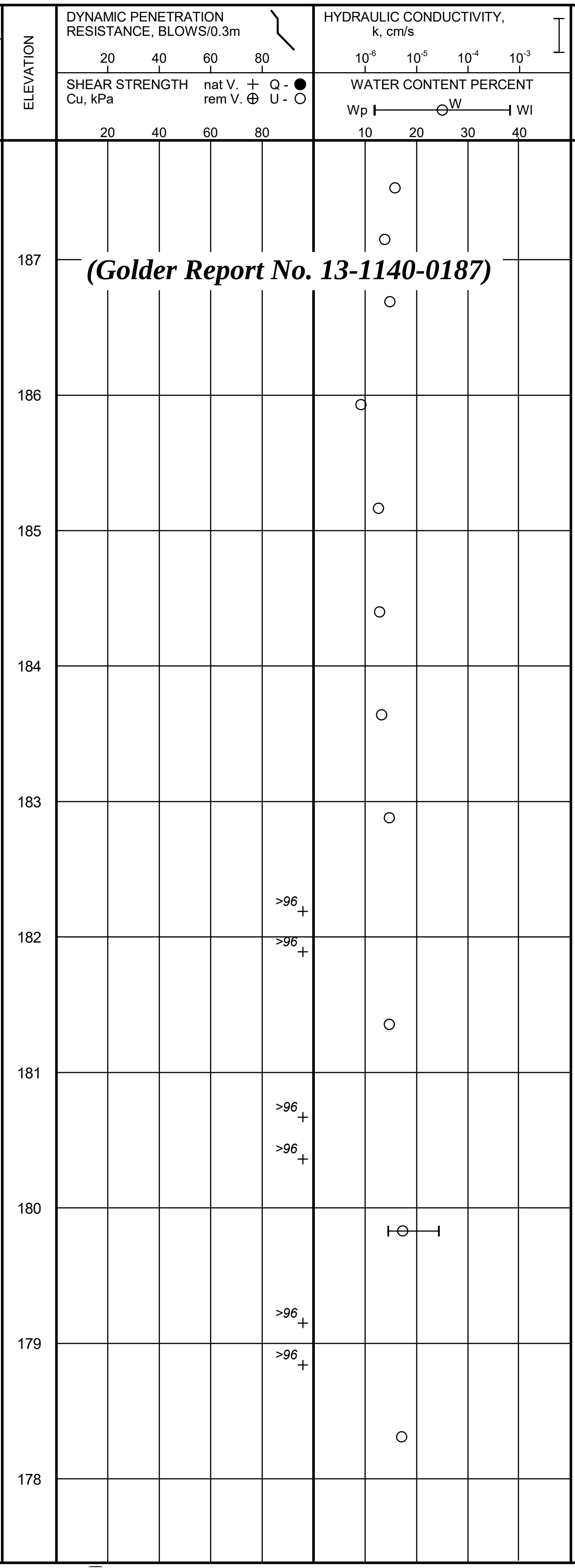
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.68
TOPSOIL - (ML) CLAYEY SILT; brown, moist	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets and layers, **(TILL)**; cohesive, w~PL, stiff	187.38 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and layers, **(TILL)**; cohesive, w<PL, very stiff	186.31 1.37
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w<PL to w>PL, very stiff	184.02 3.66
END OF BOREHOLE	178.08 9.60

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	9	
3	SS	9	
4	SS	28	
5	SS	21	
6	SS	18	
7	SS	15	
8	SS	10	
9	SS	7	
10	SS	7	MH
11	SS	8	



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-106

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

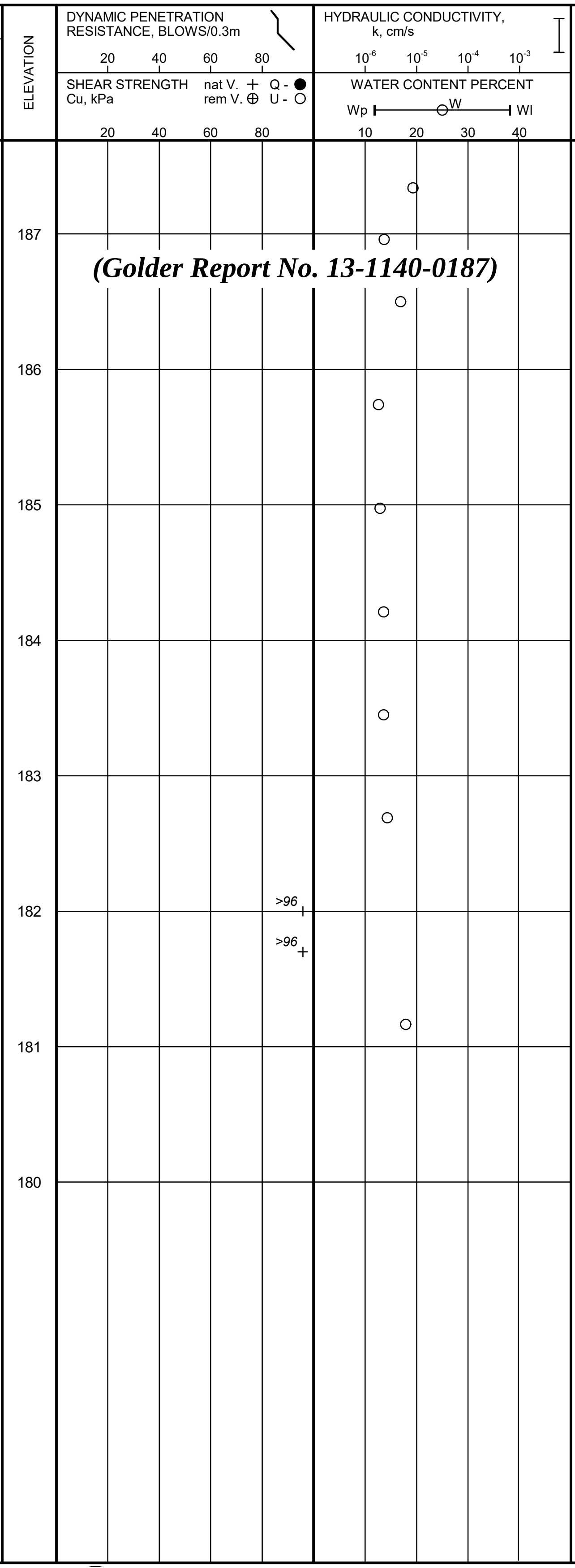
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.49
TOPSOIL - (ML) CLAYEY SILT; brown, moist	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w~PL, firm	187.19 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w<PL, very stiff	186.27 1.22
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff	184.59 2.90
END OF BOREHOLE	180.94 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	CS	
2	SS	8
3	SS	6
4	SS	15
5	SS	26
6	SS	16
7	SS	11
8	SS	10
9	SS	6



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-107

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

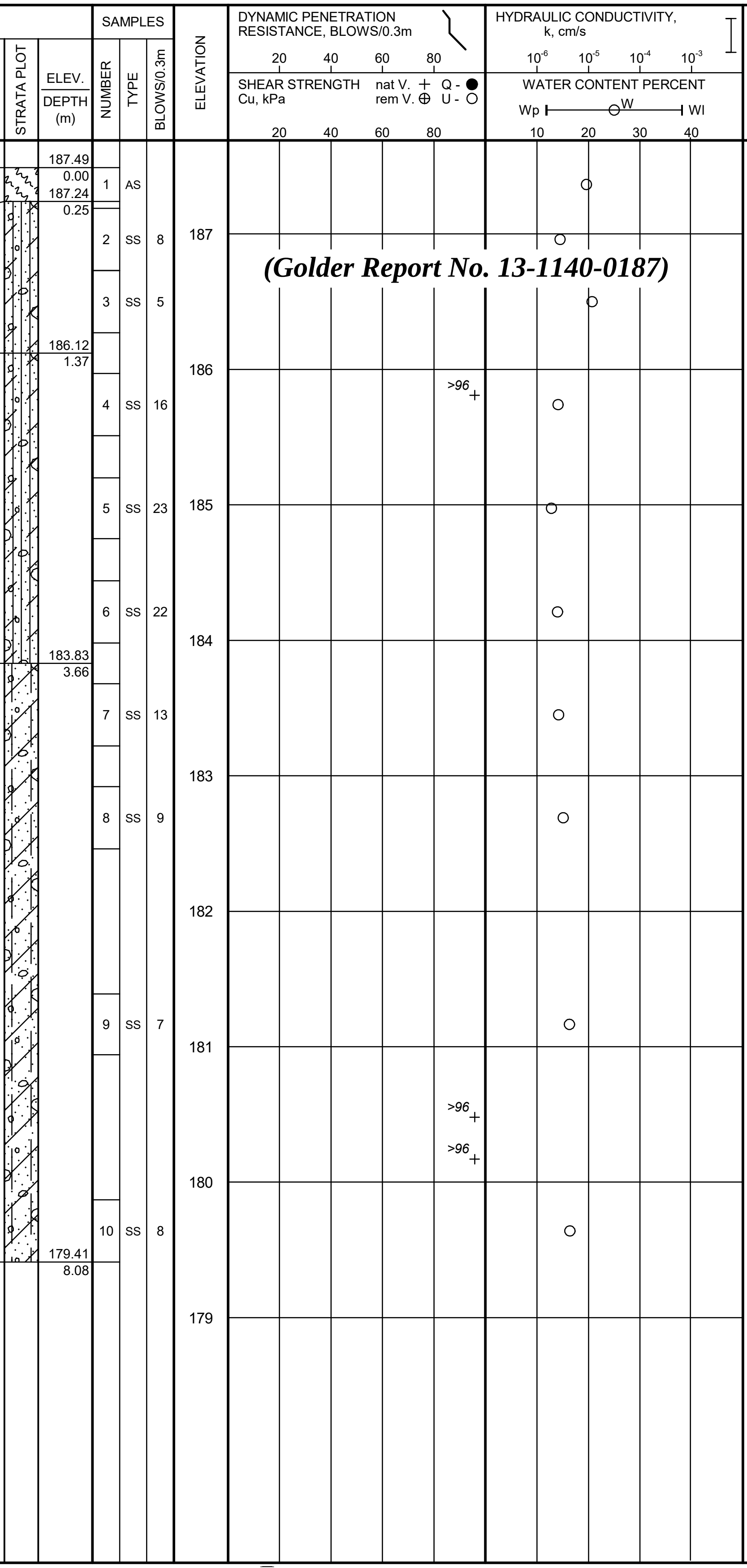
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	187.49
TOPSOIL - (ML) CLAYEY SILT; brown, moist	0.00 187.24 0.25
(ML-CL) sandy **CLAYEY SILT** to **SILTY CLAY**, trace gravel; mottled brown and grey, with sand and topsoil pockets, **(TILL)**; cohesive, w>PL, stiff to firm	186.12 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand layers and pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	183.83 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff	179.41 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	8
3	SS	5
4	SS	16
5	SS	23
6	SS	22
7	SS	13
8	SS	9
9	SS	7
10	SS	8



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-108

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

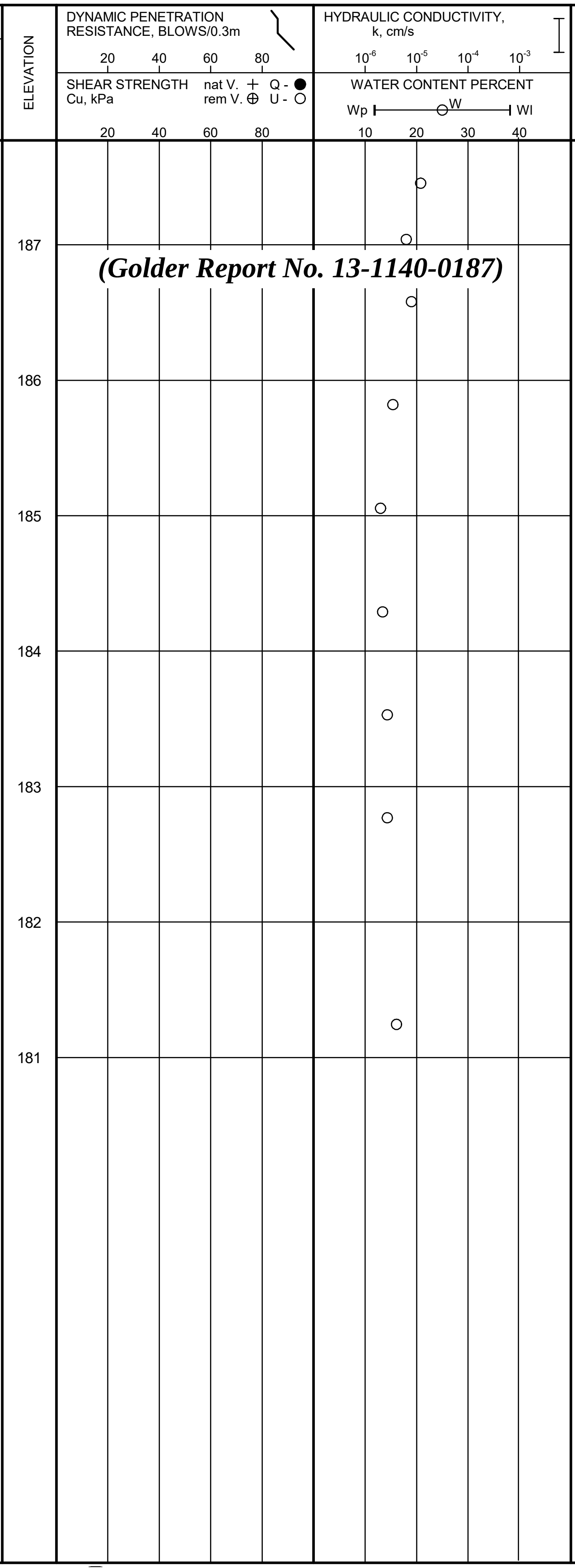
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.57 0.00
TOPSOIL - (ML) CLAYEY SILT; brown, moist	187.34 0.23
(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w>PL, very stiff to firm	186.20 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff	184.67 2.90
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff to firm	181.02 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	18
3	SS	7
4	SS	17
5	SS	23
6	SS	17
7	SS	10
8	SS	9
9	SS	6



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-109

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 16, 2013

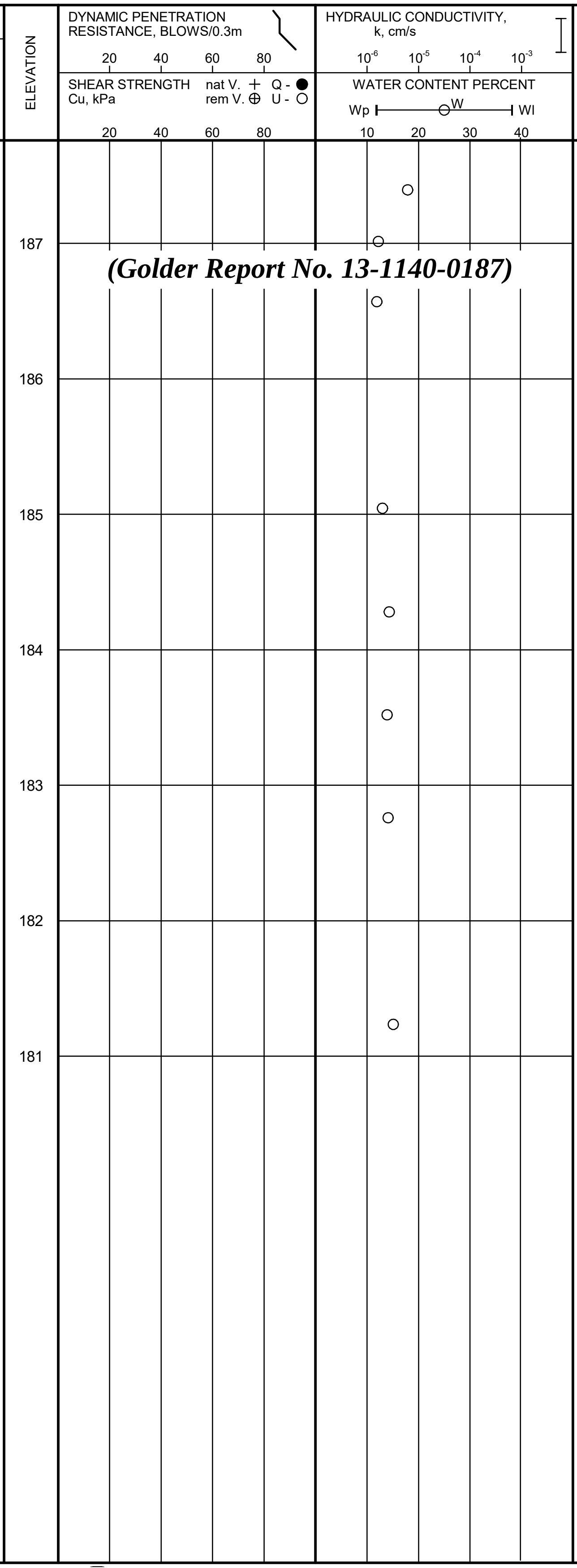
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	187.56 0.00			
TOPSOIL - (ML) CLAYEY SILT; black, moist	187.23 0.33	1	CS	
(ML) sandy **CLAYEY SILT**; mottled brown and grey; cohesive, w<PL, firm to soft	186.19 1.37	2 3	SS SS	6 3
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	184.66 2.90	4 5	SS SS	18 24
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand partings and pockets, **(TILL)**; cohesive, w~PL, stiff	181.01 6.55	6 7 8 9	SS SS SS SS	12 11 11 10
END OF BOREHOLE				



(Golder Report No. 13-1140-0187)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 16, 2013.

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-110

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

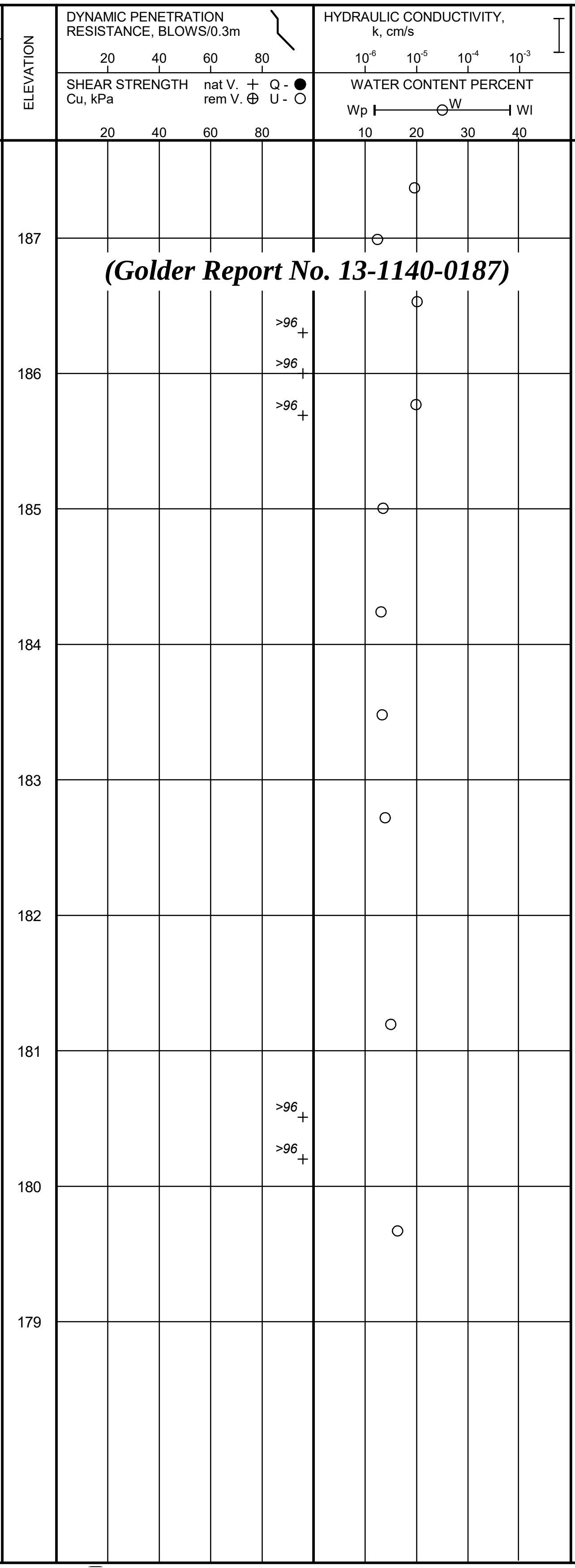
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

DEPTH SCALE METRES: 0 to 10

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.52
TOPSOIL - (ML) sandy CLAYEY SILT; black; moist	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand seams and pockets, **(TILL)**; cohesive, w<PL, firm	187.22 0.30
(CL) sandy **SILTY CLAY**, some sand, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w>PL, very stiff	186.15 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand seams and pockets, **(TILL)**; cohesive, w<PL, very stiff	185.39 2.13
(ML-CL) sandy **CLAYEY SILT** to **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff	184.62 2.90
END OF BOREHOLE	179.44 8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	6
3	SS	5
4	SS	7
5	SS	24
6	SS	15
7	SS	12
8	SS	11
9	SS	9
10	SS	10



(Golder Report No. 13-1140-0187)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 15, 2013.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-111

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

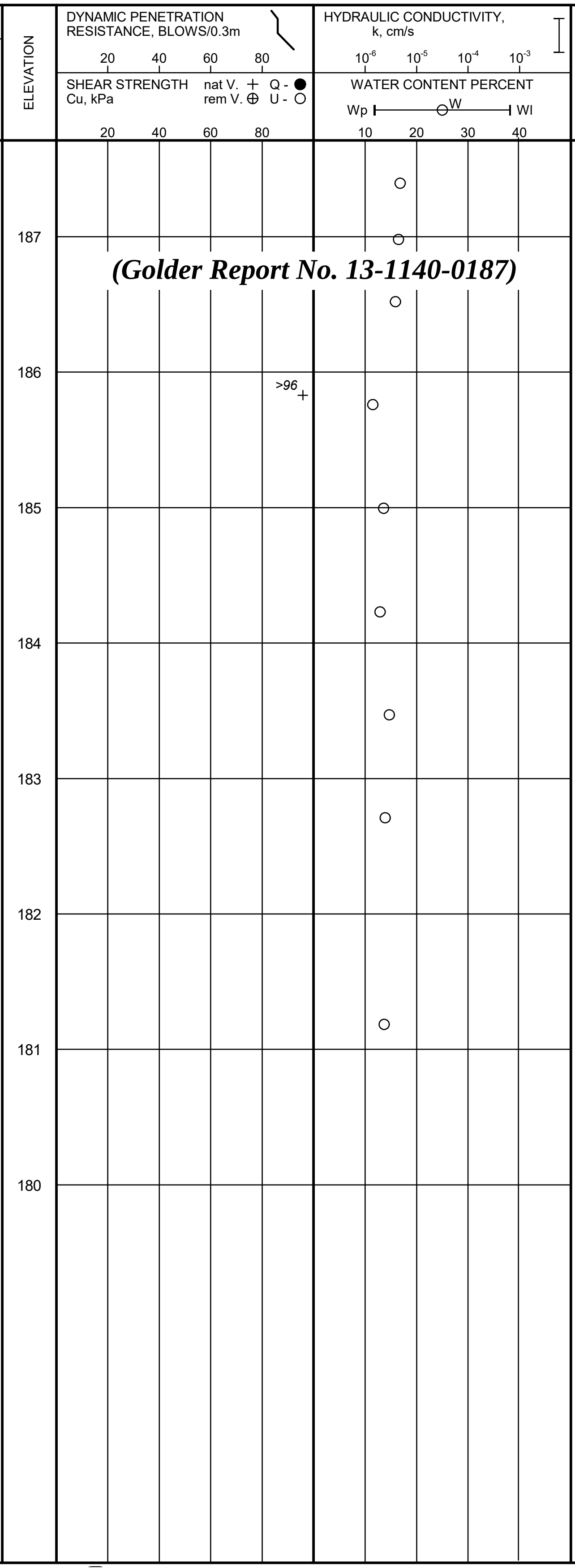
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.51
TOPSOIL - (ML) sandy CLAYEY SILT; black; moist	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets and layers, **(TILL)**; cohesive, w~PL, stiff to firm	187.28 0.23
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand partings, pockets and layers, **(TILL)**; cohesive, w<PL, very stiff	186.14 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; grey, with sand pockets and layers, **(TILL)**; cohesive, w<PL, very stiff	184.61 2.90
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, stiff	183.85 3.66
END OF BOREHOLE	180.96 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	8
3	SS	7
4	SS	18
5	SS	26
6	SS	17
7	SS	11
8	SS	13
9	SS	10



(Golder Report No. 13-1140-0187)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on October 15, 2013.

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-112

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

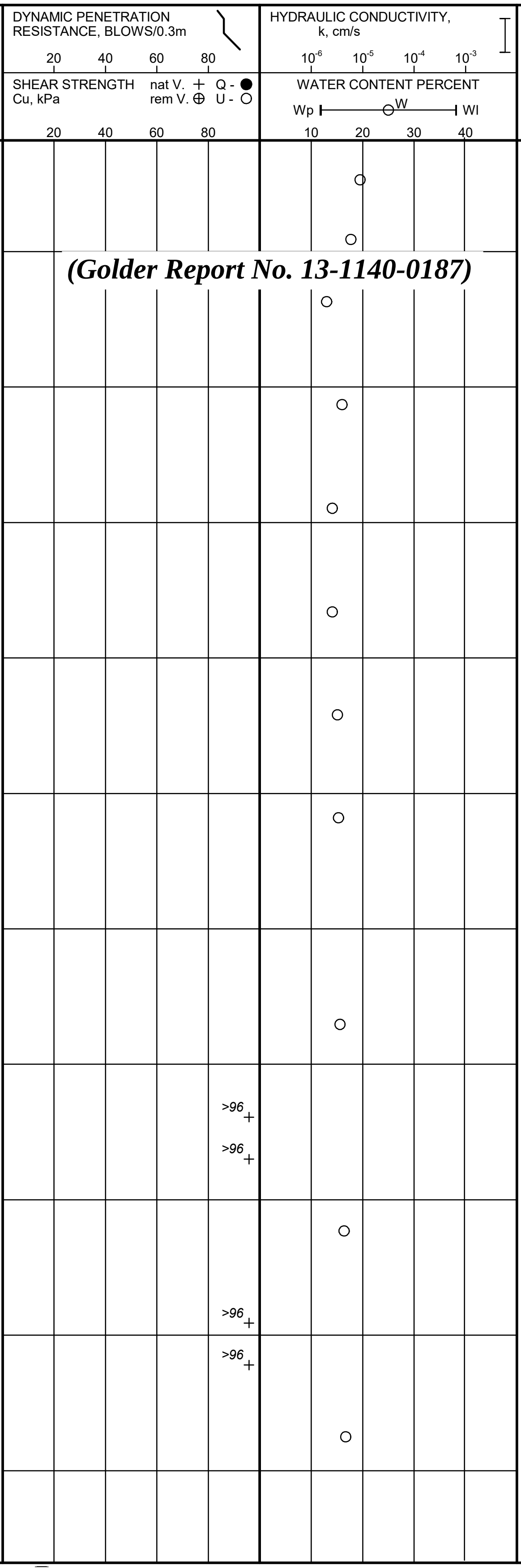
BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	187.62
TOPSOIL -(ML) sandy CLAYEY SILT; black; moist	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets and layers, **(TILL)**; cohesive, w<PL to w>PL, stiff	187.44 0.18
(ML) sandy **CLAYEY SILT**, trace gravel; brown, fissured, with sand pockets and layers, **(TILL)**; cohesive, w~PL, very stiff	186.25 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff to stiff	183.81 3.81
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff	182.06 5.56
END OF BOREHOLE	178.02 9.60

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	10
3	SS	13
4	SS	22
5	SS	24
6	SS	23
7	SS	18
8	SS	11
9	SS	8
10	SS	8
11	SS	6



ELEVATION: 187, 186, 185, 184, 183, 182, 181, 180, 179, 178

DEPTH SCALE METRES: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

(Golder Report No. 13-1140-0187)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on October 15, 2013.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-113

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

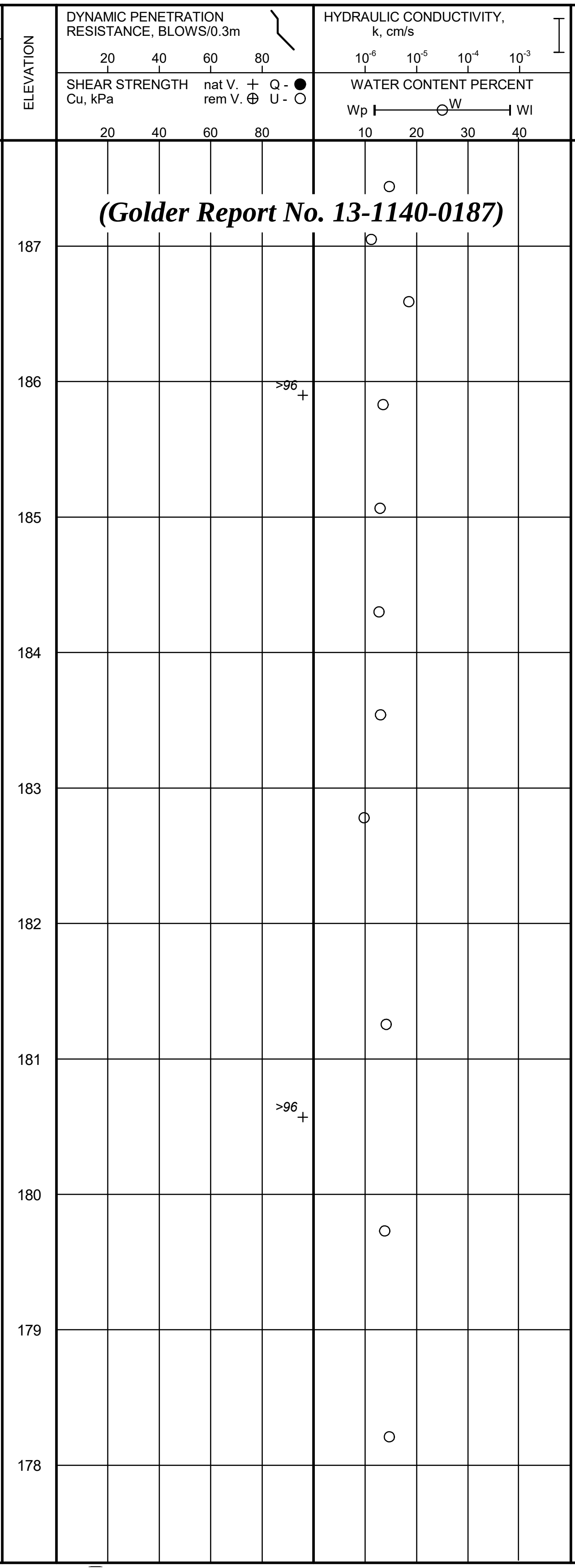
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	187.58 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; black; moist	187.30 0.28
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets/seams, and topsoil pockets, **(TILL)**; cohesive, w>PL, stiff to very stiff	185.45 2.13
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	184.68 2.90
(ML) sandy **CLAYEY SILT**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	183.92 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w<PL to w~PL, very stiff to stiff	177.98 9.60
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	11
3	SS	7
4	SS	14
5	SS	23
6	SS	24
7	SS	13
8	SS	13
9	SS	11
10	SS	12
11	SS	9



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 15, 2013.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-114

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

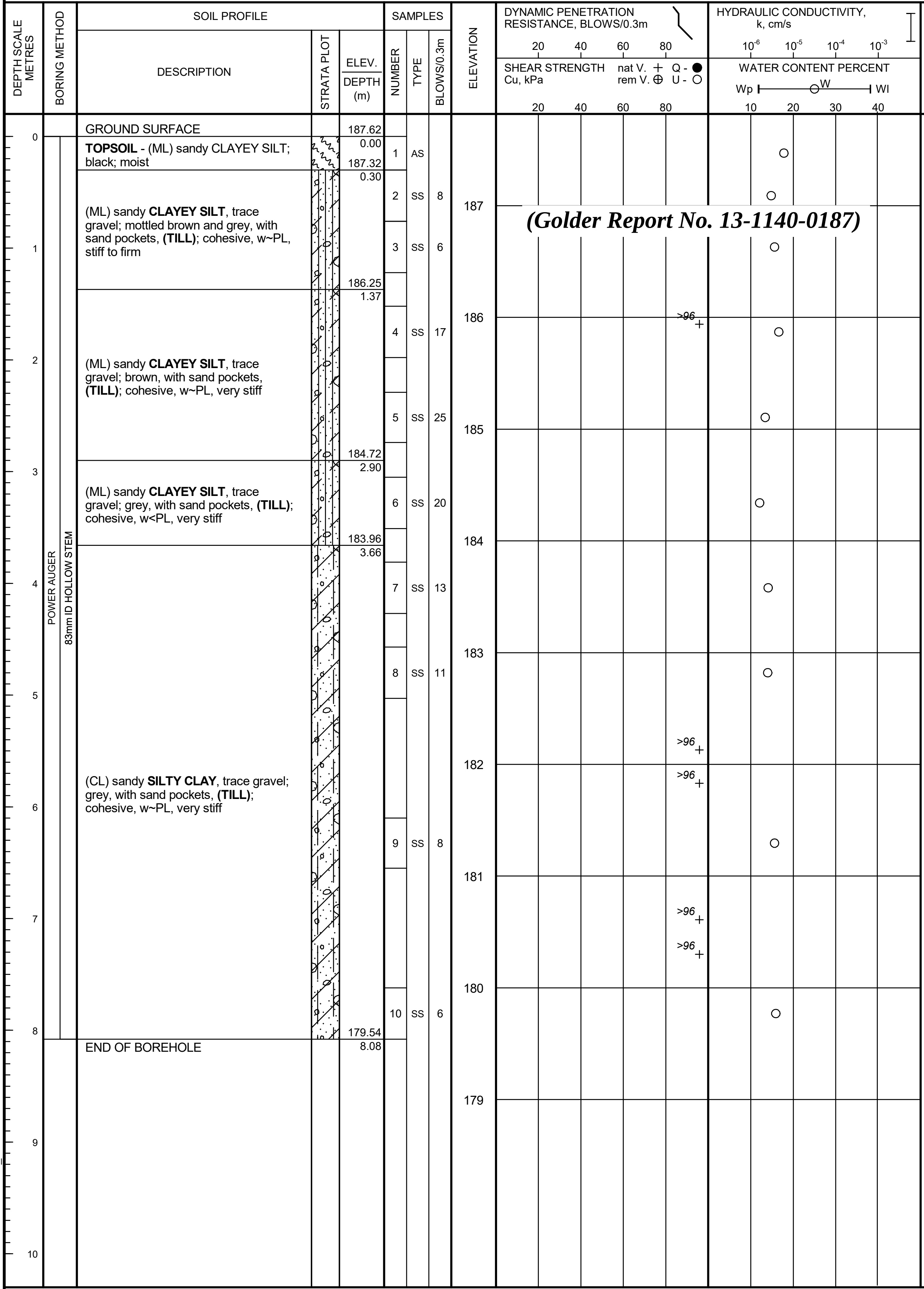
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	187.62			
TOPSOIL - (ML) sandy CLAYEY SILT; black; moist	0.00 187.32 0.30	1	AS	
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w~PL, stiff to firm	186.25 1.37	2 3	SS SS	8 6
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff	184.72 2.90	4 5	SS SS	17 25
(ML) sandy **CLAYEY SILT**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	183.96 3.66	6	SS	20
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL, very stiff	179.54 8.08	7 8 9 10	SS SS SS SS	13 11 8 6
END OF BOREHOLE				



INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 15, 2013.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-115

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

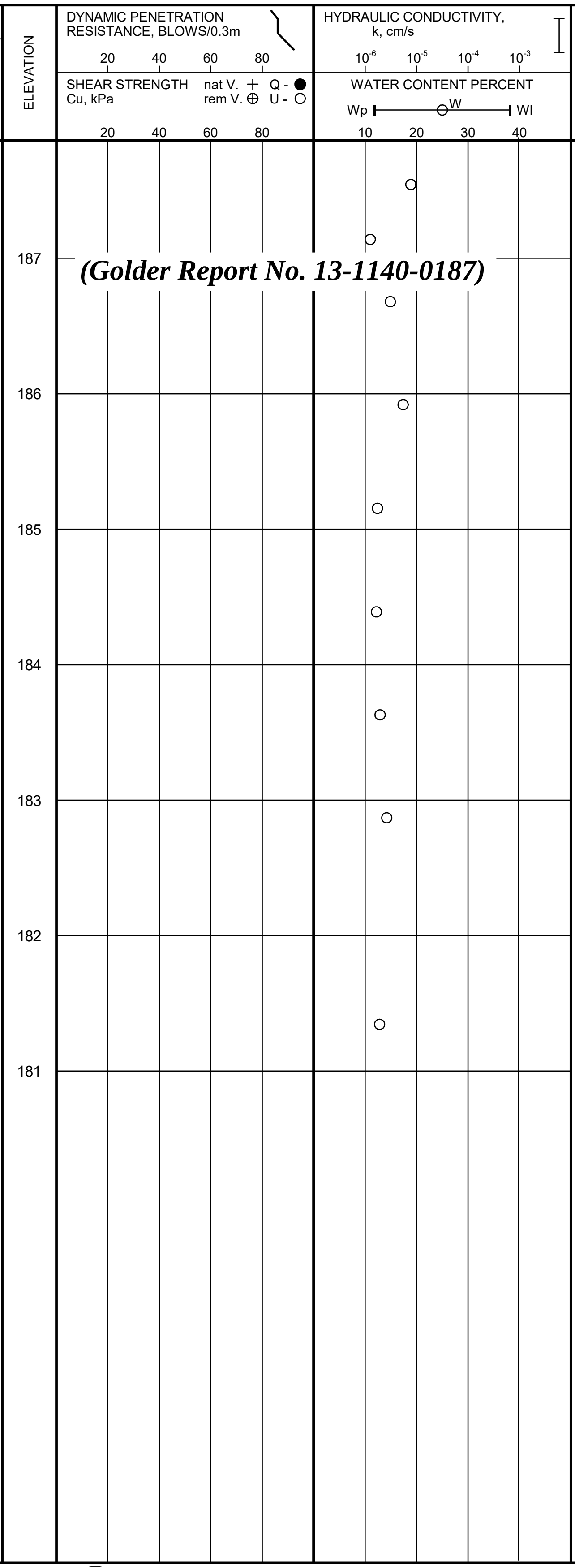
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.67 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; black; moist	187.42 0.25
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w<PL, stiff to very stiff	186.30 1.37
(ML) sandy **CLAYEY SILT**, some sand, trace gravel; brown, with sand pockets **(TILL)**; cohesive, w~PL, very stiff	184.01 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets and partings, **(TILL)**; cohesive, w~PL, stiff	181.12 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	12
3	SS	15
4	SS	21
5	SS	24
6	SS	20
7	SS	14
8	SS	12
9	SS	12



(Golder Report No. 13-1140-0187)

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on October 15, 2013.

DEPTH SCALE
1 : 50

LOGGED: SM

CHECKED:

Golder Associates

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-116

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 15, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

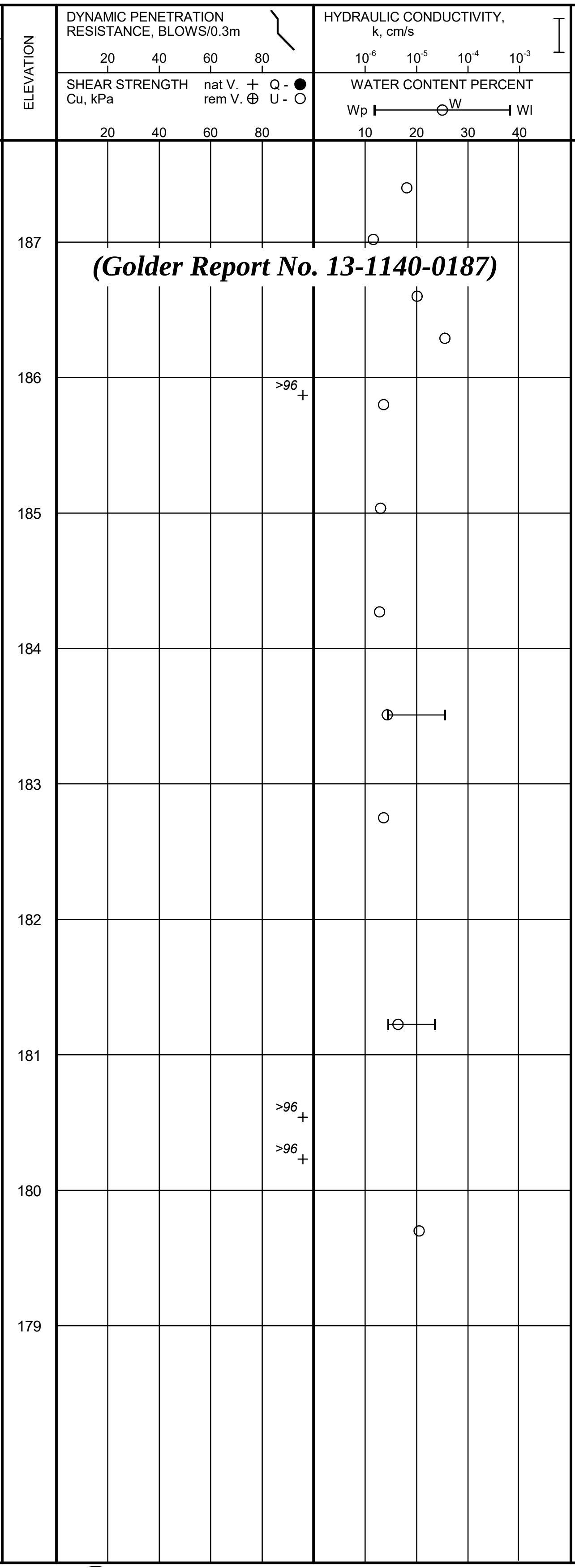
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.55
TOPSOIL - (SM) SILTY SAND; black; moist	0.00
(SM) **SILTY SAND**; mottled brown and grey, with topsoil pockets; non-cohesive, moist, very loose	187.25 0.30
(SW) **SAND**, trace to some silt; brown, with clay pockets; non-cohesive; moist, very loose	186.79 0.76
(ML) sandy **CLAYEY SILT**; brown; cohesive, w>PL, stiff	186.41 1.14
(ML) sandy **CLAYEY SILT**; brown, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	186.18 1.37
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w~PL to w>PL, very stiff	183.89 3.66
END OF BOREHOLE	179.47 8.08

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	3	
3	SS	2	
4	SS	15	
5	SS	16	
6	SS	16	
7	SS	13	MH
8	SS	12	
9	SS	10	MH
10	SS	11	

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on October 15, 2013.



(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-117

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

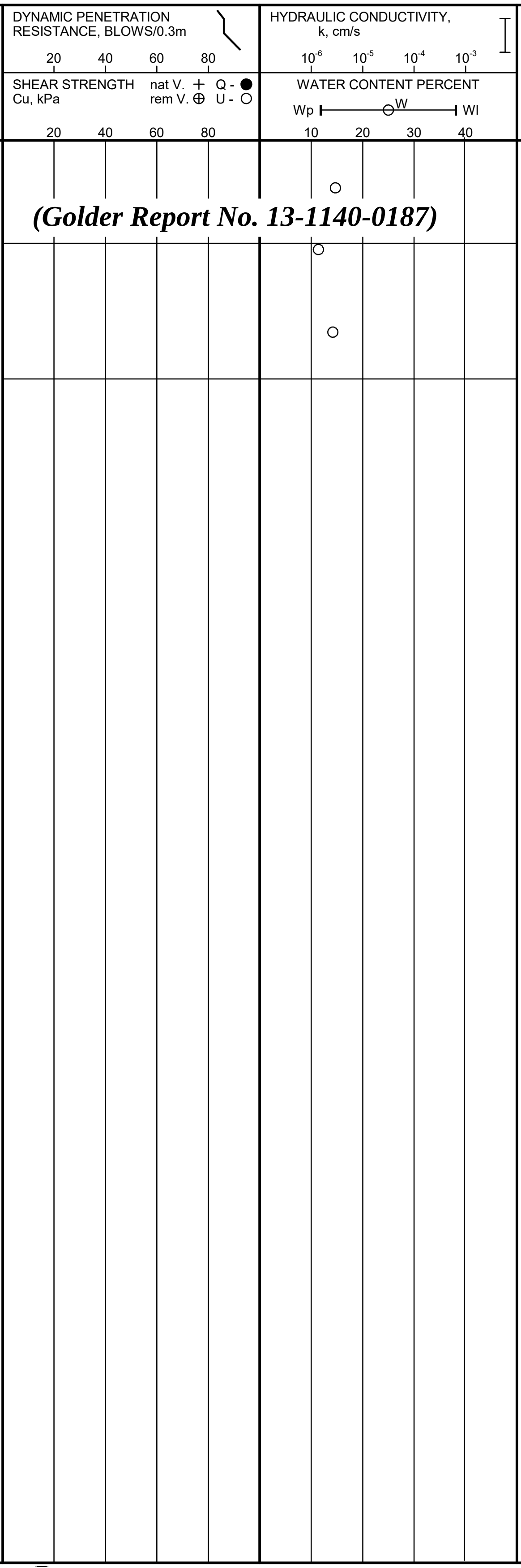
BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		187.56						
	POWER AUGER 83mm ID HOLLOW STEM	**TOPSOIL** - (ML) CLAYEY SILT; brown, moist		0.00 187.26	1	AS				Borehole dry upon completion of drilling on October 16, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, sand pockets and layers, **(TILL)**; cohesive, w<PL, firm to stiff		0.30	2	SS	6	187		
1					3	SS	12			
				186.04						
		END OF BOREHOLE		1.52				186		
2										
3										
4										
5										
6										
7										
8										
9										
10										



(Golder Report No. 13-1140-0187)

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-118

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 17, 2013

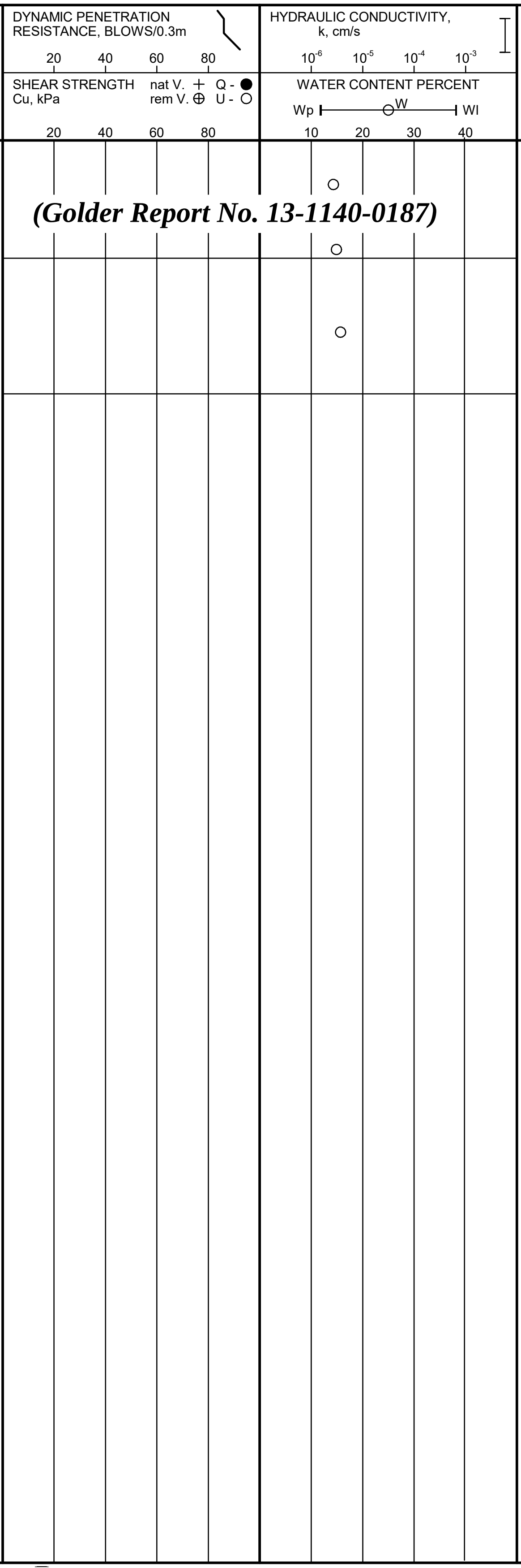
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	187.67					
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT, some sand; dark brown; moist	0.00 187.42 0.25	1	AS			Borehole dry upon completion of drilling on October 17, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, sand pockets and layers, **(TILL)**; cohesive, w~PL, stiff		2	SS	9	187	
1			186.15 1.52	3	SS	14		
		END OF BOREHOLE					186	

(Golder Report No. 13-1140-0187)



ADDITIONAL LAB. TESTING

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-119

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 17, 2013

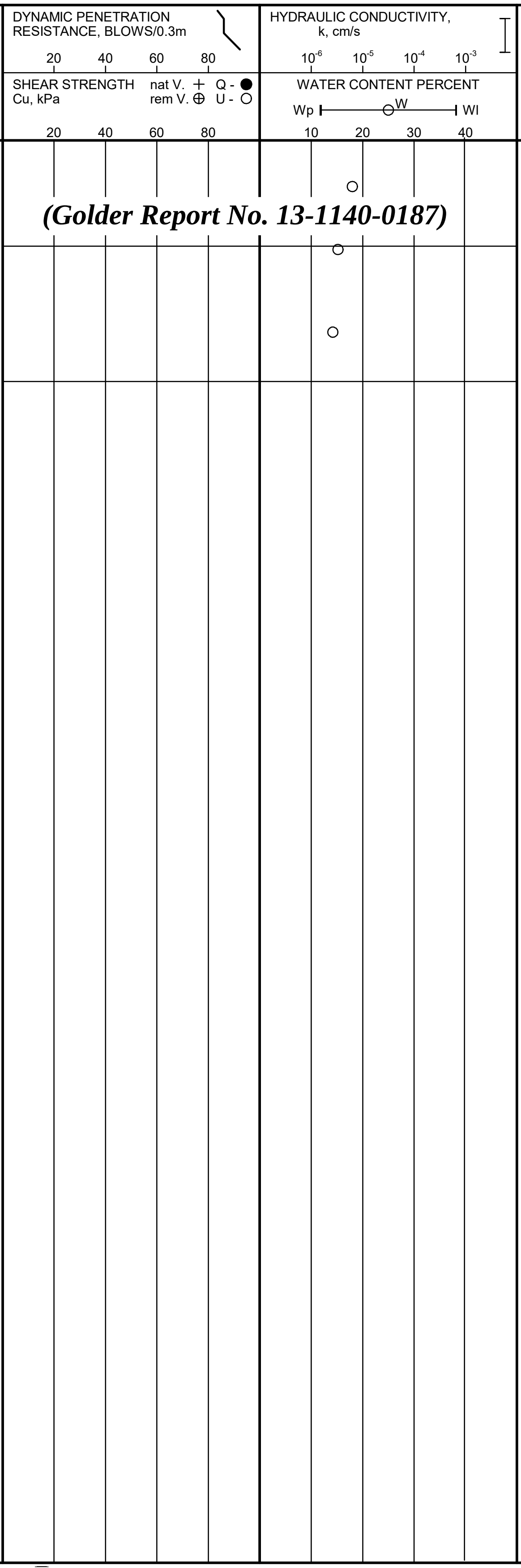
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE	187.58						
	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist	0.00	1	AS				Borehole dry upon completion of drilling on October 17, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand/topsoil pockets and rootlets, **(TILL)**; cohesive, w~PL, stiff	187.30 0.28	2	SS	12	187		
1				3	SS	13			
		END OF BOREHOLE	186.06 1.52				186		
2									
3									
4									
5									
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-120

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

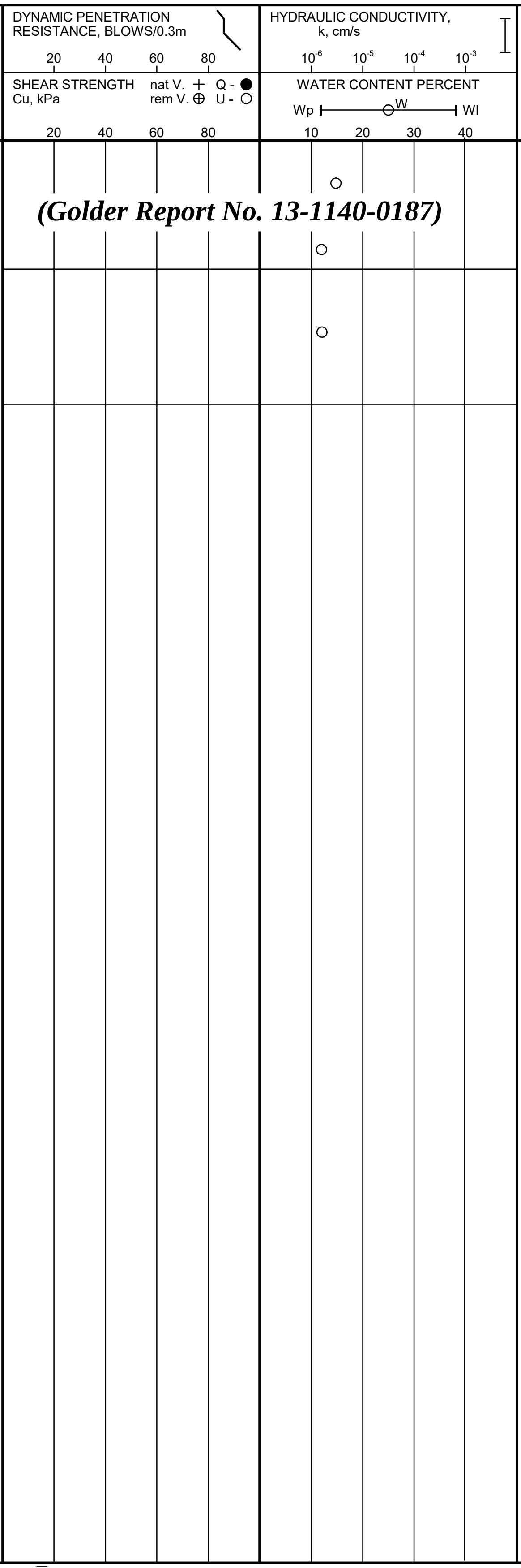
BORING DATE: October 17, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		187.75						
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist		0.00 187.52 0.23	1	AS				Borehole dry upon completion of drilling on October 17, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff		186.84 0.91	2	SS	18	187		
1		(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w<PL, very stiff		186.23 1.52	3	SS	23			
		END OF BOREHOLE						186		



(Golder Report No. 13-1140-0187)

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-121

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

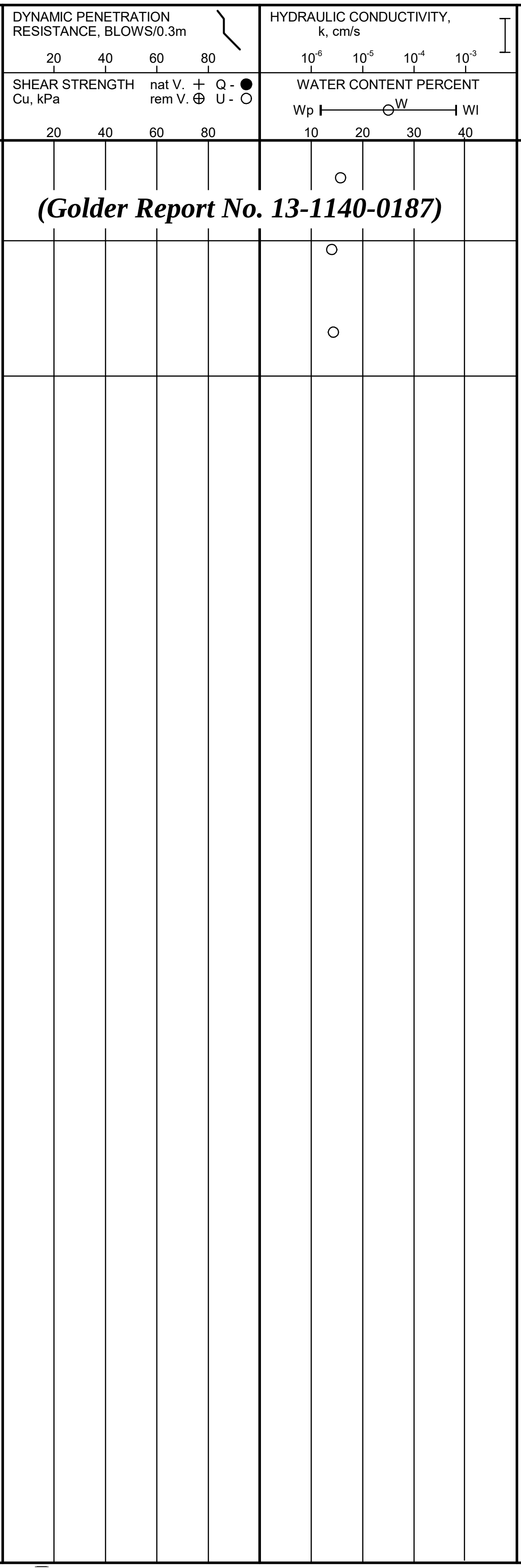
BORING DATE: October 17, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		187.54						
	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist		0.00	1	AS				Borehole dry upon completion of drilling on October 17, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w~PL, stiff		0.15	2	SS	13	187		
1		(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff		186.63 0.91	3	SS	16			
		END OF BOREHOLE		186.02 1.52				186		
2										
3										
4										
5										
6										
7										
8										
9										
10										



(Golder Report No. 13-1140-0187)

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-122

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 17, 2013

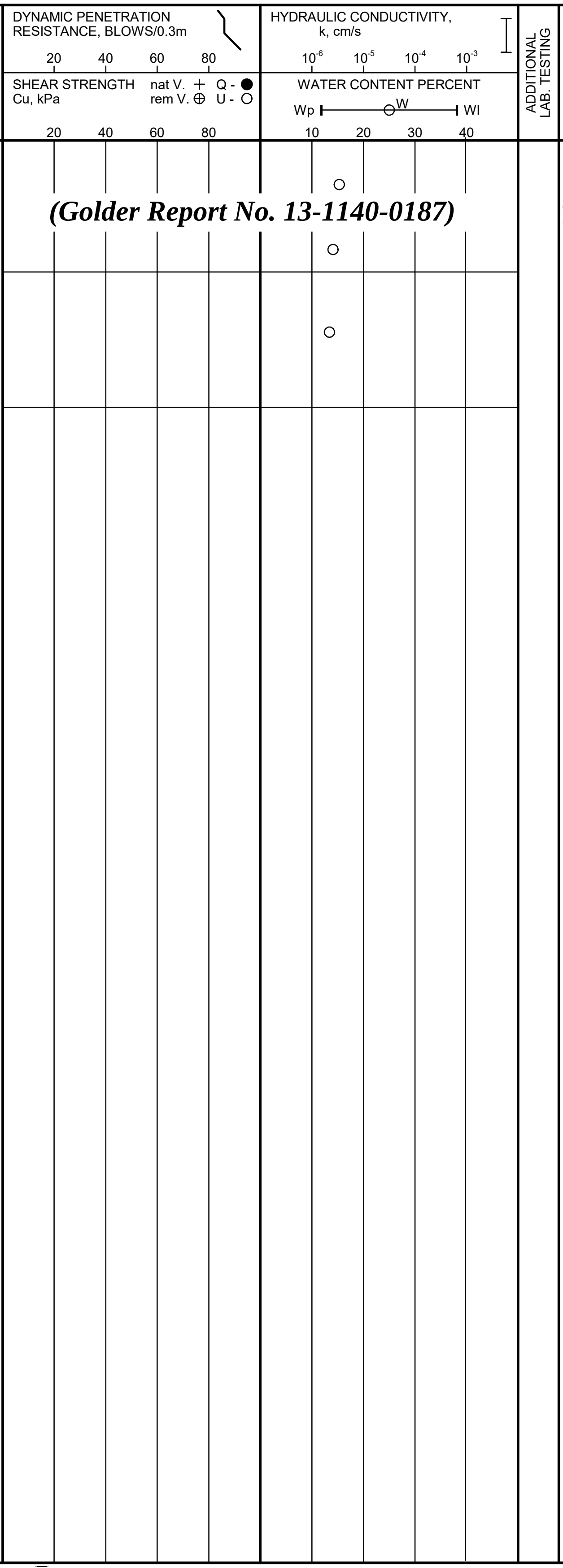
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		187.77					
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist		0.00 187.52 0.25	1	AS			Borehole dry upon completion of drilling on October 17, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand and topsoil pockets, **(TILL)**; cohesive, w~PL, stiff to very stiff		186.86 0.91	2	SS	15	187	
1		(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, oxidized fissures, **(TILL)**; cohesive, w~PL, very stiff		186.25 1.52	3	SS	25		
		END OF BOREHOLE						186	
2									
3									
4									
5									
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-123

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 17, 2013

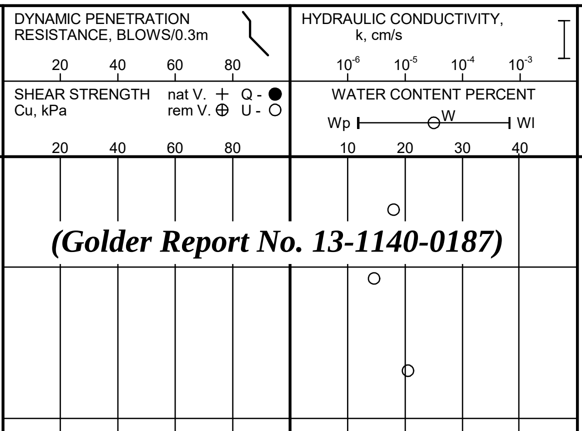
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		187.53						
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist		0.00 187.23	1	AS				Borehole dry upon completion of drilling on October 17, 2013.
1		(ML-CL) sandy **CLAYEY SILT** to **SILTY CLAY**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w~PL to w>PL, stiff		0.30 186.01	2 3	SS SS	11 12	187 186		
		END OF BOREHOLE		1.52						
2										
3										
4										
5										
6										
7										
8										
9										
10										



LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-124

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

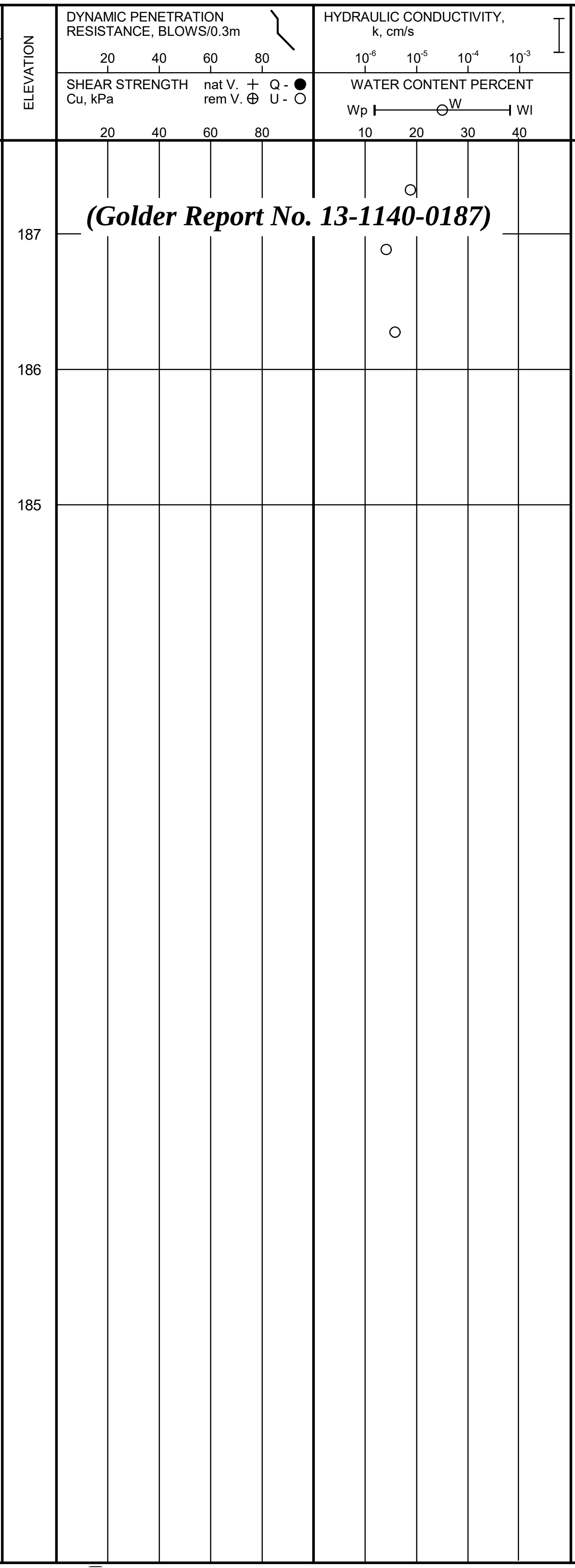
BORING DATE: October 16, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		187.49					
	POWER AUGER 83mm ID HOLLOW STEM	**TOPSOIL** - (ML) CLAYEY SILT; brown, moist		0.00	1	AS			Borehole dry upon completion of drilling on October 16, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, sand pockets and layers, **(TILL)**; cohesive, w~PL, stiff		187.16 0.33	2	SS	9		
1					3	SS	8		
		END OF BOREHOLE		185.97 1.52					



(Golder Report No. 13-1140-0187)

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187.GPJ GLDR_LON.GDT 30/10/13 DATA INPUT: DMB

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-125

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 17, 2013

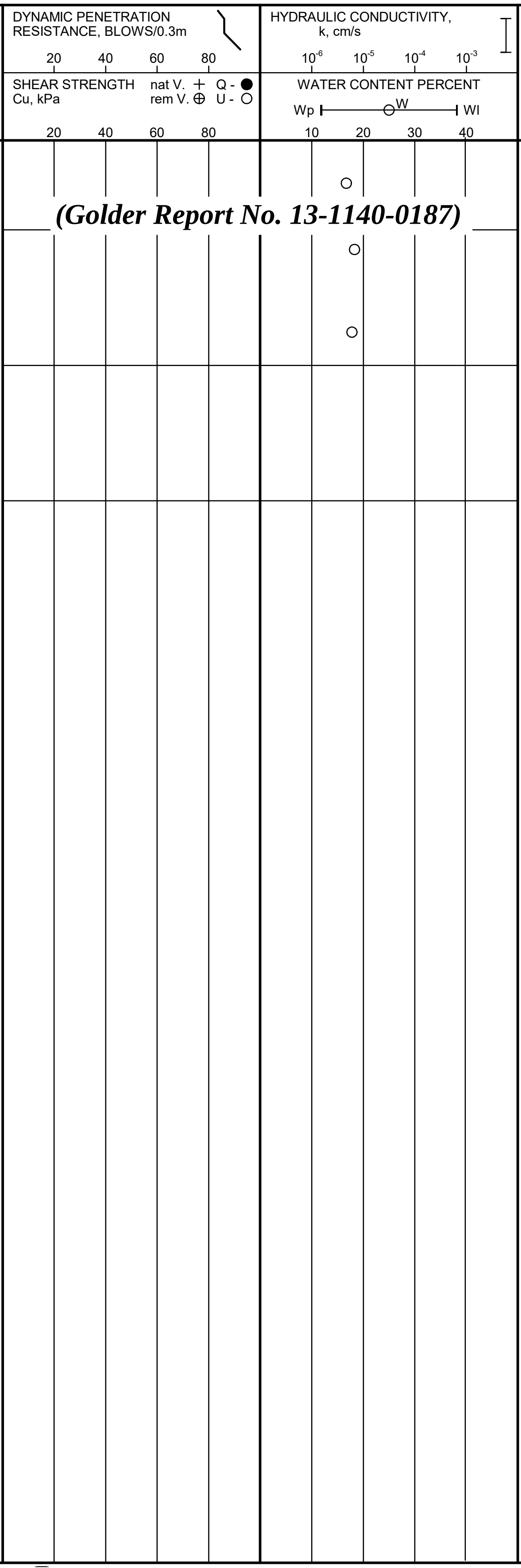
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	187.46					
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist	0.00 187.23	1	AS			Borehole dry upon completion of drilling on October 17, 2013.
		(ML-CL) sandy **CLAYEY SILT** to **SILTY CLAY**, trace gravel; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w>PL, stiff	0.23	2	SS	8	187	
1				3	SS	10		
		END OF BOREHOLE	185.94 1.52				186	
2							185	
3								
4								
5								
6								
7								
8								
9								
10								



ADDITIONAL LAB. TESTING

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 13-1140-0187

RECORD OF BOREHOLE BH-126

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

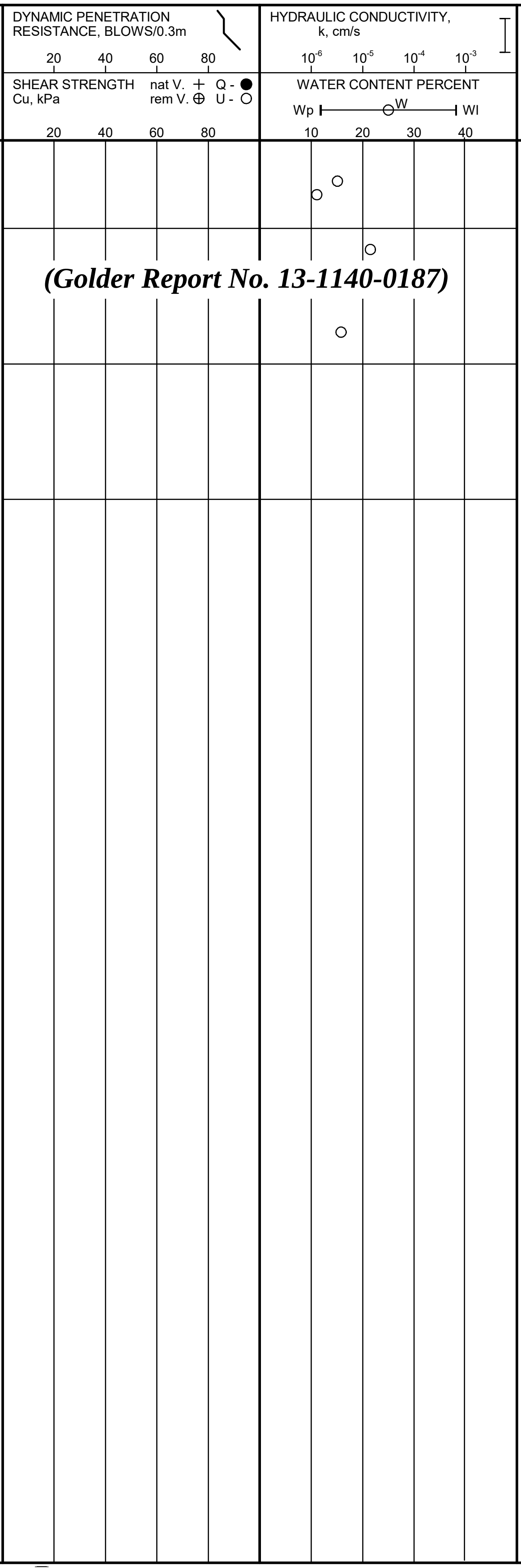
BORING DATE: October 17, 2013

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		187.45						
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) CLAYEY SILT; brown; moist		0.00	1	AS				Borehole dry upon completion of drilling on October 17, 2013.
		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with sand pockets and layers, **(TILL)**; cohesive, w>PL to w~PL, firm to stiff		187.22 0.23	2	SS	5	187		
1					3	SS	12			
		END OF BOREHOLE		185.93 1.52				186		
2								185		
3										
4										
5										
6										
7										
8										
9										
10										



(Golder Report No. 13-1140-0187)

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-201

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

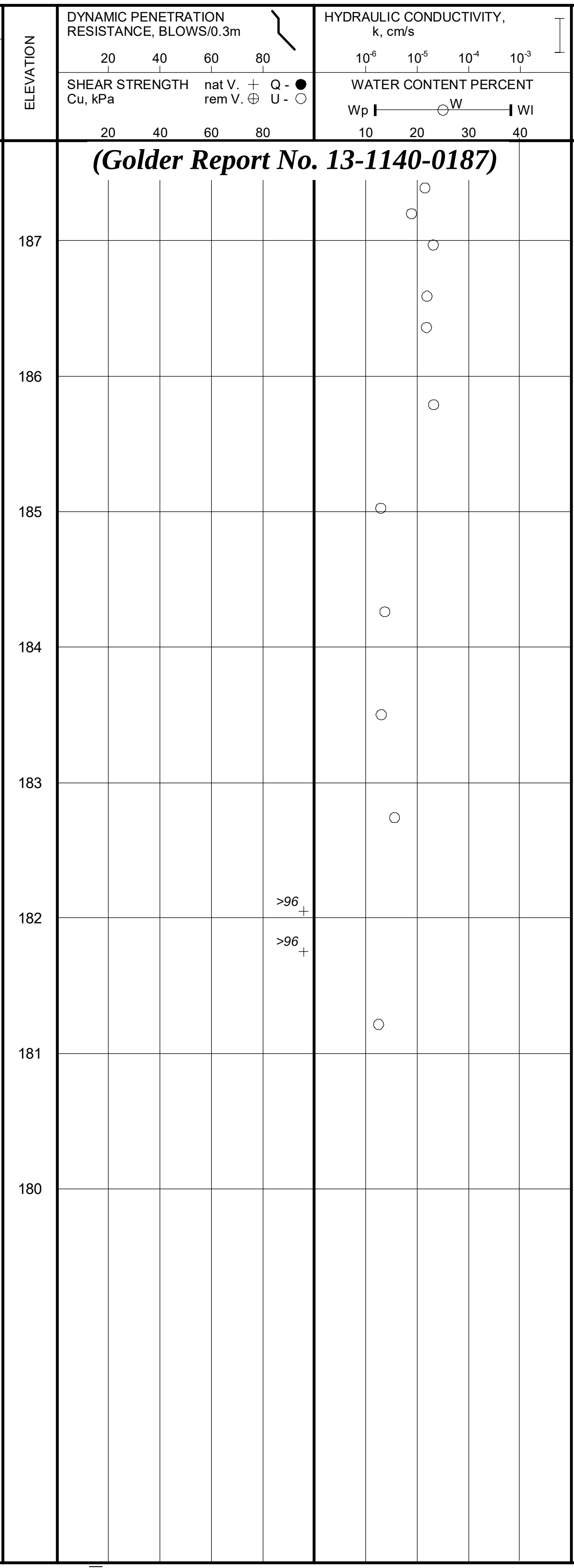
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.54 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist	187.16 0.38
(SM) **SILTY SAND**, trace to some gravel; brown; moist to wet, compact to very loose	186.40 1.14
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w>PL, soft	186.17 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and layers, **(TILL)**; cohesive, w<PL, stiff to very stiff	184.64 2.90
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w>PL, very stiff to firm	180.99 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	21
3	SS	2
4	SS	9
5	SS	17
6	SS	10
7	SS	10
8	SS	8
9	SS	6



(Golder Report No. 13-1140-0187)

INSTALLATION AND GROUNDWATER OBSERVATIONS

Ground frozen to about elev. 186.9m during drilling on February 18, 2014.

Seepage ▽

Water seepage into borehole encountered at about elev. 186.7m during drilling on February 18, 2014.

DEPTH SCALE

1 : 50

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187-2000.GPJ GLDR_LON.GDT 25/02/14 DATA INPUT: DMB

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-202

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

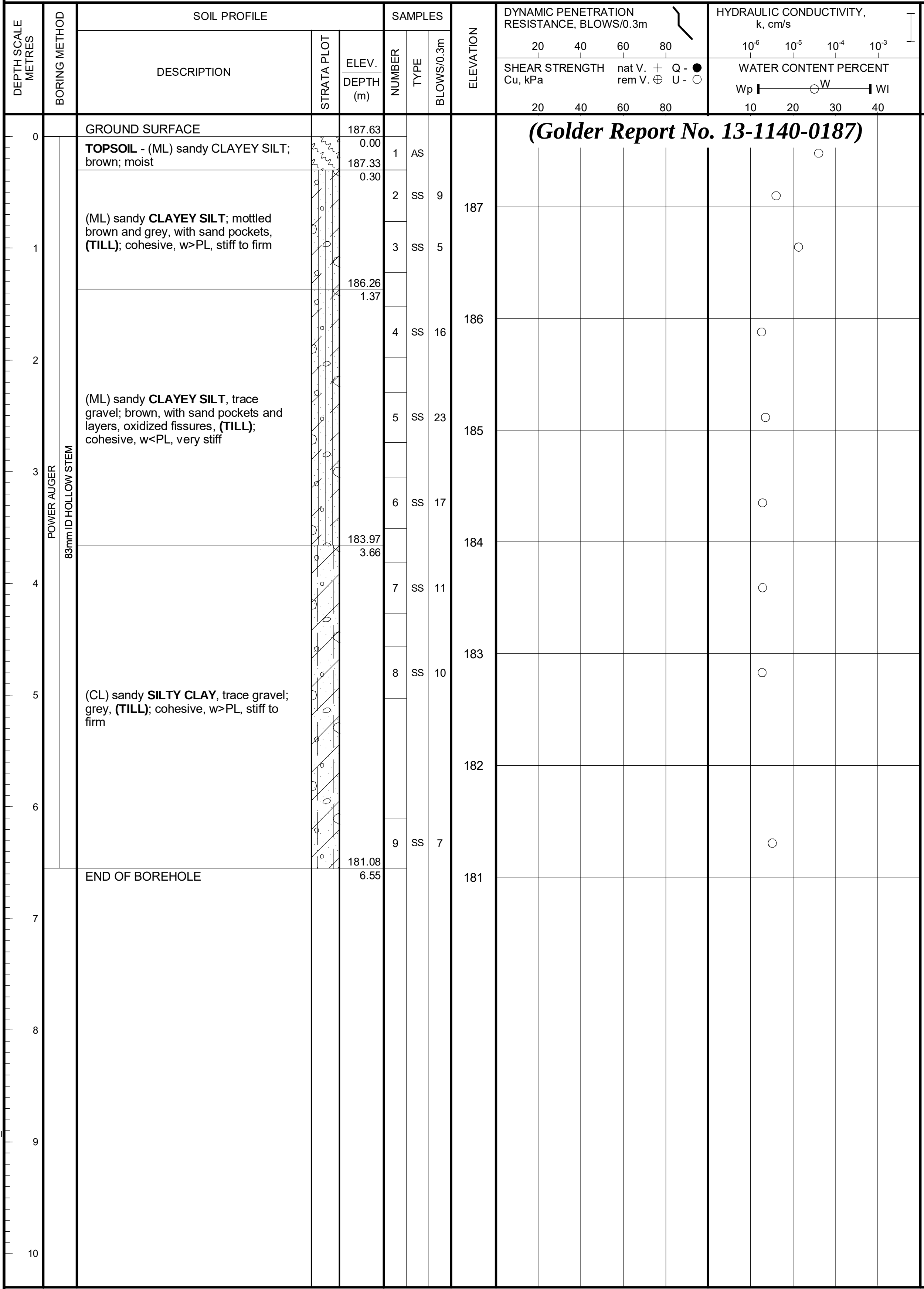
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.63 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist	187.33 0.30
(ML) sandy **CLAYEY SILT**; mottled brown and grey, with sand pockets, **(TILL)**; cohesive, w>PL, stiff to firm	186.26 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and layers, oxidized fissures, **(TILL)**; cohesive, w<PL, very stiff	183.97 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w>PL, stiff to firm	181.08 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	9
3	SS	5
4	SS	16
5	SS	23
6	SS	17
7	SS	11
8	SS	10
9	SS	7



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 187.0m during drilling on February 18, 2014.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-203

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

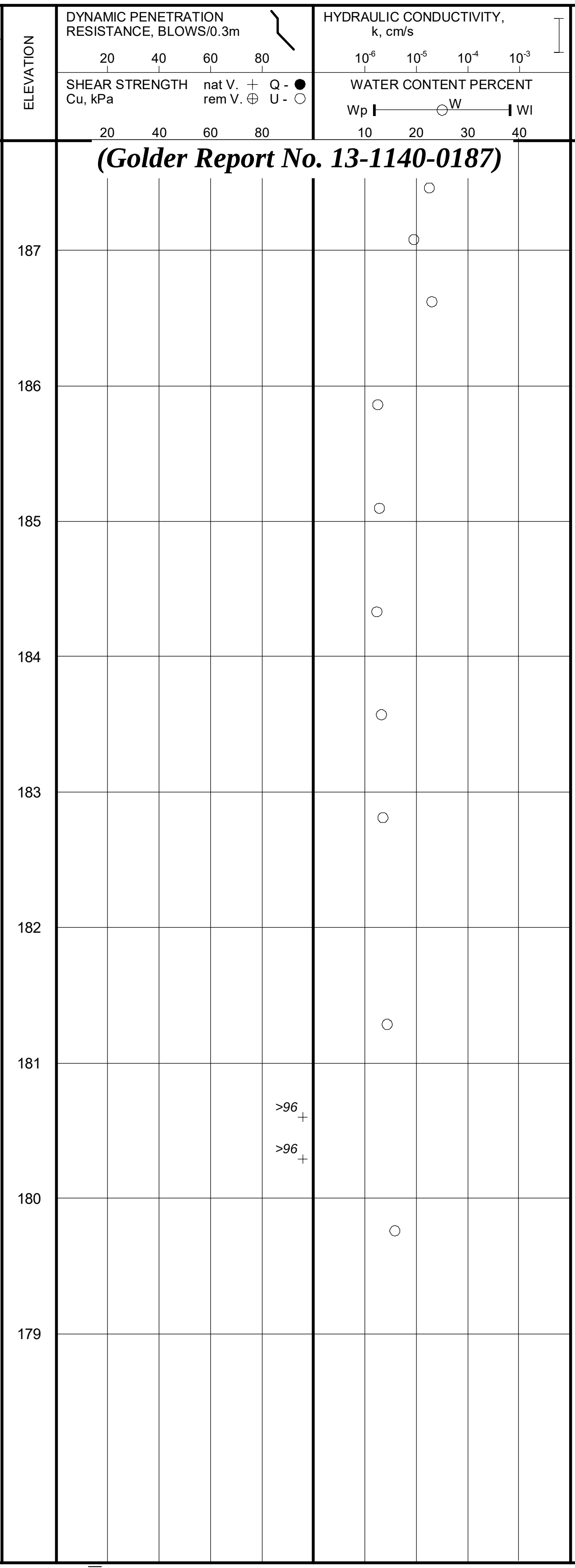
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.61 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist	187.31 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w>PL, stiff to firm	186.24 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and layers, oxidized fissures, **(TILL)**; cohesive, w<PL, very stiff	183.95 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w>PL, very stiff to firm	179.53 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	9
3	SS	5
4	SS	16
5	SS	26
6	SS	18
7	SS	10
8	SS	9
9	SS	7
10	SS	7



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 187.0m during drilling on February 18, 2014.

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-204

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

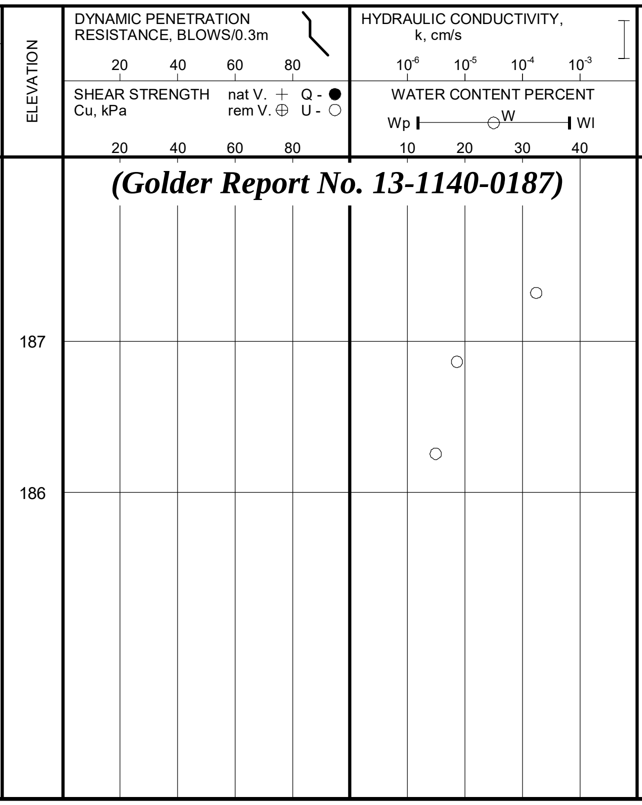
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	187.47				
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) sandy CLAYEY SILT; brown; moist	0.00	1	AS		Borehole dry upon completion of drilling on February 18, 2014. Ground frozen to about elev. 186.9m during drilling on February 18, 2014.
1	POWER AUGER UNCASED	(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w>PL, stiff	187.17 0.30	2 3	SS SS	10 8	
2 3		END OF BOREHOLE	185.95 1.52				

(Golder Report No. 13-1140-0187)



PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-205

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

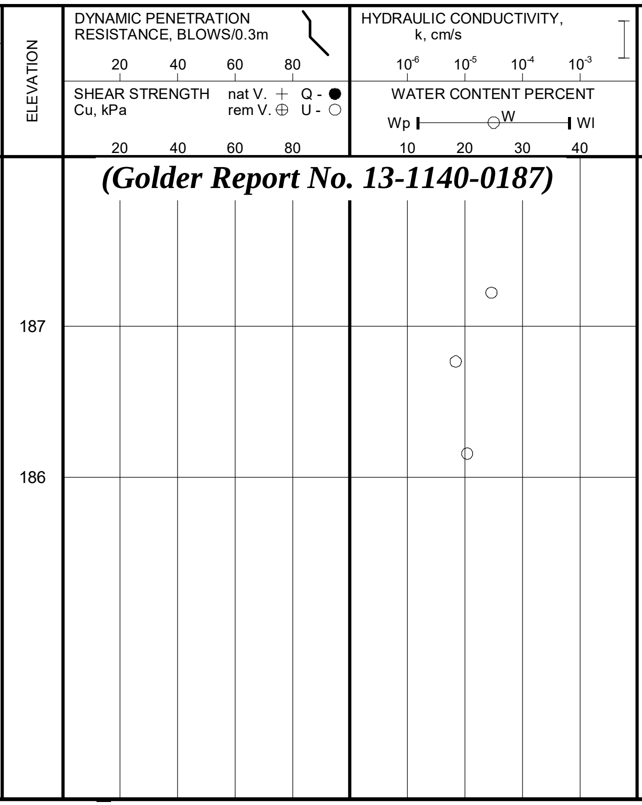
DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	187.37				
0	POWER AUGER UNCASED	**TOPSOIL** - (ML) sandy CLAYEY SILT; brown; moist	0.00	1	AS		Borehole dry upon completion of drilling on February 18, 2014. Ground frozen to about elev. 186.6m during drilling on February 18, 2014.
1	POWER AUGER UNCASED	(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w>PL, very stiff to firm	187.12 0.25	2 3	SS SS	16 7	
2 3		END OF BOREHOLE	185.85 1.52				

(Golder Report No. 13-1140-0187)



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-206

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

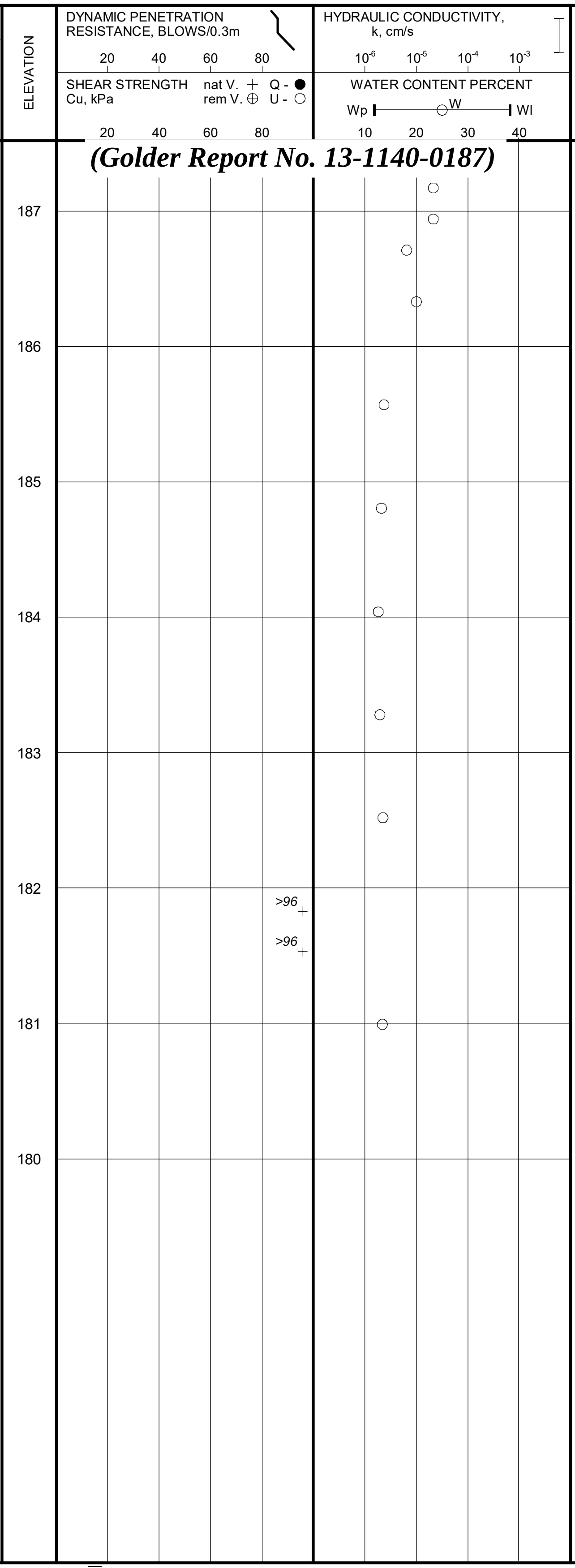
BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	187.32
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist to wet	0.00
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, fissured, **(TILL)**; cohesive, w>PL, very stiff to firm	186.86 0.46
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with silt partings, fissured, **(TILL)**; cohesive, w<PL, very stiff to stiff	185.19 2.13
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w>PL, stiff to very stiff	183.66 3.66
END OF BOREHOLE	180.77 6.55

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	15
3	SS	6
4	SS	13
5	SS	20
6	SS	14
7	SS	10
8	SS	8
9	SS	9



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 186.7m during drilling on February 18, 2014.

LDN_BHS_07 1311400187-2000.GPJ GLDR_LON.GDT 25/02/14 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-207

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

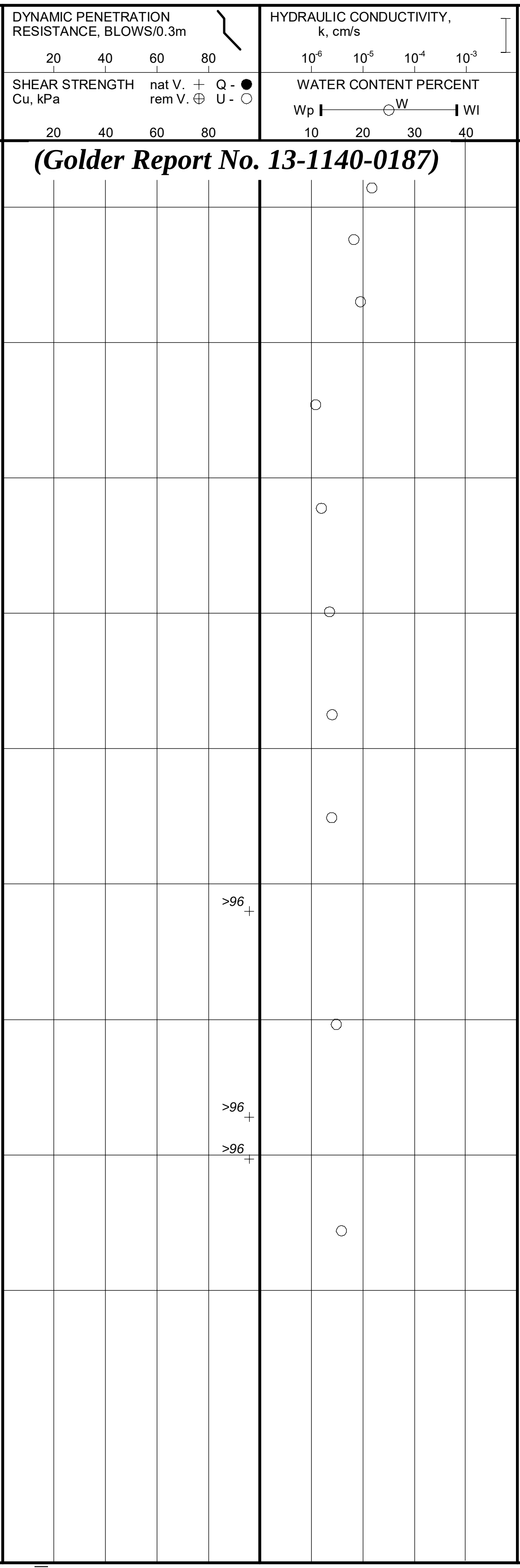
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.29 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist to wet	186.99 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, oxidized fissures, **(TILL)**; cohesive, w>PL, stiff to firm	185.92 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and partings, oxidized fissures, **(TILL)**; cohesive, w<PL, very stiff	184.39 2.90
(ML) sandy **CLAYEY SILT**, trace gravel; grey, **(TILL)**; cohesive, w<PL, very stiff	183.78 3.51
(CL) sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures, **(TILL)**; cohesive, w>PL, very stiff to firm	179.21 8.08
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	11
3	SS	5
4	SS	19
5	SS	22
6	SS	15
7	SS	9
8	SS	9
9	SS	6
10	SS	6



ELEVATION: 187, 186, 185, 184, 183, 182, 181, 180, 179

ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 186.7m during drilling on February 18, 2014.

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-208

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

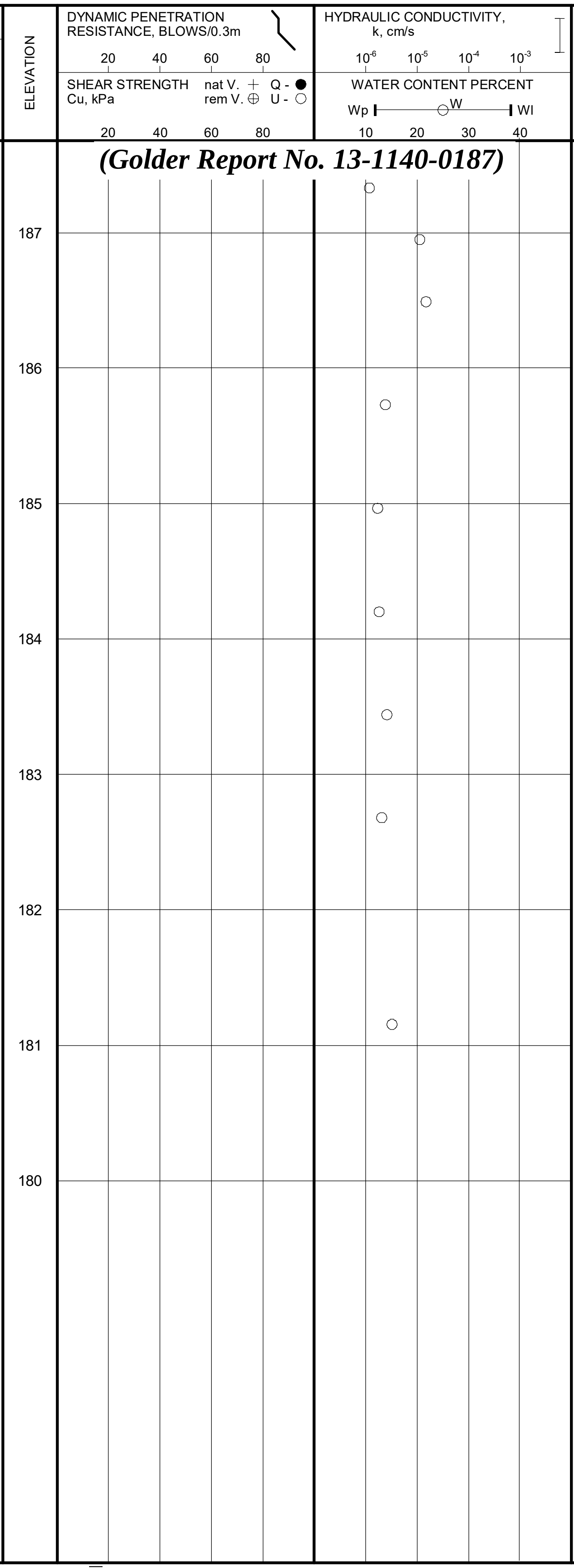
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	187.48 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist	187.18 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w>PL, very stiff to firm	186.11 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and layers, oxidized fissures, **(TILL)**; cohesive, w~PL to w<PL, very stiff	183.82 3.66
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w>PL, stiff to firm	180.93 6.55
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	17
3	SS	7
4	SS	18
5	SS	22
6	SS	18
7	SS	12
8	SS	11
9	SS	7



INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 186.7m during drilling on February 18, 2014.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187-2000.GPJ GLDR_LON.GDT 25/02/14 DATA INPUT: DMB

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-209

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0		GROUND SURFACE	187.60 0.00
	POWER AUGER 83mm ID HOLLOW STEM	**TOPSOIL** - (ML) sandy CLAYEY SILT; brown; moist	187.32 0.28
1		(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w>PL, very stiff to stiff	186.23 1.37
2–3		(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets and layers, oxidized fissures, **(TILL)**; cohesive, w<PL, very stiff	183.94 3.66
4–6		(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w>PL, stiff to firm	181.05 6.55
		END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	21
3	SS	9
4	SS	15
5	SS	22
6	SS	23
7	SS	10
8	SS	9
9	SS	7

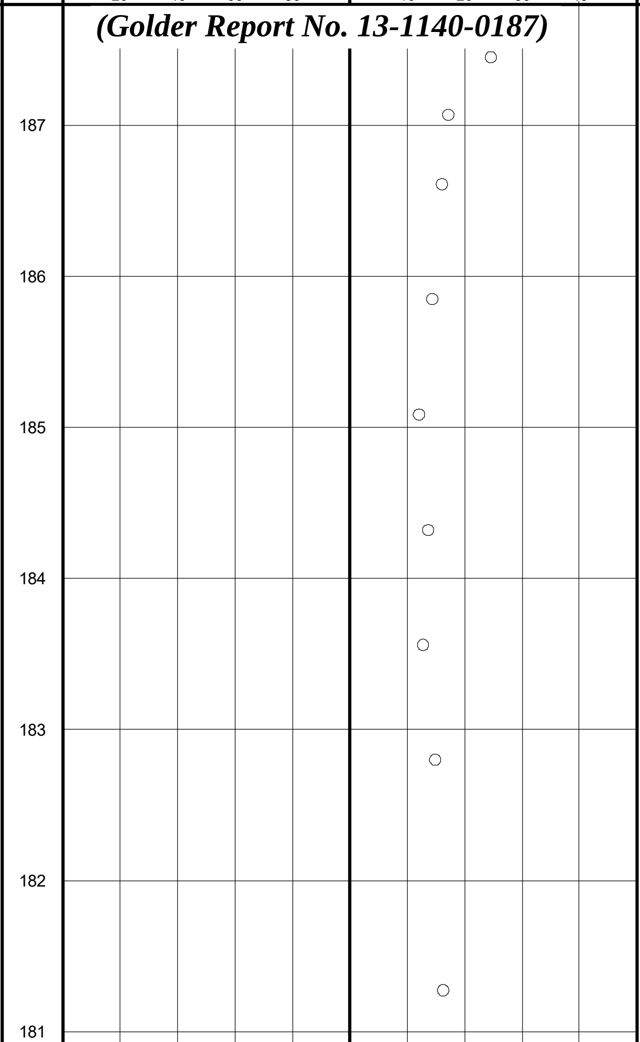
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING



INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 187.0m during drilling on February 18, 2014.

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

LDN_BHS_07 1311400187-2000.GPJ GLDR_LON.GDT 25/02/14 DATA INPUT: DMB

PROJECT: 13-1140-0187 (2000)

RECORD OF BOREHOLE BH-210

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 18, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

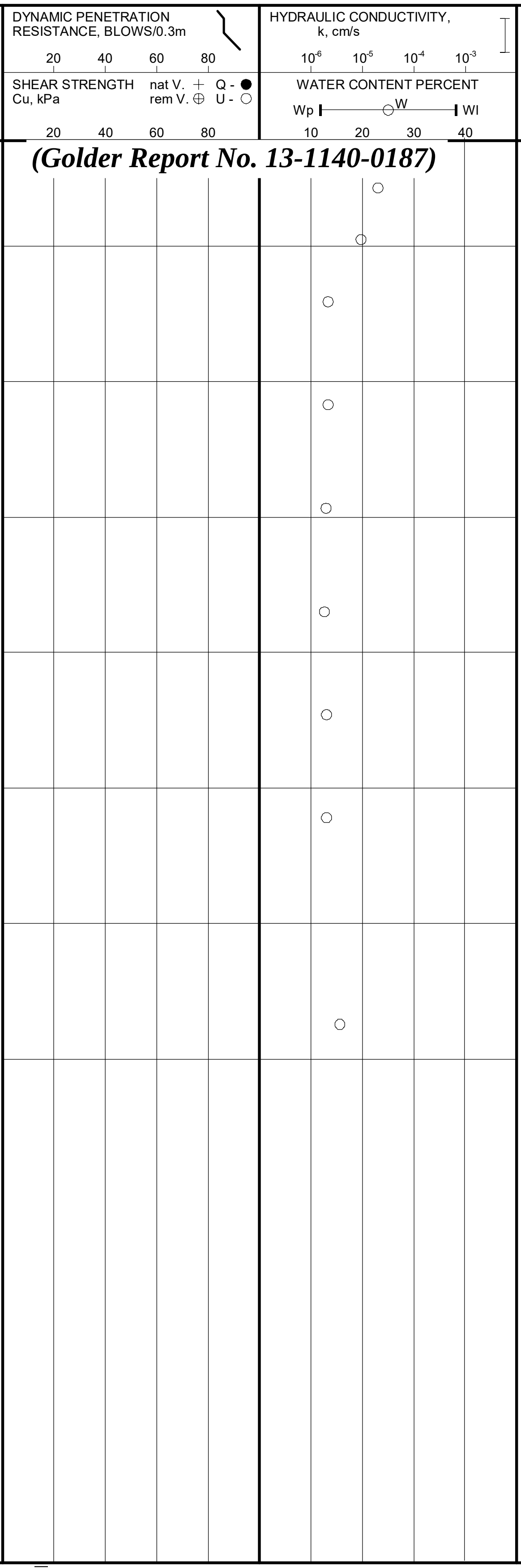
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 13-1140-0187)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	187.58 0.00
TOPSOIL - (ML) sandy CLAYEY SILT; brown; moist	187.28 0.30
(ML) sandy **CLAYEY SILT**, trace gravel; mottled brown and grey, with cobbles, **(TILL)**; cohesive, w>PL, very stiff	186.21 1.37
(ML) sandy **CLAYEY SILT**, trace gravel; brown, with sand pockets, **(TILL)**; cohesive, w<PL, very stiff	184.68 2.90
(CL) sandy **SILTY CLAY**, trace gravel; grey, with sand pockets, **(TILL)**; cohesive, w>PL, very stiff to firm	181.03 6.55
END OF BOREHOLE	

SAMPLE NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	58
3	SS	15
4	SS	15
5	SS	20
6	SS	15
7	SS	11
8	SS	10
9	SS	6



INSTALLATION AND GROUNDWATER OBSERVATIONS:

Borehole dry upon completion of drilling on February 18, 2014.

Ground frozen to about elev. 187.0m during drilling on February 18, 2014.

DEPTH SCALE 1 : 50

LOGGED: SM

CHECKED:

Golder Associates

PROJECT: 14-1140-0005

RECORD OF BOREHOLE BH-101

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: February 04, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

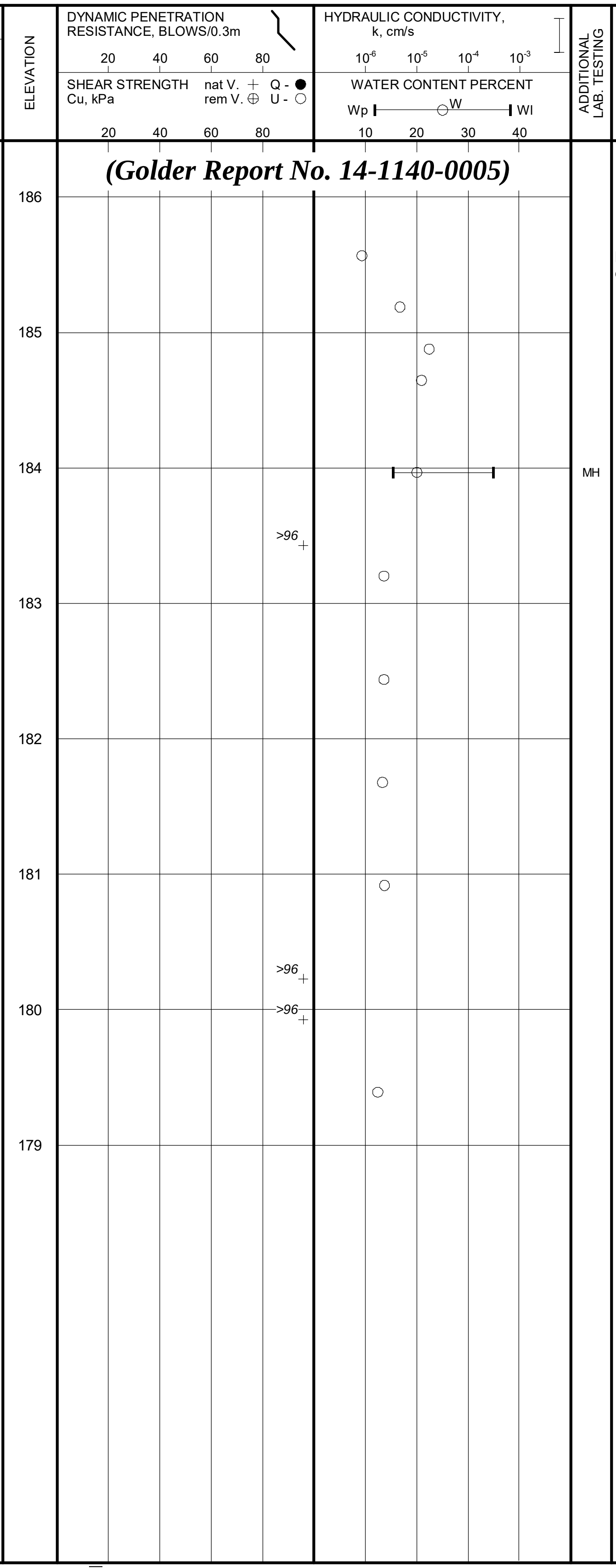
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 14-1140-0005)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

DESCRIPTION	ELEV. DEPTH (m)
PAVEMENT SURFACE	185.72
ASPHALT	0.00
FILL - (GW) SAND and GRAVEL, sub-angular; grey, **(ROADBASE)**; non-cohesive, dry	0.10
FILL - (CL) sandy SILTY CLAY, some gravel; brown, with topsoil and sand pockets; cohesive, w<PL, very stiff	185.29 0.43
TOPSOIL - (CL) SILTY CLAY; brown to black; cohesive, w<PL	184.96 0.76
(CL) **SILTY CLAY and SAND**, trace gravel; mottled brown and grey, with sand layers, **(TILL)**; cohesive, w>PL, stiff to firm	0.91
(CL) sandy **SILTY CLAY**, some gravel; brown, oxidized, **(TILL)**; cohesive, w<PL, very stiff	183.59 2.13
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff to stiff	182.06 3.66
END OF BOREHOLE	179.17 6.55

NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	28
3	SS	8
4	SS	4
5	SS	19
6	SS	23
7	SS	16
8	SS	11
9	SS	8



INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on February 4, 2014.

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

DEPTH SCALE

1 : 50

LOGGED: LS

CHECKED:

LDN_BHS_02 1411400005.GPJ 13/02/14 DATA INPUT: DMB

PROJECT: 1403551

RECORD OF BOREHOLE BH-101

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 25, 2014

DATUM: GEODETIC

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

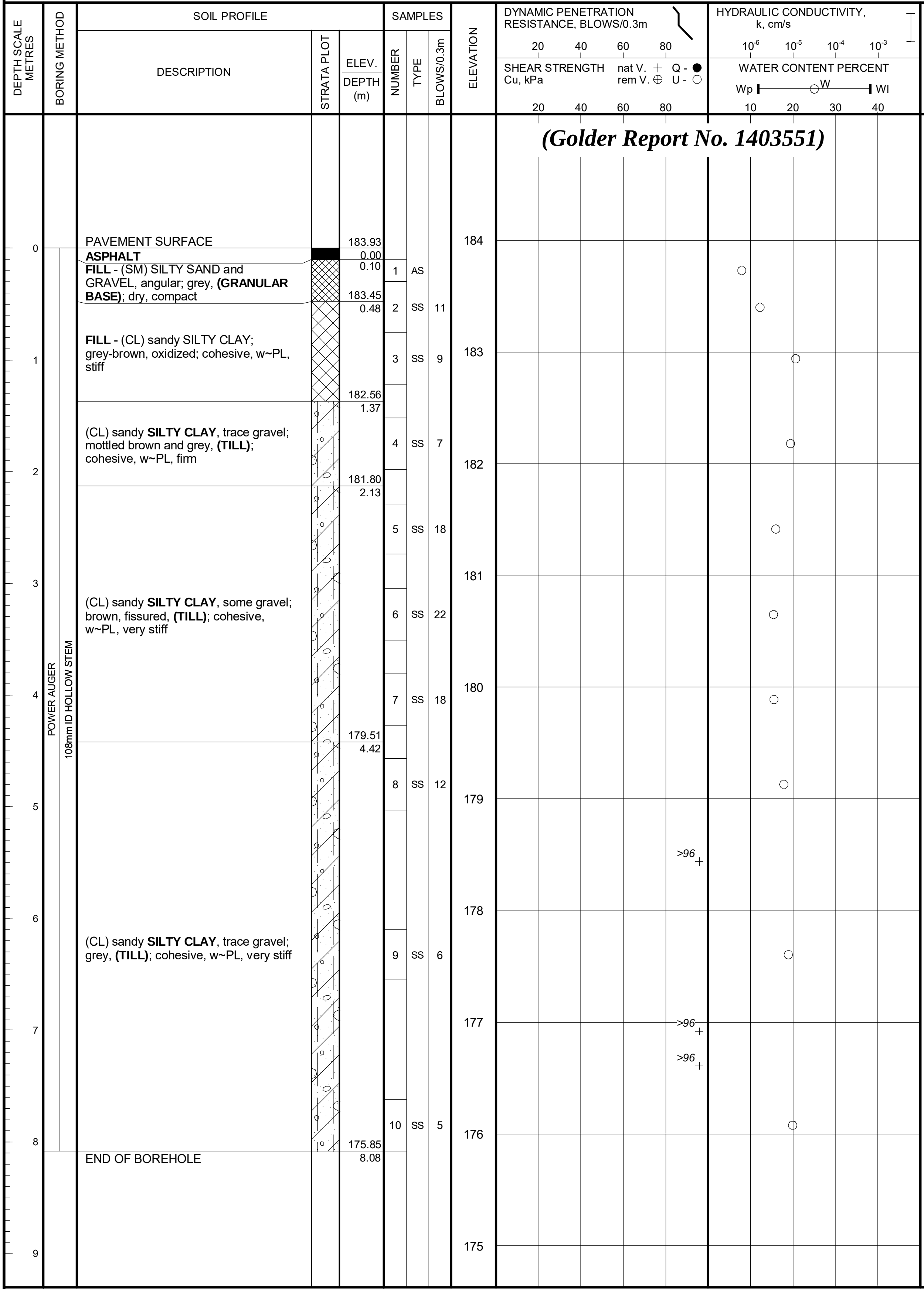
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1403551)

BORING METHOD: POWER AUGER
108mm ID HOLLOW STEM

DESCRIPTION	ELEV. DEPTH (m)
PAVEMENT SURFACE	183.93
ASPHALT	0.00
FILL - (SM) SILTY SAND and GRAVEL, angular; grey, **(GRANULAR BASE)**; dry, compact	0.10
FILL - (CL) sandy SILTY CLAY; grey-brown, oxidized; cohesive, w~PL, stiff	183.45 0.48
(CL) sandy **SILTY CLAY**, trace gravel; mottled brown and grey, **(TILL)**; cohesive, w~PL, firm	182.56 1.37
(CL) sandy **SILTY CLAY**, some gravel; brown, fissured, **(TILL)**; cohesive, w~PL, very stiff	181.80 2.13
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff	179.51 4.42
END OF BOREHOLE	175.85 8.08

NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	11
3	SS	9
4	SS	7
5	SS	18
6	SS	22
7	SS	18
8	SS	12
9	SS	6
10	SS	5



INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on April 25, 2014.

DEPTH SCALE

1 : 50

LOGGED: LS

CHECKED: *BG*

PROJECT: 1411749

RECORD OF BOREHOLE BH-101

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

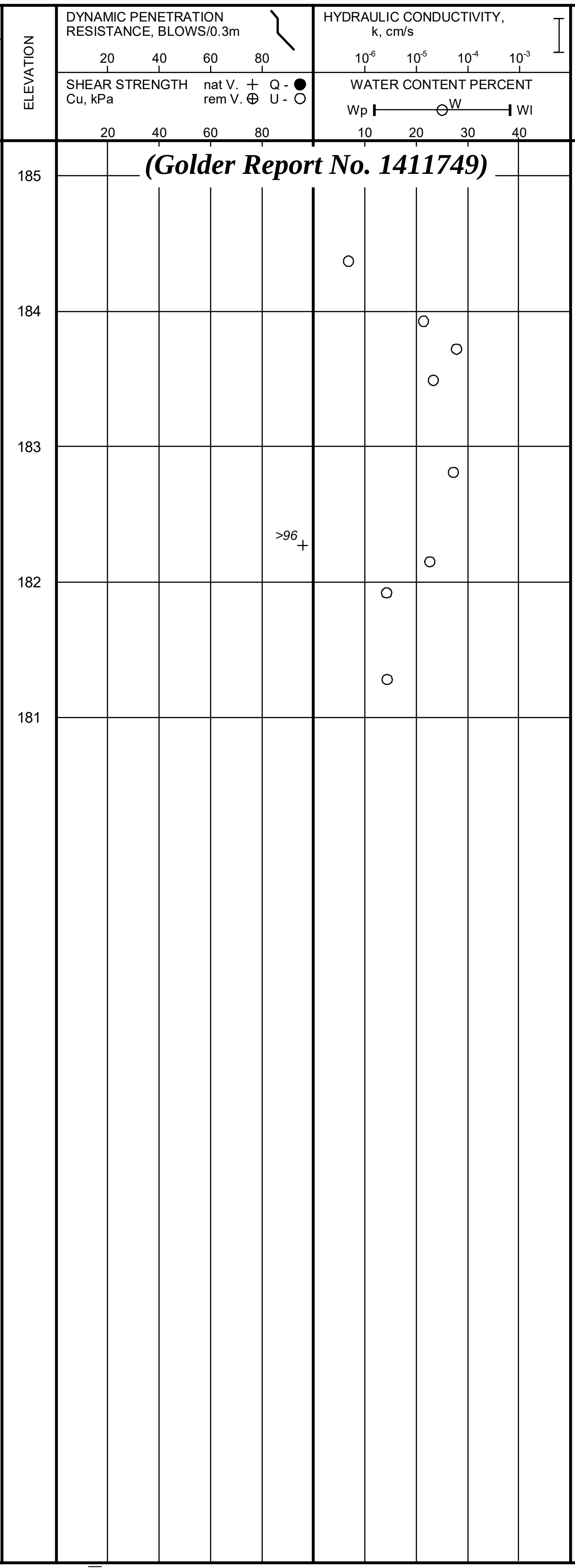
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

BORING METHOD: POWER AUGER
83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROAD SURFACE	184.56
ASPHALT	0.00
FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	0.08
FILL - (CL) sandy SILTY CLAY, trace gravel; dark brown, trace organics; cohesive, w~PL, stiff	184.05 0.51
(CI) sandy **SILTY CLAY**; mottled brown and grey, organic pockets, **(TILL)**; cohesive, w>PL, firm to very stiff	183.65 0.91
(ML) **SILT**, some sand, trace plastic fines; brown, oxidized; non-cohesive, moist, compact	182.02 2.54
(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, silt partings, **(TILL)**; cohesive, w<PL, very stiff	181.66 2.90
END OF BOREHOLE	181.05 3.51

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	9
3	SS	7
4	SS	4
5	SS	13
6	SS	28



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Borehole dry upon completion of drilling on September 23, 2014.

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

LDN_BHS_02 1411749.GPJ 09/10/14 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 1411749

RECORD OF BOREHOLE BH-102

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

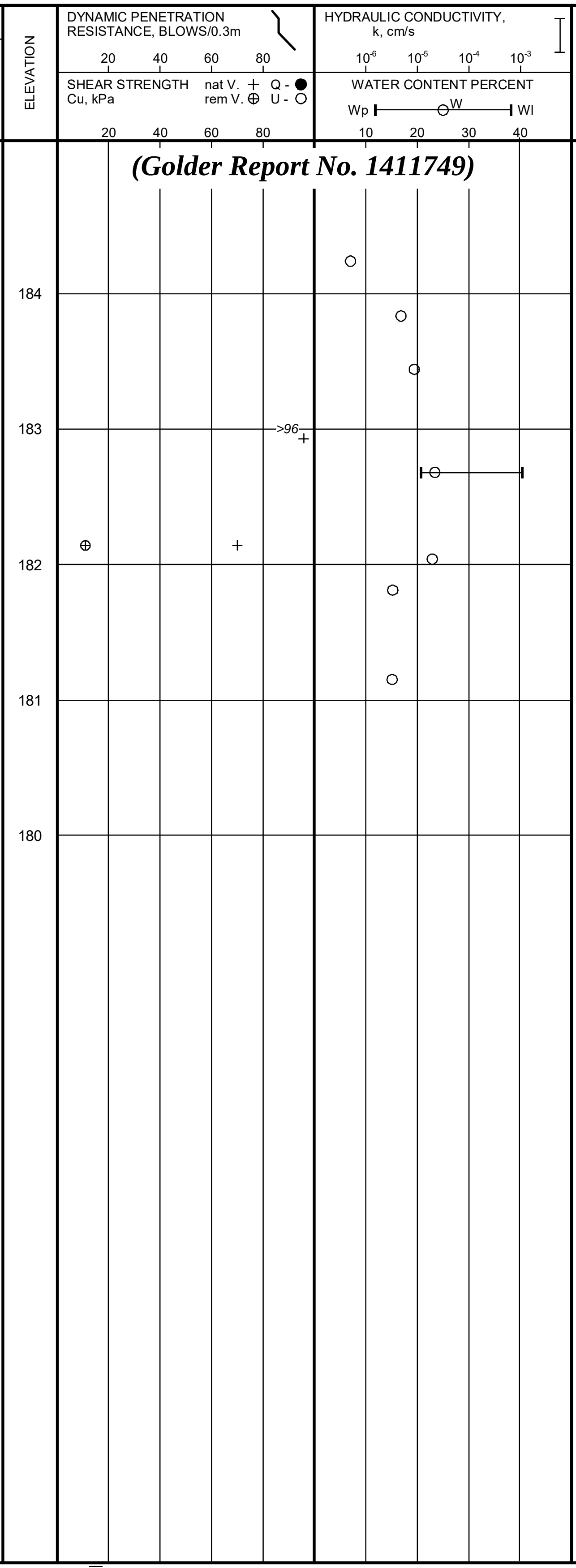
DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
POWER AUGER 83mm ID HOLLOW STEM	ROAD SURFACE	184.43					
	ASPHALT	0.00					
	FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	0.08	1	AS			
	FILL - (CL) sandy SILTY CLAY, trace gravel; dark brown/grey; cohesive, w~PL, stiff	184.00 0.43	2	SS	11		
	(CI) sandy **SILTY CLAY**; mottled brown and grey, organics in upper 150mm, **(TILL)**; cohesive, w>PL, stiff to very stiff	183.67 0.76	3	SS	7		
			4	SS	5	MH	
	(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, silt partings, **(TILL)**; cohesive, w<PL, stiff to very stiff	181.94 2.49	5	SS	13		Seepage ▽
			6	SS	19		
	END OF BOREHOLE	180.92 3.51					



Minor groundwater seepage encountered at about elev. 182.0m during drilling on September 23, 2014.

Borehole dry upon completion of drilling on September 23, 2014.

LDN_BHS_02 1411749.GPJ 09/10/14 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: LS
CHECKED:

PROJECT: 1411749

RECORD OF AUGER HOLE AH-103

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

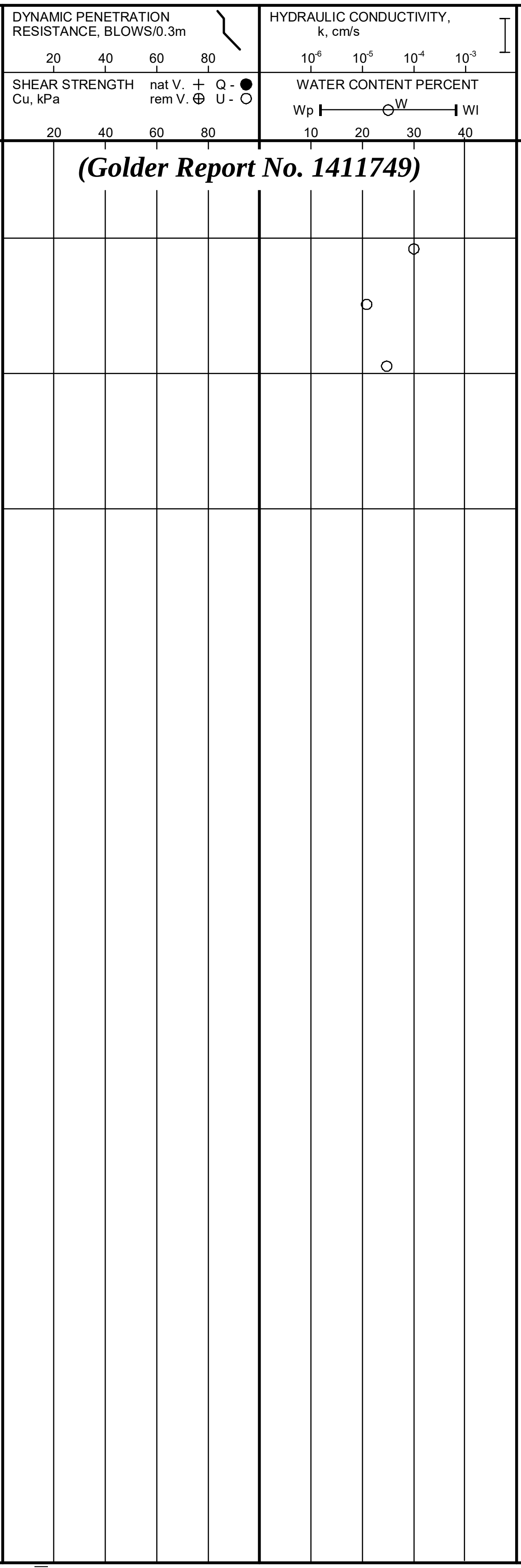
DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	184.02						
0	MANUAL DRILLING UNCASED	**TOPSOIL** - (CL) SILTY CLAY; brown; cohesive, w~PL	0.00	1	AS		184		Augerhole dry upon completion of drilling on September 24, 2014.
		(CI) sandy **SILTY CLAY**; mottled brown and grey, **(TILL)**; cohesive, w~PL	183.77 0.25	2	AS				
1				3	AS		183		
		END OF AUGERHOLE	182.80 1.22						
2							182		
3									
4									
5									
6									
7									
8									
9									



DEPTH SCALE

1 : 50

LOGGED: LS/SG

CHECKED:

LDN_BHS_02 1411749.GPJ 09/10/14 DATA INPUT: DMB

PROJECT: 1411749

RECORD OF BOREHOLE BH-104

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

DATUM: NOT SURVEYED

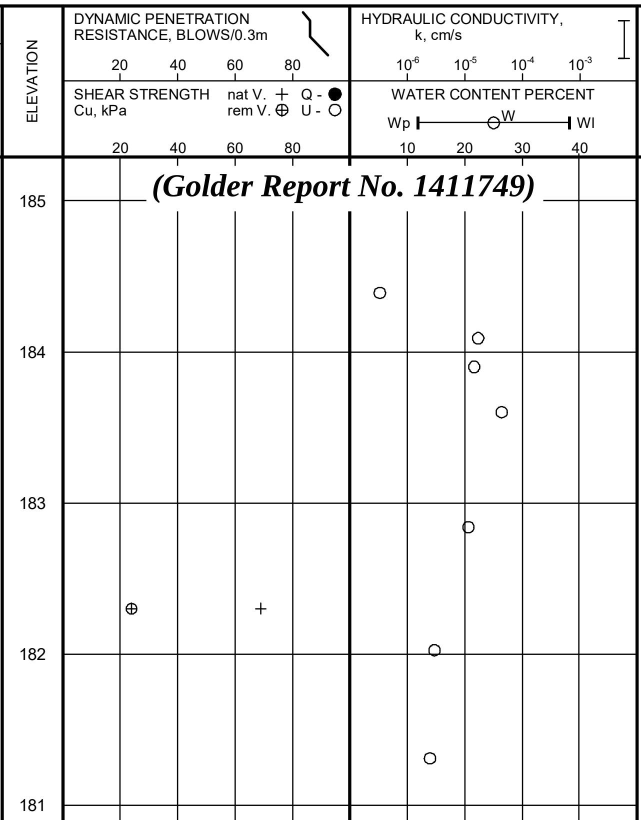
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		ROAD SURFACE	184.59			
0	POWER AUGER 83mm ID HOLLOW STEM	**ASPHALT**	0.00			
		FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	0.10 184.21	1	AS	
		FILL - (CL) sandy SILTY CLAY, trace gravel; dark grey, trace organics; cohesive, w~PL, firm	0.38 183.98 0.61	2	SS	7
1		(CI) sandy **SILTY CLAY**; mottled brown and grey, organic pockets, **(TILL)**; cohesive, w>PL, firm to stiff		3	SS	7
2			182.20 2.39	4	SS	5
3		(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, silt partings, **(TILL)**; cohesive, w<PL, stiff to very stiff		5	SS	14
			181.08 3.51	6	SS	24
		END OF BOREHOLE				

Depth scale continues 4, 5, 6, 7, 8, 9.



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Seepage ∇

Minor groundwater seepage encountered at about elev. 182.2m during drilling on September 23, 2014.

Borehole dry upon completion of drilling on September 23, 2014.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: LS
CHECKED:

PROJECT: 1411749

RECORD OF AUGER HOLE AH-105

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

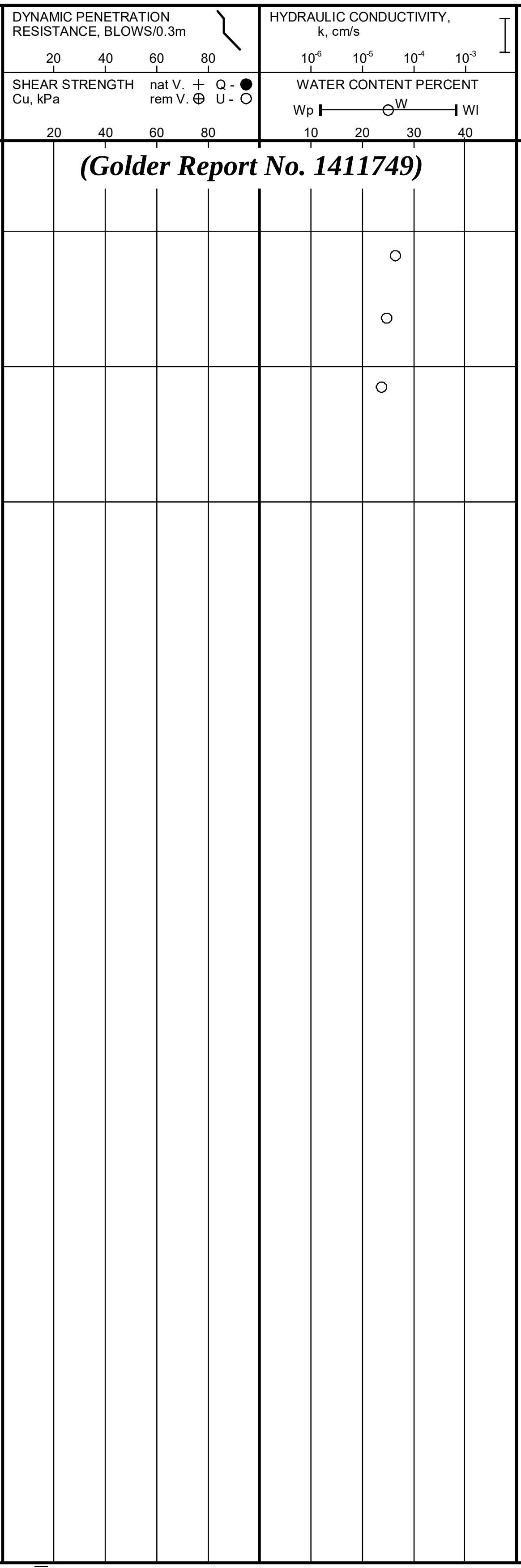
DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		183.97						
0	MANUAL DRILLING UNCASED	**TOPSOIL** - (CL) SILTY CLAY; brown; cohesive, w~PL		0.00	1	AS		184		Augerhole dry upon completion of drilling on September 24, 2014.
		(CI) sandy **SILTY CLAY**; mottled brown and grey, **(TILL)**; cohesive, w~PL		183.72 0.25	2	AS				
1				182.75	3	AS		183		
		END OF AUGERHOLE		1.22						
2								182		
3										
4										
5										
6										
7										
8										
9										



DEPTH SCALE
1 : 50

LOGGED: LS/SG
CHECKED:

PROJECT: 1411749

RECORD OF BOREHOLE BH-106

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

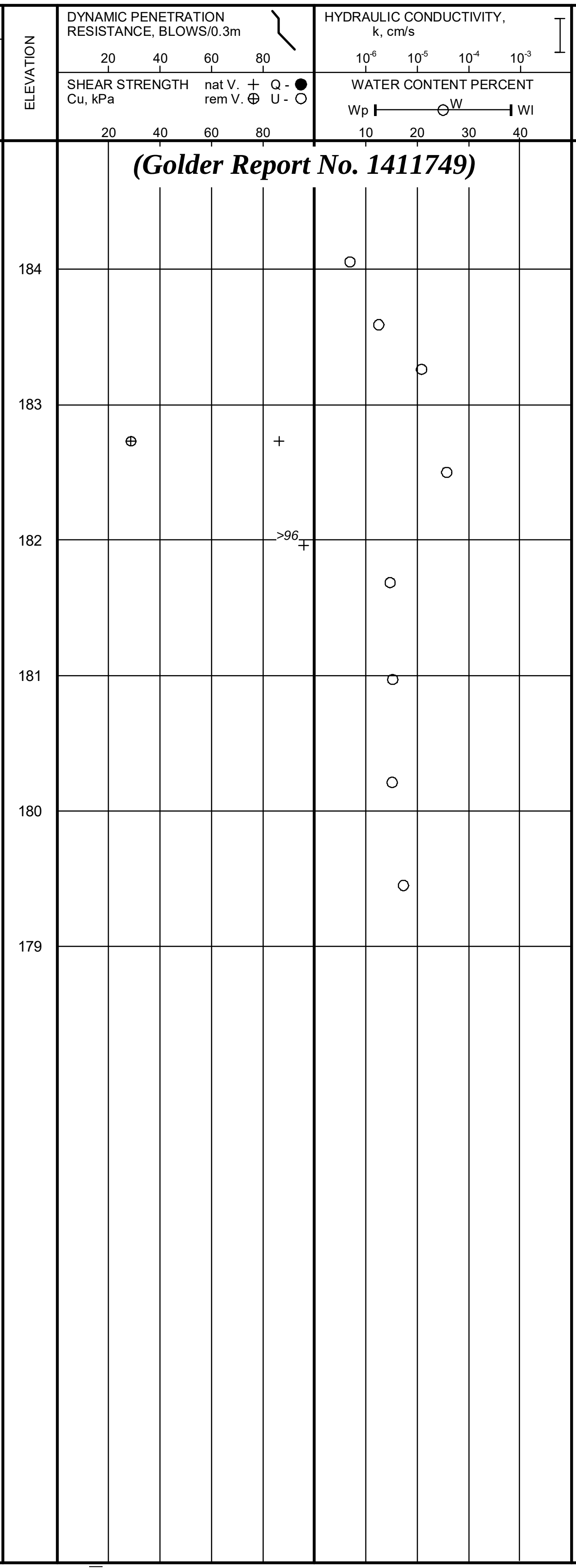
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

BORING METHOD: POWER AUGER 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROAD SURFACE	184.25
ASPHALT	0.00
FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	0.09
FILL - (CL) sandy SILTY CLAY, trace gravel; dark brown/grey, trace organics; cohesive, w~PL, stiff	183.69 0.56
(CI) sandy **SILTY CLAY**; mottled brown and grey, organic pockets, **(TILL)**; cohesive, w>PL, stiff to very stiff	183.49 0.76
(CL) sandy **SILTY CLAY**, trace gravel; brown, silt partings, **(TILL)**; cohesive, w<PL, stiff to very stiff	182.12 2.13
(CL) sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; cohesive, w~PL, very stiff to stiff	180.29 3.96
END OF BOREHOLE	179.22 5.03

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	10
3	SS	6
4	SS	5
5	SS	14
6	SS	25
7	SS	18
8	SS	9



INSTALLATION AND GROUNDWATER OBSERVATIONS

Seepage ▽

Minor groundwater seepage encountered at about elev. 182.8m during drilling on September 23, 2014.

Borehole dry upon completion of drilling on September 23, 2014.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 1411749

RECORD OF BOREHOLE BH-107

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

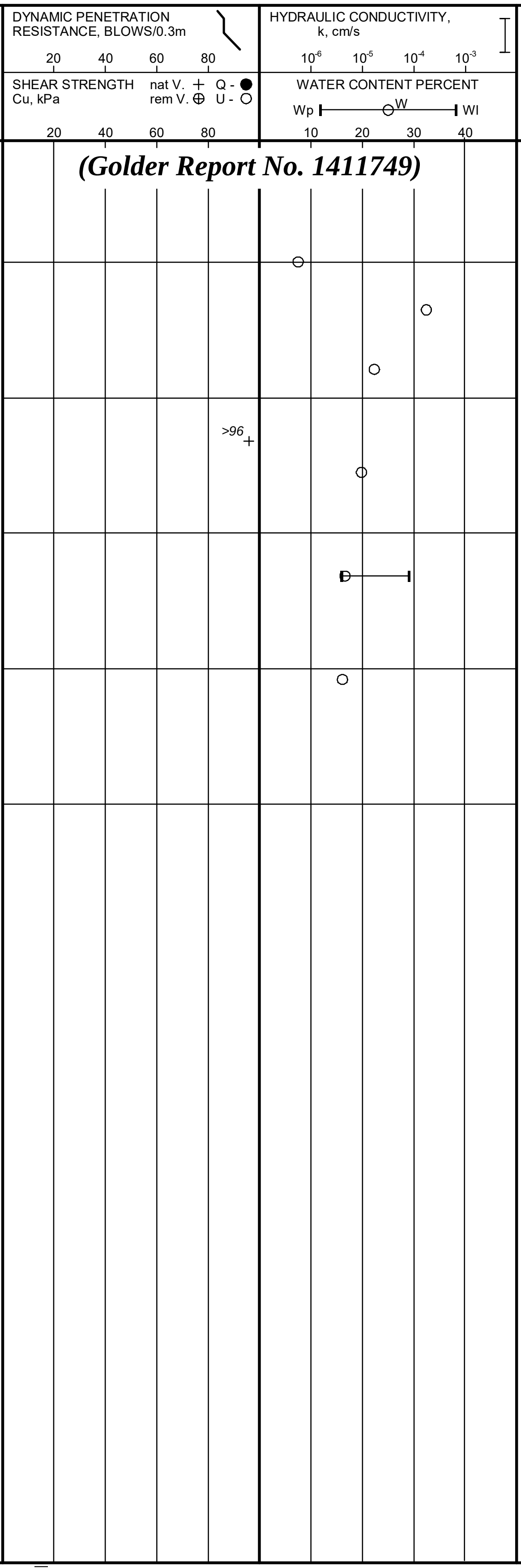
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
ROAD SURFACE	184.20	0.00
ASPHALT		0.09
FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	183.79	0.41
FILL - (CL) sandy SILTY CLAY, trace gravel; dark grey, trace organics; cohesive, w~PL, stiff	183.51	0.69
(CI) sandy **SILTY CLAY**; mottled brown and grey, **(TILL)**; cohesive, w>PL, firm to very stiff	182.07	2.13
(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, **(TILL)**; cohesive, w<PL, very stiff	180.69	3.51
END OF BOREHOLE		

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SS	10	
3	SS	6	
4	SS	7	
5	SS	18	MH
6	SS	18	



INSTALLATION AND GROUNDWATER OBSERVATIONS

Seepage ∇

Minor groundwater seepage encountered at about elev. 181.8m during drilling on September 23, 2014.

Borehole dry upon completion of drilling on September 23, 2014.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: LS
CHECKED:

LDN_BHS_02 1411749.GPJ 09/10/14 DATA INPUT: DMB

PROJECT: 1411749

RECORD OF AUGER HOLE AH-108

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

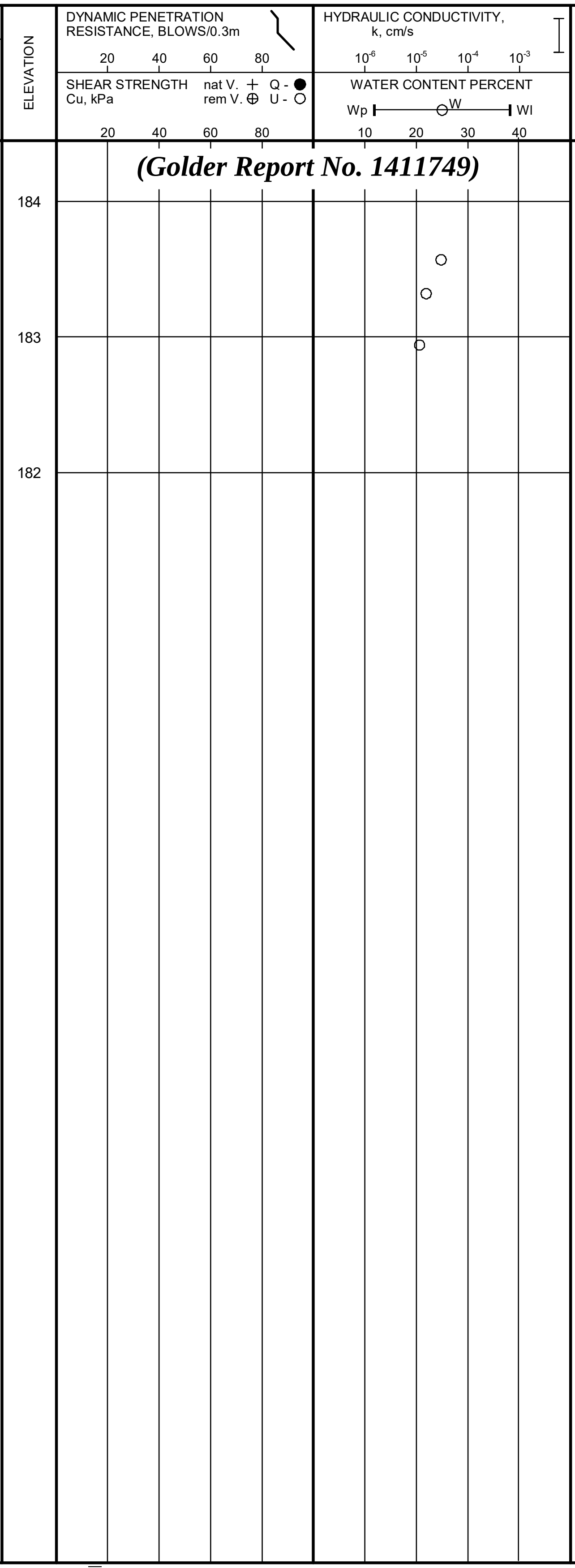
DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	183.75				
0	MANUAL DRILLING UNCASED	**TOPSOIL** - (CL) SILTY CLAY; brown; cohesive, w~PL	0.00	1	AS		Augerhole dry upon completion of drilling on September 24, 2014.
		(CI) sandy **SILTY CLAY**; mottled brown and grey, **(TILL)**; cohesive, w~PL	183.45 0.30	2	AS		
1				3	AS		
		END OF AUGERHOLE	182.53 1.22				



DEPTH SCALE

1 : 50

LOGGED: LS/SG

CHECKED:

LDN_BHS_02 1411749.GPJ 09/10/14 DATA INPUT: DMB

PROJECT: 1411749

RECORD OF BOREHOLE BH-109

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

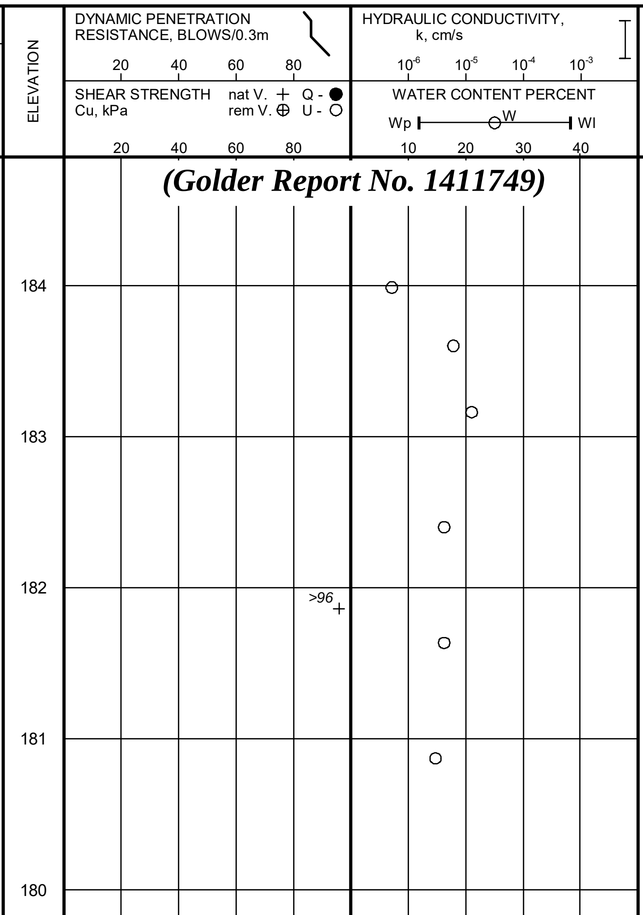
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
ROAD SURFACE	184.15
ASPHALT	0.00
FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	0.08
FILL - (CL) sandy SILTY CLAY, trace gravel; brown/grey, organic pockets; cohesive, w~PL, stiff	0.24
(CI) sandy **SILTY CLAY**; mottled brown and grey, topsoil nodules, **(TILL)**; cohesive, w>PL, firm to very stiff	183.39 0.76
(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, silt partings, with cobbles, **(TILL)**; cohesive, w<PL, stiff to very stiff	182.17 1.98
END OF BOREHOLE	180.64 3.51

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	AS	
2	SS	9
3	SS	7
4	SS	7
5	SS	12
6	SS	21



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS: Borehole dry upon completion of drilling on September 23, 2014.

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: LS

CHECKED:

PROJECT: 1411749

RECORD OF AUGER HOLE AH-110

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

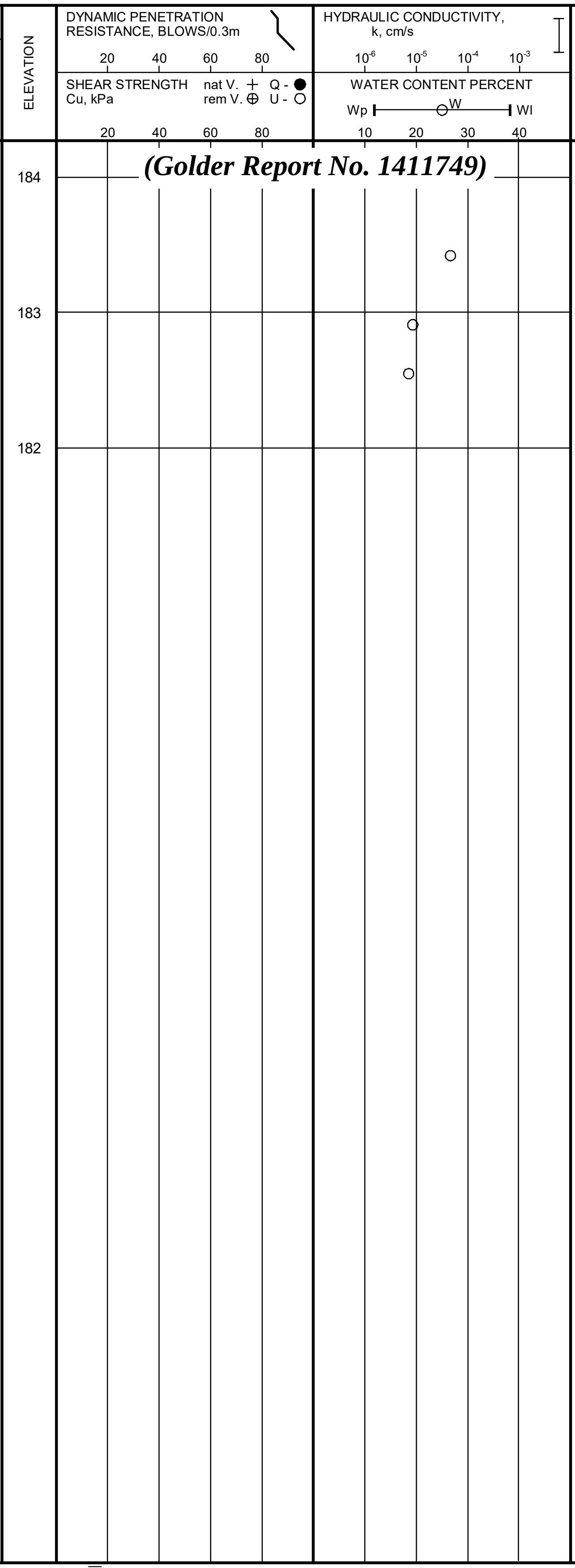
DATUM: NOT SURVEYED

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE		183.57					
0	MANUAL DRILLING UNCASED	**TOPSOIL** - (CL) SILTY CLAY; brown; cohesive, w~PL		0.00	1	AS			Augerhole dry upon completion of drilling on September 24, 2014.
		(CI) sandy **SILTY CLAY**; mottled brown and grey, **(TILL)**; cohesive, w~PL		183.24 0.33	2 3	AS AS			
1		END OF AUGERHOLE		182.35 1.22					



DEPTH SCALE

1 : 50

LOGGED: LS/SG

CHECKED:

PROJECT: 1411749

RECORD OF BOREHOLE BH-111

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: September 23, 2014

DATUM: NOT SURVEYED

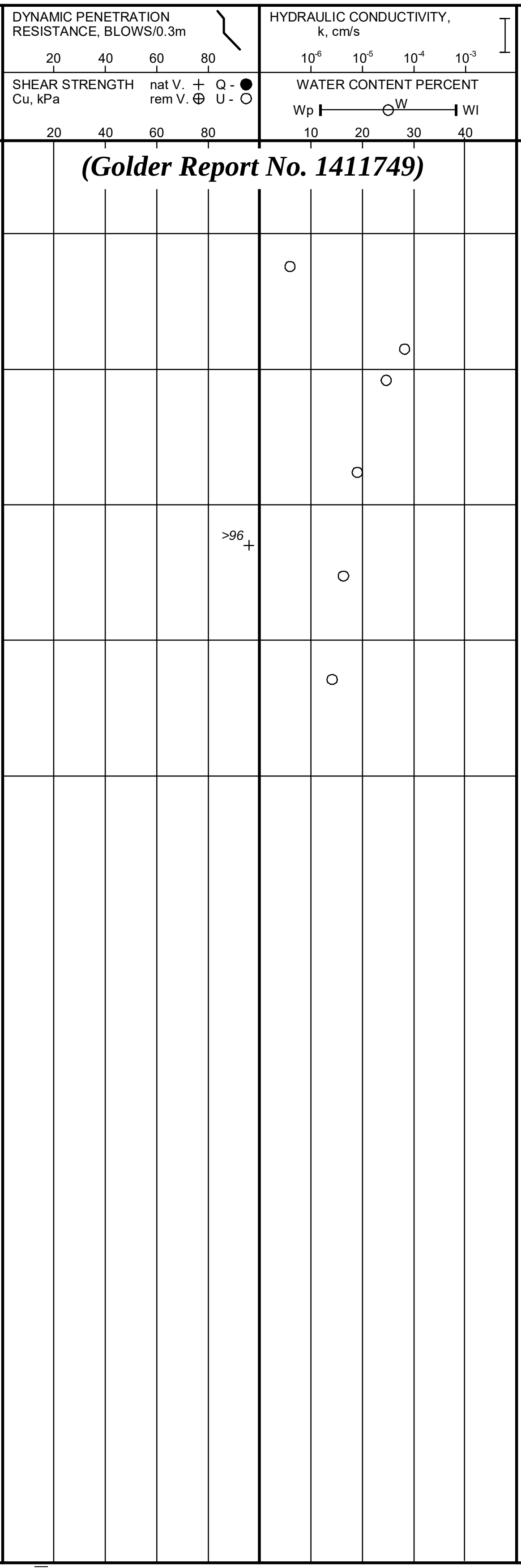
SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1411749)

BORING METHOD: POWER AUGER 83mm ID HOLLOW STEM

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION
	ROAD SURFACE	183.99				
0	**ASPHALT**	0.00 0.10				184
	FILL - (SM) SILTY SAND, some gravel, angular; grey, **(ROADBASE)**; dry	183.61 0.38	1	AS		
	TOPSOIL - (CL) SILTY CLAY, some sand; dark grey to black; cohesive, w>PL, stiff	183.08 0.91				
1	(CI) sandy **SILTY CLAY**; mottled brown and grey, organic pockets, rootlets, **(TILL)**; cohesive, w>PL, stiff to very stiff		2	SS	9	183
			3	SS	8	
2		181.86 2.13				182
	(CL) sandy **SILTY CLAY**, trace gravel; brown, fissured, silt partings, with cobbles, **(TILL)**; cohesive, w<PL, stiff to very stiff		4	SS	12	
3			5	SS	22	181
	END OF BOREHOLE	180.48 3.51				
4						180
5						
6						
7						
8						
9						



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Seepage ∇

Minor groundwater seepage encountered at about elev. 181.4m during drilling on September 23, 2014.

Borehole dry upon completion of drilling on September 23, 2014.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: LS
CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-101

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

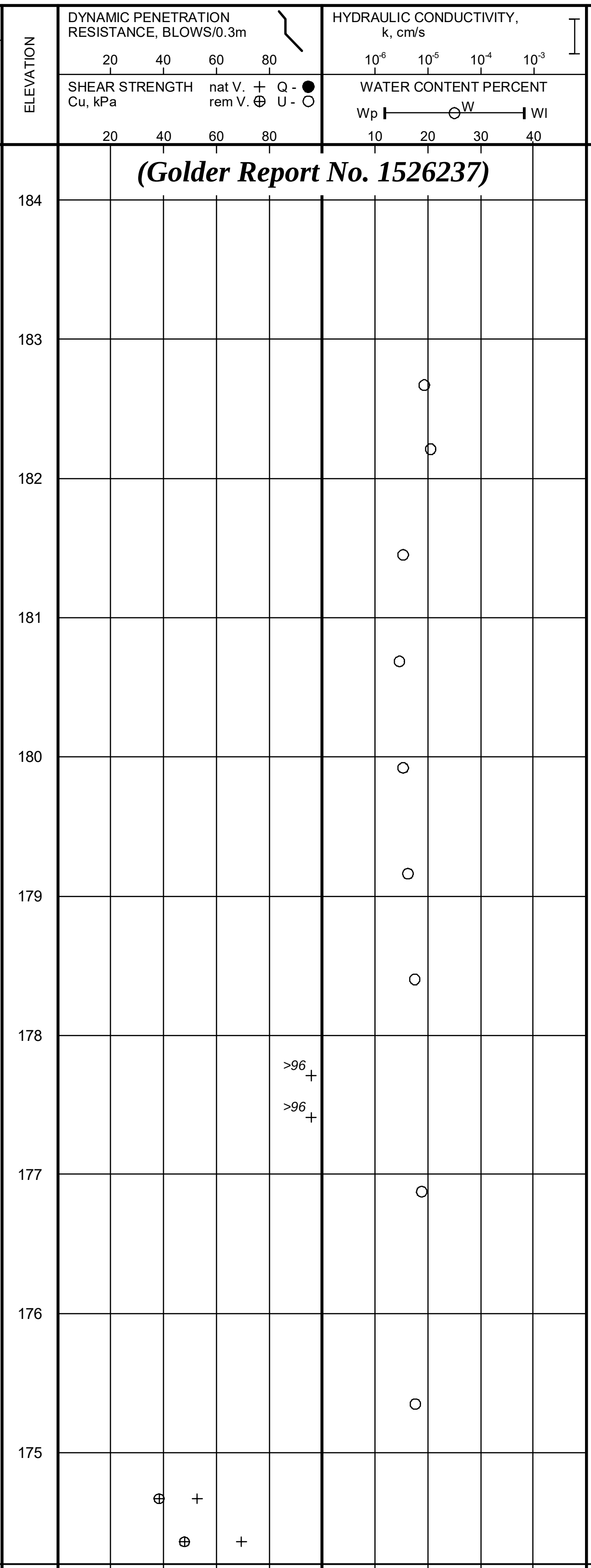
(Golder Report No. 1526237)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

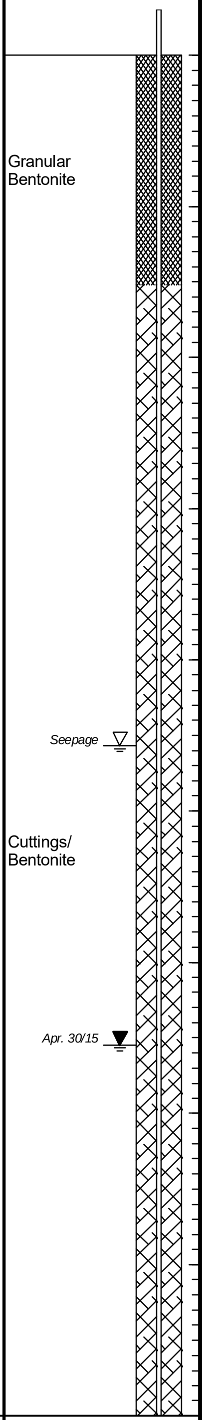
SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	183.20 0.00
TOPSOIL - sandy SILTY CLAY; brown	182.95 0.25
sandy **SILTY CLAY**, trace gravel; mottled brown and grey, trace organic pockets, **(TILL)**; firm to stiff	181.83 1.37
sandy **SILTY CLAY**, trace gravel; brown, oxidized fissures, **(TILL)**; very stiff	180.30 2.90
sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; very stiff to stiff	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	6
2	SS	8
3	SS	21
4	SS	25
5	SS	14
6	SS	11
7	SS	8
8	SS	9
9	SS	8

--- CONTINUED NEXT PAGE ---



INSTALLATION AND GROUNDWATER OBSERVATIONS



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-101

SHEET 2 OF 2

LOCATION: REFER TO LOCATION PLAN

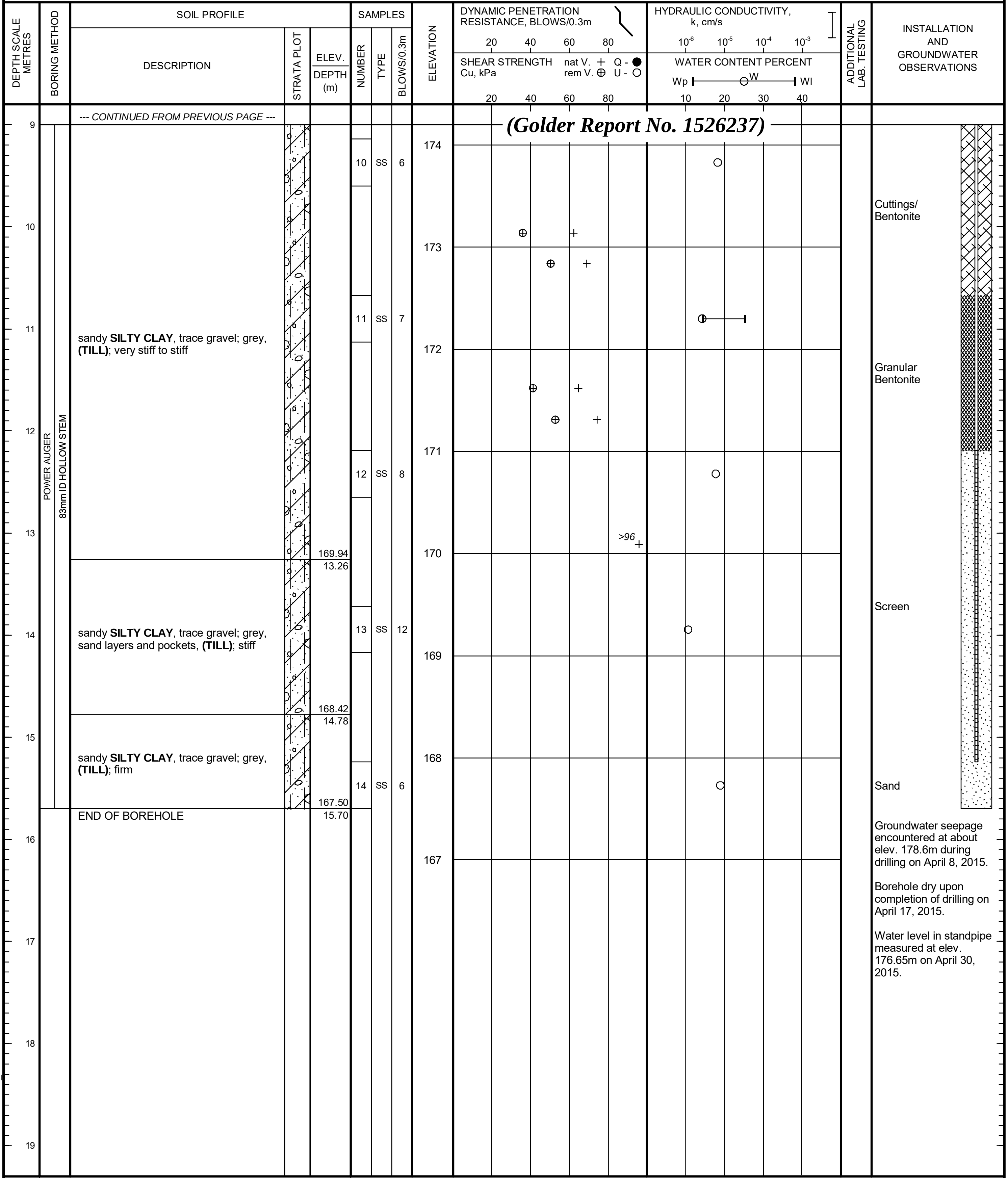
BORING DATE: April 8 and April 17, 2015

DATUM:

DRILLING CONTRACTOR: London Soil Test Ltd.

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm



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DESCRIPTION	ELEV. / DEPTH (m)
sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; very stiff to stiff	169.94 13.26
sandy **SILTY CLAY**, trace gravel; grey, sand layers and pockets, **(TILL)**; stiff	168.42 14.78
sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; firm	167.50 15.70
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/0.3m
10	SS	6
11	SS	7
12	SS	8
13	SS	12
14	SS	6

Cuttings/ Bentonite

Granular Bentonite

Screen

Sand

Groundwater seepage encountered at about elev. 178.6m during drilling on April 8, 2015.

Borehole dry upon completion of drilling on April 17, 2015.

Water level in standpipe measured at elev. 176.65m on April 30, 2015.

LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-102

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

DATUM:

DRILLING CONTRACTOR: London Soil Test Ltd.

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

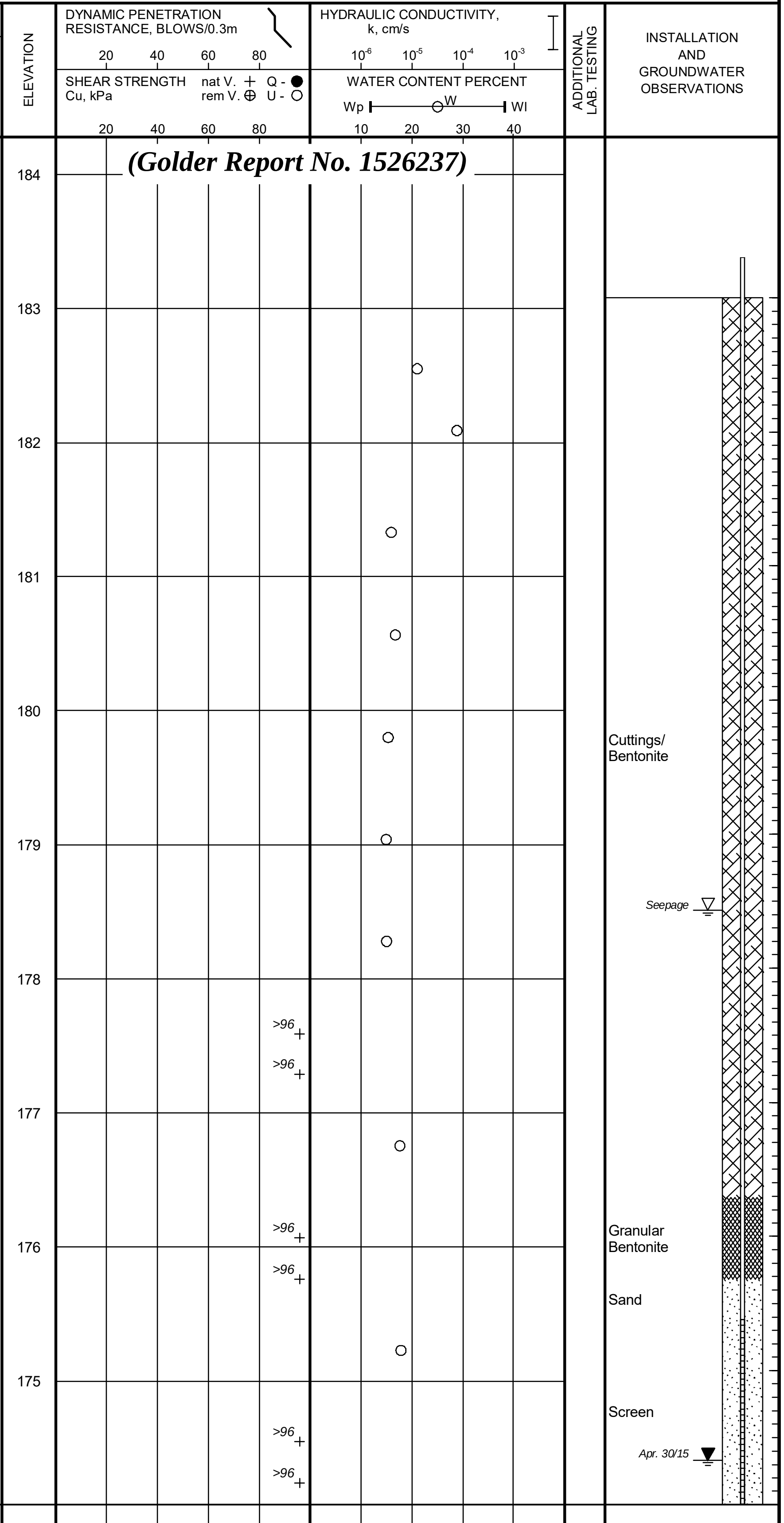
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1526237)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	183.08
0	**TOPSOIL** - sandy SILTY CLAY; brown	0.00
	sandy **SILTY CLAY**, trace gravel; mottled brown and grey, **(TILL)**; stiff to firm	182.78 0.30
1	sandy **SILTY CLAY**, trace gravel; brown, oxidized fissures, some silt partings and sand seams, **(TILL)**; very stiff	181.71 1.37
3	sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures in upper zone, **(TILL)**; very stiff to stiff	180.18 2.90
9	--- CONTINUED NEXT PAGE ---	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	8
2	SS	5
3	SS	19
4	SS	20
5	SS	14
6	SS	10
7	SS	11
8	SS	11
9	SS	9



LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM/LS

CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-102

SHEET 2 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m					
		--- CONTINUED FROM PREVIOUS PAGE ---										
9								174	(Golder Report No. 1526237)			Screen
		sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures in upper zone, **(TILL)**; very stiff to stiff		173.48 9.60	10	SS	12			○		Sand
		END OF BOREHOLE										Groundwater seepage encountered at about elev. 178.5m during drilling on April 8, 2015.
10								173				Borehole dry upon completion of drilling on April 17, 2015.
												Water level in standpipe measured at elev. 174.41m on April 30, 2015.
11												
12												
13												
14												
15												
16												
17												
18												
19												

LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM/LS
CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-103

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

DATUM:

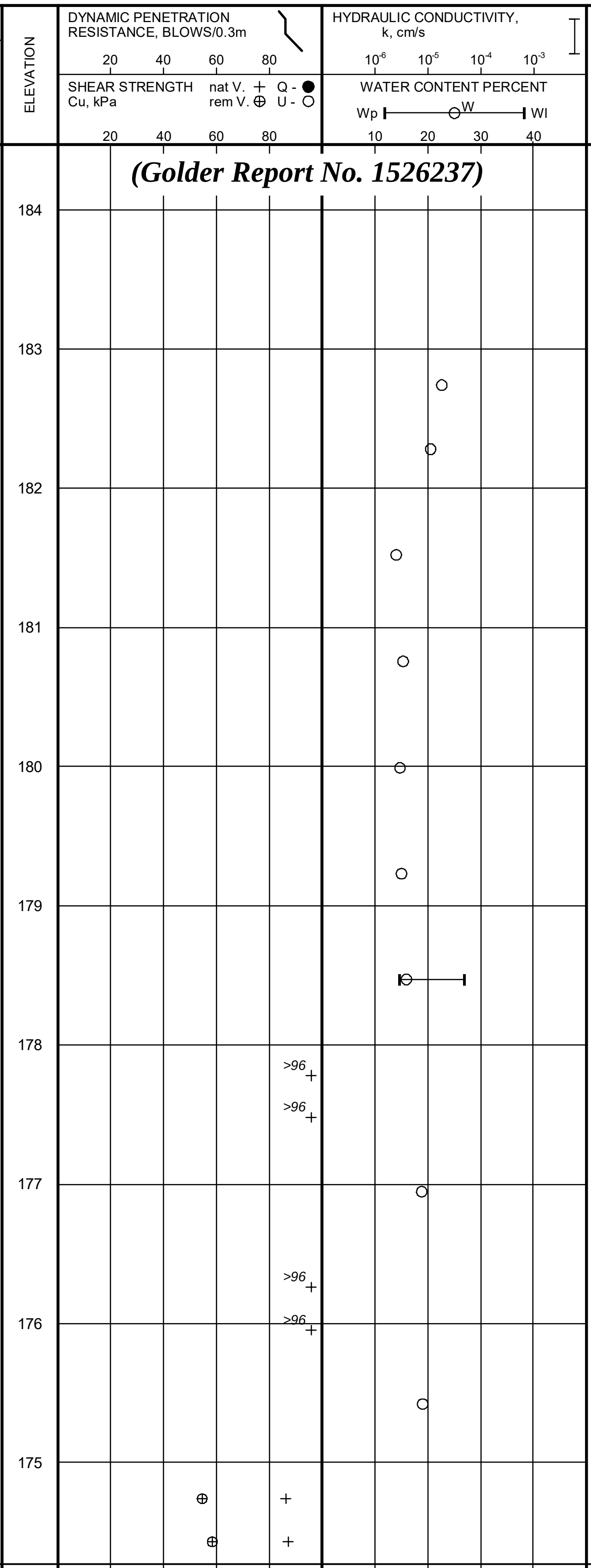
DRILLING CONTRACTOR: London Soil Test Ltd.

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1526237)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER 83mm ID HOLLOW STEM	GROUND SURFACE		183.27					
		TOPSOIL - sandy SILTY CLAY; brown		0.00					
		sandy **SILTY CLAY**, trace gravel; mottled brown and grey, **(TILL)**; firm to stiff		183.02 0.25	1	SS	7		Granular Bentonite
1					2	SS	9		
		sandy **SILTY CLAY**, trace gravel; brown, oxidized fissures, some silt partings, **(TILL)**; very stiff		181.90 1.37	3	SS	25		
2					4	SS	23		
3		sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures in upper zone, sand zones in last sample, **(TILL)**; very stiff to stiff		180.37 2.90	5	SS	15		
4					6	SS	13		
5					7	SS	10	MH	Cuttings/ Bentonite
6					8	SS	10		Seepage ▽
7									
8					9	SS	9		
9		--- CONTINUED NEXT PAGE ---							



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

PROJECT: 1526237

RECORD OF BOREHOLE BH-103

SHEET 2 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

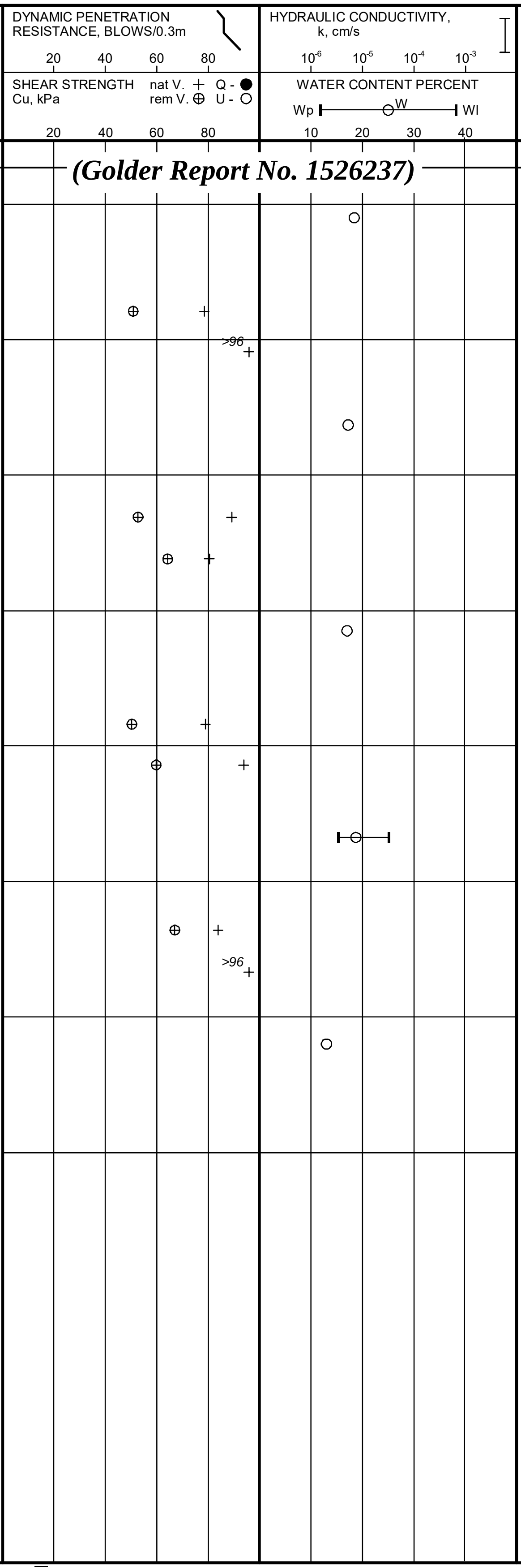
DRILLING CONTRACTOR: London Soil Test Ltd.

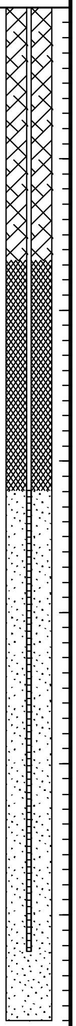
DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---								
9	POWER AUGER 83mm ID HOLLOW STEM	sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures in upper zone, sand zones in last sample, **(TILL)**; very stiff to stiff						174		
					10	SS	12			Cuttings/ Bentonite
10								173		
11					11	SS	8	172		Granular Bentonite
12					12	SS	6	171		
13								170		Screen
14					13	SS	6	169	MH	
15								168		
				167.57	14	SS	9			Sand
		END OF BOREHOLE		15.70						
16								167		Groundwater seepage encountered at about elev. 177.2m during drilling on April 8, 2015. Borehole dry upon completion of drilling on April 17, 2015. Standpipe dry on April 30, 2015.
17										
18										
19										





PROJECT: 1526237

RECORD OF BOREHOLE BH-104

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

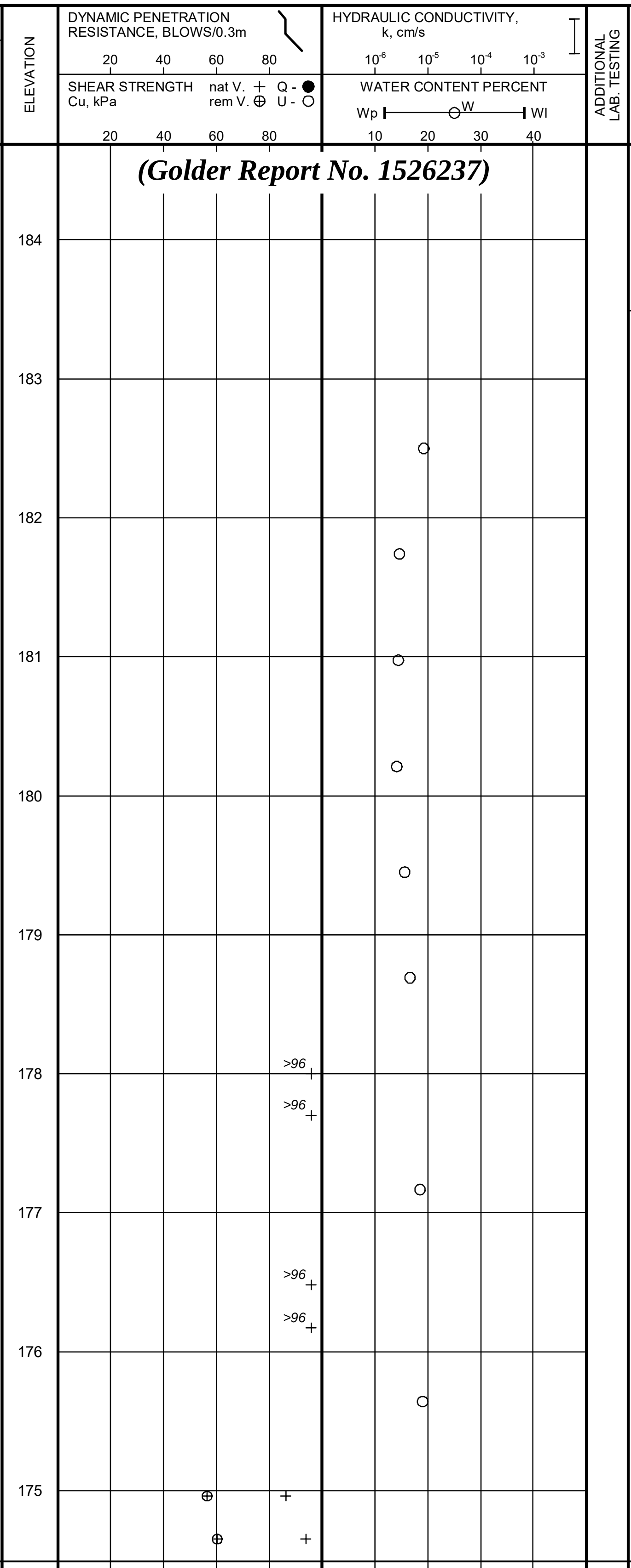
(Golder Report No. 1526237)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

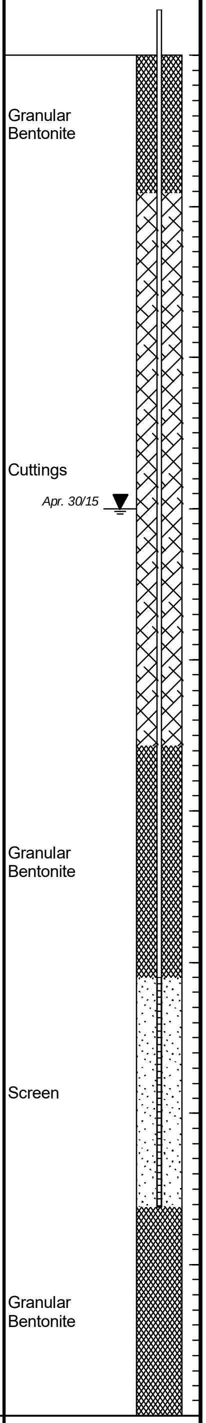
SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	183.49 0.00
TOPSOIL - sandy SILTY CLAY; brown	183.21 0.28
sandy **SILTY CLAY**, trace gravel; mottled brown and grey, **(TILL)**; very stiff	182.12 1.37
sandy **SILTY CLAY**, trace gravel; brown, oxidized fissures, **(TILL)**; very stiff	180.59 2.90
sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; very stiff to stiff	

--- CONTINUED NEXT PAGE ---

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	17
2	SS	22
3	SS	24
4	SS	17
5	SS	11
6	SS	10
7	SS	8
8	SS	10



INSTALLATION AND GROUNDWATER OBSERVATIONS



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-104

SHEET 2 OF 2

LOCATION: REFER TO LOCATION PLAN

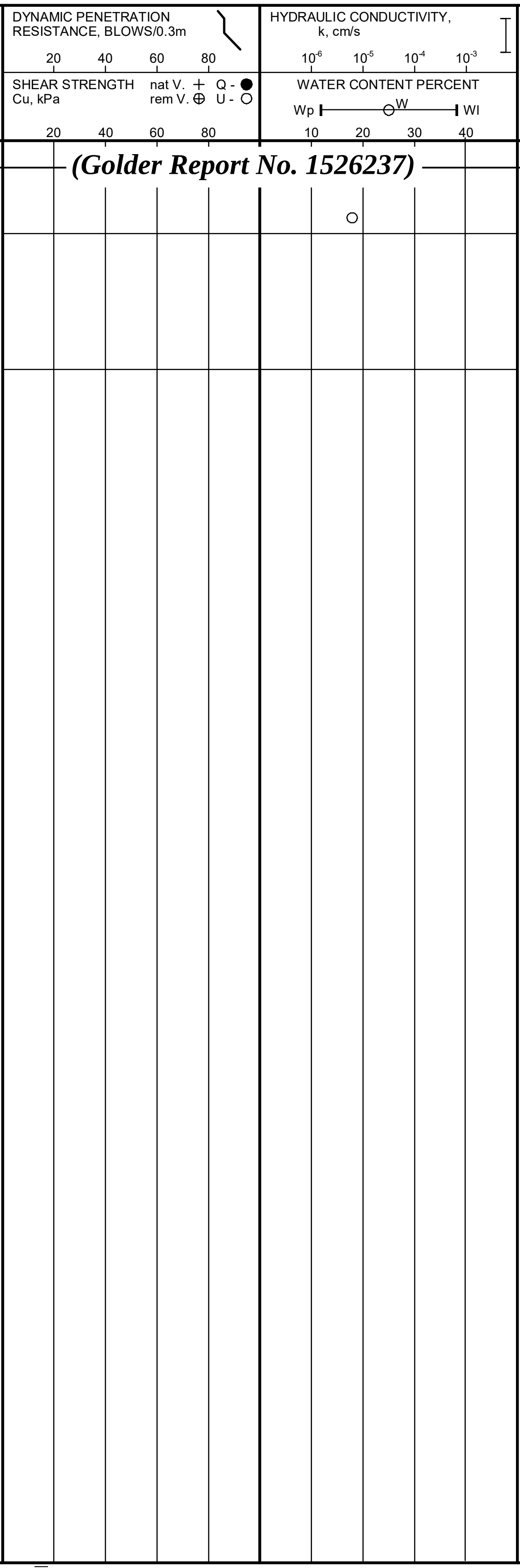
BORING DATE: April 8 and April 17, 2015
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---								
9		sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; very stiff to stiff		173.89 9.60	9	SS	11	174		Granular Bentonite
		END OF BOREHOLE								Borehole dry during and upon completion of drilling on April 8 and 17, 2015. Water level in standpipe measured at elev. 180.49m on April 30, 2015.
10								173		
11										
12										
13										
14										
15										
16										
17										
18										
19										



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-105

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

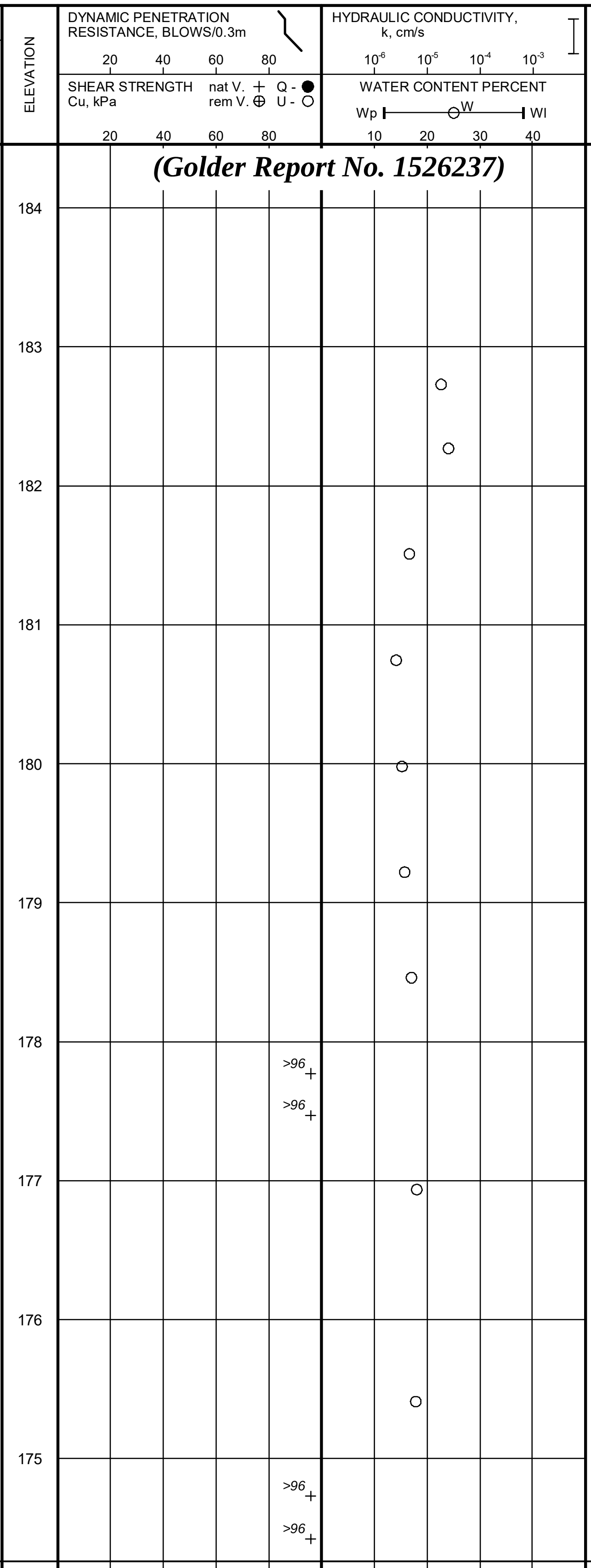
(Golder Report No. 1526237)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

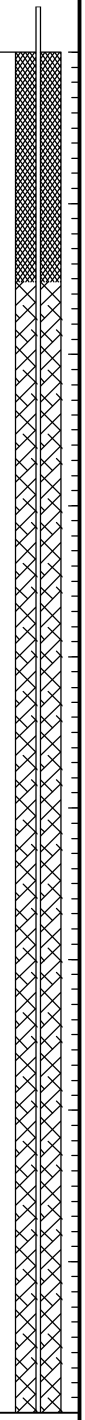
SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	183.26 0.00
TOPSOIL - sandy SILTY CLAY; brown	182.96 0.30
sandy **SILTY CLAY**, trace gravel; mottled brown and grey, trace organic pockets, **(TILL)**; firm to stiff	181.58 1.68
sandy **SILTY CLAY**, trace gravel; brown, oxidized fissures, some silt partings, **(TILL)**; very stiff to hard	180.36 2.90
sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures in upper zone, **(TILL)**; very stiff to stiff	

--- CONTINUED NEXT PAGE ---

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	10
3	SS	14
4	SS	36
5	SS	17
6	SS	11
7	SS	10
8	SS	8
9	SS	8



INSTALLATION AND GROUNDWATER OBSERVATIONS



Granular Bentonite

Cuttings/ Bentonite

LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SM

CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-105

SHEET 2 OF 2

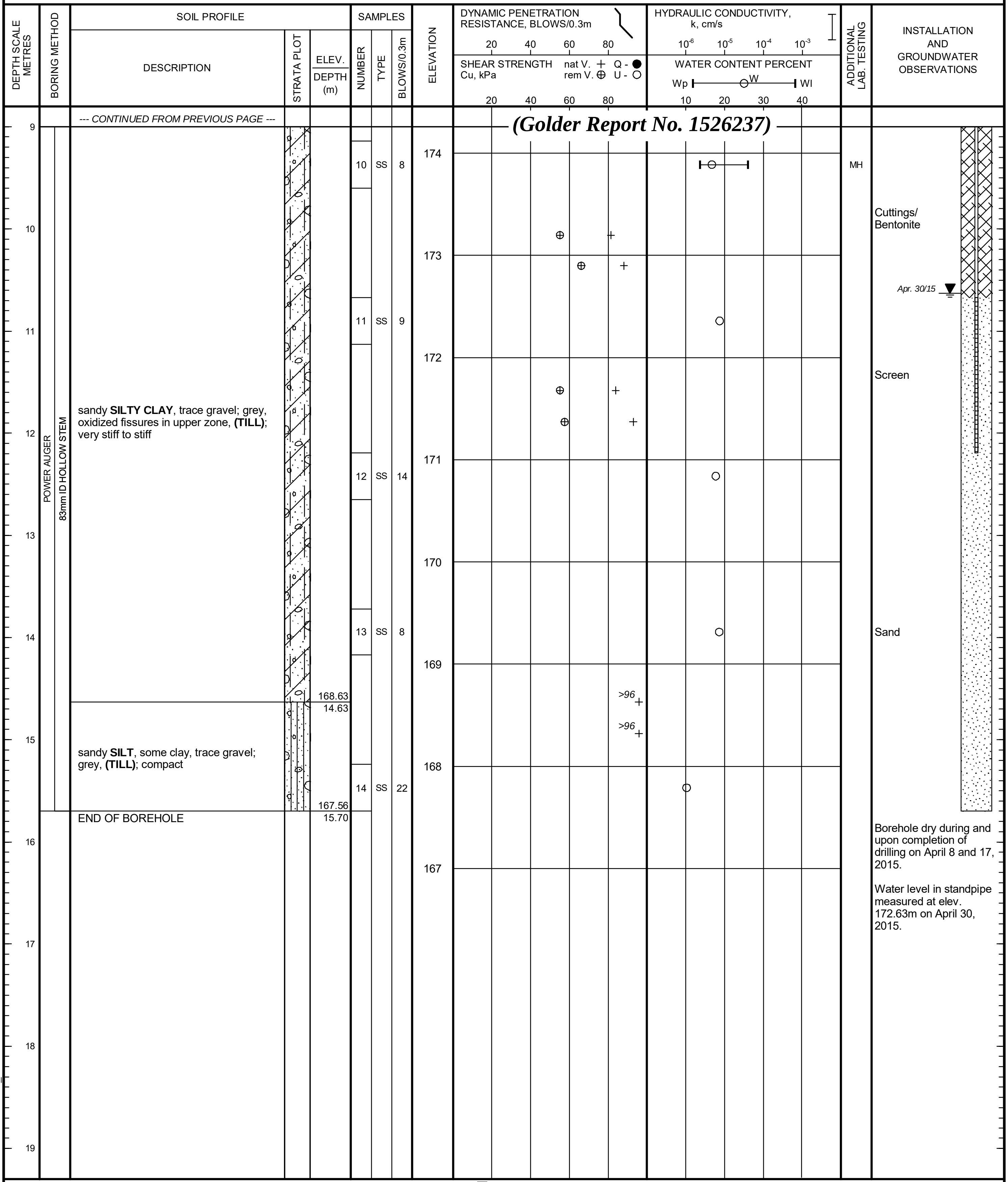
LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm



DESCRIPTION	ELEV. DEPTH (m)
sandy **SILTY CLAY**, trace gravel; grey, oxidized fissures in upper zone, **(TILL)**; very stiff to stiff	168.63 14.63
sandy **SILT**, some clay, trace gravel; grey, **(TILL)**; compact	167.56 15.70
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/0.3m
10	SS	8
11	SS	9
12	SS	14
13	SS	8
14	SS	22

Cuttings/
Bentonite

Screen

Sand

Borehole dry during and upon completion of drilling on April 8 and 17, 2015.

Water level in standpipe measured at elev. 172.63m on April 30, 2015.

LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-106

SHEET 1 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015

DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

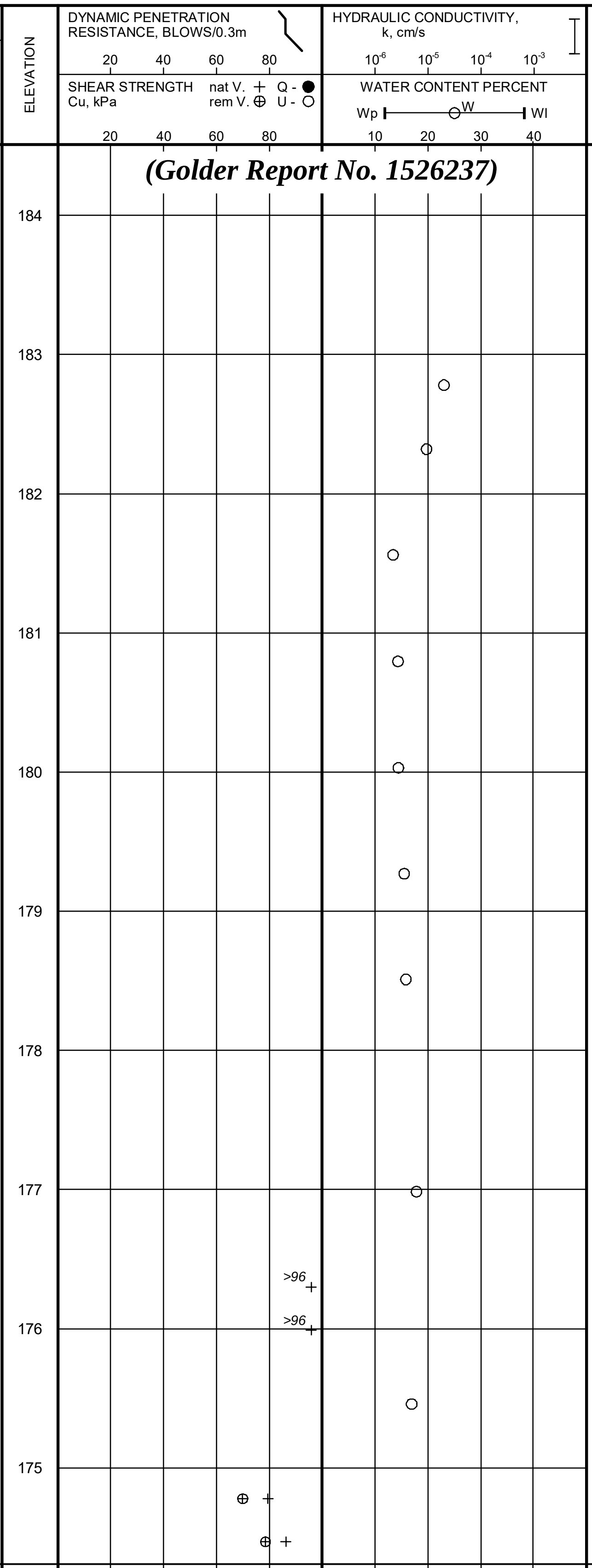
PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1526237)

BORING METHOD: POWER AUGER, 83mm ID HOLLOW STEM

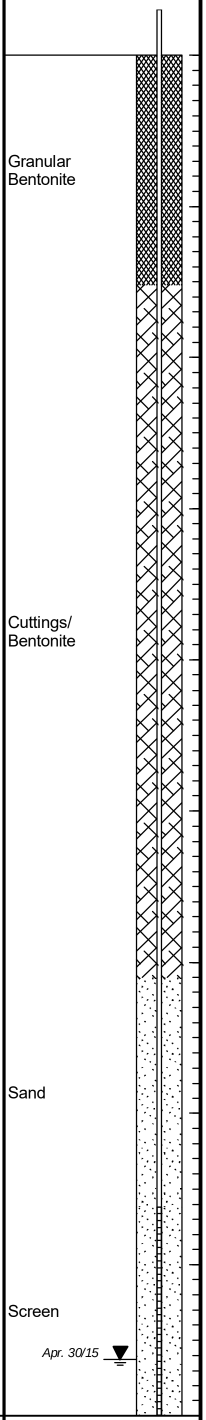
DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	183.31
TOPSOIL - sandy SILTY CLAY, trace gravel; brown	0.00
sandy **SILTY CLAY**, trace gravel; mottled brown and grey, trace organic pockets, **(TILL)**; firm to stiff	183.01 0.30
sandy **SILTY CLAY**, trace gravel; brown, oxidized fissures, **(TILL)**; very stiff to hard	181.94 1.37
sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; stiff	179.65 3.66

NUMBER	TYPE	BLOWS/0.3m
1	SS	8
2	SS	10
3	SS	26
4	SS	30
5	SS	23
6	SS	13
7	SS	11
8	SS	8
9	SS	7



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS



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DEPTH SCALE
1 : 50

LOGGED: SM
CHECKED:

PROJECT: 1526237

RECORD OF BOREHOLE BH-106

SHEET 2 OF 2

LOCATION: REFER TO LOCATION PLAN

BORING DATE: April 8 and April 17, 2015
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM:

SAMPLER HAMMER, 63.5 kg; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg; DROP, 760 mm

(Golder Report No. 1526237)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- *CONTINUED FROM PREVIOUS PAGE* ---										
9		sandy **SILTY CLAY**, trace gravel; grey, **(TILL)**; stiff		173.71 9.60	10	SS	8	174		○		Screen Sand
		END OF BOREHOLE										Borehole dry during and upon completion of drilling on April 8 and 17, 2015. Water level in standpipe measured at elev. 174.68m on April 30, 2015.
10								173				
11												
12												
13												
14												
15												
16												
17												
18												
19												

LDN_BHS_07 1526237.GPJ GLDR_LON.GDT 01/05/15 DATA INPUT: DMB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

PROJECT: 1658070

RECORD OF BOREHOLE BH-111

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

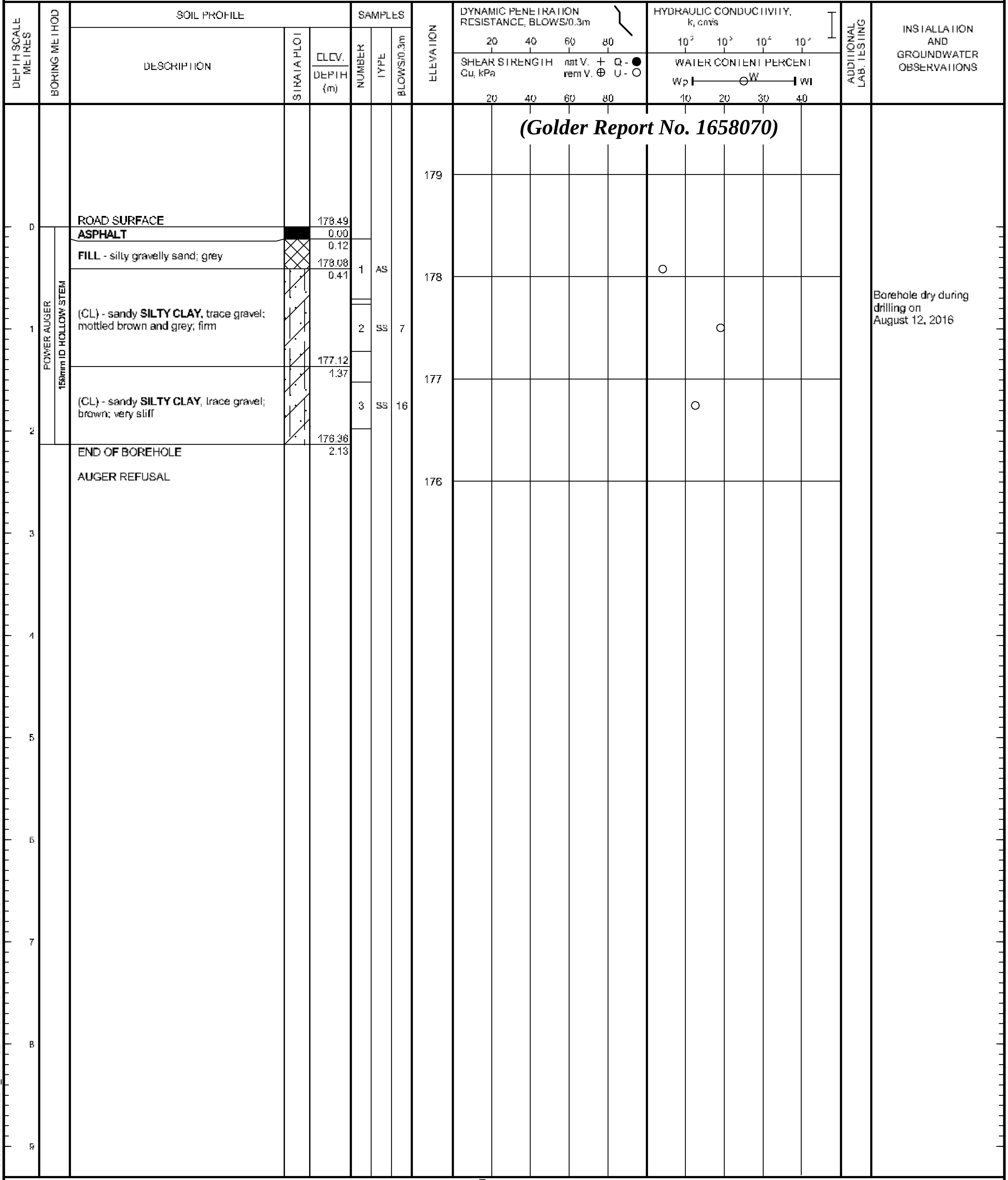
BORING DATE: August 12, 2016
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

(Golder Report No. 1658070)

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	INSTALLATION AND GROUNDWATER OBSERVATIONS
	ROAD SURFACE	178.49				
POWER AUGER 150mm ID HOLLOW STEM	**ASPHALT**	0.00				
	FILL - silty gravelly sand; grey	0.12				
		178.08 0.41	1	AS		
	(CL) - sandy **SILTY CLAY**, trace gravel; mottled brown and grey; firm		2	SS	7	Borehole dry during drilling on August 12, 2016
		177.12 1.37				
	(CL) - sandy **SILTY CLAY**, trace gravel; brown; very stiff		3	SS	16	
		176.36 2.13				
	END OF BOREHOLE AUGER REFUSAL					



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SM
CHECKED:

GOLDER

golder.com

Appendix F - 2

Little River Pollution Control Plan (LRPCP) Treatment Capacity Assessment

Memo

To: Patrick Winter, P.Eng., City of Windsor
Stacey McGuire, P.Eng., City of Windsor

From: Bram Bontje, P.Eng., Water Resources Engineering
Laura Herlehy, P.Eng., Project Coordinator

cc: Andrea Winter, P.Eng., Project Manager, Dillon Consulting Limited

Date: March 17, 2023

Subject: Sandwich South Master Servicing Plan
Little River Pollution Control Plant (LRPCP) – Capacity Assessment

Our File: 19-9817

As part of the Sandwich South Master Servicing Master Plan (SSMSP), a high-level review of available treatment capacity at the Little River Pollution Control Plant (LRPCP) has been completed. This review was conducted with the following objectives:

- Summarize current estimated loading to the LRPCP;
- Identify committed capacity through existing agreements (e.g. to the Town of Tecumseh);
- Identify projected flows associated with new developments within the SSMSP lands and the Town of Tecumseh, including future capacity reserved for the Town; and
- Identify the capacity available to the Sandwich South development area within the existing LRPCP capacity, and prior to reaching the 70% capacity threshold at which planning for facility expansion is required.

The analysis completed herein does not reflect the impacts to the treatment plant and or sanitary sewer system due to wet weather events. As part of the Environmental Assessment to be initiated for the expansion of the LRPCP, a separate analysis shall be undertaken that provide recommendations to manage extraneous flow.

1.1 Existing Flow Rates and LRPCP Rated Capacity

LRPCP has a current rated capacity of 72,800 m^3/d. Presently, the LRPCP operates with available reserve capacity with a 2020 annual average day flow rate of 44,783 m^3/d (61.5% rated capacity) and a dry month average flow rate of 38,600 m^3/d (53.0% rated capacity). Over an extended historical period of 2016 to 2018 (inclusive), in addition to the 2020 rates, the facility operated at an average daily flow rate of 43,896 m^3/d and a dry month average flow rate of 33,050 m^3/d. It is understood from earlier discussions with facility operations staff, that plant sections may be taken offline during low flow periods to maintain appropriate hydraulic residence times through the treatment processes. Annual average flow data was obtained by the LRPCP Annual report for those years.

This assessment uses the available data provided by LRPCP staff. It is recommended that more current data be used to assess capacity constraints, however there has been limited changes to the system since 2020, therefore the recommendations are anticipated to not change.

Work completed recently as part of the Windsor Sewer and Coastal Flood Protection Master Plan (WSMP) (November 2020) identified concerns with peak flow capacity (both current and future) at the

LRPCP, under extreme wet weather conditions. It was found that during wet weather conditions, the resultant sewage flow to the treatment plant was significantly greater than average sewage generation rates due to inflow and infiltration (I&I) of rainwater into the separated sanitary sewer network. The WSMP developed recommendations to mitigate basement flooding and impacts to the LRPCP. These solutions include an improved bypass at the LRPCP, improved system conveyance via larger trunk sanitary sewers, and I&I source control which mainly focused on mandating foundation drain disconnection of older homes.

This exercise focuses on average daily flows associated with residential and commercial development, as well as typical flows over and above dry periods, which are reflected in the plant's observed annual average daily flow. It is acknowledged that expansion to the LRPCP sewershed is likely to be accompanied by an increase in peak wet weather flows which also must be managed, and a more robust peak flow management strategy must be addressed at that time.

Existing flows contributing to the LRPCP consist of the following sources:

- Serviced areas within the City of Windsor (assumed population of 67,979 persons); and
- Serviced areas within the Town of Tecumseh (assumed population of 22,350 persons and area of 928 ha). The Town of Tecumseh inlets to the City's sanitary sewer system at three separate locations: Cedarwood Pump Station on Gauthier Drive, sewer inlet at E.C. Row and Banwell Road and sewer inlet at 8th Concession Road, at Highway 401.

The Town of Tecumseh (Town) has a wastewater servicing agreement with the City of Windsor (City), dated November 1, 2004 (by-law 2004-71), which permits the Town to utilize a portion of the available installed capacity of the LRPCP. At the current LRPCP capacity, the Town's allotment is 19,800 m^3/d. Currently the Tecumseh population is serviced by the LRPCP, primarily from the Cedarwood outlet at Little River Boulevard. Based on the available Tecumseh inflow data provided by the City of Windsor, the total average daily flow contribution from the Town of Tecumseh is 9,335 m^3/d. This is an average of the inflow values from 2019 and 2020 which was 9,259 m^3/d and 9,412 m^3/d respectively.

For planning purposes, the City shall commence an Environmental Assessment once the facility's total capacity approaches approximately 70% and/or other factors such as sewage influent characteristics and wet weather inflows necessitate additional treatment needs. The need for plant expansion is not solely based on the estimated sewage flow rates from the proposed development but also is dependent on influent quality and plant performance.

1.2 Methodology and Assumptions

We have developed estimated future flows to the LRPCP based on high-level assumptions, for high-level conceptual planning purposes only, based on the following assumptions:

- Flows have been estimated on a serviced population basis using a fixed per-capita flow rate. Independent contributions of industrial and commercial dischargers were not considered because the contributions from these specific activities to current loading and in future developments are more difficult to quantify. The "population based" flows in this approximation account for all activities (including industrial and commercial land use) but this approach is considered reasonable as these activities will also occur in the Sandwich South (SS) lands.
- A population-based flow of 366 litres/person/day (l/cap/d) has been assumed for current and future population for City of Windsor Flows. Per-capita flows are often estimated within a range of approximately 225 to 450 l/cap/d (2008 MECP design guidelines) and the selected value of 366 l/cap/d was established based on the current multi-year average dry-weather flow to the LRPCP and the existing serviced population. Refer to Table 1 in Section 1.3.
- The current and future "annual average flow" for each area (reflecting the portion of the rated capacity of the LRPCP consumed) was calculated by multiplying the "dry month" flow derived from the population-based flow estimate by the ratio of the annual average and dry weather flows.
- Flows that have been allocated to the Town of Tecumseh have followed the requirements of the existing servicing agreement (by-law 2004-71). Any future changes to the allocation of treatment capacity between the two municipalities will require additional evaluation of capacity to be completed.

1.3 Existing Sewage Flow Summary

The flow and population summaries included below in Table 1 have been developed to illustrate existing contributions from individual sources. The following key LRPCP data was used in reviewing capacity implications of treatment capacity flows. This assessment was completed based on the existing Environment Compliance Approval (ECA) dated January 29, 2021, Number 4681-BT3L39:

• Plant ECA Rated Capacity (Annual Average Daily Flow)	72,800 m^3/day
• Average Daily Flow (2016-2018,2020)	43,896 m^3/day
• Average Dry Weather Flow (2016-2018,2020)	33,050 m^3/day

Table 1 includes existing population estimates for the two municipalities which were obtained from the 2020 LRPCP Annual report. Based on the average daily flow, 60% of the current plant treatment capacity is utilized. Average Daily Flow represents the total flow entering the plant which includes groundwater infiltration and wet weather flows entering the system. Average Dry Weather Flow represents 45% of the plant's treatment capacity as a comparison. Average Dry Weather Flow represents the typical flow entering the plant during dry weather periods and therefore does not include increase in inflows entering the plant during wet weather events. There is a 33% difference between the Average Dry Weather Flow and Average Daily Flow which indicates that beyond typical sewage generation flows, an additional 33% factor to account for fluctuations in flow should be considered when looking forward to defining further plant treatment needs. How this factor has been used in future population growth considerations is described in Section 1.5 below.

Table 1: Current Service Area Flow Estimates

Serviced Area Name	Area (ha)	Population Estimate	Dry weather per-capita population flow (L/cap/d)	Total per-capita flow including I&I allowance (L/cap/d)	Annual Average Flow (m^3/d)
Existing Service Areas					
Windsor	3,415	67,979	366	486	33,045
Tecumseh	928	22,350			9,335 (2019/2020 Data)
Existing Service Area Subtotal	4,343	90,329			42,380

The ratio of "average daily flow" and "dry weather flow" observed at the LRPCP in the years 2016-2018 and 2020 is used to adjust per-capita flow estimates to account for normal I&I contributions in place of an “area based” estimate. The 33% difference between annual average day flow and dry weather average day flow average (equivalent to 120 l/cap/d) reflects this value.

1.4 Future Sewage Flow Summary

Table 2 summarizes the future annual average flows from the identified developable areas that are within the LRPCP drainage area. The SS area has been broken down into three areas; East Pelton Secondary Plan Area (East Pelton SPA), the County Road 42 (CR 42 SPA) and the balance of lands within the SS study area. Areas within the East Pelton SPA and CR 42 SPA will be permitted to proceed with development first with the remaining SS lands being permitted to develop after associated Secondary Plans are completed. The focus of the SSMSP study is to identify projects and servicing needs of the two SPAs only. Based on consultation with the City, development is expected to also occur in the remaining vacant lands within East Riverside. Based on existing development plans for that neighbourhood, an estimated population growth of 2,741 persons is expected. A sewer assessment to confirm if corresponding sanitary sewers servicing that area could accommodate this flow was not completed as part of this analysis. It should be noted that infill growth within the City resulting in greater population and sewage generation is considered to be negligible for the purpose of this analysis.

Table 2: Future Windsor Service Area Flow Estimates

Serviced Area Name	Population Estimate	Future Full Build-out Annual Average Flow (m^3/d)
East Pelton Secondary Plan Area	5,336	2,600
County Road 42 Secondary Plan Area	20,132	9,800
Balance of SS Area (includes employment lands)	53,434	26,000
East Riverside	2,741	1,400
Future Windsor Development Sub-total	81,643	39,800

The balance of the SS Area population also includes the development area, west of Banwell Road that is currently being developed by Stellantis as an automotive manufacturing facility. It is estimated that sewage will be generated from this site by 2025. Assessment of the estimated sewage generation rate as it relates to the treatment plant capacity is being completed separately, however the findings of both assessments are meant to assist with determining the estimated timeline for the LRPCP improvements.

A portion of the balance of the remaining treatment capacity within the LRPCP shall be reserved for Town of Tecumseh treatment needs. The Tecumseh capacity allotment is calculated per by-law 2004-71, based upon the agreed capacity allocation split. Per the By-Law, the Town is allocated 27.3% of the current plant's total capacity, which is equivalent to 19,800 m^3/d, which is also noted in the Town's Water and Wastewater 2018 Master Plan Update (WWMP). Per this agreement, Tecumseh would be allotted 25% of any future expanded facility capacity and therefore when determining the ultimate treatment capacity required under ultimate LRPCP build out, it was assumed that 25% additional capacity will be required for the Town of Tecumseh. Table 3 provides a high level flow summary of the ultimate condition capacity requirements based on this assumption, for reference only. The results of this assessment assume that the percent allocation stipulated in the existing by-Law will not change. Should the municipalities renegotiate the terms of this agreement, the corresponding threshold of development allowable within the each municipality shall be revaluated.

Table 3: Future Treatment Flow Capacity Estimate

Scenario	Annual Average Flow (m^3/d)[1]
Total Windsor Treatment Capacity Required	72,845 (33,045 Ex. + 39,800 Fut.)
Total Tecumseh Treatment Capacity Required	38,000 (WWMP 2018)
Total Ultimate Treatment Capacity Required	110,845

Note 1: Annual Average Flow does not include extraneous flow management needs to be considered to mitigate sewer surcharge and basement flooding risk and is based on average observed sewage generation rates.

1.5 Staging and Implementation

Per Section 4.1.4 g) of the ECA, the LRPCP shall report on the when the Annual Average Daily Flow reaches 80% of the rated capacity, which is equivalent to 14,530 m^3/day. Under Article 4, Section A. iv. of By-Law 2004-71, when the plant reaches 90% capacity or the effluent quality does not meet the MECP loading requirements, development can be paused until expansion proceeds. Based on these thresholds and accounting for anticipated growth within the City and Town areas, it is recommended that as the capacity of the treatment plant reaches 70%, that the City secure necessary capital budget allocation and schedule the completion of the necessary Schedule C Environmental Assessment for the plant expansion. A summary of the corresponding plant capacity and estimated remaining capacity has been provided in Table 4 (attached) under various plant capacity scenarios, to assist with developing a staging plan for the expansion of the LRPCP.

Under the 70% LRPCP Capacity usage, two scenarios were included to provide additional context on the need to proceed with the completion of an Environmental Assessment, as described below:

- Scenario 1A: Town of Tecumseh uses 90% of their total treatment capacity allocation.
    - Under this scenario, the City of Windsor should not accommodate additional population growth prior to the completion of the Environmental Assessment.
- Scenario 1B: Windsor and Town both respectively use 70% of their total treatment capacity allocation.
    - For comparison purposes, an additional approximately 6,000 persons can be accommodated, which is less then the full build out of the East Pelton and County Road 42 Secondary Plan Areas as noted in Table 2.

Based on these findings, it was confirmed that expansion of the overall LRPCP rated capacity will be required to accommodate full development. Based on this assessment, it is recommended that the City move forward with the Schedule C Environmental Assessment and pre-engineering required to expand the LRPCP treatment plant. An equivalent of 6,000 persons can be accommodated before the total treatment plant capacity reaches 70% in either the Windsor or Tecumseh development areas. The City shall commence monitoring population growth and how the estimated flows will affect the inflow capacity of the treatment plant. Beyond considerations for population growth, risks associated with wet weather storm events and inflow and infiltration management shall also continue to be top priority.

We trust that this evaluation provides the City with the necessary information required to review the LRPCP capacity as it relates to the development of the SS Area. Findings of this assessment will be integrated into the comprehensive staging plan, which will support the first phases of development. Should you have any further questions, we would be pleased to discuss the results of our evaluation in further detail.

Sandwich South Master Servicing Plan
Little River Pollution Control Plant (LRPCP) – Capacity Assessment

10/25/2022

Table 4: Assessment of LRPCP Treatment Capacity

					City of Windsor					Town of Tecumseh		
Scenario	Threshold	Existing LRPCP Rated Capacity (m3/d)	LRPCP Capacity Used (m3/d)	Total Remaining Capacity (m^3/d)	Windsor Capacity Allocation (m3/d) (72.7%)	Windsor Capacity Allocation Used (m3/d)	Percentage of Total Allocation of Treatment Capacity (%)	Sewage Flow Increase Between Thresholds (m3/d)	Estimated Allowable Population Growth Between Thresholds (with 33% Flexibility Factor)	Tecumseh Capacity Allocation (m3/d) (27.3%)	Capacity Allocation used (m3/d)	Percentage of Total Allocation (%)
Existing Conditions (2020)	Current average daily flow makes up approximately 60% of LRPCP's Treatment Capacity.	72,800	42,380	30,420	53,000	33,045	62%	-	-	19,800	9,335	47%
Scenario 1A 70% Treatment Capacity Used - Town Requires use of fully capacity allocation.	Complete Schedule C Environmental Assessment, Allocate Capital Funds to Expand Plant.	72,800	50,960	21,840	53,000	33,045	62%	None	No Population Growth	19,800	17,820	90%
Scenario 1B 70% Treatment Capacity Used Tecumseh Growth needs match City of Windsor needs.	Complete Schedule C Environmental Assessment, Allocate Capital Funds to Expand Plant.	72,800	50,960	21,840	53,000	37,100	70%	4,055	6,000	19,800	13,860	70%
Scenario 2 80% Treatment Capacity - Assumes Tecumseh has used all capacity.	Monitor treatment capacity needs and complete treatment plant expansion.	72,800	58,240	14,560	53,000	38,440	73%	1,340	2,000	19,800	19,800	100%
Scenario 3 90% Treatment Capacity - Assumes Tecumseh has used all capacity.	Expanded treatment plant shall be in operation and expanded treatment capacity must be available.	72,800	65,520	7,280	53,000	45,720	86%	7,280	11,000	19,800	19,800	100%

NOTES: All flows included above represent average daily flows and does not represent instantaneous inflow entering LRPCP. Need for plant expansion and/or upgrades shall also consider wet weather inflow and infiltration into the upstream sanitary system to mitigate bypass of flows and mitigation basement flood risk. Influent quality characteristics must also be monitored and may trigger additional plant improvements.

Appendix F – 3

Sanitary Sewer Design

Sandwich South Master Servicing Plan - Municipal Servicing Functional Design Report
Appendix F-3

SANDWICH SOUTH MASTER SERVICING STUDY SANITARY SEWER DESIGN SHEET

Date: April 2023

Project Name: Sandwich South Master Servicing Study
Project No: 19-9817

The Peaking Factor was derived:
Using Harmon Formula= Y (Y or N)
From a Table= N
Value from table=

Residential Average Daily Flow= 363 L/Cap.D
Peak Extraneous Flow= 0.156 L/Ha.S

180.000
0.013
1,987.900

City of Windsor

Location			**Flow Characteristics**									**Sewer Design/Profile**						
ROAD/STN	LOCATION		INDIVIDUAL		CUMULATIVE		PEAKING FACTOR M	POP FLOW Q(p) (L/s)	PEAK EXTR. FLOW Q(i) (L/s)	EXTERNAL FLOWS (L/s)	PEAK DESIGN FLOW Q(d) (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE DIA. (mm)	Wall Thickness (mm)	SLOPE (%)	FALL (m)	VELOCITY (m/s)
	FROM MH	TO MH	POP	AREA (ha.)	POP	AREA (ha.)												
Oldcastle	EX	1	0.0	0.00	0	0.00	4.500	0.000	0.000	325.000	**325.00**	**557.98**		900		0.095	0.000	0.88
8th Conc (A1)	1	2	11647.0	267.97	11647	267.97	2.889	141.351	41.803		**508.15**	**690.74**	1900.0	975		0.095	1.805	0.93
Baseline Rd (A2)	3	2	818.0	28.85	818	28.85	3.855	13.247	4.501		**17.75**	**44.10**		250		0.550	0.000	0.90
Baseline (A4)	4	2	1629.0	37.87	1629	37.87	3.653	25.004	5.908		**30.91**	**44.10**		250		0.550	0.000	0.90
8th Conc.	2	5	0.0	0.00	14094	334.69	2.805	166.124	52.212		**543.34**	**690.74**	475.0	975		0.095	0.451	0.93
CR42 (A3)	6	5	1567.0	27.40	1567	27.40	3.666	24.134	4.274		**28.41**	**37.61**		250		0.400	0.000	0.77
CR42 (A5)	5	7	4906.0	98.98	20567	461.07	2.640	228.147	71.927		**625.07**	**1031.51**	885.0	1200		0.070	0.620	0.91
CR42 (A6)	7	8	3584.0	90.69	24151	551.76	2.570	260.823	86.075		**671.90**	**1031.51**	540.0	1200		0.070	0.378	0.91
9th Conc. (A7)	9	10	7729.0	176.12	7729	176.12	3.065	99.524	27.475		**127.00**	**166.56**	1330.0	525		0.150	1.995	0.77
9th Conc. (A8)	10	11	5967.0	122.43	13696	298.55	2.818	162.153	46.574		**208.73**	**245.60**	905.0	600		0.160	1.448	0.87
9th Conc. (A9)	11	8	5462.0	88.99	19158	387.54	2.671	215.009	60.456		**275.47**	**352.05**	865.0	750		0.100	0.865	0.80
CR42 (A10)	8	12	2334.0	148.52	45643	1087.82	2.302	441.365	169.700		**936.06**	**1537.69**	1400.0	1350		0.083	1.162	1.07
10th Conc. (A11)	13	14	8775.0	173.26	8775	173.26	3.011	111.001	27.029		**138.03**	**221.39**	1310.0	600		0.130	1.703	0.78
10th Conc. (A12)	14	15	5213.0	122.33	13988	295.59	2.809	165.069	46.112		**211.18**	**278.79**	905.0	675		0.110	0.996	0.78
10th Conc. (A13)	15	16	5758.0	144.23	19746	439.82	2.658	220.514	68.612		**289.13**	**369.23**	1280.0	750		0.110	1.408	0.84
CR42 (A14)	17	18	3199.0	90.72	3199	90.72	3.419	45.946	14.152		**60.10**	**85.89**	775.0	375		0.240	1.860	0.78
CR42 (A15)	18	16	1421.0	60.54	4620	151.26	3.277	63.601	23.597		**87.20**	**120.96**	445.0	450		0.180	0.801	0.76
CR42 to 900 Stub	16	19	0.0	0.00	24366	591.08	2.567	262.752	92.208		**354.96**	**453.92**	75.0	825		0.100	0.075	0.85
Lzn Pkwy 900 Stub	19	12	0.0	0.00	24366	591.08	2.567	262.752	92.208		**354.96**	**670.06**	375.0	900		0.137	0.514	1.05
Lzn Pkwy (A16)	12	20	0.0	26.36	70009	1705.26	2.132	627.105	266.021		**1218.13**	**2098.31**	665.0	1650		0.053	0.352	0.98
Lzn Pkwy (A17)	21	20	3170.0	93.19	3170	93.19	3.422	45.575	14.538		**60.11**	**84.09**	880.0	375		0.230	2.024	0.76
Srvc Rd B (A18)	20	22	2489.0	80.57	75668	1879.02	2.102	668.398	293.127		**1286.53**	**1630.44**	1153.0	1650		0.032	0.369	0.76
CP Rail (A19)	22	23	2178.0	70.53	77846	1949.55	2.092	684.142	304.130		**1313.27**	**1630.44**	1300.0	1650		0.032	0.416	0.76
Banwell (A20)	23	24	1464.0	38.35	79310	1987.90	2.085	694.680	310.112		**1329.79**	**1630.44**	1450.0	1650		0.032	0.464	0.76
EC ROW Crossing	24	25	0.0	0.00	79310	1987.90	2.085	694.680	310.112		**2312.79**	**2629.60**	420.0	2100		0.023	0.097	0.76

🟧	Exisitng Sewers
🟥	Proposed Trunk Sanitary Sewers

Date: Apr. 10, 2023

SANDWICH SOUTH MASTER SERVICING PLAN
TABLE F3-1 SANITARY POPULATION PROJECTION

Little River Pollution Control Plant (LRPCP) Drainage Area			
Area	**Land Use**	**Area (ha)**	**Design Population**
A1	EP Mixed Use	14.78	1360
	EP Med Res	5.64	451
	EP Low Res	75.12	2704
	Future Employment	44.53	3028
	Future Urban	35.67	1784
	CR42 Low Res	30.94	2321
	Open Space/SWM/ROW	61.29	0
Total		**267.97**	**11647**
A2	Res (EX)	16.48	238
	Comm (EX)	8.53	580
	Open Space/ROW	3.84	0
Total		**28.85**	**818**
A3	Comm (EX)	23.05	1567
	Open Space/ROW	4.35	0
Total		**27.40**	**1567**
A4	CR42 Business Park Type I	11.33	770
	CR42 Low Res	11.45	859
	Open Space/SWM/ROW/Nat Heritage	15.09	0
Total		**37.87**	**1629**
A5	EP Low Res	0.68	24
	CR42 Business Park Type I	17.22	1171
	Future Employment	54.57	3711
	Solar Farm	21.59	0
	Open Space/SWM/ROW/Nat Heritage	5.60	0
Total		**98.98**	**4906**
A6	Future Employment	44.73	3042
	CR42 Business Park Type II	7.33	542
	Solar Farm	36.90	0
	Open Space/ROW	1.73	0
Total		**90.69**	**3584**
A7	Future Employment	109.54	7449
	Future Urban	5.61	281
	Open Space/SWM/ROW	60.97	0
Total		**176.12**	**7729**
A8	CR42 Low Res	54.60	4095
	Future Urban	20.19	1010
	Possible Future Regional Park*	17.24	862
	Open Space/SWM/ROW	30.40	0
Total		**122.43**	**5967**
A9	CR42 Med Res	13.57	1438
	CR42 Commercial	1.63	121
	CR42 Mixed Use	12.12	1357
	CR42 Business Park Type II	9.50	703
	CR42 Major Institutional (Hospital)	24.25	1843
	Open Space/SWM/ROW/Nat Heritage	27.92	0
Total		**88.99**	**5462**
A10	CR42 Business Park Type II	9.74	721
	Future Employment	23.73	1614
	Open Space/SWM/ROW/Nat Heritage	115.05	0
Total		**148.52**	**2334**

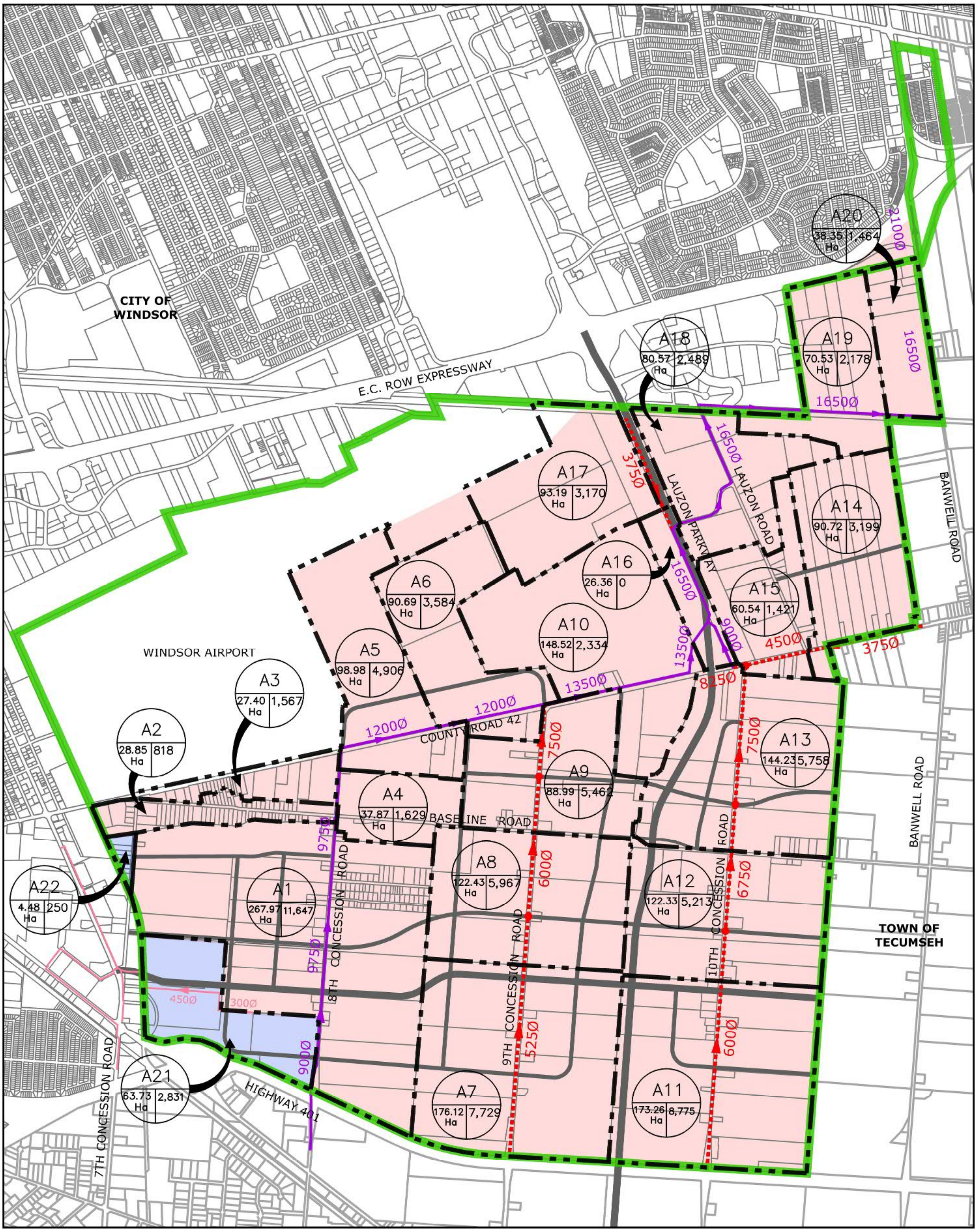
A11	Future Employment	129.04	8775
	ROW/SWM	44.22	0
Total		**173.26**	**8775**
A12	CR42 Low Res	22.63	1697
	Future Urban	22.00	1100
	Future Employment	35.53	2416
	ROW/SWM	42.17	0
Total		**122.33**	**5213**
A13	CR42 Business Park Type I	23.39	1591
	CR42 Business Park Type II	6.24	462
	Future Urban	74.12	3706
	ROW/SWM	40.48	0
Total		**144.23**	**5758**
A14	Future Urban	59.62	2981
	Future Mixed Use	3.20	218
	ROW/SWM	27.90	0
Total		**90.72**	**3199**
A15	Future Urban	23.30	1165
	Future Mixed Use	3.77	256
	ROW/SWM	33.47	0
Total		**60.54**	**1421**
A16	ROW/SWM/Natural Heritage	26.36	0
Total		**26.36**	**0**
A17	Future Employment	46.62	3170
	Solar Farm	46.57	0
Total		**93.19**	**3170**
A18	Future Employment	36.60	2489
	ROW/SWM	43.97	0
Total		**80.57**	**2489**
A19	Future Employment	30.23	2056
	Future Mixed Use	1.80	122
	ROW/SWM	38.50	0
Total		**70.53**	**2178**
A20	Future Mixed Use	14.81	1007
	Future Employment	6.72	457
	ROW/SWM	16.82	0
Total		**38.35**	**1464**
Lou Romano Water Reclamation Plant (LRWRP) Drainage Area			
A21	Minor Institutional	15.77	347
	Major Institutional	12.09	363
	Commercial Centre	23.05	1706
	Private Recreation	5.33	416
	ROW	7.49	0
Total		**63.73**	**2831**
A22	Comm (EX)	3.67	250
	ROW	0.81	0
Total		**4.48**	**250**

Note:

* To provide flexibility for relocation of the regional park, it was assumed that residential land use population could be accommodated here.

Appendix F – 3-1

Sanitary Sewer Drainage Area Plan



SANDWICH SOUTH
MASTER SERVICING PLAN

LEGEND

- 🟩 STUDY AREA
- 🟥 SANDWICH SOUTH SANITARY DRAINAGE AREA
- 🟦 LOU ROMANO WATER RECLAMATION PLANT DRAINAGE AREA
- ▬ PROPOSED INTERNAL ROAD NETWORK
- → EXISTING SANITARY TRUNK SEWERS
- - - - PROPOSED SANITARY TRUNK SEWERS

A12 — DRAINAGE AREA ID
DRAINAGE AREA (Ha)
POPULATION

PROPOSED SANITARY DRAINAGE AREA PLAN

FIGURE F3-1

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO.
(WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

**2019 IMAGERY - THE DIGITAL MAP LAYERS HAVE BEEN USED WITH EXPRESS PERMISSION OF THE CORPORATION OF THE COUNTY OF ESSEX

SCALE: 1:12500
STATUS: FINAL
PROJECT: 19-9817

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DATE: April 14, 2023

File Location: c:\pw working directory\projects 2019\dillon_32edr\dms76053\19-9817 san layout.dwg April, 14, 2023 11:12 AM

Appendix F - 4

Storm Sewer Design Sheets

F-4-1
City of Windsor Sandwich South Master Servicing Plan
STORMWATER MANAGEMENT PONDS
Design Summary

Pond Name	Associated Pump Stations	Catchment Area	Storm Sewers to Pond	Pond Inlet Sewer Size (mm)	Critical Pond Water Level Elevations							Minimum Permanent Pool Volume (m3)		Minimum Active Storage Volume (1:100 Year Flood) (m3)	Minimum Active Storage Volume Urban Stress Test (m3)	Estimated Total Pond Excavation from Top of Bank (m3)	Freeboard (m)	Inlet Invert to Pond	Outlet Invert to Pump Station (From Pond)	Max. Pond Release Rate (m3/s)	Inlet Invert to Pump Station	Pond Outlet Conduit Size (mm)	Pump Station Outlet Invert Elevation	Pump Station Outlet Elevation (Top of Pipe)	Municipal Drain Bottom at Outlet Elevation	Finished Grade (Top Rim of Pump Station)	Flood Protection Elevations
					Bottom	Permanent Pool (NWL)	Depth of PP	1:100 Year	UST	Top of Bank	Depth	Required	Provided			Provided											
P1*	PS1	East Pelton North	West (Outlet 1)	1800	183.80	N/A	N/A	185.71	186.32	188.50	4.70	N/A	N/A	86,850	117,800	187,500	1.68	183.80	183.00	0.745	182.70	750	185.23	185.980	184.73	187.48	187.31
			Central (Outlet 2)	2400	183.20	N/A	N/A			188.00	4.80							183.20									
			East (Outlet 3)	2700	183.00	N/A	N/A			187.50	4.50							183.00									
P2	PS2	East Pelton South	Outlet 1	2250	182.40	183.90	1.50	186.77	187.36	189.50	7.10	8,159	8,645	39,750	52,900	111,000	2.14	183.90	183.90	0.312	183.60	500	187.28	187.78	185.20	189.28	188.66
P3*	PS3	CR42SPA South	West (8th Conc.) (Outlet 1)	3000	181.40	N/A	N/A	183.59	184.25	186.00	4.60	N/A	N/A	153,300	206,100	421,500	0.95	181.40	180.20	1.347	179.90	1500	181.5	183.00	181.38	184.50	184.71
			Central (New Road) (Outlet 2)	2400	180.70	N/A	N/A			185.20	4.50							180.70									
			East (9th Conc.) (Outlet 3)	2400	180.20	N/A	N/A			184.50	4.30							180.20									
			East (New Road E) (Outlet 4)	1950	180.20	N/A	N/A			184.50	4.30							180.20									
P4	PS4	CR42SPA North	Mid Trunk - Between CR 42 and Baseline Road (Outlet 2)	2250	177.00	179.00	2.00	181.92	182.61	183.50	6.50	16,428	18,036	81,200	111,800	157,000	0.89	179.00	179.00	0.312	178.70	600	181.90	182.50	185.20	184.00	183.64
			Along Baseline Road (Outlet 1)	2400	177.00	179.00					6.50							179.50									
P5	PS5	CR42SPA East	Outlet 1	2700	176.00	178.00	2.00	180.83	181.41	183.50	7.50	8,454	10,249	45,900	61,100	112,100	2.09	178.00	178.00	0.397	177.70	500	180.91	181.41	179.67	182.91	183.55
P6	PS6	CR42SPA South East	Outlet 1	2700	177.30	179.30	2.00	182.66	183.31	184.50	7.20	9,296	10,800	47,250	62,400	95,200	1.19	181.30	179.30	0.379	179.00	500	183.00	183.50	180.70	185.00	183.96
P7	PS7	Lauzon Parkway South	Outlet 1	1200	177.10	179.10	2.00	180.76	181.16	183.00	5.90	700	2,727	4700	6,500	14,700	1.84	179.10	179.1	0.044	178.8	100	181.34	181.44	179.22	182.94	182.94
P8	PS8	Lauzon Parkway North	Along CR42 (Outlet 1)	3000	176.60	178.60	2.00	181.77	182.51	183.50	6.90	27,700	32,076	141,200	190,404	247,300	0.29	178.60	178.00	1.195	177.70	1500	180.00	181.50	179.22	183.00	182.94
			Along Proposed Airport Road (Outlet 2)	3000	176.00	178.00	2.00			182.80	6.80							178.00									
			Along Lauzon Parkway (Outlet 3)	1050	176.30	178.30	2.00			182.4	6.10							178.30									

* P1 and P3 Ponds are Dry Ponds that will not have a permanent pool. The bottom of the pond represents the bottom of the active storage portion of the pond.

Table F-4-2
City of Windsor Sandwich South Master Servicing Plan
Storm Pump Station
Design Summary

Pump Station	Description (Wet Well Size)	PS Required Capacity m3/s	Permanent Pool (Elevation m)*	Pond Bottom (Elevation m)	Finished Grade (Elevation m)	PS Depth m	Discharge Invert	Total Dynamic Head	Pump Configuration	Discharge Pipe Diameter mm	Outlet Pipe Size mm	Pump motors kW each
P1	6.0 x 10.0 m	0.745	N/A	183.00	187.48	6.78	184.73	3.63	2 duty + 1 standby	450	750	35
P2	5.0 x 3.5 m	0.312	183.90	182.40	189.28	8.18	185.20	3.20	1 duty + 1 standby	450	500	30
P3	9.0 x 15.0 m	1.345	N/A	180.20	184.50	6.60	181.38	3.08	2 duty + 1 standby	925	1500	75
P4	8.0 x 15.0 m	0.597	179.00	177.00	183.50	8.80	179.90	2.80	2 duty + 1 standby	600	900	35
P5	5.0 x 3.5 m	0.365	178.00	176.00	182.91	8.21	179.67	3.57	1 duty + 1 standby	450	500	30
P6	5.0 x 3.5 m	0.379	179.30	177.30	185.00	9.00	180.70	3.30	1 duty + 1 standby	450	500	30
P7	3.6 m DIA	0.044	179.10	177.10	182.94	7.14	179.22	2.02	1 duty + 1 standby	100	200	3
P8	9.0 x 15.0 m	1.258	178.00	176.00	183.00	8.30	179.22	3.12	2 duty + 1 standby	925	1500	75

EAST PELTON NORTH (West) POND-P1 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.800	3,880.71	N/A	N/A	0.00	N/A	0.00
184.000	4,413.69	0.200	829.44	829.44	828.87	828.87
184.500	5,762.67	0.500	2544.09	3373.53	2536.61	3365.47
185.000	7,130.40	0.500	3223.27	6596.80	3217.21	6582.68
185.500	8,523.53	0.500	3913.48	10510.28	3908.31	10490.99
186.000	9,921.82	0.500	4611.34	15121.62	4606.91	15097.90
186.500	11,348.79	0.500	5317.65	20439.27	5313.66	20411.56
187.000	12,791.25	0.500	6035.01	26474.28	6031.42	26442.98
187.500	14,252.33	0.500	6760.90	33235.18	6757.60	33200.58

EAST PELTON NORTH (Central) POND-P1 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.200	4,575.43	N/A	N/A	0.00	N/A	0.00
183.500	5,493.78	0.300	1510.38	1510.38	1508.28	1508.28
184.000	7,012.50	0.500	3126.57	4636.95	3118.86	4627.14
184.500	8,546.94	0.500	3889.86	8526.81	3883.54	8510.68
185.000	10,069.24	0.500	4654.05	13180.86	4648.85	13159.53
185.500	11,590.83	0.500	5415.02	18595.88	5410.56	18570.09
186.000	13,115.53	0.500	6176.59	24772.46	6172.66	24742.75
186.500	14,642.36	0.500	6939.47	31711.94	6935.97	31678.72
187.000	16,170.00	0.500	7703.09	39415.03	7699.93	39378.66
187.500	17,690.57	0.500	8465.14	47880.17	8462.30	47840.95

EAST PELTON NORTH (East) POND-P1 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.000	12,990.04	N/A	N/A	0.00	N/A	0.00
183.500	15,312.78	0.500	7075.70	7075.70	7067.75	7067.75
184.000	17,652.86	0.500	8241.41	15317.11	8234.48	15302.23
184.500	20,013.86	0.500	9416.68	24733.79	9410.51	24712.74
185.000	22,394.83	0.500	10602.17	35335.97	10596.60	35309.33
185.500	24,793.70	0.500	11797.13	47133.10	11792.05	47101.38
186.000	27,214.63	0.500	13002.08	60135.18	12997.38	60098.77
186.500	29,653.54	0.500	14217.04	74352.22	14212.68	74311.45
187.000	32,111.19	0.500	15441.18	89793.41	15437.11	89748.56
187.500	34,589.72	0.500	16675.23	106468.64	16671.39	106419.95

EAST PELTON SOUTH POND-P2 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.900	6,849.70	N/A	N/A	0.00	N/A	0.00
184.400	9,219.32	0.500	4017.25	4017.25	4002.61	4002.61
184.900	11,628.20	0.500	5211.88	9229.14	5200.24	9202.86
185.400	14,076.32	0.500	6426.13	15655.27	6416.39	15619.25
185.900	16,563.69	0.500	7660.00	23315.27	7651.57	23270.83
186.400	19,090.30	0.500	8913.50	32228.76	8906.03	32176.85
186.900	21,656.16	0.500	10186.62	42415.38	10179.88	42356.73
187.400	24,261.27	0.500	11479.36	53894.74	11473.19	53829.92
187.900	26,905.62	0.500	12791.72	66686.46	12786.02	66615.95
188.400	29,589.22	0.500	14123.71	80810.17	14118.39	80734.34
188.900	32,312.06	0.500	15475.32	96285.49	15470.33	96204.67
189.340	34,740.63	0.440	14751.59	111037.08	14748.37	110953.03

CR42SPA SOUTH (West) POND-P3 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
181.400	9,102.41	N/A	N/A	0.00	N/A	0.00
181.700	10,784.01	0.300	2982.96	2982.96	2979.40	2979.40
182.200	13,599.75	0.500	6095.94	9078.91	6082.35	9061.75
182.700	16,438.51	0.500	7509.56	16588.47	7498.36	16560.11
183.200	19,297.13	0.500	8933.91	25522.38	8924.37	25484.48
183.700	22,170.21	0.500	10366.84	35889.22	10358.53	35843.01
184.200	25,070.47	0.500	11810.17	47699.39	11802.74	47645.76
184.500	26,815.91	0.300	7782.96	55482.35	7781.49	55427.25

CR42SPA SOUTH (Central) POND-P3 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
180.700	10,374.44	N/A	N/A	0.00	N/A	0.00
181.200	13,034.73	0.500	5852.29	5852.29	5839.65	5839.65
181.700	15,693.05	0.500	7181.94	13034.24	7171.67	13011.33
182.200	18,347.37	0.500	8510.10	21544.34	8501.47	21512.79
182.700	21,006.91	0.500	9838.57	31382.91	9831.07	31343.87
183.200	23,665.72	0.500	11168.16	42551.07	11161.56	42505.43
183.700	26,325.13	0.500	12497.71	55048.78	12491.81	54997.24
184.200	28,974.38	0.500	13824.88	68873.66	13819.59	68816.83
184.500	30,574.26	0.300	8932.30	77805.95	8931.22	77748.05

CR42SPA SOUTH (East) POND-P3 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
180.200	10,727.84	N/A	N/A	0.00	N/A	0.00
180.700	13,089.50	0.500	5954.33	5954.33	5944.55	5944.55
181.200	15,466.11	0.500	7138.90	13093.24	7130.65	13075.20
181.700	17,864.31	0.500	8332.61	21425.84	8325.41	21400.61
182.200	20,282.10	0.500	9536.60	30962.45	9530.21	30930.82
182.700	22,721.44	0.500	10750.89	41713.33	10745.12	41675.93
183.200	25,176.72	0.500	11974.54	53687.87	11969.29	53645.23
183.700	27,653.46	0.500	13207.54	66895.42	13202.70	66847.93
184.200	30,152.40	0.500	14451.46	81346.88	14446.96	81294.89
184.500	31,657.09	0.300	9271.42	90618.30	9270.51	90565.40

CR42SPA NW POND-P4 ACTIVE STORAGE						
ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
179.000	14,192.63	N/A	N/A	0.00	N/A	0.00
179.500	18,887.59	0.500	8270.05	8270.05	8242.15	8242.15
180.000	24,122.42	0.500	10752.50	19022.56	10725.85	18968.00
180.500	28,429.63	0.500	13138.01	32160.57	13123.28	32091.28
181.000	32,775.33	0.500	15301.24	47461.81	15288.37	47379.65
181.500	37,159.54	0.500	17483.72	64945.52	17472.25	64851.90
182.000	41,582.23	0.500	19685.44	84630.97	19675.08	84526.99
182.500	46,043.43	0.500	21906.41	106537.38	21896.95	106423.93
183.000	50,543.11	0.500	24146.63	130684.02	24137.90	130561.83
183.500	55,081.30	0.500	26406.10	157090.12	26397.97	156959.80

CR42SPA EAST POND-P5 ACTIVE STORAGE						
ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
178.000	8,515.21	N/A	N/A	0.00	N/A	0.00
178.500	11,187.10	0.500	4925.58	4925.58	4910.41	4910.41
179.000	13,898.26	0.500	6271.34	11196.92	6259.09	11169.50
179.500	16,648.68	0.500	7636.73	18833.65	7626.39	18795.90
180.000	19,438.36	0.500	9021.76	27855.41	9012.76	27808.66
180.500	22,267.31	0.500	10426.42	38281.83	10418.41	38227.07
181.000	25,135.51	0.500	11850.70	50132.53	11843.47	50070.54
181.500	28,042.98	0.500	13294.62	63427.15	13288.00	63358.53
182.000	30,989.71	0.500	14758.17	78185.33	14752.04	78110.57
182.500	33,975.71	0.500	16241.36	94426.68	16235.63	94346.21
183.000	37,000.96	0.500	17744.17	112170.85	17738.79	112085.00

CR42SPA SE POND-P6 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
179.300	6,691.24	N/A	N/A	0.00	N/A	0.00
179.800	8,810.36	0.500	3875.40	3875.40	3863.27	3863.27
180.300	10,968.66	0.500	4944.76	8820.16	4934.91	8798.19
180.800	13,166.14	0.500	6033.70	14853.86	6025.34	14823.53
181.300	15,402.79	0.500	7142.23	21996.09	7134.92	21958.46
181.800	17,678.63	0.500	8270.36	30266.44	8263.82	30222.28
182.300	19,993.65	0.500	9418.07	39684.51	9412.14	39634.42
182.800	22,347.84	0.500	10585.37	50269.88	10579.91	50214.33
183.300	24,741.22	0.500	11772.27	62042.15	11767.19	61981.52
183.800	27,173.78	0.500	12978.75	75020.90	12974.00	74955.52
184.300	29,645.51	0.500	14204.82	89225.72	14200.34	89155.86
184.500	30,645.18	0.200	6029.07	95254.79	6028.79	95184.66

LAUZON PARKWAY & CR42 INTERSECTION POND-P7 ACTIVE STORAGE						
ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
179.100	1,751.72	N/A	N/A	0.00	N/A	0.00
179.600	2,376.07	0.500	1031.95	1031.95	1027.99	1027.99
180.100	3,039.69	0.500	1353.94	2385.89	1350.54	2378.53
180.600	3,742.56	0.500	1695.56	4081.45	1692.52	4071.05
181.100	4,484.70	0.500	2056.81	6138.26	2054.02	6125.07
181.600	5,266.10	0.500	2437.70	8575.96	2435.08	8560.15
182.100	6,086.76	0.500	2838.21	11414.17	2835.74	11395.89
182.600	6,946.68	0.500	3258.36	14672.53	3255.99	14651.88

LAUZON PARKWAY & CR42 INTERSECTION POND-P8 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
178.000	19,477.08	N/A	N/A	0.00	N/A	0.00
178.500	25,452.93	0.500	11232.50	11232.50	11199.24	11199.24
179.000	31,467.49	0.500	14230.11	25462.61	14203.55	25402.79
179.500	37,520.76	0.500	17247.06	42709.67	17224.89	42627.68
180.000	43,612.73	0.500	20283.37	62993.04	20264.29	62891.97
180.500	49,743.42	0.500	23339.04	86332.08	23322.24	86214.21
181.000	55,912.82	0.500	26414.06	112746.14	26399.04	112613.25
181.500	64,361.67	0.500	30068.62	142814.77	30043.86	142657.11
182.000	67,915.17	0.500	33069.21	175883.98	33065.23	175722.34
182.500	71,512.38	0.500	34856.89	210740.86	34853.02	210575.36
183.000	75,152.25	0.500	36666.16	247407.02	36662.39	247237.76

SANDWICH SOUTH MSR - P1- OUT_1
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MP
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c **2) Intensity (i) = a*t^b** **3) Insert Intensity**

Manning's n = 0.013

Based on 1:10 Year Storm Event
City of Windsor

a= 1511.000 **a=** **i=**
b= 9.500 **b=**
c= 0.845

Total Area (ha)= 15.70 Outlet Invert Elevation= 183.800 Ground Elevation @ Outlet = 188.50 High Water Level at Outlet= 184.73

Location												Sewer Design / Profile										Cover			Hydraulic Grade Line	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P1-2	J-1	J-2	10.40	0.80	23.06	23.06	20.0	2.53	20.00	86.55	**1996.08**	**2882.24**	1.35	165	205.0	1650	0.10	184.315	184.110	0.21		189.900	3.77	3.52	186.01	Okay
P1-1	J-2	J-3	5.30	0.82	12.15	35.22		1.67	22.53	80.73	**2842.94**	**3634.96**	1.43	178	143.0	1800	0.10	184.110	183.967	0.14		189.450	3.36	3.15	185.91	Okay
OUT	J-3	OUT_1	0.00	0.00	0.00	35.22		1.95	24.20	77.34	**2723.55**	**3634.96**	1.43	178	167.0	1800	0.10	183.967	183.800	0.17		189.100	3.15	2.72	185.77	Okay

SANDWICH SOUTH MSR - P1- OUT_2
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MP
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Based on 1:10 Year Storm Event
City of Windsor

Manning's n = 0.013

Total Area (ha)= 42.60

Outlet Invert Elevation= 183.200

Ground Elevation @ Outlet = 188.00

High Water Level at Outlet= 184.73

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P1-10	J-4	J-6	5.20	0.94	13.63	13.63	20.0	4.77	20.00	86.55	**1179.94**	**1601.22**	1.12	159	320.0	1350	0.09	185.203	184.915	0.29	0.400	189.450	2.74	2.58	186.55	Okay
P1-3	J-5	J-6	9.00	0.82	20.55	20.55	20.0	8.08	20.00	86.55	**1778.42**	**2235.37**	1.26	152	613.0	1500	0.10	185.528	184.915	0.61	0.400	189.800	2.62	2.43	187.03	Okay
P1-3_1	J-6	J-7	2.80	0.81	6.27	40.45		1.40	28.08	70.54	**2853.82**	**3634.96**	1.43	178	120.0	1800	0.10	184.515	184.395	0.12	0.400	189.000	2.51	2.43	186.32	Okay
P1-5	J-7	J-8	15.50	0.81	34.93	75.39		3.07	29.48	68.40	**5156.09**	**6590.62**	1.66	216	305.0	2250	0.10	183.995	183.690	0.31	0.200	188.800	2.34	2.18	186.25	Okay
P1-4	J-8	OUT_2	10.10	0.76	21.36	96.75		2.79	32.54	64.16	**6206.91**	**7828.34**	1.73	229	290.0	2400	0.10	183.490	183.200	0.29		188.333	2.21	2.17	185.89	Okay

SANDWICH SOUTH MSR - P1- OUT_3
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MP
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c
2) Intensity (i) = a*t^b
3) Insert Intensity

Manning's n = 0.013

Based on 1:10 Year Storm Event
City of Windsor

a= 1511.000
b= 9.500
c= 0.845

a=
b=

i=

Total Area (ha)= 48.10
Outlet Invert Elevation= 183.000
Ground Elevation @ Outlet = 187.50
High Water Level at Outlet= 184.73

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P1-9	J-10	J-11	12.90	0.90	32.33	32.33	20.0	3.67	20.00	86.55	**2798.39**	**3448.43**	1.36	178	298.0	1800	0.09	184.874	184.606	0.27	0.800	188.800	1.95	1.92	186.67	Okay
P1-8	J-11	J-12	14.70	0.83	33.95	66.28		2.77	23.67	78.40	**5196.42**	**6590.62**	1.66	216	275.0	2250	0.10	183.806	183.531	0.28		188.500	2.23	2.00	186.32	Okay
P1-7	J-12	J-13	7.50	0.83	17.35	83.64		1.42	26.43	73.27	**6127.89**	**9201.96**	1.80	241	154.0	2550	0.10	183.531	183.377	0.15		188.000	1.68	1.63	186.15	Okay
P1-6	J-13	OUT_3	13.00	0.82	29.50	113.14		3.93	27.85	70.90	**8021.62**	**10167.12**	1.78	254	419.0	2700	0.09	183.377	183.000	0.38		187.800	1.47	1.55	186.08	Okay

SANDWICH SOUTH MSR - P2- OUT
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MP
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c **2) Intensity (i) = a*t^b** **3) Insert Intensity**

Based on 1:10 Year Storm Event
City of Windsor

a= 1511.000 **a=** **i=**
b= 9.500 **b=**
c= 0.845

Manning's n = 0.013

Total Area (ha)= 32.10
Outlet Invert Elevation= 183.900
Ground Elevation @ Outlet = 189.50
High Water Level at Outlet= 185.83

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
[STM-25] P2-3	J1	J2	6.30	0.60	10.51	10.51	20.0	5.73	20.00	86.55	**909.50**	**1232.89**	1.09	146	375.0	1200	0.10	185.943	185.568	0.38	0.500	189.250	1.96	2.99	187.14	Okay
[STM-26] P2-2	J2	J3	12.00	0.90	30.02	40.53		5.16	25.73	74.49	**3019.19**	**3634.96**	1.43	216	442.5	1800	0.10	185.068	184.625	0.44	0.500	189.900	2.82	2.16	186.87	Okay
[STM-27] P2-1	J3	J4	13.80	0.90	34.53	75.06		1.31	30.90	66.36	**4980.97**	**6590.62**	1.66	250	130.0	2250	0.10	184.125	183.995	0.13		188.800	2.18	2.31	186.38	Okay
[STM-28] P2-1	J4	OUT		0.90		75.06		0.96	32.20	64.60	**4848.73**	**6590.62**	1.66	250	95.0	2250	0.10	183.995	183.900	0.10		188.800	2.31	3.10	186.25	Okay

SANDWICH SOUTH MSR - P3- OUT_1
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Manning's n = 0.013

Total Area (ha)= 70.3

Outlet Invert Elevation= 181.400

Ground Elevation @ Outlet = 186.00

High Water Level at Outlet= 182.49

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P3-5	J1	J2	38.30	0.80	85.18	85.18	20.0	5.72	20.00	86.55	**7372.22**	**9585.65**	1.67	254	575.0	2700	0.08	183.809	183.349	0.46	0.600	188.800	2.04	1.88	186.51	Okay
P3-1	J2	J3	32.00	0.80	71.17	156.35		3.48	25.72	74.50	**11648.61**	**14886.51**	2.11	279	440.0	3000	0.11	182.749	182.265	0.48	0.600	188.180	2.15	2.16	185.75	Okay
Outlet	J3	Out_1	0.00	0.00	0.00	156.35		2.20	29.21	68.80	**10756.70**	**14193.73**	2.01	279	265.0	3000	0.10	181.665	181.400	0.27	0.000	187.700	2.76	1.32	184.67	Okay

SANDWICH SOUTH MSR - P3- OUT_2
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South
Project Number:19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Manning's n = 0.013

Total Area (ha)= 36.8

Outlet Invert Elevation= 180.700

Ground Elevation @ Outlet = 185.20

High Water Level at Outlet= 182.49

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P3-6	J4	J5	16.90	0.80	37.59	37.59	20.0	4.14	20.00	86.55	**3253.02**	**4024.80**	1.35	191	335.0	1950	0.08	182.049	181.781	0.27	0.500	186.500	2.31	2.08	184.00	Okay
P3-2	J5	J6	19.90	0.82	45.17	82.75		4.18	24.14	77.45	**6409.38**	**8210.44**	1.81	229	455.0	2400	0.11	181.281	180.780	0.50	0.000	186.000	2.09	2.09	183.68	Okay
Outlet	J6	Out_2	0.00	0.00	0.00	82.75		0.77	28.32	70.16	**5805.69**	**7828.34**	1.73	229	80.0	2400	0.10	180.780	180.700	0.08	0.000	185.500	2.09	1.87	183.18	Okay

Dillon Consulting Ltd.

SANDWICH SOUTH MSR - P3- OUT_3
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name:Sandwich South MSR
Project Number: 19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Manning's n = 0.013

Total Area (ha)= 39.91

Outlet Invert Elevation= 180.200

Ground Elevation @ Outlet = 185.20

High Water Level at Outlet= 182.49

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P3-7	J7	J8	17.70	0.80	39.36	39.36	20.0	3.82	20.00	86.55	**3407.01**	**4499.86**	1.51	191	345.0	1950	0.10	181.190	180.845	0.35	0.100	186.000	2.67	2.11	183.34	Okay
P3-3	J8	J9	22.21	0.80	49.40	88.76		4.29	23.82	78.09	**6931.66**	**7828.34**	1.73	229	445.0	2400	0.10	180.745	180.300	0.45	0.000	185.100	1.73	1.57	183.15	Okay
Outlet	J9	Out_3	0.00	0.00	0.00	88.76		0.96	28.10	70.50	**6257.86**	**7828.34**	1.73	229	100.0	2400	0.10	180.300	180.200	0.10	0.000	184.500	1.57	2.37	182.70	Okay

SANDWICH SOUTH MSR - P3 - OUT_4
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name:Sandwich South MSR
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Based on 1:10 Year Storm Event
City of Windsor

Manning's n = 0.013

Total Area (ha)= 36.3

Outlet Invert Elevation= 180.200

Ground Elevation @ Outlet = 184.50

High Water Level at Outlet= 182.49

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P3-8	J10	J11	15.10	0.23	9.65	9.65	20.0	5.66	20.00	86.55	**835.63**	**1232.89**	1.09	146	370.0	1200	0.10	182.449	182.079	0.37	1.050	186.500	2.71	2.08	183.65	Okay
P3-4	J11	J12	21.20	0.80	47.15	56.80		4.06	25.66	74.63	**4238.99**	**4719.49**	1.58	203	385.0	1950	0.11	181.029	180.605	0.42	0.050	185.500	2.32	1.74	183.09	Okay
Outlet	J12	Out_4	0.00	0.00	0.00	56.80		3.93	29.72	68.04	**3865.02**	**4499.86**	1.51	203	355.0	1950	0.10	180.555	180.200	0.36	0.000	184.500	1.79	2.15	182.75	Okay

SANDWICH SOUTH MSR - P4- OUT_1
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Based on 1:10 Year Storm Event
City of Windsor

Manning's n = 0.013

Total Area (ha)= 46.9
Outlet Invert Elevation= 179.500
Ground Elevation @ Outlet = 184.00
High Water Level at Outlet= 180.62

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P4-3	J6	J7	27.90	0.79	60.91	60.91	20.0	7.26	20.00	86.55	**5271.68**	**6715.38**	1.94	203	845.0	2100	0.15	182.081	180.813	1.27		187.070	2.69	2.38	184.18	Okay
P4-8	J7	J8	9.70	0.77	20.76	81.67		4.73	27.26	71.86	**5868.58**	**7219.67**	1.82	216	515.0	2250	0.12	180.813	180.195	0.62		185.500	2.22	2.60	183.06	Okay
P4-9	J8	OUT_1	9.30	0.77	19.91	101.58		6.69	31.99	64.88	**6590.08**	**7828.34**	1.73	229	695.0	2400	0.10	180.195	179.500	0.70		185.260	2.44	1.87	182.60	Okay

SANDWICH SOUTH MSR - P4- OUT_2
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Manning's n = 0.013

Total Area (ha)= 34.001

Outlet Invert Elevation= 179.500

Ground Elevation @ Outlet = 183.40

High Water Level at Outlet= 180.62

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P4-6	J9	J10	22.00	0.71	43.43	43.43	20.0	5.27	20.00	86.55	**3758.46**	**4719.49**	1.58	191	500.0	1950	0.11	180.670	180.120	0.55		184.600	1.79	2.34	182.72	Okay
P4-7	J10	OUT_2	12.00	0.74	24.69	68.11		6.23	25.27	75.32	**5130.21**	**6590.62**	1.66	216	620.0	2250	0.10	180.120	179.500	0.62		184.600	2.01	1.43	182.37	Okay

SANDWICH SOUTH MSR - P5
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Based on 1:10 Year Storm Event
City of Windsor

Manning's n = 0.013

Total Area (ha)= 53

Outlet Invert Elevation= 178.500

Ground Elevation @ Outlet = 183.50

High Water Level at Outlet= 179.88

Location													**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P5-3	J1	J2	20.60	0.90	51.54	51.54	20.0	4.26	20.00	86.55	**4460.87**	**5483.08**	1.58	203	405.0	2100	0.10	181.210	180.805	0.41	0.500	184.850	1.34	1.34	183.31	Okay
P5-4	J2	J4	3.10	0.90	7.76	59.30		1.21	24.26	77.22	**4578.86**	**5483.08**	1.58	203	115.0	2100	0.10	180.305	180.190	0.12	0.650	184.450	1.84	1.61	182.41	Okay
P5-1	J3	J4	16.40	0.90	41.03	41.03	20.0	4.04	20.00	86.55	**3551.37**	**4499.86**	1.51	191	365.0	1950	0.10	180.805	180.440	0.37	0.900	184.300	1.35	1.52	182.76	Okay
P5-2	J4	J5	9.00	0.90	22.52	122.85		2.58	25.47	74.95	**9207.92**	**10717.08**	1.87	254	290.0	2700	0.10	179.540	179.250	0.29	0.500	184.100	1.61	2.10	182.24	Okay
P5-5	J5	OUT1	3.90	0.95	10.30	133.15	20.0	2.23	28.06	70.58	**9396.95**	**10717.08**	1.87	254	250.0	2700	0.10	178.750	178.500	0.25		184.300	2.60	2.05	181.45	Okay

SANDWICH SOUTH MSR - P6 SOUTH-EAST
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c		**2) Intensity (i) = a*t^b**		**3) Insert Intensity**	
a=	1511.000	**a=**		**i=**	
b=	9.500	**b=**			
c=	0.845				

Manning's n = 0.013

Total Area (ha)= 52.4
Outlet Invert Elevation= 179.300
Ground Elevation @ Outlet = 184.50
High Water Level at Outlet= 182.00

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P6-1	J1	J2	26.20	0.90	65.55	65.55	20.0	3.93	20.00	86.55	**5673.53**	**6912.31**	1.74	216	410.0	2250	0.11	180.774	180.323	0.45	0.500	186.250	3.01	2.06	183.02	Okay
P6-2	J2	J3	26.20	0.80	58.27	123.82		2.80	23.93	77.87	**9641.77**	**11240.17**	1.96	254	330.0	2700	0.11	179.823	179.460	0.36	0.080	184.850	2.07	2.09	182.52	Okay
[STM-47] Outlet	J3	OUT_1	0.00		0.00	123.82		0.71	26.73	72.75	**9007.90**	**10717.08**	1.87	254	80.0	2700	0.10	179.380	179.300	0.08	0.000	184.500	2.17	2.25	182.08	Okay

SANDWICH SOUTH MSR - P7
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Based on 1:10 Year Storm Event
City of Windsor

Manning's n = 0.013

Total Area (ha)= 5.55

Outlet Invert Elevation= 179.100

Ground Elevation @ Outlet = 183.00

High Water Level at Outlet= 180.09

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P7-1	J1	J2	4.60	0.90	11.51	11.51	20.0	2.83	20.00	86.55	**996.12**	**1232.89**	1.09	146	185.0	1200	0.10	179.405	179.220	0.19	0.060	182.430	1.68	2.23	180.61	Okay
P7-2	J4	J3	0.30	0.95	0.79	0.79	20.0	1.56	20.00	86.55	**68.57**	**94.42**	0.85	76	80.0	375	0.29	179.587	179.355	0.23	0.060	183.100	3.06	3.09	180.53	Okay
P7-3	J5	J3	0.65	0.95	1.72	1.72	20.0	4.13	20.00	86.55	**148.58**	**192.33**	0.89	89	220.0	525	0.20	179.795	179.355	0.44	0.060	183.200	2.79	2.93	180.67	Okay
	J3	J2	0.00	0.00	0.00	2.51		0.99	24.13	77.48	**194.40**	**237.81**	0.84	95	50.0	600	0.15	179.295	179.220	0.08	0.060	182.900	2.91	2.89	180.41	Okay
OUTLET	J2	OUT_1	0.00	0.00	0.00	14.02		0.70	25.12	75.61	**1059.86**	**1350.56**	1.19	146	50.0	1200	0.12	179.160	179.100	0.06	0.000	182.800	2.29	2.55	180.36	Okay

SANDWICH SOUTH MSR - P8 - OUT_1
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

1) Intensity (i) = a/(t+b)^c **2) Intensity (i) = a*t^b** **3) Insert Intensity**

Based on 1:10 Year Storm Event
City of Windsor

a= 1511.000 **a=** **i=**
b= 9.500 **b=**
c= 0.845

Manning's n = 0.013

Total Area (ha)= 91.50 Outlet Invert Elevation= 178.600 Ground Elevation @ Outlet = 183.50 High Water Level at Outlet= 180.38

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P8-1	J0	J1	22.40	0.90	56.04	56.04	20.0	14.48	20.00	86.55	**4850.65**	**6590.62**	1.66	216	1440.0	2250	0.10	183.346	181.906	1.44	0.600	188.980	3.17	2.43	185.60	Okay
P8-2	J1	J2	21.80	0.90	54.54	110.59		8.62	34.48	61.76	**6830.16**	**7828.34**	1.73	229	895.0	2400	0.10	181.306	180.411	0.90	0.300	186.800	2.86	1.66	183.71	Okay
P8-3	J2	J3	8.70	0.90	21.77	132.36		4.86	43.10	53.09	**7027.16**	**9201.96**	1.80	241	525.0	2550	0.10	180.111	179.586	0.53	0.400	184.700	1.80	1.62	182.66	Okay
P8-4	J3	J4	27.40	0.90	68.55	200.91		4.83	47.96	49.28	**9899.94**	**12695.26**	1.80	279	520.0	3000	0.08	179.186	178.770	0.42	0.100	184.000	1.53	1.75	182.19	Okay
P8-9	J5	J4	11.20	0.90	28.02	28.02	20.0	6.38	20.00	86.55	**2425.33**	**3157.34**	1.48	165	565.0	1650	0.12	179.948	179.270	0.68	0.600	183.800	2.04	2.71	182.07	Okay
OUT_1	J4	OUT_1	0.00	0.00	0.00	228.93		0.82	52.78	46.03	**10537.62**	**12695.26**	1.80	279	88.0	3000	0.08	178.670	178.600	0.07	0.000	183.800	1.85	1.62	181.67	Okay

SANDWICH SOUTH MSR - P8- OUT_2
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Manning's n = 0.013

Total Area (ha)= 80.10

Outlet Invert Elevation= 178.500

Ground Elevation @ Outlet = 183.50

High Water Level at Outlet= 180.38

Location												**Sewer Design / Profile**										**Cover**			**Hydraulic Grade Line**	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P8-5	J6	J7	26.10	0.90	65.30	65.30	20.0	4.68	20.00	86.55	**5651.88**	**7001.88**	1.55	229	435.0	2400	0.08	180.174	179.826	0.35	0.010	185.620	2.82	2.25	183.04	Okay
P8-6	J7	J8	25.40	0.90	63.55	128.85		4.36	24.68	76.42	**9846.38**	**12695.26**	1.80	279	470.0	3000	0.08	179.816	179.440	0.38	0.010	184.700	1.61	1.08	182.82	Okay
P8-7	J8	J9	18.20	0.90	45.54	174.39		3.49	29.05	69.04	**12040.22**	**14193.73**	2.01	279	420.0	3000	0.10	179.430	179.010	0.42	0.030	183.800	1.09	1.11	182.43	Okay
P8-8	J9	OUT_2	10.40	0.90	26.02	200.41		3.03	32.53	64.17	**12860.59**	**15548.45**	2.20	279	400.0	3000	0.12	178.980	178.500	0.48	0.000	183.400	1.14	1.72	181.98	Okay

SANDWICH SOUTH MSR - P8- OUT_3
STORM SEWER DESIGN SHEET

Intensity Option # 1

Project Name: Sandwich South MSR
Project Number: 19-9817

Based on 1:10 Year Storm Event
City of Windsor

1) Intensity (i) = a/(t+b)^c
a= 1511.000
b= 9.500
c= 0.845

2) Intensity (i) = a*t^b
a=
b=

3) Insert Intensity
i=

Manning's n = 0.013

Total Area (ha)= 4.20

Outlet Invert Elevation= 178.500

Ground Elevation @ Outlet = 183.50

High Water Level at Outlet= 180.38

Location												Sewer Design / Profile										Cover			Hydraulic Grade Line	
Road /Stations	**From MH**	**To MH**	**Area (ha)**	**Run. Coef.**	**2.78AC**	**Accum. 2.78AC**	**T of In (min)**	**T of F (min)**	**T of Conc. (min)**	**Intensity (mm/hr)**	**Exp. Flow (L/s)**	**Capacity (L/s)**	**Velocity (m/s)**	**Wall Thickness (mm)**	**Length (m)**	**Pipe Dia. (mm)**	**Slope (%)**	**Invert Up MH**	**Invert Low MH**	**Fall (m)**	**Drop Across Low MH (m)**	**Ground Elev Up MH**	**Cover @ Up MH (m)**	**Cover @ Low MH (m)**	**HGL Elevation at Upstream MH**	**HGL Elev vs. Grnd Elev @ Up MH**
P8-10	J10	J11	2.40	0.90	6.00	6.00	20.0	6.50	20.00	86.55	**519.71**	**701.13**	1.10	121	430.0	900	0.15	179.777	179.132	0.65	0.030	182.300	1.50	2.55	181.05	Okay
P8-11	J11	OUT_3	1.80	0.90	4.50	10.51		5.47	26.50	73.14	**768.60**	**1057.61**	1.22	127	401.0	1050	0.15	179.102	178.500	0.60	0.000	182.700	2.42	3.82	180.70	Okay

Appendix F – 4-1

SWM Strategy - East Pelton Secondary Plan Area

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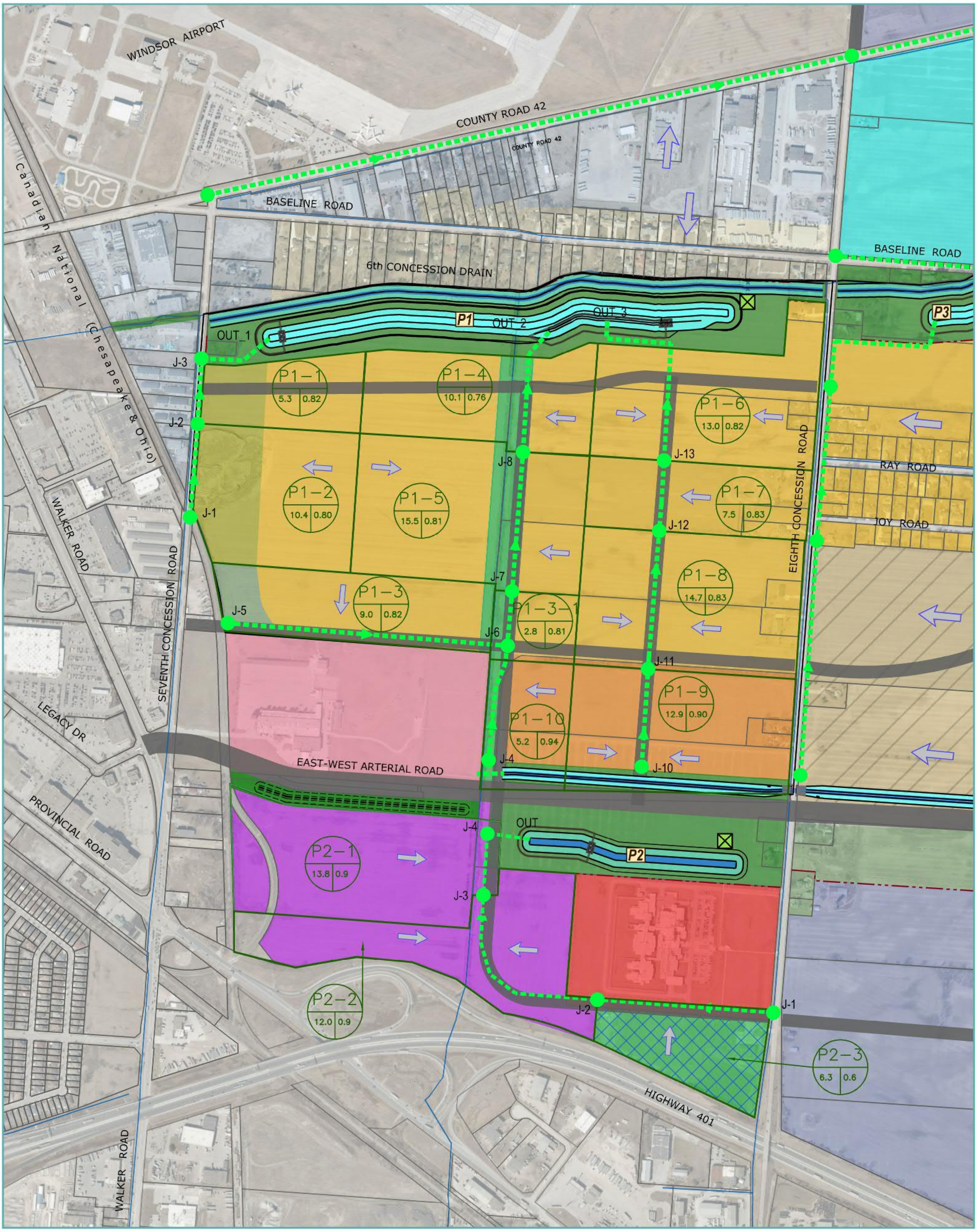

SANDWICH SOUTH MASTER SERVICING PLAN

- - - TRUNK STORM SEWER
▬ FUTURE COLLECTOR AND ARTERIAL ROADS
▨ OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
P1 TYPICAL POND NAME
— EXISITING DRAINS
DRAINAGE AREA ID
DRAINAGE AREA (Ha)
RUNOFF COEFFICIENT

🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
← PROPOSED STORM SEWER DRAINAGE
☒ STORMWATER PUMP STATION
🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL
▭ STORMWATER MANAGEMENT POND - ACTIVE STORAGE
═ MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND

🟨 Low Density Residential
▭ Medium Density Residential
▭ Business Park Type I
▨ Business Park Type II
🟥 Major Institutional
▭ Existing Employment
▭ Existing Residential
▨ Private Recreation
▭ Minor Institutional
🟧 Mixed Use
▭ Natural Heritage
▭ Neighbourhood Commercial
🟩 Open Space/Park
▭ Commercial Centre
🟩 SWM Corridor
▨ Airport Solar Farm
▨ Future Employment
▨ Future Urban

STORMWATER MANAGEMENT STRATEGY

EAST PELTON SPA

FIGURE F4-1

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

**2019 IMAGERY - THE DIGITAL MAP LAYERS HAVE BEEN USED WITH EXPRESS PERMISSION OF THE CORPORATION OF THE COUNTY OF ESSEX

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SCALE: 1:4000
STATUS: FINAL
PROJECT: 19-9817

DATE: April 17, 2023

File Location: c:\pw working directory\projects 2019\dillon_32edr\dms90713\199817-02-swm-ponds.dwg April, 17, 2023 2:01 PM

Appendix F – 4-2

SWM Strategy - County Road 42 Secondary Plan Area

Sandwich South Master Servicing Plan
Municipal Servicing Functional Design Report
May 2023 - 19-9817

DILLON
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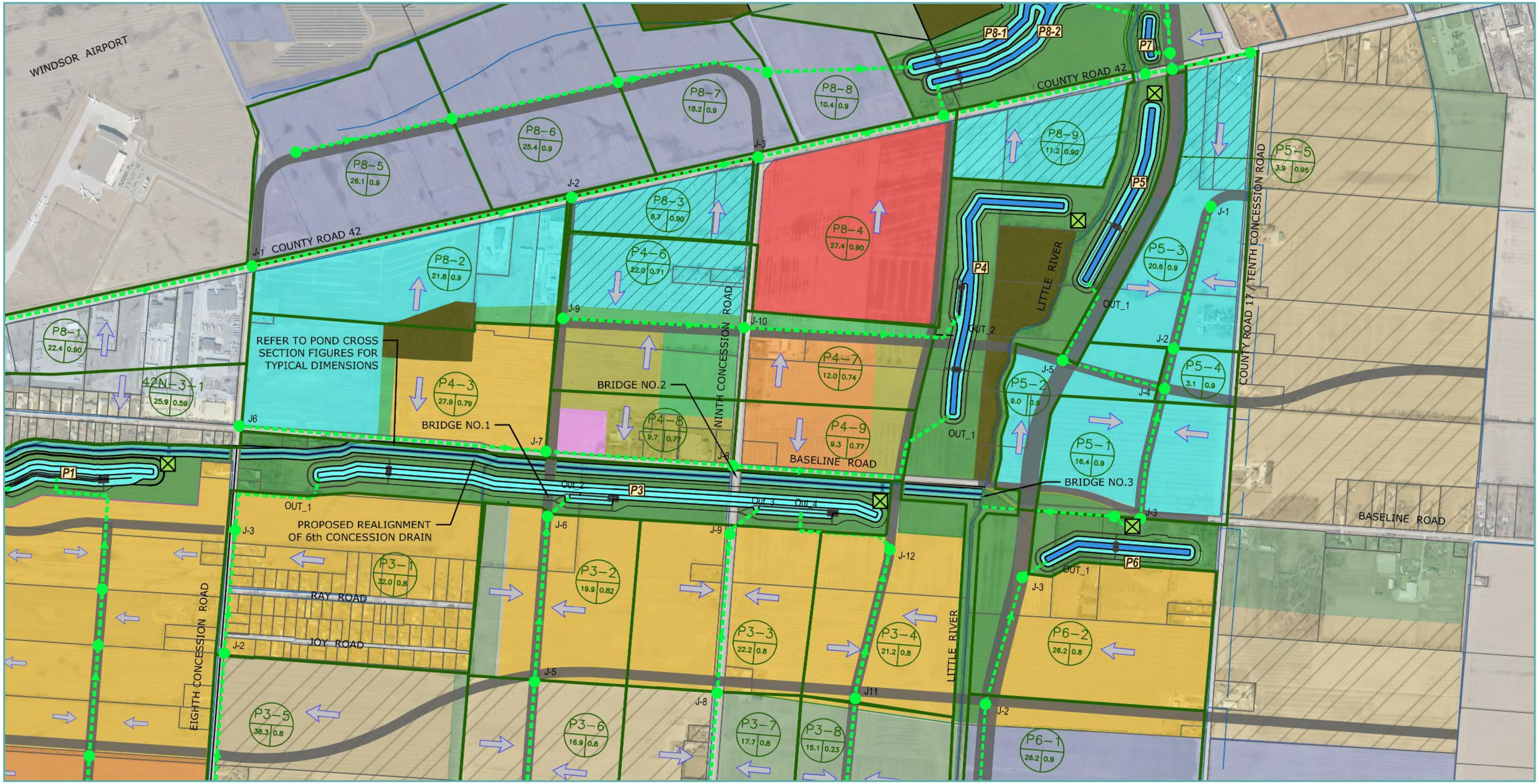

TRUNK STORM SEWER

EXISITING DRAINS

DRAINAGE AREA ID

DRAINAGE AREA (Ha)

RUNOFF COEFFICIENT

FUTURE COLLECTOR AND ARTERIAL ROADS

OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR

OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR

PROPOSED STORM SEWER DRAINAGE ARROW

P1 TYPICAL POND NAME

☒ STORMWATER PUMP STATION

STORMWATER MANAGEMENT POND- PERMANENT POOL

STORMWATER MANAGEMENT POND - ACTIVE STORAGE

MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND
- Low Density Residential
- Medium Density Residential
- Business Park Type I
- Business Park Type II
- Major Institutional
- Existing Employment
- Existing Residential
- Private Recreation
- Minor Institutional
- Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- Open Space/Park
- Commercial Centre
- SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT STRATEGY
CR42 SPA
FIGURE F4-2

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

**2019 IMAGERY - THE DIGITAL MAP LAYERS HAVE BEEN USED WITH EXPRESS PERMISSION OF THE CORPORATION OF THE COUNTY OF ESSEX

N W E S

STATUS: FINAL
SCALE: 1:5000
PROJECT: 19 9817
DATE: April 17, 2023

File Location: c:\pw working directory\projects 2019\dillon_32edr\dms90713\199817-02-swm-ponds.dwg April, 17, 2023 2:38 PM

Appendix F – 4-3

SWM Strategy - Lauzon Parkway and County Road 42 Intersection

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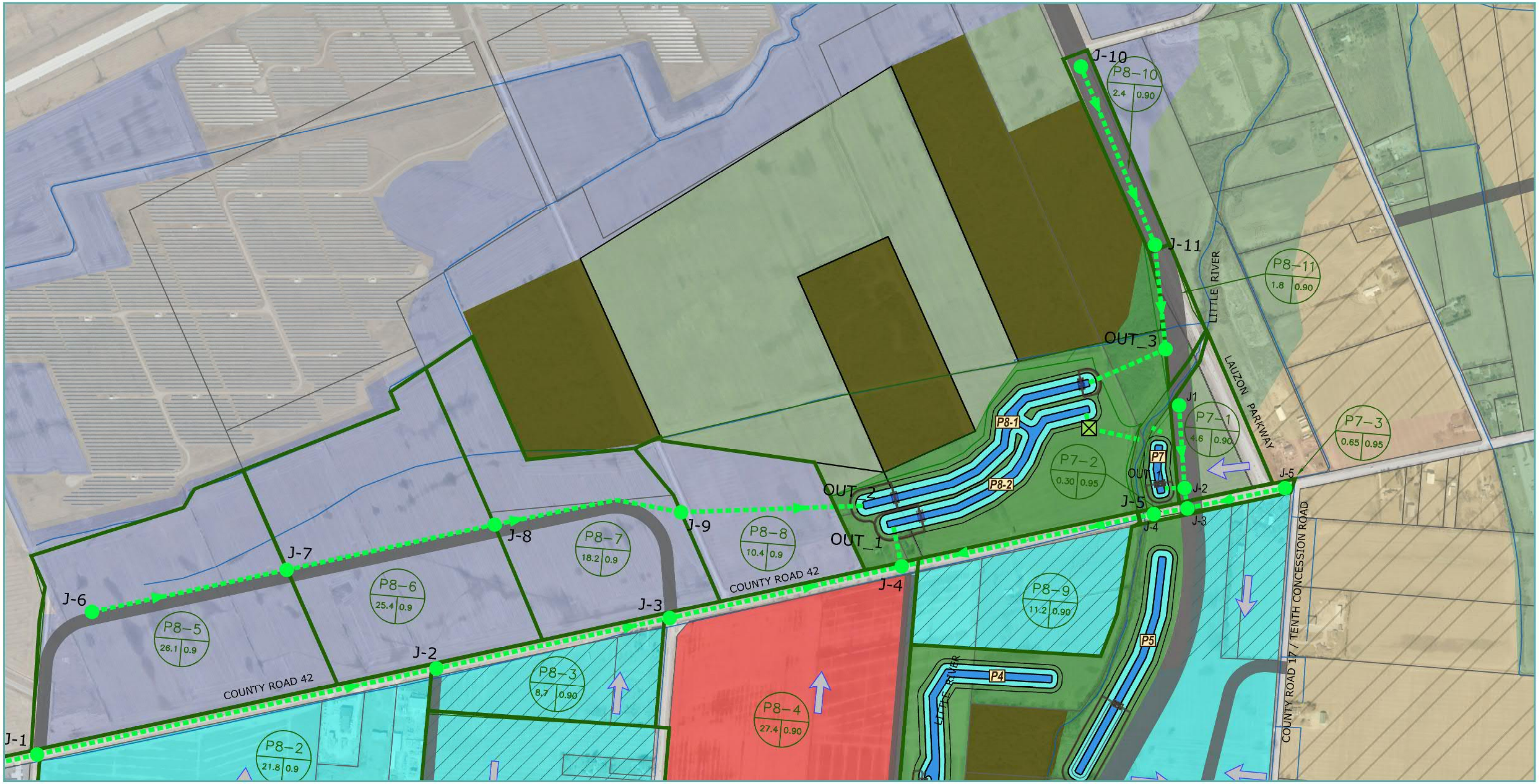

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT STRATEGY
LAUZON PARKWAY AND CR42 INTERSECTION

FIGURE F4-3

TRUNK STORM SEWER

EXISITING DRAINS

DRAINAGE AREA ID

DRAINAGE AREA (Ha)

RUNOFF COEFFICIENT

FUTURE COLLECTOR AND ARTERIAL ROADS

OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR

OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR

PROPOSED STORM SEWER DRAINAGE ARROW

P1 TYPICAL POND NAME

☒ STORMWATER PUMP STATION

STORMWATER MANAGEMENT POND- PERMANENT POOL

STORMWATER MANAGEMENT POND - ACTIVE STORAGE

MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

LEGEND

- Low Density Residential
- Medium Density Residential
- Business Park Type I
- Business Park Type II
- Major Institutional
- Existing Employment
- Existing Residential
- Private Recreation
- Minor Institutional
- Mixed Use
- Natural Heritage
- Neighbourhood Commercial
- Open Space/Park
- Commercial Centre
- SWM Corridor
- Airport Solar Farm
- Future Employment
- Future Urban

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

**2019 IMAGERY - THE DIGITAL MAP LAYERS HAVE BEEN USED WITH EXPRESS PERMISSION OF THE CORPORATION OF THE COUNTY OF ESSEX

N W E S

STATUS: FINAL SCALE: 1:4000 PROJECT: 19 9817 DATE: April 17, 2023

File Location: c:\pw working directory\projects 2019\dillon_32edr\dms90713\199817-02-swm-ponds.dwg April, 17, 2023 2:36 PM

Appendix F - 5

Sandwich South Master Servicing Criteria and Assumptions Memo

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Memo

To: Patrick Winters, P.Eng. – City of Windsor

From: Laura Herlehy, P.Eng. – Dillon Consulting Limited
Dean Rice, P.Eng. - Dillon Consulting Limited
Ryan Langlois, P.Eng. – Dillon Consulting Limited

cc: Fahd Mikheal, P.Eng. – City of Windsor
Anna Godo, P.Eng. – City of Windsor
Andrea Winter, P.Eng. - Dillon Consulting Limited

Date: June 7, 2021

Subject: Sandwich South Master Servicing Study – Underground Infrastructure Design Criteria and Assumptions

Our File: 19-9817

On April 29, 2021, Dillon Consulting Limited (Dillon) provided a presentation to City of Windsor Engineering Staff regarding Criteria and Assumptions used to complete the Master Servicing Plan for the Sandwich South Secondary Plan Area in the City of Windsor. The following memo provides a summary of design criteria and assumptions presented and used for infrastructure servicing design as part of the Sandwich South Master Servicing Plan (SSMSP). A copy of the presentation from the April 29, 2021 meeting has been attached for reference. The purpose of this memo is to provide the City an opportunity to review and provide comment on the design criteria established. The design criteria listed herein will be used as a basis for the development of an Area Specific Standalone Development Manual which will provide the framework for all future development in this area.

The design criteria and assumptions outlined herein have been developed through a review of City of Windsor and regional/provincial design guidelines along with completed and ongoing studies and secondary plans for the Sandwich South project area. Documents reviewed and referenced include the following:

- City of Windsor Development Manual (2015);
- Upper Little River Watershed Master Drainage and Stormwater Management Plan (Stantec Consulting Limited) (ongoing);
- Secondary Plans:
    - East Pelton Planning Area;
    - County Road 42 Planning Area (ongoing);
- Growth Management Study (Hemson Consulting Ltd., ongoing);
- WUC Water System Master Plan 2019 Update (2020);
- Windsor Sewer and Coastal Flood Protection Master Plan (Dillon Consulting Limited, 2020);
- Design Guidelines for Sewage Works (MECP, 2008);
- Draft Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval (MECP, 2019);

- Windsor/Essex Region Stormwater Management Standards Manual (ERCA, 2018); and
- Sanitary Sewer Servicing Study for Lands Annexed from the Town of Tecumseh (Stantec, 2006)

The design of the proposed municipal services is based on the land use plan for the Sandwich South area (provided by Hemson in 2018) and has been attached for reference.

We also understand that the City of Windsor is currently updating the 2015 Development Manual which includes infrastructure design criteria. This information is not currently available and therefore has not been reviewed as part of this memo.

Stormwater Servicing

Storm Sewer Design

It is our understanding that the City of Windsor has adopted the 2018 Windsor/Essex Region Stormwater Management Standards Manual (WERSWM) as the governing stormwater design guidelines for both major and minor system stormwater design. As such, the design criteria outlined in the WERSWM will be adopted by the SSMSP, including a 0.30 m minor system HGL clearance/depth requirement from proposed finished ground elevation. Additionally, velocities and cover requirements have been added to the design which are found within the City of Windsor Development Manual (2015). The proposed design criteria for trunk storm sewer infrastructure is summarized within Table 1 below.

Table 1: Proposed Storm Sewer Design Criteria

Parameter	Design Criteria
Return Period	1:5 Year
Storm Sewer Design	Rational Method
Hydraulic Storm Sewer Sizing	Manning's Equation
Manning's Roughness Coefficient 'n'	0.013
IDF Rainfall Data	Windsor Airport (Station No 6139525)
Initial Time of Inlet (T_i)	20 Minutes
Minimum Velocity	0.76 m/s
Maximum Velocity	3.0 m/s
Minimum Pipe Cover	1.0 m
Minimum Trunk Sewer Diameter[1]	1050 mm

Note 1: For the purposes of this SSMSP, functional design and cost estimates will be provided for trunk infrastructure only. This includes storm sewers greater than 1050 mm in diameter.

In order to quantify stormwater flows using the rational method, proposed runoff coefficients for the various land uses within the Sandwich South project area were established (Table 2).

These coefficients align with those found within the WERSWM. Weighted runoff coefficients were determined based on the established land use plan (Hemson, 2018).

Table 2: Proposed Runoff Coefficients and Impervious Values

Proposed Land Use	Runoff Coefficient*	Impervious (%)*
Green Space	0.20	0
Residential –Single Family	0.60	60
Residential –Single Family (lot size 500 m2 or less)	0.70	70
Residential – Semi-Detached	0.70	70
Residential – Townhouse/ Row housing	0.80	80
Industrial/ Commercial	0.90	90

*Values from Windsor/Essex Region Stormwater Management Standards Manual (2018)

Stormwater Management Facilities

Regional Stormwater Management (SWM) Facilities throughout the Sandwich South area are to be sized for both water quantity and water quality control, in conjunction with the requirements set out within the WERSWM and the 2003 MOE Stormwater Management Planning and Design Manual (SWMPDM). The SWM Facilities are to be sized based on the proposed contributing service area and future development densities. In order to quantify the required stormwater volume requirements for quantity control using dynamic SWM modelling, impervious values for the various land uses within the Sandwich South project area where used and are included in Table 2. These values align with those found within the WERSWM.

The SWM Design requirements through the Sandwich South area are to adhere to the following:

- Water Quality: Provide a Normal Level of Protection (70% long-term SS Removal) for water quality treatment through:
  - Provide permanent pool within the SWM Facility to meet the requirements set out within Table 3.2 and Table 4.6 of the SWMPDM; and
  - Provide inlet forebay to meet the minimum design criteria, settling distances and dispersion lengths as per Table 4.6 and Section 4.6.2 of the SWMPDM.
- Water Quantity Control: Provide sufficient active storage volume within the SWM Facility to control post development peak flows to the municipal drain capacity:
  - Maximum post-development 2-year allowable release rate of 3 L/s/ha;
  - Maximum post-development 5-year allowable release rate of 4 L/s/ha;
  - Maximum post-development 100-year and UST allowable release rate of 6 L/s/ha;

  - Meet the 1:100 year storage requirements with a minimum 0.30 m freeboard from pond water surface elevation to proposed top of bank;, and
  - Meet the Urban Stress Test (UST) storage requirements where the pond water surface elevation is not exceeding the proposed top of bank.
- Trunk storm sewer design takes into consideration the proposed tailwater within the SWM facility based on the dynamic modelling water levels for an adequate collection and conveyance design for developed service area runoff.
- Pond drawdown time to be less than 48 hours for the 1:100 year storm event.
- Pond inlet pipes to be unsubmerged during dry weather.
- Due to the proximity of SWM Facilities to the Windsor International Airport (WIA), the functional design of the SWM Facilities are to consist of elongated ponds, maximizing length, minimizing width and using steeper side slopes along the wetted perimeter, where feasible, to mitigate against waterfowl. The SWM Facilities are therefore to be sized based on the criteria below. For reference, a conceptual pond cross section has been attached:
  - Side Slopes: 5:1 (active storage) and 1.5:1 (permanent pool); and
  - Total Pond depths of approximately 4 m - 5 m, comprised of:
    - An approximately 1.5 m deep permanent pool; and
    - An approximately 2.5 m – 3.5 m deep active storage area;
      - Pond depth and footprint is dependent on the necessary cover required on the corresponding storm sewer system which will vary for each drainage area.
  - Ponds to outlet to existing/future municipal drains via pump stations:
    - Consolidated regional pump stations are preferred to minimize overall long term operation and maintenance costs; and
    - A functional design of the pump station will be developed and reviewed with the City
      - Pump stations to require backup power generation.
  - Ponds to be located within future SWM corridors (established per the Upper Little River Watershed Master Drainage and Stormwater Management Plan (ULRMP)):
    - Municipal drains providing outlet for all pond/PSs will run continuously along these corridors, including 6th Concession Drain, the proposed East-West Arterial Drain and the existing Little River Drain;
    - Corridors will include natural linkages to each SWM Facility, maintenance access pathways, provide framework for the Natural Heritage System and active transportation facilities; and
    - Based on the criteria listed above and the functional design of the required SWM corridor features, the required corridor width will be refined.
  - Through discussions with WIA staff, waterfowl mitigation measures to be incorporated in SWM Facility design include:
    - Minimizing permanent open water space (ie. Permanent Pool) width and promoting heavy vegetative plantings along the sloped banks;

- Provide screening along the top of banks such as trees, and rocks; and
- Once the criteria listed above is approved by the City, the corresponding functional pond, pump station and storm sewer layout will be provided to the City and WIA to provide further comment and review.

Sanitary Servicing

The following is intended to provide recommendations for trunk sanitary sewer design criteria to be included within the SSMSP. For the purpose of the SSMSP, trunk sanitary sewers are defined as those 375mm in diameter or greater. The functional design and associated costs estimates for this study will be provided for trunk sanitary sewers only.

Sanitary Sewage Generation Rate

A review of various local and regional sewage generation rates was undertaken to provide a comparison with the current City of Windsor development manual. This comparison included the sewage rates used in the design of the existing Sandwich South Trunk Sanitary Sewer (SSTSS) as outlined within the Sanitary Sewer Servicing Study for Lands Annexed from the Town of Tecumseh (SSSEA, 2006), which will serve as the sanitary outlet for the Sandwich South Area. A summary of the sewage generation rates can be found within Table 3 below.

Table 3: Comparison of Average Sewage Generation Rates

Location	Generation Rate (L/Cap/day)
Windsor (Current Development Manual, 2015)	363
MECP	225-450
Amherstburg	450
Tecumseh	300
Lakeshore	450
SSSEA (2006)	363

The current City of Windsor sewage generation rate of 363 L/Cap/day is within the MECP recommended range (225 L/cap/day – 450 L/cap/day). The Town of Amherstburg and Lakeshore rates are at the upper end of the MECP recommendations whereas, the rate used in the Town of Tecumseh is lower. Based on this review it is recommended that a sewage generation rate of 363 L/Cap/day be used for sanitary sewage design within the Sandwich South Project area. Not only does this rate align with the existing City standard, it also aligns with the rate used in the SSSEA design.

Peaking Factor

The City of Windsor development manual recommends the use of an “Ultimate Flow Factor” (UFF) in place of the Harmon Formula, outlined by the MECP, to calculate peak sanitary flows. A comparison of the UFF and Harmon Formula shows that the UFF produces a higher peak factor by between 20% and 60% and has a higher minimum factor and lower maximum population (3.8 and 20,000 persons) compared with the Harmon Formula (2.0 and 100,000 persons). The Annexed Lands Sanitary EA also used the Harmon Formula in the design of the existing SSTSS. Considering the estimated design population of 82,000 and the potential impacts a higher design flow could have on the existing SSTSS, we recommend using the Harmon Formula for the peaking factor within the Sandwich South project area.

Sanitary Design Population Densities

Sanitary design population densities outlined within the City’s Development Manual were compared with the East Pelton and County Road 42 Secondary Plans. It was found that the secondary plans generally permit increased residential density for both medium and low density land uses, when compared with the 50 persons per hectare outlined within the current Development Manual. The secondary plans were used to create specific design densities based on the land use and allowable densities found within the respective secondary plans.

Table 4 below outlines the proposed residential population densities for the Sandwich South area. The assumptions used to determine the aforementioned densities include 3.0 persons per unit for low density and 2.0 persons per unit for medium density. Future urban area population density is proposed to align with the City Development Manual.

Table 4: Proposed Residential Population Densities

Land Use	East Pelton	County Road 42	Other
Low Density Residential	36ppl/ha	75ppl/ha	--
Medium Density Residential	80ppl/ha	106ppl/ha	--
Mixed Use	92ppl/ha	112ppl/ha	--
Future Urban	--	--	50ppl/ha

For comparison, the population densities for the SSSEA are: 49.4ppl/ha (Residential) and 55.6ppl/ha (Mixed Use). The Development Manual lists a Residential density of 50ppl/ha. It should be noted that the Low Density Residential population densities between the two secondary plan areas are significantly different. It was discussed during the April 29, 2021 meeting, that a blended density of 50 ppl/ha may be more suitable, the City shall confirm the most appropriate density that is expected for these areas.

Table 5 outlines the proposed Commercial and Industrial population densities. The densities are based on the current City Development Manual.

Table 5: Proposed Commercial/Industrial Population Densities

Land Use	East Pelton	County Road 42	Other
Commercial	74ppl/ha	74ppl/ha	--
Business Park Type I	--	68ppl/ha	--
Business Park Type II	--	74ppl/ha	--
Future Employment	--	--	68ppl/ha

For comparison, the population densities for the Annexed Lands Sanitary EA are: 64.8ppl/ha (Commercial) and 92.7ppl/ha (Industrial). The population densities for the City of Windsor Development Manual are:

- 74ppl/ha (Commercial), and
- 62ppl/ha (Industrial)

Institutional/other population densities were developed using MECP guidelines and the City of Windsor Development Manual. Equivalent population densities for Major Institutional and Private Recreation land uses are based on per bed or per site sewage generation rates outlined within the MECP Sewer Design Guidelines (2008) and the total site area. Minor Institutional density has been taken from the City's Development Manual. A summary of Institutional/Other population densities is outlined within Table 6 below.

Table 6: Proposed Institutional/Other Population Densities

Land Use	East Pelton	County Road 42
Major Institutional	Correctional Facility 30ppl/ha (equivalent)	Hospital 76ppl/ha (equivalent)
Minor Institutional	Church 22ppl/ha	--
Private Recreation	Windsor Campground 78ppl/ha (equivalent)	--

Assumptions used to generate equivalent institutional/other population densities are listed below:

- Major Institutional (Correctional Facility)
    - 315 beds
    - 12.17 ha site
    - 363 L/bed/day
- Major Institutional (Hospital)
    - 669 beds (full buildout)- Windsor Regional Hospital Stage 1 Proposal Submission Part B, June 2015
    - 24.25 ha site

    - 1000L/bed/day (MECP)
- Private Recreation (Windsor Campground)
    - 208 sites (184 serviced)
    - 5.4 ha site
    - 735L/site/day (MECP composite rate)

For comparison, the City of Windsor Development Manual has a listed density of 22ppl/ha for institutional land use. The Annexed Lands Sanitary EA did not have comparable densities for the above noted land uses.

Extraneous Flow Allowances

Extraneous flow allowances represent the dry weather ground water infiltration rate that could be expected over the life cycle of the proposed sanitary sewer. These values do not represent infiltration observed post construction, as newly constructed systems should not result in extraneous flows greater than 5%-10% for the design infiltration rate. For comparison, design rates from other sources were reviewed which included the SSSEA, the City of Windsor Development Manual, MECP 2019 Draft Sewer Design Criteria, and adjacent Town/Municipality Development Manuals. The values from these sources for comparison are shown in Table 7 below.

Table 7: Sanitary Infiltration Rate Comparison

Source	Infiltration Rate
SSSEA (2006)	0.117 L/s/ha
City of Windsor Development Manual (2015)	0.156 L/s/ha
Draft MECP Sewer Design Criteria (2019)	0.1-0.25 L/s/ha
Tecumseh	0.19 L/s/ha
Amherstburg	0.2 L/s/ha
Lakeshore	0.21 L/s/ha

Based on a review of the infiltration rates noted above, it is recommended that the extraneous flow allowance of 0.156 L/s/ha be used for sanitary design within the Sandwich South project area. This recommended value is within the new MECP guidelines range, however is greater than that assumed in the SSSEA.

We further note that extraneous flow is not used in the determination of treatment plant capacity as treatment plant capacity is a function of average population flow. The available treatment plant capacity and threshold of development that could occur prior to plant expansion will be provided via a separate summary memo.

For the Windsor Sewer and Coastal Flood Protection Master Plan (2020) (WSMP), a wet weather flow allowance from the Sandwich South development area of 1.0 L/s/Ha was allocated in the ultimate condition sewer model. The development of that value is outlined in the WSMP, Technical Volume 2

Report. That value is not intended to be the basis for sewer design as an extraneous flow allowance but was used to represent a wet weather inflow and infiltration estimate to evaluate flood risk areas downstream within existing developed areas within the City.

Design Flow

The peak design flow was reviewed for both the Little River Pollution Control Plant (LRPCP) and the Lou Romano Water Reclamation Plant (LRWRP) drainage areas based on the design criteria and assumptions listed previously. A summary of the Sandwich South design sanitary flow is outlined below.

Little River Pollution Control Plant

- Total Sanitary Design Population: **78,900**
- Sanitary Drainage Area: **1,979 ha**
- SSMSP Peak Design Flow: **2,305 L/s**
  - 325 L/s Oldcastle (Tecumseh)
  - 983 L/s Tecumseh Hamlet
- Annexed Lands Sanitary EA (SSSEA) Peak Design Flow: **2,441 L/s**
- Capacity of Downstream Sewer (ID 269393): **2,629 L/s**

Lou Romano Water Reclamation Plant

- Total Sanitary Design Population: **3,192**
- Sanitary Drainage Area: **68 ha**
- Peak Design Flow: **57 L/s**

Based on the above, the downstream sanitary trunk sewer facilities will have capacity to accommodate the full build out of the study area based on the established land use plan and listed population densities.

Additional Sanitary Servicing Recommendations

The following additional recommendations have been proposed for inclusion within the Sandwich South Master Servicing Report:

- All new manholes shall be watertight and wrapped in waterproof membrane if installed below the seasonally high groundwater table (proposed MECP design criteria).
- Sanitary flows for all new development should be monitored pre (if applicable) and post construction. The City shall include maximum extraneous flow requirements in development agreements both ultimate design conditions (0.156 L/S/ha) for post construction conditions (5% - 10% of the ultimate condition design allowance).
- Sampling manholes for all larger developments and manholes at the downstream end of all new development shall be installed and sized to accommodate monitoring equipment.
- Sewage Ejectors to be required for all new homes.
- Building Management:
  - Home management practices- prohibit window wells and roof drain connections, enforce proper lot grading; and

    - Inspection/testing of private drain connection (through permitting process).

Little River Pollution Control Plant

A review of the existing LRPCP capacity is currently underway. Once the sanitary design criteria and population flows outlined herein have been confirmed, the available plant capacity can be quantified in terms of allowable sanitary sewage generation. Further to this, development progress (population growth) triggers will be established to indicate when capacity improvements to the LRPCP should be considered.

Water Distribution & Servicing

The water distribution and servicing requirements and upgrades within the Sandwich South project area were evaluated as part of the WUC Water System Master Plan 2019 (WUCMP) Update. The WUC MP used existing infrastructure and future growth projections to model the performance of the water treatment and distribution system and provide recommendations on water infrastructure improvements required to meet future demand, including within Sandwich South.

Some of the key assumptions used in the report include the following:

- Water system demand criteria based on 2017 ENWIN Treated Water Pumpage Report
    - Residential/non-residential (ICI) split (52%/48%)
    - Maximum day demand factor of 1.47
    - Peak hour demand factor of 2.28
- Water demand rates:
    - Future residential water demand: **227 L/cap/d**
    - Future non-residential water demand: **210 L/cap/d**

Within the study included recommendations for proposed trunk watermain to service this area, defined as 400 mm diameter or greater. Local distribution mains will be required to provide services to new development however design of those facilities is outside the scope of this project.

The WUCMP recommended the following trunk watermain distribution infrastructure:

- 8th Concession Road - County Road 42 to Highway 401- 600 mm diameter WM;
- County Road 42 – 8th Concession Road to East City Limits - 600 mm diameter WM;
- 9th Concession Road - County Road 42 to Highway 401- 400 mm diameter WM;
- 10th Concession Road - County Road 42 to Highway 401 - 400 mm diameter WM; and
- Highway 401 – 8th Concession Road to 10th Concession Road. - 400 mm diameter WM

A new elevated storage tank is proposed in the area of the Provincial Road and Walker Road intersection. The elevated tank will be similar in specifications to the existing Hanna Elevated Tank and will be required to provide adequate capacity and pressure in the proposed development area. It should be noted that the Town of Tecumseh's Water and Wastewater master plan also recommends a water tower in this area, future coordination between the two municipalities is required.

The recommendations related to the Sandwich South study area found within the WUC MP (watermain sizes, costs, etc.) are proposed to be included (referenced) within the SSMSP. It is assumed that no further water servicing assessment is required. Required alignments for these watermains shall be accommodated in the functional design of the SSMSP.

Utilities

Hydro One

A meeting was held with Hydro One in March 2020 to discuss Hydro One servicing in the development area. Hydro One has immediate plans to extend aerial hydro service along the south side of County Road 42. Alignment to be provided to the City for approval as it relates to the CR42 EA and proposed roadway cross section.

Other Utilities

The other utilities are aware of the project and have been provided with the land use and proposed populations. There are currently no noted concerns with utility servicing and follow-up correspondence will be conducted once road cross-sections are available to confirm utility alignments.

Closure

Dillon requests confirmation that the City is in agreement with above noted infrastructure design criteria and that it is acceptable for use within the Sandwich South Master Servicing Report. Confirming the design criteria is a critical step in finalizing the infrastructure design alternatives in preparation of PIC 2.

Regards,

Laura Herlehy

Laura Herlehy, P.Eng.
Project Engineer

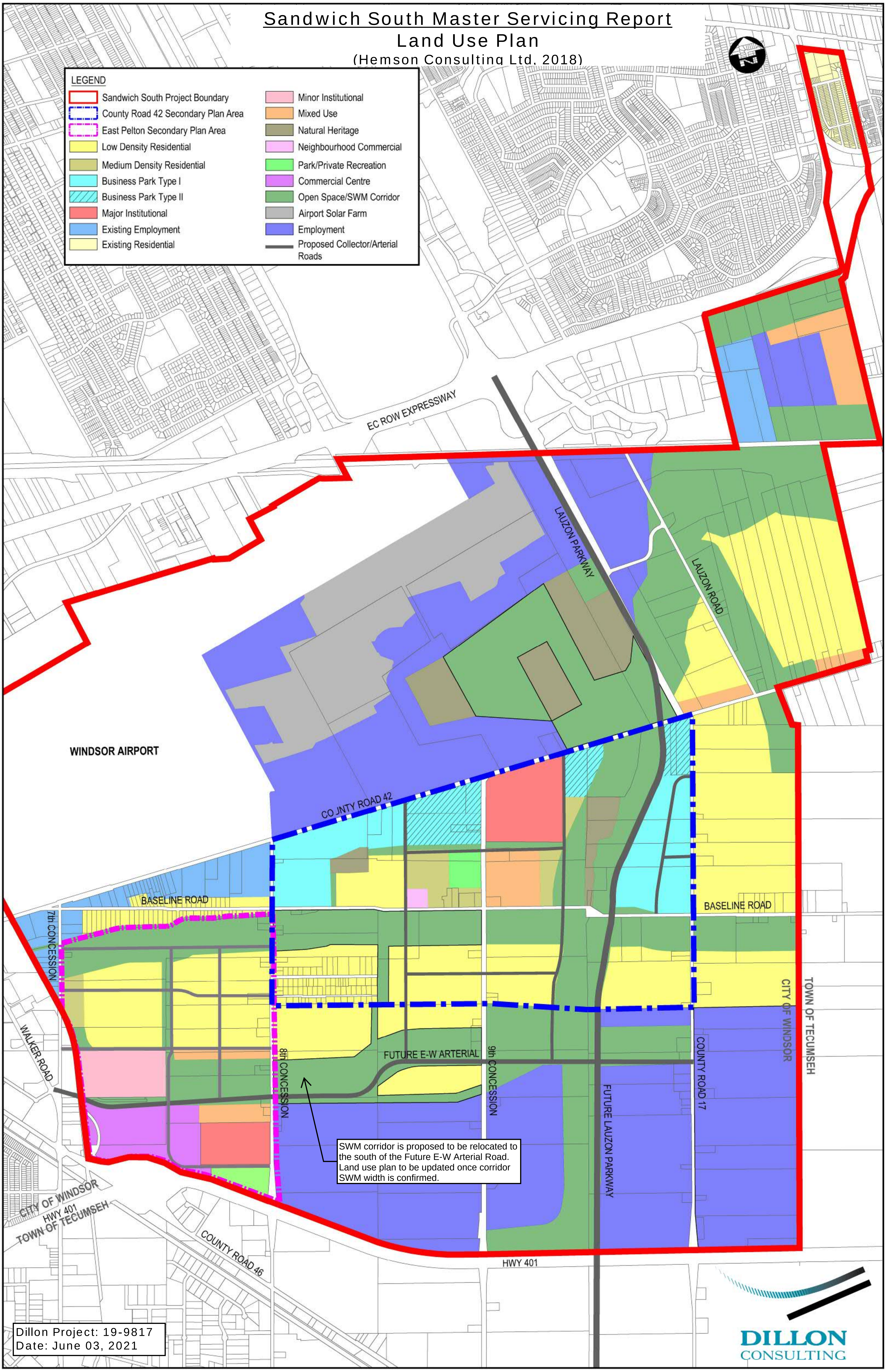
Dean Rice, M.A.Sc., P.Eng.
Project Engineer

Ryan Langlois, P.Eng.
Water Resources Engineer

Sandwich South Master Servicing Report

Land Use Plan

(Hemson Consulting Ltd, 2018)

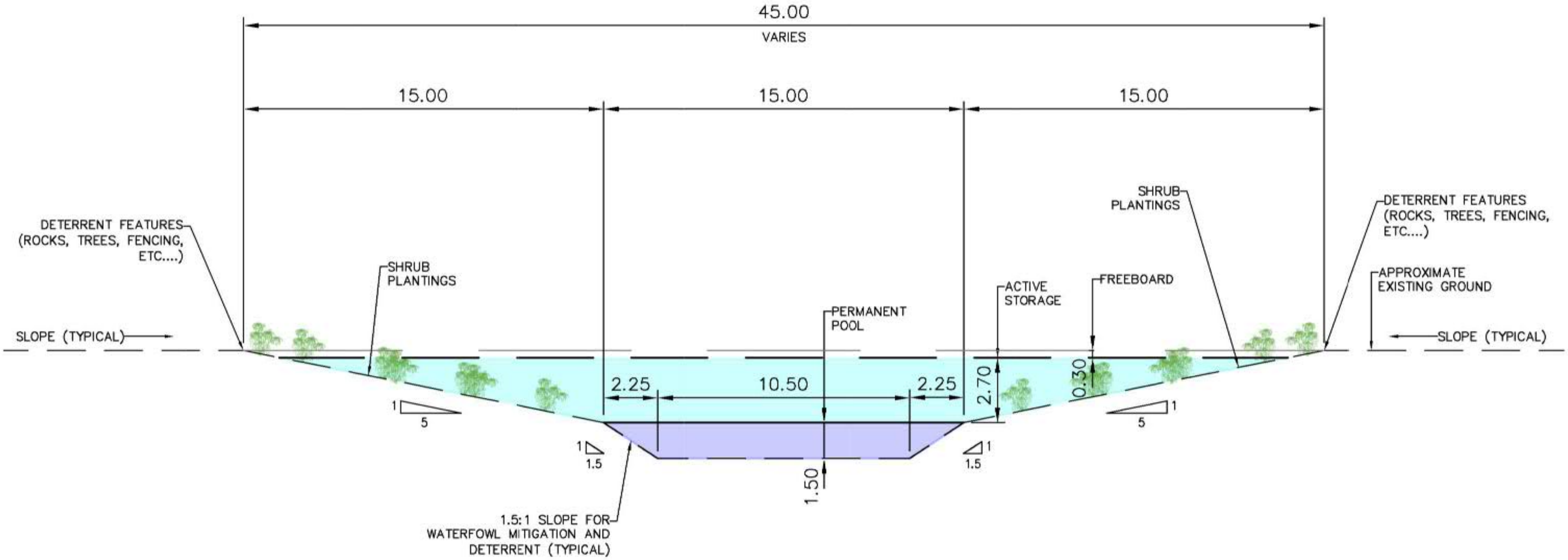


SWM corridor is proposed to be relocated to the south of the Future E-W Arterial Road. Land use plan to be updated once corridor SWM width is confirmed.

Dillon Project: 19-9817
Date: June 03, 2021

DILLON CONSULTING

Sandwich South Master Servicing Report
Conceptual Pond Section



Dillon Project: 19-9817
Date: June 03, 2021

DILLON CONSULTING

Sandwich South Secondary Plan Area- Servicing

Criteria and Assumptions Review Meeting

April 29, 2021

Agenda and Purpose

Agenda

- Sanitary Servicing
  - Population Densities
  - Extraneous Flow Allowances
  - Treatment Plant – Next Steps
- Water Distribution/ENWIN
- Stormwater Management/Storm Servicing
- Utilities
  - Hydro One Discussions
  - Next Steps
- Coordination with Developers
- Next Steps

Meeting Purpose

- Confirm design criteria for various municipal services.

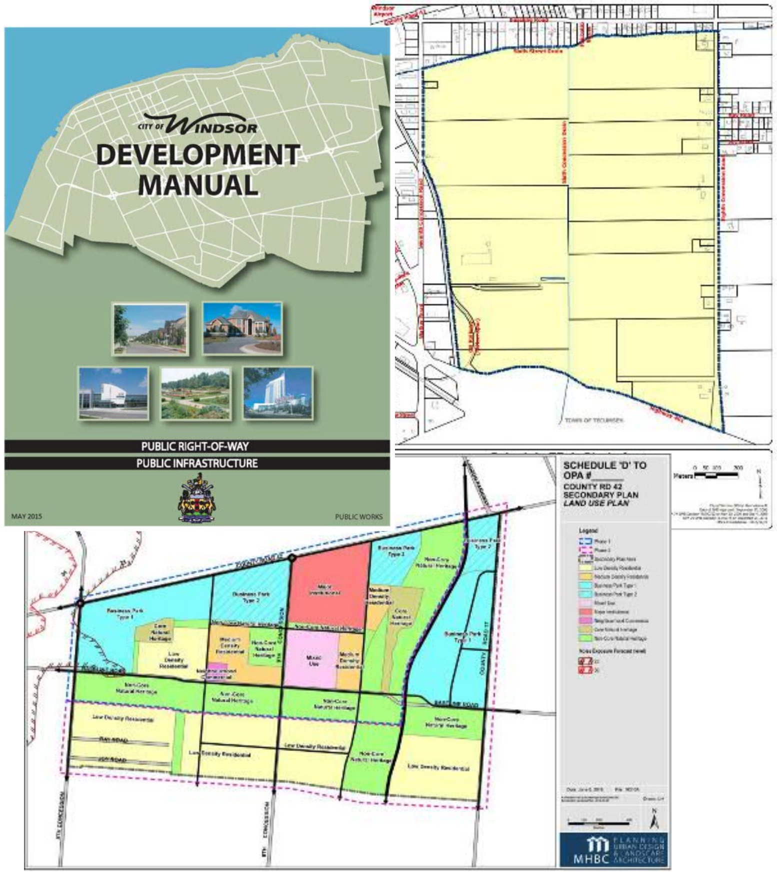
SANDWICH SOUTH
MASTER SERVICING
PLAN

Sanitary Servicing

Sanitary Sewer Design Criteria

Sources for criteria:

- City of Windsor Development Manual (2015)
  - Pipe minimum parameters
  - Flow volume parameters (population densities, ultimate flow factors, etc.)
- Secondary Plans:
  - East Pelton
  - County Road 42
- Hemson Growth Management Study (ongoing)
- Design Guidelines for Sewage Works (MECP)
  - Revised MECP Design Guidelines



Sewage Generation Flow Assumptions

Sewage Generation Rate

Location	Generation Rate (L/s/Cap)
City of Windsor	363
MECP	225-450
Amherstburg	450
Tecumseh	347
Lakeshore	450
Annexed Lands EA (2006)	363

SSMSP

It is proposed to maintain the current City of Windsor sewage generation rate of 363L/s/cap.

Sewage Generation Flow Assumptions

Sanitary Design Population Densities: Residential

Land Use	East Pelton	County Road 42	Other
Low Density Residential	36ppl/ha	75ppl/ha	--
Medium Density Residential	80ppl/ha	106ppl/ha	--
Mixed Use	92ppl/ha	112ppl/ha	--
Future Urban	--	--	50ppl/ha

Annexed Lands EA: 49.4ppl/ha (Residential)
55.6ppl/ha (Mixed Use)
City of Windsor Development Manual: 50ppl/ha

<u>Assumptions</u>

- Unit density based on Secondary Plans
- Future Urban density from City of Windsor Development Manual (Residential)
- 3.0 persons per unit (Low Density)
- 2.0 persons per unit (Medium Density)

Sewage Generation Flow Assumptions

Sanitary Design Population Densities: Commercial/Industrial

Land Use	East Pelton	County Road 42	Other
Commercial	74ppl/ha	74ppl/ha	--
Business Park Type I	--	68ppl/ha	--
Business Park Type II	--	74ppl/ha	--
Future Employment	--	--	68ppl/ha

Annexed Lands EA: 64.8ppl/ha (Commercial)
92.7ppl/ha (Industrial)
City of Windsor Development Manual: 74ppl/ha (Commercial)
62ppl/ha (Industrial)

<u>Assumptions</u>

- Population density based on City of Windsor Development Manual
- Business Park Type I and Future Employment (combination of Commercial and Industrial)

Sewage Generation Flow Assumptions

Sanitary Design Population Densities: Institutional/Other

Land Use	East Pelton	County Road 42
Major Institutional	Correctional Facility 30ppl/ha (equivalent)	Hospital 76ppl/ha (equivalent)
Minor Institutional	Church 22ppl/ha	--
Private Recreation	Windsor Campground 78ppl/ha (equivalent)	--

Annexed Lands EA: N/A
City of Windsor Development Manual: 22ppl/ha

<u>Assumptions</u>

- Correctional Facility- 315 beds/12.17ha
- Hospital- 669 beds/24.25ha
- Windsor Campground- 208 sites (184 serviced)/5.4ha

Extraneous Flows Assumptions

- Windsor Sewer Master Plan
  - 1 L/s/Ha Allowance for Sandwich South and all new Development Areas
  - Included in Ultimate Condition basement flood solution mitigation solutions.
  - Not intended for detailed design criteria.

- Comparison Table:

Infiltration Rate	Source
0.117 L/s/ha	Stantec – 2006 Sanitary EA
0.156 L/s/ha	City of Windsor Development Manual
0.1-0.25 L/s/ha	MECP 2020 Draft Criteria for consolidated ECA and New Guidelines

Extraneous Flows Assumptions

It is recommended that an extraneous flow allowance of 0.156 L/s/ha be used.

- Sewer sizes remain similar than using 0.156 L/s/ha
- Within the new MECP guidelines
- Greater than Sandwich South Design

- Value represents the long term infiltration allowance used to size the sewers for the lifetime of the pipe.
- New subdivisions shall be required to meet a percentage of that value (5%-10% of the total allowable).

Note: Extraneous Flow values is noted used in the determination of plant expansion. Treatment capacity is a function of population growth.

Design Flow and Peaking Factor

Little River Pollution Control Plant

- Total Sanitary Design Population: 78,900
- Sanitary Drainage Area: 1,979 ha
- Infiltration Rate: 0.156 L/s/ha
- Peaking Factor: Harmon
- Peak Design Flow: 2,305 L/s
  - 325 L/s Oldcastle (Tecumseh)
  - 983 L/s Tecumseh Hamlet
- Capacity of D/S sewer (EC ROW): 2629 L/s (88%)
- 2006 Sanitary EA Peak design flow: 2,441 L/s

Lou Romano Water Reclamation Plant

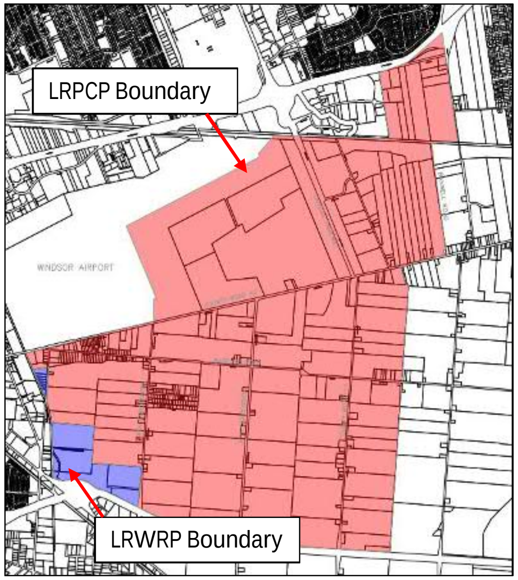
Total Sanitary Design Population: 3,192

Sanitary Drainage Area: 68ha

Infiltration Rate: 0.156 L/s/ha

Peaking Factor: Harmon

Peak Design Flow: 57 L/s



Other Recommendations

Sandwich South Development Manual

Other Recommendations

- All manholes shall be watertight and wrapped in waterproof membrane (new MECP ICL requirement).
- All new developments will need to be monitored pre (if applicable) and post construction. The City shall include max. extraneous flow requirements in development agreements.
- Sampling manholes for all larger developments and manholes at the downstream end of developments to accommodate monitoring equipment.
- Sewage Ejectors for new homes
- Building Management:
  - Home management practices- prohibit window wells, roof drain connections, enforce proper lot grading
  - Inspection/Testing of private connection (through permitting process)

Little River Pollution Control Plant (PCP)

Next Steps

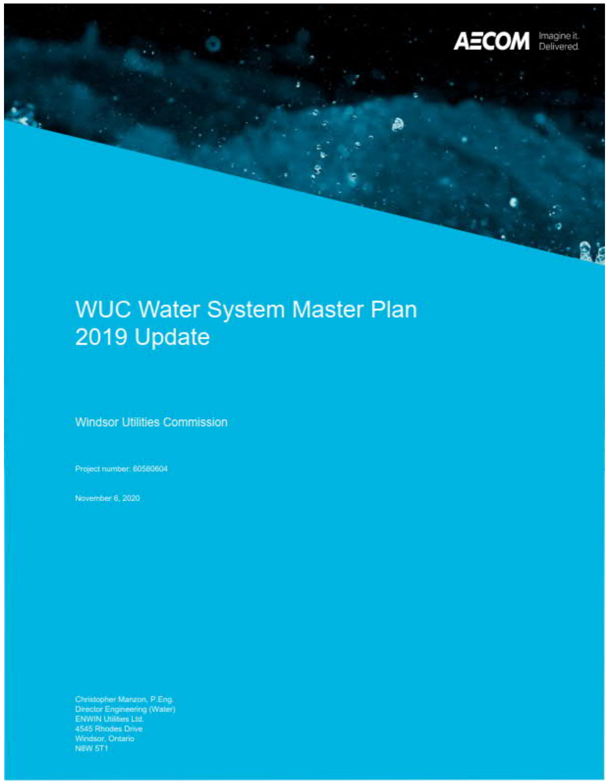
- Identify available capacity and population growth potential within the LRPCP.

- Develop a phasing plan illustrating areas of development….
  - In advance of LRPCP expansion
  - Under phased expansion of the LRPCP, corresponding to sanitary trunk sewer extensions.

Water Distribution & Servicing

Water Distribution Analysis

- Water distribution system performance and required upgrades were analyzed
  - WUC Water System Master Plan Update (WWSMPU), in 2019 (by AECOM Canada Ltd.)
- Used existing infrastructure and future growth projections to model performance of the water treatment and distribution system in consideration of future development.
  - Growth projections



AECOM Imagine it. Delivered.

WUC Water System Master Plan
2019 Update

Windsor Utilities Commission

Project number: 60580604

November 6, 2020

Christopher Manzon, P.Eng.
Director Engineering (Water)
ENWIN Utilities Ltd.
4545 Rhodes Drive
Windsor, Ontario
N8W 5T1

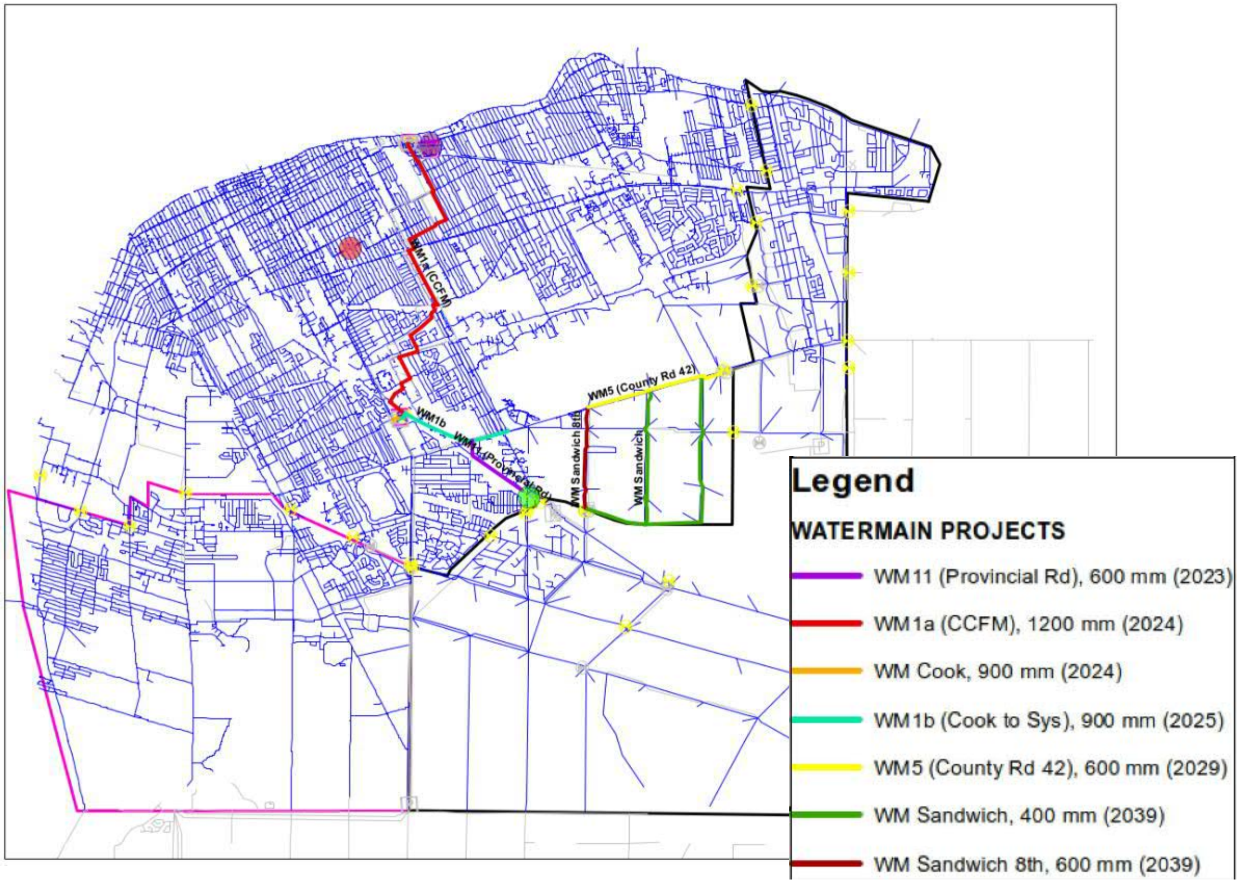
Water Servicing Assumptions

Assumptions used in the AECOM Report (all pertain to Windsor):

- Population growth based on WUC 2013 Master Plan
    - 2024 population estimate of 228,410; 2049 estimate of 252,369
- Water system demand criteria based on 2017 ENWIN Treated Water Pumpage Report
    - Including residential / non-residential (ICI) split (52%/48%)
- Maximum day demand factor of 1.47 and peak hour demand factor of 2.28
- Water demand rates:
    - Future residential water use: 227 L/cap/d
    - Future non-residential water use: 210 L/cap/d

HL1
OK2

Recommended Water Infrastructure Works to 2049



- Trunk watermains proposed in the study area
  - Trunks considered as 400 mm diameter and greater

- Adjacent distribution mains will be required to provide services

- New elevated tank proposed
  - Same water level and capacity as existing 'Hanna Elevated Tank'
  - Proposed for Provincial Road/ Walker Road area

- Cost Estimates provided for works

- Assumed no further assessment required for servicing requirements

Slide 17

HL1 what were the water service needs based on? Include note that population density is based on the recently completed Hemson Growth Study ....pull reference from the report.

Herlehy, Laura, 2021-04-18

OK2 Added new slide (above) to identify specific factors. Growth factors were from 2013 MP

Oxford, Kaelee, 2021-04-19

Recommended Infrastructure Works to 2049

- Watermain Distribution Layout will be incorporated into the SSMSP

Slide 18

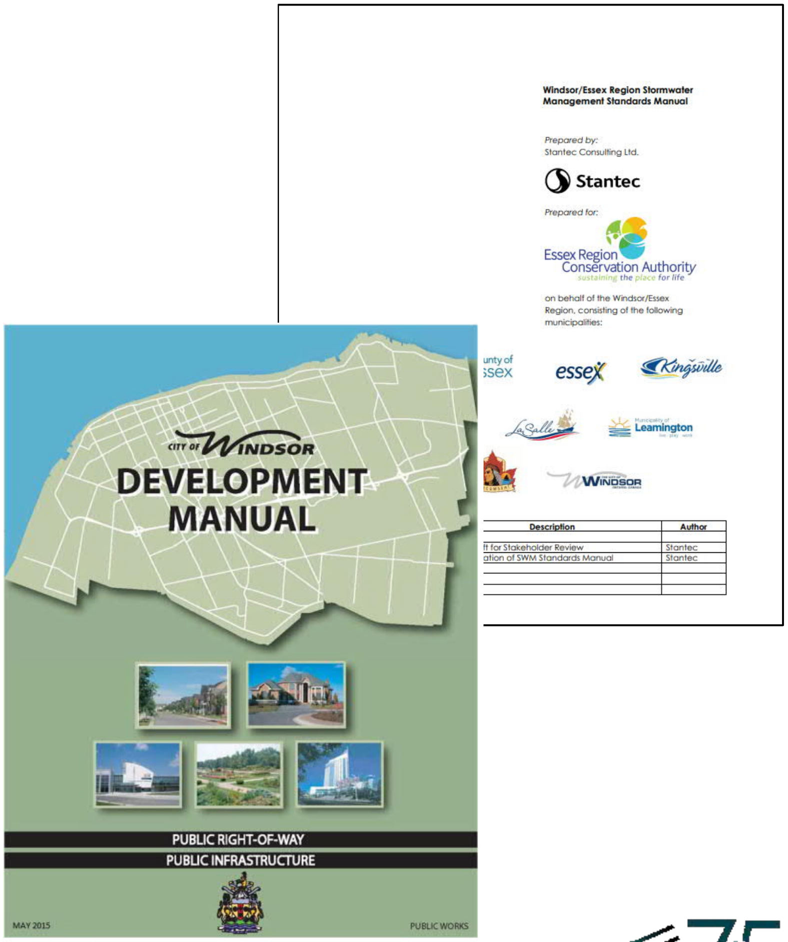
HL2	change image to a zoom in to the area of the watermain Herlehy, Laura, 2021-04-18
OK1	changed Oxford, Kaelee, 2021-04-19

Storm Servicing

Stormwater Management Criteria

Sources for criteria:

- City of Windsor Development Manual (2015)
    - Pipe minimum parameters
- Windsor/Essex Region Stormwater Management Standards Manual (2018)
    - Runoff quantification assumptions and criteria
    - Design storm criteria
    - Quantity control criteria
    - Quality control criteria



Windsor/Essex Region Stormwater Management Standards Manual

Prepared by:
Stantec Consulting Ltd.

Prepared for:
Essex Region Conservation Authority

on behalf of the Windsor/Essex Region, consisting of the following municipalities:

Description	Author
ft for Stakeholder Review	Stantec
ation of SWM Standards Manual	Stantec

CITY OF WINDSOR
DEVELOPMENT MANUAL

PUBLIC RIGHT-OF-WAY
PUBLIC INFRASTRUCTURE

MAY 2015
PUBLIC WORKS

Storm Drainage Design Criteria

Storm Sewer & Drainage Design Criteria

Source: WE Region SWM Manual, City Standards

Parameter	Design Criteria
Return Period	1:5 Year Return Period
Storm Sewer Design	Rational Method/Modelling
Hydraulic Storm Sewer Sizing	Manning's Equation
Manning's Roughness Coefficient 'n'	0.013
IDF Rainfall Data	Windsor Airport (Station No 6139525)
Initial Time of Inlet (T_i)	20 Minutes

Runoff Coefficients

Source: WE Region SWM Manual

Proposed Land Use	Runoff Coefficient
Green Space	0.2
Residential –Single	0.6
Residential – Townhouse/ Row housing	0.8
Residential – Semi-Detached	0.7
Industrial/ Commercial	0.9

Stormwater Sewer Design Criteria

Specific Storm Sewer Criteria:

- Minimum velocity: 0.76 m/s
- Maximum velocity: 3.0 m/s
- Minimum slope: 0.1%
- Minimum depth of cover: 1.0m

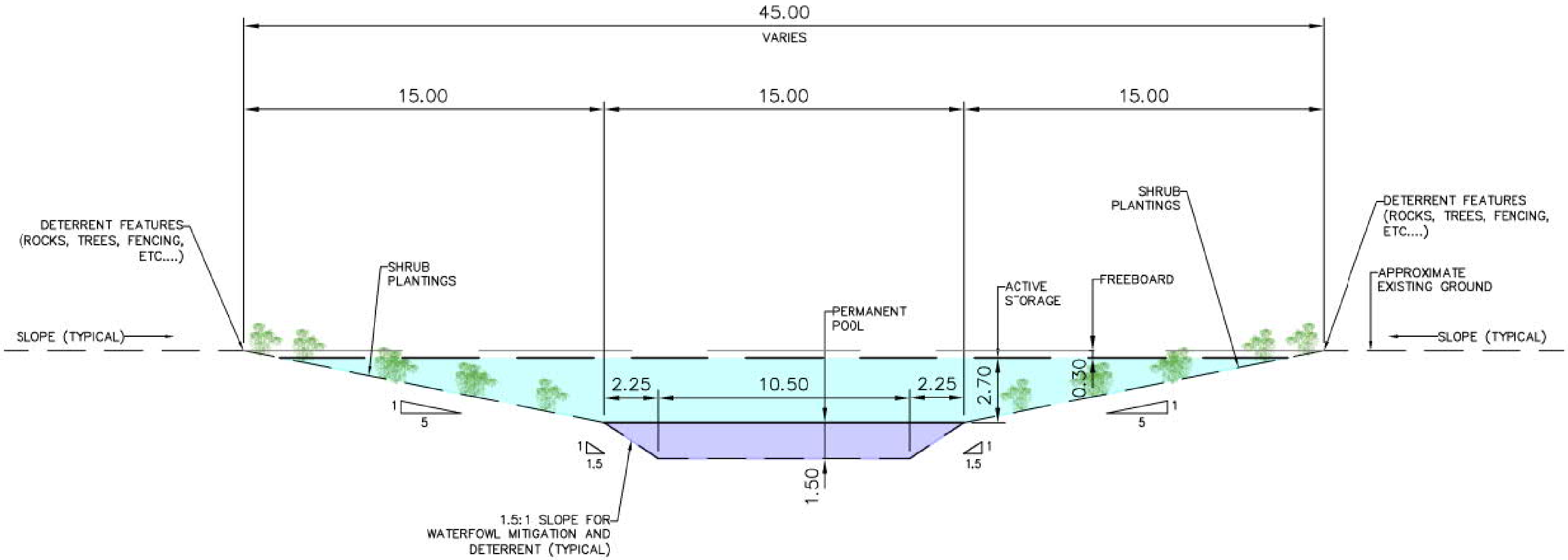
Design Alternatives Criteria:

- Utilize proposed road corridors for other infrastructure
- Consideration of feasibility of staging future development
- Location and optimization of outlet points to storm facilities

Stormwater Management Strategy

- Stormwater management strategy will include:
  - Trunk storm sewers for collection and conveyance in developed areas
  - Stormwater storage facilities (elongated ponds) for quality and quantity control
    - Ponds to have 5:1 side slopes (active storage) and 1.5:1 side slopes (permanent pool)
    - Total Pond depth to be approximately 3-4m
      - Approximately 1.5m permanent pool
    - Ponds to outlet to existing/future municipal drains via pump stations
      - Number of pump stations to be minimized
    - Ponds to be located within SWM corridors (ULRMP)
      - Corridors to include maintenance access and active transportation facilities
      - Corridor widths to be confirmed.
    - Waterfowl mitigation measures to be included in pond design:
      - Minimize open water length
      - Include plantings along banks
      - Windsor Airport has been consulted and will provide comments on proposed pond design

Conceptual Storm Pond | East Pelton North

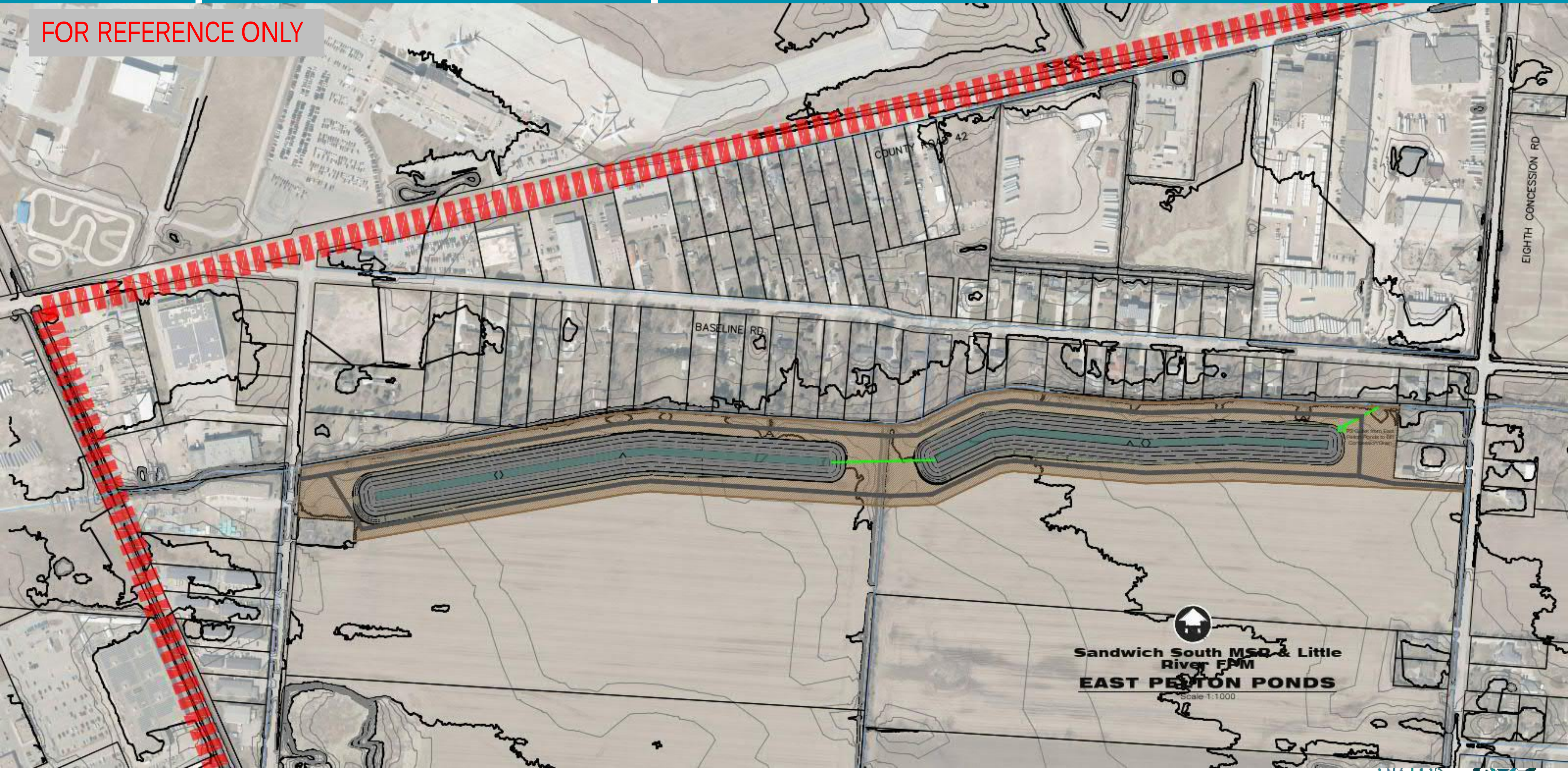


Sandwich South MSR

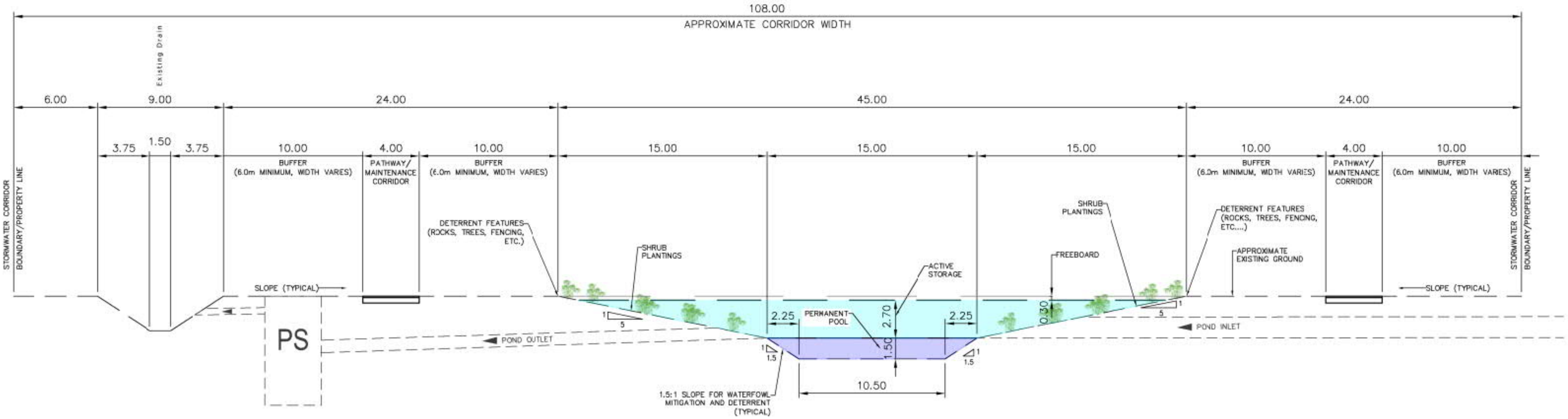
CONCEPTUAL POND SECTION

Conceptual Storm Pond | East Pelton North

FOR REFERENCE ONLY



Conceptual Stormwater Corridor | East Pelton North



Sandwich South MSR
EAST PELTON NORTH
CONCEPTUAL SWM CORRIDOR SECTION

Utilities

Utilities

Hydro One

- Meeting held in March 2020
- Immediate plans to extend aerial hydro service along the south side of CR42. Alignment to be provided to the City for approval as it relates to the CR42 EA and proposed roadway cross section.

Other Utilities

- Aware of project, land use and proposed populations
- No noted concerns with servicing
- Follow up once road cross-sections are developed to confirm utility alignments

Next Steps

Next Steps

- Confirm design criteria and assumptions
  - Stormwater servicing
  - Sanitary servicing
- Prepare functional design
  - Stormwater Ponds
    - Pond cross-sections and layout

- Coordinate with Windsor Airport
- Transportation Criteria/Assumptions Presentation - Week of May 17th
  - Develop Typical Road Utility Cross-Sections

Appendix F - 6

Utility Coordination Meeting Minutes

MEETING MINUTES

Subject: Sandwich South Master Servicing Study – Utility Coordination Meeting
Date and Time: February 2, 2022 – 2:00 p.m.
Location: Virtual Meeting
Our File: 19-9817

Attendees

Patrick Winters	City of Windsor
Dave Hartleib	MNSi
Justin Greer	MNSi
Spencer Johnston	Enwin – Water
Christopher Manzon	Enwin – Water
Darryl Litster	Cogeco
Fayez Youssef	Cogeco
Lei Zhu	Hydro One
Brandon Riddiford	Hydro One
Will Ceccacci	Enbridge
Jessica Hughes	Enbridge
David Cowing	Bell
Tyson Fuerth	Bell
Laura Herlehy	Dillon Consulting Limited
Dean Rice	Dillon Consulting Limited
Tolulope Oludemi	Dillon Consulting Limited

Notes

Item	Discussion	Action By
1.	**Project Overview**	
1.1.	Project Objectives: • Provide municipal infrastructure to service the future development of the Sandwich South Study Area. • The first phases of development will be permitted the following areas as these areas have associate Secondary Plan: ○ East Pelton Secondary Plan Area ○ County Road 42 Secondary Plan Area • The Sandwich South Master Servicing Report (SSMSP) and Functional Servicing Design Report are currently being developed. This will provide more details on the proposed developments and municipal infrastructures.	**Info.**

- A staging plan will be provided with project list to assist the City with planning for future capital projects and servicing of future development.

1.2. Background

1.2.1. The SSSMP team met with utilities at the onset of this project on X. Subsequent to that meeting, the utilities were provided total estimated populations for the SSMSP area as well as a land use plan and draft road network. **Info.**

1.2.2. An updated population estimated per Secondary Plan and final road network plan was provided to the utilities for their review and input. **All Utilities**

2. **Project Schedule/Timelines**

2.1. Anticipated completion of study – Spring 2022. **Info.**

2.2. It is expected that the detailed design of the 7th Concession Road will commence this year. This road will be urbanized before residential development is complete. **Info.**

2.3. City of Windsor: **Info.**

- The City is currently under pressure from developers within the East Pelton secondary plan area.
- Permit approvals to commence shortly on East Pelton secondary plan area.
- For construction along County Road 42, the works within the existing Class EA will be in effect.
- The proposed hospital on County Road 42 is a major development priority.

3. **Utilities**

3.1. Utility servicing strategies are required for the East Pelton and County Road 42 secondary plan areas. Dillon will coordinate with the utilities for the required depth of the future services. **Utilities**

- Utilities to provide potential constraints and servicing strategies for the two secondary plan areas.
- This is to include required extension of existing utilities to service the secondary plan areas as well as requirements to accommodate existing utilities.

3.2. As discussed previously, combined joint use trenches for future servicing will be accommodated within the right-of-way. **Info.**

- It is expected that underground services be implemented for local servicing.

3.3. The road cross-section drawings will be distributed to the utilities to comment on the placement and depth of the joint trenches. Typical mains will be provided in the drawings. Alignments have been allocated for joint use trench for the utilities and gas. **Dillon**

- There are rural cross sections and ditches in the existing lands within the study area. Each road will be urbanized as development happens.
- Alignment for district energy has also been included, these lines will supply heating and cooling for the area catering to the City of Windsor's goal to achieve net-zero neighbourhoods. No additional information on the source or proposed distribution network for this system at this time.

3.4. Dillon to provide detailed breakdown of estimated population for each area to utilities. The utilities shall provide commentary to the SSMSP on how the initial phases will be serviced and through what main routes. **Dillon**

3.5. **Bell**

3.5.1. No foreseen issues. More details from development planning (including detailed population density for each area) would be required for more detailed constraints/servicing strategies. **Dillon**

3.5.2. Existing plant along County Road 42 that can be used to provide access and servicing for the future developments. **Info.**

3.5.3. Potential concern would be from the proposed development on 9th Concession Road due to existing boundary line for two of the switching sections. **Info.**

3.6. **Enbridge**

3.6.1. Enbridge to look into potential constraints (including budgeting and sizing constraints) and propose servicing strategies following Dillon's provision of the population breakdown for each area. **Enbridge**

3.6.2. Separate meeting to be set up to discuss the project in more detail. **Enbridge/Dillon**

3.6.3. Confirmed that there will be no overlap with the current construction project (installation of a plant) east of Lauzon Parkway. The City will proceed with the reconstruction of Country Road 42 from the Town of Tecumseh border, west, continuing from the County's improved section. **Info.**

3.6.4. City of Windsor has a goal to develop net-zero neighbourhoods within the study area. Developers would need to meet some of the strategies to achieve a net-zero neighbourhood. **Enbridge**

- District energy for heating and cooling to be considered to assist in achieving this goal.

3.7. **Hydro One**

3.7.1. Estimated population is required to determine the necessary capacity for the future proposed developments. **Info.**

- Available capacity has been provided to Dillon previously based on the draft land use plan.

3.7.2.	Influx of load is perceived for the future developments. Timelines of development would be required.	**Dillon**
3.7.3.	There are currently overhead lines on 7th Concession Road. When construction works are being planned to urbanize the road, Hydro One should be made aware to discuss the adjustments/relocations of the existing overhead lines.	**Info.**
3.7.4.	It is expected that relocations to underground services using joint use trenches would be required within the study area, as there are currently existing overhead lines within the areas.	**Info.**
3.7.5.	Hydro One to provide list of servicing needs/strategies and constraints following provision of the estimated populations.	**Hydro One**
3.8.	**Cogeco**	
3.8.1.	Current ongoing project of installing a running line along County Road 42 to provide fibre to the area. It is expected that this project will not be in conflict with the Sandwich South project. • Mapping for the project will be provided to Dillon.	**Cogeco**
3.8.2.	Cogeco to provide list of servicing needs/strategies and constraints following provision of the estimated populations.	**Cogeco**
3.9.	**MNSi**	
3.9.1.	No current concerns. MNSi would need estimated populations, especially in the southern area of County Road 42, to give more detailed servicing needs.	**MNSi**
3.10.	**Water (Enwin)**	
3.10.1	There might be a project with Enwin and the Town of Tecumseh along 7th Concession Road within the next year. More details to be provided to Dillon. • Potential trunk infrastructure around developed homes that might be a trigger, to be discussed when more information is available. • Enwin needs to budget for future plans. Enwin and the City of Windsor will coordinate on this future projects.	**Enwin**
3.10.2	Windsor Utilities Commissions Master Plan (2019) has been provided to Dillon for proposed trunk watermains along major roadways.	
4.	**Next Steps**	
4.1.	Dillon to provide detailed map with the number of units/estimated population for the first phase development for East Pelton and County Road 42 secondary plan areas.	
4.2.	Each utility to provide potential constraints and servicing strategies by **end of February** to assist with coordination on future developments.	**Utilities**

4.3.	Functional Servicing Design Report to be completed in March Master Study Report to be completed Spring 2022.	**Dillon**

Errors and/or Omissions

These minutes were prepared by Tolulope Oludemi, who should be notified of any errors and/or omissions.

Distribution

Andrea Winter	Dillon Consulting Limited

MEETING MINUTES

Subject: Sandwich South Master Servicing Study – Meeting with Enbridge Gas Inc.
Date and Time: December 9, 2019 – 1:00 p.m.
Location: Dillon Consulting Limited Office, 3200 Deziel Drive, Windsor, Ontario
Our File: 19-9817

Attendees

Will Ceccacci	Enbridge Gas Inc.
Dean Rice	Dillon Consulting Limited
Robert Molliconi	Dillon Consulting Limited
Alessia Mussio	Dillon Consulting Limited

Notes

Item	Discussion	Action By
1.	**Project Overview**	
1.1.	Project Objectives: • Provide framework for future development within the Sandwich South study area. • Developed endorsed utility servicing strategies. • Create development phasing strategy. • Develop road cross-sections including utility corridors.	**Info.**
1.2.	Two secondary plans exist within the study area: • East Pelton; and • County Road 42 (currently under appeal).	**Info.**
1.3.	The City is currently under pressure from developers within the East Pelton secondary plan area.	**Info.**
1.4.	Initial phase(s) of development is anticipated to take place within the East Pelton secondary plan area.	**Info.**
1.5.	The City of Windsor is currently undertaking a population growth study which will provide estimated population data for the remainder of the study area.	**Info.**
1.6.	Project Schedule: • Anticipated completion Spring 2021.	**Info.**
2.	**Utilities**	
2.1.	Dillon is currently evaluating the transportation network within the study area. Once completed, this will provide the basis for utility/infrastructure corridors.	**Info.**
2.2.	Joint use trenches were discussed for future servicing.	**Info.**

2.3.	Joint use trenches would be intended to provide capacity for future expansion and phasing.	**Info.**
2.4.	Estimated population data and land use information will be provided to all utilities once available.	**Dillon**
2.5.	**Enbridge Gas Inc.**	
2.5.1.	Enbridge confirmed that Will Ceccacci and Jessica Hughes remain the contacts for this project.	**Info.**
2.5.2.	Dillon to provide estimated population data and land use once available.	**Dillon**
2.5.3.	Enbridge to discuss with their engineering department to determine the capacity needed for the study area.	**Enbridge**
2.5.4.	Enbridge to provide current utility standards (bury depth, duct sizing, separation, etc.).	**Enbridge**
3.	**Next Steps**	
3.1.	Additional meetings will be held once further details are known.	**Info.**

Errors and/or Omissions

These minutes were prepared by Alessia Mussio who should be notified of any errors and/or omissions.

Distribution

Andrea Winter	Dillon Consulting Limited

AM:d

December 13, 2019

MEETING MINUTES

Subject: Sandwich South Master Servicing Study – Cogeco
Date and Time: November 21, 2019 – 2:30pm
Location: Dillon Consulting Office, 3200 Deziel Drive, Windsor, Ontario
Our File: 19-9817

Attendees

Larry Applewhaite	Cogeco
Dean Rice	Dillon Consulting Ltd.
Robert Molliconi	Dillon Consulting Ltd.
Alessia Mussio	Dillon Consulting Ltd.

Notes

Item	Discussion	Action By
1.	**Project Overview**	**Info.**
1.1	Project Objectives: • Provide framework for future development within the Sandwich South study area. • Developed endorsed utility servicing strategies. • Create development phasing strategy. • Develop road cross-sections including utility corridors.	
1.2	Two secondary plans exist within the study area: • East Pelton; and • County Road 42 (currently under appeal).	**Info.**
1.3	The City is currently under pressure from developers within the East Pelton secondary plan area.	**Info.**
1.4	Initial phase(s) of development is anticipated to take place within the East Pelton secondary plan area.	**Info.**
1.5	The City of Windsor is currently undertaking a population growth study which will provide estimated population data for the remainder of the study area.	**Info.**
1.6	Project Schedule: • Anticipated completing Spring 2021.	**Info.**

2.	**Utilities**	
2.1	Dillon is currently evaluating the transportation network within the study area. Once completed, this will provide the basis for utility/infrastructure corridors.	**Info.**
2.2	Joint use trenches were discussed for future servicing.	**Info.**
2.3	Joint use trenches would be intended to provide capacity for future expansion and phasing.	**Info.**
2.4	Estimated population data and land use information will be provided to all utilities once available.	**Dillon**
2.5	**Cogeco**	
2.5.1	Cogeco is currently in the process of updating their overhead and fiber cables on 7th Concession and Walker Road.	**Cogeco**
2.5.2	Cogeco indicated that they have frequent coordination meetings with Bell and MNSi since room is becoming scarce.	**Info.**
2.5.3	Cogeco confirmed that Larry Applewhaite will remain the contact for this project.	**Info.**
2.5.4	Cogeco indicated they would need pedestals as a point source for connections.	**Info.**
2.5.5	Dillon requested for Cogeco to provide the existing infrastructure that Cogeco already has in place within the study area.	**Dillon**
2.5.6	Dillon requested for Cogeco's standards and sizing	**Dillon**
3.	**Next Steps**	
3.1	Additional meetings will be held once further details are known.	**Info.**

Errors and/or Omissions

These minutes were prepared by Alessia Mussio who should be notified of any errors and/or omissions.

Distribution

Larry Applewhaite	Cogeco
Andrea Winter	Dillon Consulting Limited

MEETING MINUTES

Subject: Sandwich South Master Servicing Study – Utility Coordination Meeting
Date and Time: November 14, 2019 – 2:00 p.m.
Location: Dillon Consulting Limited Office, 3200 Deziel Drive, Windsor, Ontario
Our File: 19-9817

Attendees

Adam Pillon	City of Windsor
Patrick Winters	City of Windsor
Tyson Fuerth	Bell Canada
David Cowing	Bell Canada
Dave Hartleib	MNSi
Spencer Johnston	Enwin
Chris Manzon	Enwin
Robert Molliconi	Dillon Consulting Limited
Dean Rice	Dillon Consulting Limited
Alessia Mussio	Dillon Consulting Limited

Notes

Item	Discussion	Action By
1.	Project Overview	
1.1.	Project Objectives: • Provide framework for future development within the Sandwich South study area. • Developed endorsed utility servicing strategies. • Create development phasing strategy. • Develop road cross-sections including utility corridors.	Info.
1.2.	Two secondary plans exist within the study area: • East Pelton; and • County Road 42 (currently under appeal).	Info.
1.3.	The City is currently under pressure from developers within the East Pelton secondary plan area.	Info.
1.4.	Initial phase(s) of development is anticipated to take place within the East Pelton secondary plan area.	Info.
1.5.	The City of Windsor is currently undertaking a population growth study which will provide estimated population data for the remainder of the study area.	Info.
1.6.	Project Schedule: • Anticipated completion Spring 2021.	Info.

2.	Utilities	
2.1.	Dillon is currently evaluating the transportation network within the study area. Once completed, this will provide the basis for utility/infrastructure corridors.	Info.
2.2.	Joint use trenches were discussed for future servicing.	Info.
2.3.	Joint use trenches would be intended to provide capacity for future expansion and phasing.	Info.
2.4.	Estimated population data and land use information will be provided to all utilities once available.	Dillon
2.5.	Bell Canada	
2.5.1.	Bell indicated that existing infrastructure mapping requests need to be requested from bell.moc@Telecon.ca due to the size of the area.	Info.
2.5.2.	Bell to provide current utility standards (bury depth, duct sizing, separation, etc.).	Bell
2.5.3.	Bell confirmed that Tyson Fuerth and David Cowing remain the contacts for this project.	Info.
2.6.	MNSi	
2.6.1.	MNSi to provide mapping of existing and planned infrastructure within the study area.	MNSi
2.6.2.	Bell to provide current utility standards (bury depth, duct sizing, separation, etc.).	MNSi
2.6.3.	MNSi confirmed that Dave Hartleib will remain the contact for this project.	Info.
2.7.	Utility outcomes: • Phased trunk utility alignments; • Design criteria; and • Typical utility cross-sections (joint-use trench). •	Info.
3.	Water	
3.1.	Enwin is currently in the process of updating their 2014 Master Plan.	Info.
3.2.	Enwin to investigate design assumptions within the Sandwich South study area and provide to Dillon.	Enwin
3.3.	Dillon to provide estimated population data and land use once available.	Dillon
3.4.	Enwin to provide existing infrastructure mapping within the study area.	Enwin
3.5.	Project outcomes: • Trunk watermain alignments; • Design criteria; • Trunk watermain phasing; and • Trunk watermain cost estimates.	Info.

4.	Next Steps	
4.1.	Additional meetings will be held once further details are known.	Info.

Errors and/or Omissions

These minutes were prepared by Alessia Mussio who should be notified of any errors and/or omissions.

Distribution

Will Ceccacci	Enbridge (Union Gas)
Larry Applewhaite	Cogeco
Daniel Haggins	Cogeco
Andrea Winter	Dillon Consulting Limited

AM:d

November 25, 2019

Appendix F - 7

Implementation Plan and Cost Estimates

Sandwich South Master Servicing Plan
Municipal Servicing Functional Design Report
May 2023 - 19-9817

DILLON
CONSULTING

Appendix F-7
Sandwich South Master Servicing Plan

Budgetary Cost Estimate Assumptions

The estimate of probable costs included in this report are based on the following overall project assumptions.

Road Infrastructure Costs

- Estimated construction costs are based on the improvements identified in Figure 9-1.
- Improvement concept and functional design plans are subject to change based on additional information determined/developed during the detailed design stages.
- Roadway construction costs include full road reconstruction including, but not limited, to the following components:
  - Removal of existing roadways, where applicable;
  - Earth Excavation;
  - Full Granular 'A' base;
  - Asphalt Road Surface ;
  - Curb and Gutter;
  - Catchbasins;
  - Local Storm Sewer;
  - Sidewalks and Bike Lanes;
  - Pavement Markings;
  - Streetlighting;
  - Traffic signals;
  - New Street Trees; and
  - Restoration.
- Proposed road sections for asphalt roads were developed using the cross sections developed for this project included in Figure F9-2 to F9-8. All road sections will require verification by a geotechnical engineer during detailed design.
- Allowances for bike facilities were included based on current Ontario Traffic Manual recommendations.
- Costs for relocating/abandoning utility infrastructure will be over and above the cost estimates provided herein.
- Removal estimated quantities are based on assumptions of existing road width and cross-sectional information.

Stormwater Management Pond and Sewer Infrastructure Costs

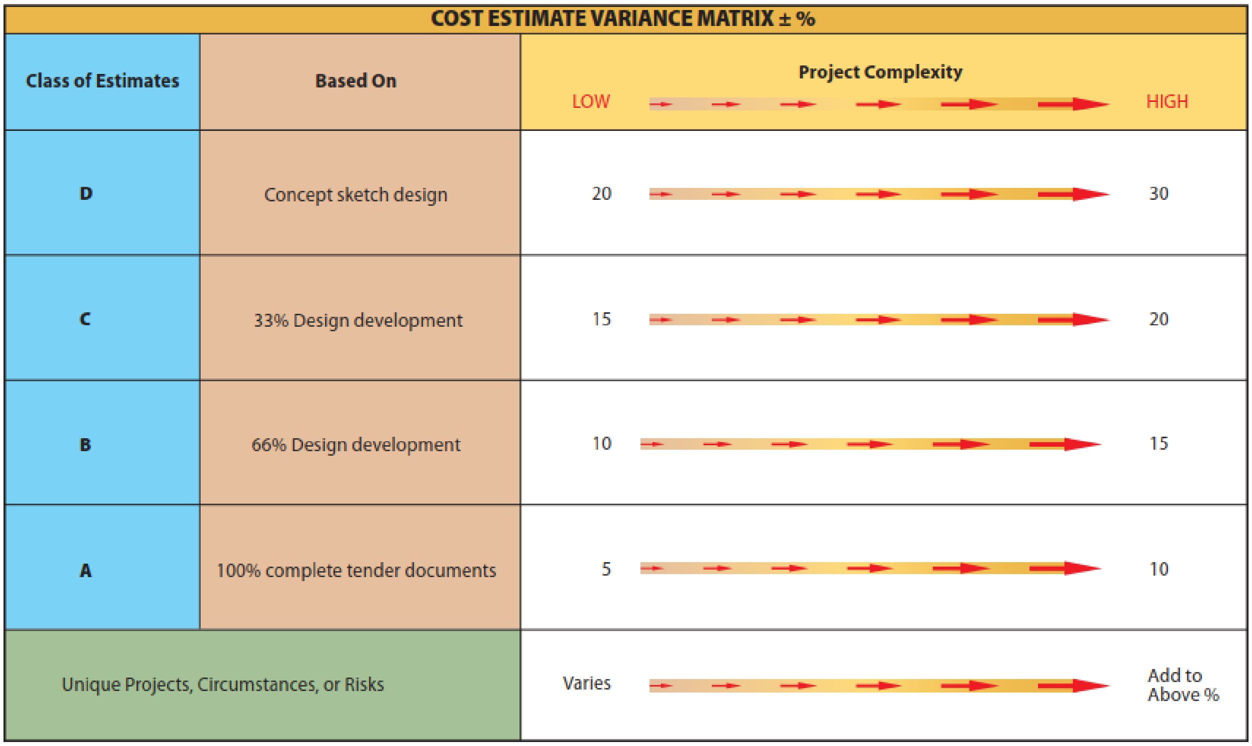
- It is assumed that excess material will need to be transported offsite for reuse. Acquisition of land to accommodate material storage and/or handling of materials at the reuse location is not included in these costs.

General Costs

- Cost estimates do not include any costs associated with land acquisition, land appraisal, legal costs, and/or expropriation costs.
- Areas of high potential for archaeological material exists within some project areas. Any costs associated with archaeological assessment or construction delays as a result of any Stage 2, Stage 3 and Stage 4 archaeological works are not included.
- Costs associated with the demolition of existing buildings and houses within the project limits have not been included.
- Credit associated with external funding sources are not considered in this summary.
- Costs for any required Record of Site Condition (RSC) Assessments have not been included.
- Cost estimates are based on 2022 construction prices, excluding taxes. Timing of construction may have significant impacts on the estimated costs included herein.
- Cost estimates do not include any fees associated with any required third party agency reviews, permits, and approvals.
- Cost estimates are for construction and engineering costs only. Costs for annualized maintenance of identified improvements has not been included in the construction cost estimates.
- An allowance of 20% has been included for engineering. This includes the preparation of preliminary and detailed design plans, construction administration and onsite inspection. Costs for topographic and legal surveys, environmental site assessments and geotechnical investigations are also included in the 20% engineering allowance.
- Construction phasing and staging of the various components of this project could have a significant impact to the overall costs. Since the anticipated phasing/staging of these works is not currently known, any additional costs associated with the construction of multiple of phases have not been included in our estimates.
- A general allowance for traffic control has been included in the cost estimates for roads and infrastructure related works. Costs associated with maintaining traffic and access during construction will be highly dependent on the construction phasing/staging of the works.
- Construction cost estimates are Class D Estimates and a +30% contingency has been added. A Class "D" estimate is prepared when a project is at the "Conceptual Design" stage. Conceptual design is defined as the beginning of a project when preliminary spatial needs have been identified.

Cost Estimate Variance Matrix

The following Cost Estimate Variance Matrix[1] has been developed to provide a range of estimate variance (plus or minus), based on the level of construction documents completion, in combination with an evaluation of the level of complexity of the project.



COST ESTIMATE VARIANCE MATRIX ± %

Class of Estimates	Based On	Project Complexity	
		LOW	HIGH
D	Concept sketch design	20	30
C	33% Design development	15	20
B	66% Design development	10	15
A	100% complete tender documents	5	10
Unique Projects, Circumstances, or Risks		Varies	Add to Above %

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[1] "Guide to Cost Predictability in Construction" (November 2012) by Joint Canadian Federal Government/Industry Cost Predictability Taskforce

Sandwich South Master Servicing Plan Municipal Servicing Functional Design Report

Appendix F-7

Municipal Infrastructure Budgetary Cost Estimates

Date May 2023

Phases	Schedule C Environmental Assessments	Transportation Network Improvements	Municipal Drainage Improvements	Stormwater Management Facilities and Storm Trunk Sewers	Sanitary Trunk Infrastructure	Total
5 Year Horizon	$1.34M	$10.50M	$6.95M	$18.70M	N/A	$37.49M
Phase 1 – East Pelton	$0.30M/EA	$36.52M	$10.03M	$62.18M	N/A	$108.73M
Phase 1 – CR42 SPA	$0.30M/EA	$86.53M	$7.86M	$125.75M	$1.26M	$221.40M
Phase 2 – East Pelton	$0.30M/EA	$21.10M	N/A	$28.50M	N/A	$49.60M
Phase 2 – CR42 SPA	$0.30M/EA	$100.67M	$8.04M	$178.27M	$9.87M	$296.85M

Note: All costs are listed in million dollars (M)

Table F-9-1
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
5 Year Horizon (2023-2028)

Project Title	Project Description	Estimated Cost
Schedule C Roadway Environmental Assessment		
Collector Road Improvements Environmental Assessment - Schedule C	8th Concession Corridor from County Road 42 to Highway 401.	$ 520,000
	9th Concession Corridor from County Road 42 to Highway 401.	$ 520,000
LRPCP Expansion - Schedule C EA	Expansion of LRPCP Schedule C EA.	$ 300,000
Total		$ 1,340,000
Transportation		
9th Concession Road	Construct a two-lane road along 9th Concession Corridor from County Road 42 to Baseline Road.	$ 5,100,000
7th Concession Road	Reconstruct a two-lane road along 7th Concession Corridor from County Road 42 to the Future E-W Arterial Road.	$ 5,400,000
Total		$ 10,500,000
Municipal Drains		
6th Concession Drain Realignment	Relocate 6th Concession Drain from 7th Concession Road to 8th Concession Road. (1.4km) To be incorporated into the Drainage Report being prepared by Baird AE.	$ 5,500,000
7th Street Drain Relocation South of New E-W Arterial Road from Railway to Windsor Christian Fellowship Stormwater Management Feature	Relocate 7th Street Drain from Walker Road to 7th Conc. Drain to accommodate the expanded East West Arterial Roadway from the Railway At-Grade Crossing to Christian Fellowship Stormwater Management Feature.	$ 1,450,000
Total		$ 6,950,000
Stormwater Management Servicing		
P7 Drainage Area - East of Lauzon Parkway, north of CR42		
P7 SWM Pond	Construct a receiving pond located between County Road 42 and Lauzon Parkway.	$ 3,970,000
P7 Pump Station	Construct a storm pump station for Pond 7 including, standby power generator.	$ 1,570,000
P7 Trunk Storm Sewer on CR42 and Lauzon Parkway	Install storm sewers along Lauzon Parkway to Pond 7 (Outlet 1).	$ 690,000
Total		$ 6,230,000
P8 Drainage Area - West of Lauzon Parkway, CR42 Drainage and Airport Lands		
P8 SWM Pond (Phase 1)	Construct a receiving pond located along County Road 42. Pond construction shall be phased to serve the initial Lauzon Parkway reconstruction. The remainder of the airport development lands are not anticipated to develop immediately therefore the remaining pond construction costs are included in Phase 2 CR42 SPA Phase Summary (Table F-9-4). (20% Cost)	$ 6,346,000
P8 Pump Station (Phase 1)	Construct storm pump station. Pump station shall be built initially with partial capacity based on the phased implementation of the pond storage capacity as described above. (50% Factor)	$ 2,320,000
P8 Trunk Storm Sewer - CR42 (Phase 1)	Construct 250 m of storm trunk sewers routing from the NE corner of the Hospital Site to P8 Pond.	$ 2,900,000
P8 Trunk Storm Sewer - Lauzon Parkway	Construct 300 m of storm trunk sewers within the Lauzon Parkway/CR42 Intersection construction Phase Limits. In the interim, remaining roadway drainage shall be provided via an open drainage ditch along the west side of Lauzon Parkway. Until the review of Lauzon Parkway Improvements are completed.	$ 900,000
Total		$ 12,470,000
Sanitary		
9th Concession Sanitary Trunk Sewer	Construct sanitary sewer along 9th Concession Road from County Road 42 to Baseline Road (0.9km). Required to serve the Windsor Regional Hospital Facility.	$ 1,260,000
Total		$ 1,260,000

Notes:

Refer to Figures F4-1 to F4-3 for pond labels.

Costs are based on the functional design of the proposed infrastructure completed to date.

Costs exclude costs for property acquisition.

Table F-9-2
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Phase 1 - County Road 42 Secondary Plan Area

Project Title	Project Description	Estimated Cost
Schedule C Environmental Assessments		
Schedule C Roadway Environmental Assessment Allowance	For all Collector Roads required that span various development areas, and are not approved through a Draft Plan of Subdivision process.	Allowance of $300,000 per individual Schedule C EA. See notes below
Transportation		
County Road 42 (Phase A) - Lauzon Parkway to City limits	Widening County Road 42 from two lanes to four lanes. The road segment is from Lauzon Parkway to the City limit. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 5,250,000
County Road 42 (Phase B) - Lauzon Parkway to 9th Concession Road	Widening County Road 42 from two lanes to four lanes. The road segment is from Lauzon Parkway to 9th Concession. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 6,100,000
County Road 42 (Phase C) - 8th Concession Road to 9th Concession Road	Widening County Road 42 from two lanes to four lanes including a roundabout at 9th Concession Road Intersection. The road segment is from 8th Concession to 9th Concession. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 13,040,000
County Road 42 (Phase D) - Walker Road to 8th Concession Road	Widening County Road 42 from two lanes to four lanes including roundabouts at 7th and 8th Concession Road. The road segment is from Walker Road to 8th Concession. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 19,140,000
Baseline Road (Phase A) - 7th Concession Road to 8th Concession Road	Traffic calming and road Improvements along Baseline Road from 7th Concession to 8th Concession Road.	$ 7,800,000
Baseline Road (Phase B) - 8th Concession Road to 9th Concession Road	Reconstruct Baseline Road from 8th Concession Road to 9th Concession Road.	$ 7,600,000
Baseline Road (Phase C) - 9th Concession Road to Lauzon Parkway	Reconstruct Baseline Road from 9th Concession Road to Lauzon Parkway.	$ 6,600,000
Baseline Road (Phase D) - Lauzon Parkway to 10th Concession Road	Reconstruct Baseline Road from Lauzon Parkway to 10th Concession Road.	$ 3,200,000
C5 Road (Phase A) - County Road 42 to Baseline Road	Construct a two-lane road from County Road 42 to Baseline Road. The road segment located between 8th Concession Road and 9th Concession Road.	$ 4,100,000
C7 Road (Phase A) - County Road 42 to Baseline Road	Construct a two-lane road from County Road 42 to Baseline Road. The road segment located between 9th Concession Road and Future Lauzon Parkway.	$ 7,800,000
C6 Road (Phase A) - C5 Road to C7 Road	Construct a two-lane road from C5 Road to C7 Road. The road segment located between County Road 42 and Baseline Road.	$ 5,900,000
Total		$ 86,530,000
Municipal Drains		
6th Concession Drain Realignment	Relocate 6th Concession Drain from 8th Concession Road to Little River (2.0km). Work to be completed prior to the construction of Baseline Road.	$ 7,860,000
Total		$ 7,860,000

Table F-9-2
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Phase 1 - County Road 42 Secondary Plan Area

Stormwater Management Servicing		
P8 Drainage Area - West of Lauzon Parkway, CR42 Drainage and Airport Lands		
P8 Trunk Storm Sewer - CR42 (Remaining Phases)	Install storm sewers along the County Road 42 from 7th Concession Road to Pond 8 (Outlet 1).	$ 32,840,000
P8 Trunk Storm Sewer - Airport Lands	Install storm sewers within the airport lands up to Pond 8 (Outlet 2).	$ 37,700,000
Total		$ 70,540,000
P4 Drainage Area - West of Lauzon Parkway		
P4 SWM Pond	Construct a receiving pond located between C7 Road and Future Lauzon Parkway.	$ 27,110,000
P4 Pump Station	Construct a pump station for Pond 4.	$ 3,560,000
P4 Storm Sewer County Road 42 - Phase A	Install storm sewers along Baseline Road from 8th Concession Road to Pond 4 (Outlet 1).	$ 16,490,000
P4 Storm Sewer County Road 42 - Phase B	Install storm sewers along C6 Road from C5 Road to Pond 4 (Outlet 2).	$ 8,050,000
Total		$ 55,210,000

Notes:
Refer to Figures F4-1 to F4-3 for pond labels.
Refer to Figure F10-1 for road labels.
Costs are based on the functional design of the proposed infrastructure completed to date.
Costs exclude costs for property acquisition.
Refer to the cost assumptions summary sheet.
Schedule C EA's for roads shall be completed if the following is satisfied. (Based on MCEA Guidelines (2023))

- To accommodate road widening, the municipal ROW requires widening or property acquisition.
- Cost for transportation project exceeds project cost values listed in the MCEA document.
- Roadway spans multiple plans of subdivisions such that the road alignment will establish the collector road alignment for area spans over more than one draft plan of subdivision.

Table F-9-3
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Phase 1 - East Pelton Secondary Plan Area

Project Title	Project Description	Estimated Cost
Schedule C Roadway Environmental Assessment		
Schedule C Roadway Environmental Assessment Allowance	All Collector Roads	Allowance of $300,000 per individual Schedule C EA. See notes below
Transportation		
East-West Arterial Road - Walker Road Intersection Improvements	Reconstruct Walker Road intersection including new leg extension for East-West Arterial Road and 7th Conc. Road. Refer to the Lauzon Parkway Environmental Assessment and Addendum (2014, 2015).	$ 800,000
East-West Arterial Road - Walker Road to 4490 7th Conc. Road Access and Roundabout	Construct a four-lane road from Walker Road to 4490 7th Conc. Road access and roundabout. Refer to the Lauzon Parkway Environmental Assessment and Addendum (2014, 2015).	$ 6,360,000
East-West Arterial Road - 4490 7th Concession Road Roundabout to 8th Conc. Road	Construct a two-lane road from 4490 7th Conc. Road roundabout to 8th Conc. Road, constructing a roundabout at the C1 Intersection. Refer to the Lauzon Parkway Environmental Assessment and Addendum (2014, 2015).	$ 5,260,000
C3 Road - 7th Concession Road to 8th Concession Road	Construct a two-lane road from 7th Concession Road to 8th Concession Road.	$ 7,500,000
C2 Road - C3 Road to East-West Arterial Road	Construct a two-lane road from C3 Road to East-West Arterial Road.	$ 5,400,000
C1 Road (Phase A) - C3 Road to East-West Arterial Road	Construct a two-lane road from Baseline Road intersection to Future East-West Arterial Road intersection.	$ 3,500,000
8th Concession Road (Phase A) - County Road 42 to C3 Road	Reconstruct a two-lane road from County Road 42 to C3 Road.	$ 4,100,000
8th Concession Road (Phase B) - C3 Road to East-West Arterial Road	Reconstruct a two-lane road from C3 Road to East-West Arterial Road.	$ 3,600,000
Total		$ 36,520,000
Municipal Drain		
7th Concession Drain Realignment From 7th Conc. Street Drain to 8th Conc. Drain (See Fig F-9-4)	Construction a Municipal Drain from 7th Concession Road to Little River (2.9km).	$ 10,000,000
7th Drain Abandonment - 7th Street Drain to 6th Concession Drain	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
Total		$ 10,030,000
Stormwater Management Servicing		
P1 Drainage Area - North East Pelton Area		
P1 SWM Pond	Construct a receiving pond located between 7th Concession Road and 8th Concession Road.	$ 34,960,000
P1 Pump Station	Construct a pump station for Pond 1.	$ 2,720,000
P1 Storm Sewer (7th Conc.)	Install storm sewers along 7th Concession Road to Pond 1 (Outlet 1).	$ 3,210,000
P1 Storm Sewer (C1)	Install storm sewers along C1 Road From East-West Arterial Road to Pond 1 (Outlet 2).	$ 10,270,000
P1 Storm Sewer (C2)	Install storm sewers along C2 Road From East-West Arterial Road to Pond 1 (Outlet 3).	$ 11,020,000
Total		$ 62,180,000

Notes:

Refer to Figures F4-1 to F4-3 for pond labels.

Costs are based on the functional design of the proposed infrastructure completed to date.

Costs exclude costs for property acquisition.

Schedule C EA's for roads shall be completed if the following is satisfied. (Based on MCEA Guidelines (2023))

- To accommodate road widening, the municipal ROW requires widening or property acquisition.
- Cost for Transportation project exceeds project cost values listed in the MCEA document.
- Roadway spans multiple plans of subdivisions such that the road alignment will establish the collector road alignment for area spans over more than one draft plan of subdivision.

Table F-9-4

City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Phase 2 - County Road 42 Secondary Plan Area

Project Title	Project Description	Estimated Cost
Transportation		
10th Concession Road (Phase A) - County Road 42 to Baseline Road	Reconstruct 10th Concession Road from County Road 42 to Baseline Road.	$ 6,800,000
10th Concession Road (Phase B) - Baseline Road to C4 Road	Reconstruct 10th Concession Road from Baseline Road to C4 Road.	$ 3,400,000
C4 Road (Phase B) - 8th Concession Road to 10th Concession Road	Construct a two-lane road from 8th Concession Road to 10th Concession Road.	$ 14,600,000
C5 Road (Phase B) - Baseline Road to East-West Arterial Road	Construct a two-lane road from Baseline Road intersection to East-West Arterial intersection.	$ 14,300,000
C6 Road (Phase B) - 10th Concession Road to Lauzon Parkway	Construct a two-lane road from Future Lauzon Parkway intersection to 10th Concession Road/County Road 17.	$ 9,400,000
C6 Road (Phase C) - Lauzon Parkway to C7 Road (Optional)	Need for road segment to be confirmed through future traffic assessments. Construct road from Future Lauzon Parkway intersection to C7 Road.	Costs and feasibility shall be confirmed as development proceeds.
C7 Road (Phase B) - Baseline Road to East-West Arterial Road	Construct a two-lane road from Baseline Road intersection to East West Arterial intersection.	$ 5,400,000
C8 Road - 10th Concession Road to Baseline Road	Construct a two-lane Road from 10 Concession Road to Baseline Road.	$ 5,400,000
East-West Arterial Road - 8th Concession Road to 9th Concession Road. (Phase B)	Construct a two-lane road from 8th Concession Road to 9th Concession Road and a roundabout at 8th Concession Road Intersection. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 8,640,000
East-West Arterial Road - 9th Concession Road to Lauzon Parkway (Phase C)	Construct a two-lane road from 9th Concession Road to Lauzon Parkway and a roundabout at 9th Concession Intersection. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 5,430,000
East-West Arterial Road - Lauzon Parkway to 10th Concession Road. (Phase D)	Construct a two-lane road from Lauzon Parkway to 10th Concession Road and a roundabout at 10th Concession intersection. Refer to the Lauzon Parkway Environmental Assessment (2014).	$ 5,600,000
9th Concession Road (Phase B) - Baseline Road to East-West Arterial Road	Reconstruct a two-lane road along 9th Concession Road from Baseline Road to East West Arterial Road.	$ 16,600,000
9th Concession Road (Phase C) - East-West Arterial to Highway 401	Reconstruct a two-lane road along 9th Concession Road from East-West Arterial Road to Highway 401.	$ 5,100,000
Total		$ 100,670,000
Municipal Drain		
(2A) Drainage Works - After 7th Conc. Drain (E-W Art. Drain) Re-Alignment		
8th Concession Drain Abandonment - 7th Conc. Drain (E-W Art. Drain) to 6th Conc. Drain	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
Hayes Drain Abandonment - 7th Conc. Drain (E-W Art. Drain) to 6th Conc. Drain	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
9th Concession Drain Abandonment - 7th Conc. Drain (E-W Art. Drain) to 6th Conc. Drain	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
Hurley Relief Drain Realignment From Southwest End of the Windsor Campground to County Road 17/10th Concession Road (See Fig F-9-4)	Construction a Municipal Drain from the southwest end of the Windsor campground to County Road 17/10th Concession Road (2.0km).	$ 7,860,000
Total		$ 7,950,000
(2B) Drainage Works - After Hurley Relief Drain Re-Alignment		
Existing Hurley Relief Drain Abandonment - Hurley Relief Drain to 9th Concession Drain	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
Hayes Drain Abandonment - Hurley Relief Drain to 7th Concession Drain (E-W Art. Drain)	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
9th Concession Drain Abandonment - Hurley Relief Drain to 7th Conc. Drain (E-W Art. Drain)	Cost associated with completing Drainage Act Report for Drain Abandonment.	$ 30,000
Total		$ 90,000

Table F-9-4
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Phase 2 - County Road 42 Secondary Plan Area

Stormwater Management Servicing			
P3 Drainage Area - West of Lauzon Parkway, South Of Baseline Road			
P3 Pump Station	Construct a pump station, a pond outlet, and a stand-by power generator.	$	3,730,000
P3 SWM Pond	Construct a receiving pond P3, landscaping and maintenance pathway.	$	45,300,000
P3 Trunk Storm Sewer (8th Concession Road)	Install stormwater sewers along 8th Concession Road from East-West Arterial Road to Pond 3 (Outlet 1).	$	16,330,000
P3 Trunk Storm Sewer (9th Concession Road)	Install stormwater sewers along 9th Concession Road from East-West Arterial Road to Pond 3 (Outlet 3).	$	7,990,000
P3 Trunk Storm Sewer (C5 Road)	Install stormwater sewers along C5 road from East-West Arterial Road to Pond 3 (Outlet 2).	$	7,810,000
P3 Trunk Storm Sewer (C7 Road)	Install stormwater sewers along C7 Road from East-West Arterial Road to Pond 3 (Outlet 4).	$	6,360,000
Total		$	87,520,000
P5 Drainage Area - East of Lauzon Parkway, South of CR42			
P5 Pump Station	Construct a pump station, a pond outlet, and a stand-by power generator.	$	1,890,000
P5 SWM Pond	Construct a receiving pond (P5), landscaping and maintenance pathway.	$	20,360,000
P5 Storm Sewers (C8 Road - C6 Road)	Install stormwater sewers along C6 Road and C8 Road From C8 Road to Pond 5 (Outlet 1).	$	12,210,000
Total		$	34,460,000
P6 Drainage Area - East of Lauzon Parkway, South of Baseline Road			
P6 Pump Station	Construct a pump station, a pond outlet and a stand-by power generator and a associated gravity sewer along C4 Road.	$	2,470,000
P6 SMW Pond	Construct a receiving pond (P6), landscaping and maintenance pathway.	$	17,150,000
P6 Storm Sewers (Lauzon Parkway)	Install stormwater sewers along Future Lauzon Parkway from East-West Arterial Road to Pond 6 (Outlet 1).	$	8,020,000
Total		$	27,640,000
P8 Drainage Area - West of Lauzon Parkway, CR42 Drainage and Airport Lands			
P8 SWM Pond (Phase 2)	Construct the remainder of the receiving pond located along County Road 42. (80% Cost)	$	25,380,000
P8 Pump Station (Phase 2)	Construct a storm pump station. Pump station configuration shall be staged based on the phased implementation of the pond storage capacity as described above. (50% Factor)	$	2,320,000
P8 Trunk Storm Sewer - Lauzon Parkway	Construct the remainder of the trunk sewer located along Lauzon Parkway after the Lauzon Parkway improvements are complete. (50%)	$	950,000
Total		$	28,650,000
Sanitary			
9th Concession Road - Sanitary Trunk Sewer - Baseline Road to C4 Road	Install sanitary trunk sewers along 9th Concession Road from Baseline Road to C4 Road.	$	1,020,000
10th Concession Road - Sanitary Trunk Sewer - Baseline Road to C4 Road	Install sanitary trunk sewers along 10th Concession Road from County Road 42 to C4 Road.	$	3,170,000
9th Concession Road - Sanitary Trunk Sewer - C4 Road to HWY 401	Install sanitary trunk sewers along 9th Concession Road from C4 Road to Highway 401.	$	1,760,000
10th Concession Road - Sanitary Trunk Sewer - C4 Road to HWY 401	Install sanitary trunk sewers along 10th Concession Road from C4 Road to Highway 401.	$	1,850,000
County Road 42 - Sanitary Trunk Sewer - Lauzon Parkway to City Limits	Install sanitary trunk sewers along County Road 42 from Lauzon Parkway to City Limits.	$	1,200,000
Lauzon Parkway - Sanitary Trunk Sewer - CP Railroad to Service Road B	Install sanitary trunk sewers along Lauzon Parkway from Canadian Pacific Railroad to Service Road B.	$	870,000
Total		$	9,870,000

Notes:
Refer to Figures F4-1 to F4-3 for pond labels.
Costs are based on the functional design of the proposed infrastructure completed to date.
Costs exclude costs for property acquisition.

Table F-9-5
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Phase 2 - East Pelton Secondary Plan Area

Project Title	Project Description	Cost
Transportation		
8th Concession Road (Phase C) - from East-West Arterial Road to Highway 401	Reconstruct a two-lane road along 8th Concession Road from East-West Arterial Road to Highway 401.	$ 4,600,000
C1 Road (Phase B) - East-West Arterial Road to 8th Concession Road	Construct a two-lane road from East-West Arterial Road to Future 8th Concession Road.	$ 9,000,000
C4 Road (Phase A) - 7th Concession Road to 8th Concession Road	Construct a two-lane road from 7th Concession Road to 8th Concession Road.	$ 7,500,000
Total		$ 21,100,000
Stormwater Management Servicing		
P2 Pump Station	Construct a pump station, a pond outlet, and a stand-by power generator.	$ 1,890,000
P2 SWM Pond	Construct a receiving pond (P2), landscaping and maintenance pathway.	$ 19,480,000
PS2 Trunk Storm Sewer (C1 Road)	Install stormwater sewers along C1 Road to Pond 2 (Outlet 1).	$ 7,130,000
Total		$ 28,500,000

Notes:
Refer to Figures F4-1 to F4-3 for pond labels.
Costs are based on the functional design of the proposed infrastructure completed to date.
Costs exclude costs for property acquisition.

Table F-9-6
City of Windsor Sandwich South Master Servicing Plan
Project Implementation Summary and Cost Estimates
Arterial Road Network - FROM LAUZON PARKWAY EA (2014)

LAUZON PARKWAY INTERIM BUILD 4 LANES
FOREST GLADE DRIVE TO HIGHWAY 401

Location	Estimated Cost (2022 $M)
Twin Oaks Drive to Service Road B - 4 Lanes	$ 11,170,000
Service Road B - Intersection	$ 3,220,000
Service Road B to CR42 - 4 Lanes*	$ 10,500,000
County Road 42 Intersection Improvements*	$ 9,480,000
County Road 42 to Baseline Road - 4 Lanes	$ 5,930,000
Baseline Road Intersection Improvements	$ 4,910,000
Baseline Road to E-W Arterial - 4 Lanes	$ 4,400,000
E-W Arterial Intersection Improvements	$ 7,790,000
E-W Arterial to Highway 401 Interchange - 4 Lanes	$ 4,070,000
TOTAL	**$ 61,470,000**

COUNTY ROAD 42 - WALKER ROAD TO CITY / COUNTY BOUNDARY

Location	Reference
Walker Road Intersection Improvements	See Table F-9-2
Walker Road to 7th Concession Road and Baseline Road - Build 4 Lanes	See Table F-9-2
7th Concession Road and Baseline Road Roundabout	See Table F-9-2
7th Concession Road to 8th Concession Road - Build 4 Lanes	See Table F-9-2
8th Concession Road Roundabout	See Table F-9-2
8th Concession Road to 9th Concession Road - Build 4 Lanes	See Table F-9-2
9th Concession Road Roundabout	See Table F-9-2
9th Concession Road to Lauzon Parkway - Build 4 Lanes	See Table F-9-2
Lauzon Parkway to City/County Boundary - Build 4 Lanes	See Table F-9-2

E-W ARTERIAL - BUILDING NEW 2- LANES ROAD

Location	Reference
Walker Road Intersection Improvements	See Table F-9-3
Walker Road to 4490 7th Concession Road Roundabout Access- Build 4 Lanes	See Table F-9-3
4490 7th Concession Road Roundabout Access	See Table F-9-3
Future Collector Road Roundabout	See Table F-9-3
Future Collector Road Roundabout to 8th Concession Road- Build Lanes	See Table F-9-3
8th Concession Road Roundabout	See Table F-9-4
8th Concession Road to 9th Concession Road- Build 2 Lanes	See Table F-9-4
9th Concession Road Roundabout	See Table F-9-4
9th Concession Road Roundabout to Lauzon Parkway - Build 2 Lanes	See Table F-9-4
E-W Arterial and Lauzon Parkway Intersection (Cost included in Lauzon Parkway Total)	
Lauzon Parkway to 10th Concession Road/ County Road17- Build 2 Lanes	See Table F-9-4
10th Concession Road/ County Road 17 Roundabout	See Table F-9-4

* Timing of arterial road network improvements will be depend forecasted traffic demand which will be dependent on timing of development within this area as well as areas outside of Sandwich South. Phasing included herein was recommended through the Lauzon Parkway Environmental Assessment (2014).

Sandwich South Master Servicing Plan

Functional Design Report - Cost Estimates

Date: Feb, 2023

P1 Stormwater Pond Construction Cost Estimate

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P1 POND					
1	Pond Excavation and Grading	m^3	187,462	$ 35.00	$ 6,561,170.00
2	Pond Landscaping (shrubs, trees, etc.)	m	2,240	$ 2,800.00	$ 6,272,000.00
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	c) 750mm Pond Outlet Conduit to the Pump Station	m	50	$ 720.00	$ 36,000.00
4	Transportation of Soil Off-Site	m^3	187,462	$ 40.00	$ 7,498,480.00
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	33,600	$ 10.00	$ 336,000.00
6	Recreational Trail	m	2,240	$ 720.00	$ 1,612,800.00
SUB-TOTAL					$ 22,408,200.00
Construction Contingency (30%)					$ 6,722,460.00
SUB-TOTAL					$ 29,130,660.00
Engineering Fee Estimate (20%)					$ 5,826,132.00
TOTAL P1 POND CONSTRUCTION COST					$ 34,956,792.00
STORM SEWER P1:OUTLET-1					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1650mm Diameter Trunk Sewer	m	205	$ 3,000.00	$ 615,000.00
4	3000mm Maintenance Hole (for 1650mm Trunk Sewer)	m	205	$ 156.00	$ 31,980.00
5	1800mm Diameter Trunk Sewer	m	310	$ 3,600.00	$ 1,116,000.00
6	3000mm Maintenance Tees (for 1800mm Trunk Sewer)	m	310	$ 156.00	$ 48,360.00
7	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
8	Isolator ROW Plus	ha	16	$ 5,000.00	$ 78,500.00
SUB-TOTAL					$ 2,057,540.00
Construction Contingency (30%)					$ 617,262.00
SUB-TOTAL					$ 2,674,802.00
Engineering Fee Estimate (20%)					$ 534,960.40
TOTAL P1: OUTLET-1 CONSTRUCTION COST					$ 3,209,762.40
STORM SEWER P1:OUTLET-2					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1350mm DIA. Trunk Sewer	m	320	$ 2,160.00	$ 691,200.00
4	2400mm Maintenance Hole (for 1350mm Trunk Sewer)	m	320	$ 156.00	$ 49,920.00
5	1500mm DIA. Trunk Sewer	m	613	$ 2,640.00	$ 1,618,320.00
6	2400mm Maintenance Hole (for 1500mm Trunk Sewer)	m	613	$ 156.00	$ 95,628.00
7	1800mm DIA. Trunk Sewer	m	120	$ 3,600.00	$ 432,000.00
8	3000mm Maintenance Hole (for 1800mm Trunk Sewer)	m	120	$ 156.00	$ 18,720.00
9	2250mm DIA. Trunk Sewer	m	305	$ 4,800.00	$ 1,464,000.00
10	3600mm Maintenance Hole (for 2250mm Trunk Sewer)	m	305	$ 156.00	$ 47,580.00
11	2400mm DIA. Trunk Sewer	m	290	$ 6,000.00	$ 1,740,000.00
12	3600mm Maintenance Hole (for 2400mm Trunk Sewer)	m	290	$ 156.00	$ 45,240.00
13	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
14	Isolator ROW Plus	ha	43	$ 5,000.00	$ 212,500.00
SUB-TOTAL					$ 6,582,808.00
Construction Contingency (30%)					$ 1,974,842.40
SUB-TOTAL					$ 8,557,650.40
Engineering Fee Estimate (20%)					$ 1,711,530.08
TOTAL P1:OUTLET-2 CONSTRUCTION COST					$ 10,269,180.48

STORM SEWER P1:OUTLET-3					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1800mm DIA. Trunk Sewer	m	298	$ 3,600.00	$ 1,072,800.00
4	3000mm Maintenance Hole (for 1800mm Trunk Sewer)	m	298	$ 156.00	$ 46,488.00
5	2250mm DIA. Trunk Sewer	m	275	$ 4,800.00	$ 1,320,000.00
6	3600mm Maintenance Hole (for 2250mm Trunk Sewer)	m	275	$ 156.00	$ 42,900.00
7	2550mm DIA. Trunk Sewer	m	154	$ 6,600.00	$ 1,016,400.00
8	Concrete Maintenance Hole - (Chamber) (for 2550mm Trunk Sewer)	m	154	$ 240.00	$ 36,960.00
9	2700mm DIA. Trunk Sewer	m	419	$ 7,200.00	$ 3,016,800.00
10	Concrete Maintenance Hole - (Chamber) (for 2700mm Trunk Sewer)	m	419	$ 240.00	$ 100,560.00
13	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
14	Isolator ROW Plus	ha	48	$ 5,000.00	$ 240,500.00
SUB-TOTAL					$ 7,061,108.00
Construction Contingency (30%)					$ 2,118,332.40
SUB-TOTAL					$ 9,179,440.40
Engineering Fee Estimate (20%)					$ 1,835,888.08
TOTAL P1:OUTLET-3 CONSTRUCTION COST					$ 11,015,328.48

P1 PUMP STATION (PS1)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station - Includes 400mm Discharge Pipe to Drain	L.S	--	$ 1,500,000.00	$ 1,500,000.00
2	Cost of 125kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	EA	1	$ 108,000.00	$ 108,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	1050mm Discharge Pipes to East-West Arterial Drain	m	35	$ 1,440.00	$ 50,400.00
SUB-TOTAL					$ 1,738,800.00
Contingency (30%)					$ 521,640.00
SUB-TOTAL					$ 2,260,440.00
Engineering Fees (20%)					$ 452,088.00
PS1 - PUMP STATION TOTAL CONSTRUCTION COST					$ 2,712,528.00

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

P2 STORM WATER POND CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P2 Pond					
1	Pond Excavation and Grading	m^3	111,037	$ 35.00	$ 3,886,297.80
2	Pond Landscaping (shrubs, trees, etc.)	m	1,100	$ 2,800.00	$ 3,080,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
5	525mm Pond Outlet Conduit to the Pump Station	m	50	$ 540.00	$ 27,000.00
6	Transportation of Soil Off-Site	m^3	111,037	$ 40.00	$ 4,441,483.20
7	Restoration (Topsoil and Hydroseed and Sod)	m^2	16,500	$ 10.00	$ 165,000.00
8	Recreational Trail	m	1,100	$ 720.00	$ 792,000.00
SUB-TOTAL					$ 12,483,531.00
Construction Contingency (30%)					$ 3,745,059.30
SUB-TOTAL					$ 16,228,590.30
Engineering Fee Estimate (20%)					$ 3,245,718.06
TOTAL P2 POND CONSTRUCTION COST					$ 19,474,308.36

STORM SEWER P2:OUTLET					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1200mm Diameter Trunk Sewer (Concrete 100-D)	m	375	$ 1,800.00	$ 675,000.00
4	2400mm Maintenance Hole (for 1200mm Trunk Sewer)	m	375	$ 156.00	$ 58,500.00
5	1800mm Diameter Trunk Sewer (Concrete 100-D)	m	443	$ 3,600.00	$ 1,594,800.00
6	2400mm Maintenance Hole (for 1200mm Trunk Sewer)	m	443	$ 156.00	$ 69,108.00
7	3000mm x 1500mm Concrete Box Culvert	m	225	$ 9,000.00	$ 2,025,000.00
8	Concrete Maintenance Hole - (Chamber) (for 3000mmx1500mm Box Culvert)	m	225	$ 240.00	$ 54,000.00
9	3000mmx1500mm Box Culvert 45° bend	EA	1	$ 25,000.00	$ 25,000.00
10	3000mmx1500mm Transition Plug with 1800mm Diameter Trunk Sewer	EA	1	$ 9,800.00	$ 9,800.00
SUB-TOTAL					$ 4,568,908.00
Construction Contingency (30%)					$ 1,370,672.40
SUB-TOTAL					$ 5,939,580.40
Engineering Fee Estimate (20%)					$ 1,187,916.08
TOTAL P2:OUTLET CONSTRUCTION COST					$ 7,127,496.48

P2 PUMP STATION(PS2)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station	L.S	--	$ 1,000,000.00	$ 1,000,000.00
2	Cost of 60kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	EA	1	$ 96,000.00	$ 96,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	2-450mm Discharge Pipes to East-West Arterial Drain	m	70	$ 480.00	$ 33,600.00
SUB-TOTAL					$ 1,210,000.00
Contingency (30%)					$ 363,000.00
SUB-TOTAL					$ 1,573,000.00
Engineering Fees (20%)					$ 314,600.00
TOTAL PS2 - PUMP STATION CONSTRUCTION COST					$ 1,887,600.00

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Date: Feb, 2023

P3 STORMWATER POND CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P3 Pond					
1	Pond Excavation and Grading	m^3	223,740	$ 35.00	$ 7,830,900.00
2	Pond Landscaping (shrubs, trees, etc.)	m	3,295	$ 2,800.00	$ 9,226,000.00
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	c) 1050mm Pond Outlet Conduit to the Pump Station	m	50	$ 1,440.00	$ 72,000.00
4	Transportation of Soil Off-Site	m^3	223,740	$ 40.00	$ 8,949,600.00
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	49,425	$ 10.00	$ 494,250.00
6	Recreational Trail	m	3,295	$ 720.00	$ 2,372,400.00
SUB-TOTAL					$ 29,036,900.00
Construction Contingency (30%)					$ 8,711,070.00
SUB-TOTAL					$ 37,747,970.00
Engineering Fee Estimate (20%)					$ 7,549,594.00
TOTAL P3 POND CONSTRUCTION COST					$ 45,297,564.00
STORM SEWER P3:OUTLET-1					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	2700mm DIA. Trunk Sewer	m	575	$ 7,200.00	$ 4,140,000.00
4	Chamber Maintenance Hole (for 2700mm Trunk Sewers)	m	575	$ 240.00	$ 138,000.00
5	3000mm DIA. Trunk Sewer	m	705	$ 7,800.00	$ 5,499,000.00
6	Chamber Maintenance Hole (for 3000mm Trunk Sewers)	m	705	$ 240.00	$ 169,200.00
7	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
8	Isolator ROW Plus	ha	70	$ 5,000.00	$ 349,500.00
SUB-TOTAL					$ 10,463,400.00
Construction Contingency (30%)					$ 3,139,020.00
SUB-TOTAL					$ 13,602,420.00
Engineering Fee Estimate (20%)					$ 2,720,484.00
TOTAL P3:OUTLET-1 CONSTRUCTION COST					$ 16,322,904.00
STORM SEWER P3:OUTLET-2					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1950mm DIA. Trunk Sewer	m	335	$ 3,900.00	$ 1,306,500.00
4	3000mm Maintenance Hole (for 1950mm Trunk Sewer)	m	335	$ 156.00	$ 52,260.00
5	2400mm DIA. Trunk Sewer	m	535	$ 6,000.00	$ 3,210,000.00
6	3600mm Maintenance Hole (for 2400mm Trunk Sewer)	m	535	$ 156.00	$ 83,460.00
7	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
8	Isolator ROW Plus	ha	37	$ 5,000.00	$ 184,000.00
SUB-TOTAL					$ 5,003,920.00
Construction Contingency (30%)					$ 1,501,176.00
SUB-TOTAL					$ 6,505,096.00
Engineering Fee Estimate (20%)					$ 1,301,019.20
TOTAL P3:OUTLET-2 CONSTRUCTION COST					$ 7,806,115.20

STORM SEWER P3:OUTLET-3					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1950mm DIA. Trunk Sewer	m	345	$ 3,900.00	$ 1,345,500.00
4	3000mm Maintenance Hole (for 1950mm Trunk Sewer)	m	345	$ 156.00	$ 53,820.00
5	2400mm DIA. Trunk Sewer	m	545	$ 6,000.00	$ 3,270,000.00
6	3600mm Maintenance Hole (for 2400mm Trunk Sewer)	m	545	$ 156.00	$ 85,020.00
7	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
8	Isolator ROW Plus	ha	40	$ 5,000.00	$ 199,550.00
SUB-TOTAL					$ 5,121,590.00
Construction Contingency (30%)					$ 1,536,477.00
SUB-TOTAL					$ 6,658,067.00
Engineering Fee Estimate (20%)					$ 1,331,613.40
TOTAL P3:OUTLET-3 CONSTRUCTION COST					$ 7,989,680.40

STORM SEWER P3:OUTLET-4					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1200mm DIA. Trunk Sewer	m	370	$ 1,800.00	$ 666,000.00
4	2400mm Maintenance Hole (for 1200mm Trunk Sewer)	m	370	$ 156.00	$ 57,720.00
5	1950mm DIA. Trunk Sewer	m	740	$ 3,900.00	$ 2,886,000.00
6	3000mm Maintenance Hole (for 1950mm Trunk Sewer)	m	740	$ 156.00	$ 115,440.00
7	OGS unit	EA	1	$ 110,000.00	$ 110,000.00
8	Isolator ROW Plus	ha	36	$ 5,000.00	$ 182,000.00
SUB-TOTAL					$ 4,074,860.00
Construction Contingency (30%)					$ 1,222,458.00
SUB-TOTAL					$ 5,297,318.00
Engineering Fee Estimate (20%)					$ 1,059,463.60
TOTAL P3:OUTLET-4 CONSTRUCTION COST					$ 6,356,781.60

P3 PUMP STATION (PS3)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station	L.S	--	$ 2,000,000.00	$ 2,000,000.00
2	Cost of 250kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	EA	1	$ 216,000.00	$ 216,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	1500mm Discharge Pipe to 6th Concession Drain	m	35	$ 2,640.00	$ 92,400.00
SUB-TOTAL					$ 2,388,800.00
Construction Contingency (30%)					$ 716,640.00
SUB-TOTAL					$ 3,105,440.00
Engineering Fee Estimate (20%)					$ 621,088.00
TOTAL P3 PUMP STATION CONSTRUCTION COST					$ 3,726,528.00

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Date: Aug, 2022

P4 CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P4 POND					
1	Pond Excavation and Grading	m^3	139,532	$ 35.00	$ 4,883,608.10
2	Pond Landscaping (shrubs, trees, etc.)	m	1,847	$ 2,800.00	$ 5,172,720.00
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	c) 525mm Pond Outlet Conduit to the Pump Station	m	50	$ 720.00	$ 36,000.00
4	Transportation of Soil Off-Site	m^3	139,532	$ 40.00	$ 5,581,266.40
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	27,711	$ 10.00	$ 277,110.00
6	Recreational Trail	m	1,847	$ 720.00	$ 1,330,128.00
SUB-TOTAL					$ 17,372,582.50
Construction Contingency (30%)					$ 5,211,774.75
SUB-TOTAL					$ 22,584,357.25
Engineering Fee Estimate (20%)					$ 4,516,871.45
TOTAL P4 POND CONSTRUCTION COST					$ 27,101,228.70

STORM SEWER P4:OUT 1					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	2100mm DIA. Trunk Sewer	m	845	$ 4,200.00	$ 3,549,000.00
4	3600mm Maintenance Hole (for 1950mm Trunk Sewer)	m	845	$ 156.00	$ 131,820.00
5	2250mm DIA. Trunk Sewer	m	515	$ 4,800.00	$ 2,472,000.00
6	3600mm Maintenance Hole (for 2250mm Trunk Sewer)	m	515	$ 156.00	$ 80,340.00
7	2400mm DIA. Trunk Sewer	m	695	$ 6,000.00	$ 4,170,000.00
8	3600mm Maintenance Hole (for 2400mm Trunk Sewer)	m	695	$ 156.00	$ 108,420.00
SUB-TOTAL					$ 10,569,280.00
Construction Contingency (30%)					$ 3,170,784.00
SUB-TOTAL					$ 13,740,064.00
Engineering Fee Estimate (20%)					$ 2,748,012.80
TOTAL P4: OUT 1 CONSTRUCTION COST					$ 16,488,076.80

STORM SEWER P4:OUT 2					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1950mm DIA. Trunk Sewer	m	500	$ 3,900.00	$ 1,950,000.00
4	3000mm Maintenance Hole (for 1950mm Trunk Sewer)	m	500	$ 156.00	$ 78,000.00
5	2250mm DIA. Trunk Sewer	m	620	$ 4,800.00	$ 2,976,000.00
6	3600mm Maintenance Hole (for 2250mm Trunk Sewer)	m	620	$ 156.00	$ 96,720.00
SUB-TOTAL					$ 5,158,420.00
Construction Contingency (30%)					$ 1,547,526.00
SUB-TOTAL					$ 6,705,946.00
Engineering Fee Estimate (20%)					$ 1,341,189.20
TOTAL P4: OUT 2 CONSTRUCTION COST					$ 8,047,135.20

P4 PUMP STATION (PS4)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station - Includes 400mm Discharge Pipe to Drain	L.S	--	$ 2,040,000.00	$ 2,040,000.00
2	Cost of 125kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	L.S	1	$ 108,000.00	$ 108,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	1050mm Discharge Pipes to East-West Arterial Drain	m	35	$ 1,440.00	$ 50,400.00
SUB-TOTAL					$ 2,278,800.00
Construction Contingency (30%)					$ 683,640.00
SUB-TOTAL					$ 2,962,440.00
Engineering Fees Estimate (20%)					$ 592,488.00
PS4 PUMP STATION TOTAL CONSTRUCTION COST					$ 3,554,928.00

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Date: Aug, 2022

P5 STORMWATER POND CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P5 Pond					
1	Pond Excavation and Grading	m^3	112,171	$ 35.00	$ 3,925,979.75
2	Pond Landscaping (shrubs, trees, etc.)	m	1,230	$ 2,800.00	$ 3,444,000.00
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	c) 525mm Pond Outlet Conduit to the Pump Station	m	50	$ 540.00	$ 27,000.00
4	Transportation of Soil Off-Site	m^3	112,171	$ 40.00	$ 4,486,834.00
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	18,450	$ 10.00	$ 184,500.00
6	Recreational Trail	m	1,230	$ 720.00	$ 885,600.00
SUB-TOTAL					$ 13,045,663.75
Construction Contingency (30%)					$ 3,913,699.13
SUB-TOTAL					$ 16,959,362.88
Engineering Fee Estimate (20%)					$ 3,391,872.58
TOTAL P5 POND CONSTRUCTION COST					$ 20,351,235.45

STORM SEWER P5:OUTLET					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	1950mm DIA. Trunk Sewer	m	365	$ 3,900.00	$ 1,423,500.00
4	3000mm Maintenance Hole (for 1950mm Trunk Sewer)	m	365	$ 156.00	$ 56,940.00
5	2100mm DIA. Trunk Sewer	m	520	$ 4,200.00	$ 2,184,000.00
6	3600mm Maintenance Hole (for 2100mm Trunk Sewer)	m	520	$ 156.00	$ 81,120.00
9	2700mm DIA. Trunk Sewer	m	540	$ 7,200.00	$ 3,888,000.00
10	Chamber Maintenance Hole (for 2700mm Trunk Sewer)	m	540	$ 240.00	$ 129,600.00
SUB-TOTAL					$ 7,820,860.00
Construction Contingency (30%)					$ 2,346,258.00
SUB-TOTAL					$ 10,167,118.00
Engineering Fee Estimate (20%)					$ 2,033,423.60
TOTAL P5: OUTLET CONSTRUCTION COST					$ 12,200,541.60

P5 PUMP STATION (PS5)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station - Includes 400mm Discharge Pipe to Drain	L.S	--	$ 1,000,000.00	$ 1,000,000.00
2	Cost of 60kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	EA	1	$ 96,000.00	$ 96,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	2-450mm Discharge Pipes to Little River	m	70	$ 480.00	$ 33,600.00
SUB-TOTAL					$ 1,210,000.00
Contingency (30%)					$ 363,000.00
SUB-TOTAL					$ 1,573,000.00
Engineering Fees (20%)					$ 314,600.00
TOTAL PS5 PUMP STATION CONSTRUCTION COST					$ 1,887,600.00

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Date: Aug, 2022

P6 CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P6 Pond					
1	Pond Excavation and Grading	m3	95,255	$ 35.00	$ 3,333,917.65
2	Pond Landscaping (shrubs, trees, etc.)	m	1,015	$ 2,800.00	$ 2,842,000.00
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	c) 525mm Pond Outlet Conduit to the Pump Station	m	50	$ 540.00	$ 27,000.00
4	Transportation of Soil Off-Site	m^3	95,255	$ 40.00	$ 3,810,191.60
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	15,225	$ 10.00	$ 152,250.00
6	Recreational Trail	m	1,015	$ 720.00	$ 730,800.00
SUB-TOTAL					$ 10,987,909.25
Construction Contingency (30%)					$ 3,296,372.78
SUB-TOTAL					$ 14,284,282.03
Engineering Fee Estimate (20%)					$ 2,856,856.41
TOTAL P6 POND CONSTRUCTION COST					$ 17,141,138.43

STORM SEWER P6:OUTLET					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
3	2250mm DIA. Trunk Sewer	m	410	$ 4,800.00	$ 1,968,000.00
4	3000mm Maintenance Hole (for 2250mm Trunk Sewer)	m	410	$ 156.00	$ 63,960.00
5	2700mm DIA. Trunk Sewer	m	410	$ 7,200.00	$ 2,952,000.00
6	Chamber Maintenance Hole (for 2700mm Trunk Sewer)	m	410	$ 240.00	$ 98,400.00
SUB-TOTAL					$ 5,140,060.00
Construction Contingency (30%)					$ 1,542,018.00
SUB-TOTAL					$ 6,682,078.00
Engineering Fee Estimate (20%)					$ 1,336,415.60
TOTAL P6_OUTLET CONSTRUCTION COST					$ 8,018,493.60

P6 PUMP STATION(PS6)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station - Includes 400mm Discharge Pipe to Drain	L.S	--	$ 1,000,000.00	$ 1,000,000.00
2	Cost of 60kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	EA	1	$ 96,000.00	$ 96,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	Supply 825mm DIA. Trunk Sewer (Outlet to Little River from PS)				
	a) 825mm DIA. Trunk Sewer	m	398	$ 840.00	$ 333,984.00
	b) 1500mm Maintenance Hole (for 825mm Trunk Sewer)	m	398	$ 90.00	$ 35,784.00
6	2-450mm Discharge Pipes to Little River	m	70	$ 480.00	$ 33,600.00
SUB-TOTAL					$ 1,579,768.00
Contingency (30%)					$ 473,930.40
SUB-TOTAL					$ 2,053,698.40
Engineering Fees (20%)					$ 410,739.68
TOTAL PS6 PUMP STATION CONSTRUCTION COST					$ 2,464,438.08

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P7 STORMWATER POND CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P7 Pond					
1	Pond Excavation and Grading	m^3	14,673	$ 35.00	$ 513,538.55
2	Pond Landscaping (shrubs, trees, etc.)	m	366	$ 2,800.00	$ 1,023,960.00
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	150	$ 227.00	$ 34,050.00
	c) 525mm Pond Outlet Conduit to the Pump Station	m	50	$ 540.00	$ 27,000.00
4	Transportation of Soil Off-Site	m^3	14,673	$ 40.00	$ 586,901.20
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	5,486	$ 10.00	$ 54,855.00
6	Recreational Trail	m	366	$ 720.00	$ 263,304.00
SUB-TOTAL					$ 2,538,608.75
Construction Contingency (30%)					$ 761,582.63
SUB-TOTAL					$ 3,300,191.38
Engineering Fee Estimate (20%)					$ 660,038.28
TOTAL P7 POND CONSTRUCTION COST					$ 3,960,229.65

STORM SEWER P7-OUTLET					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	100	$ 227.00	$ 22,700.00
	Lauzon Parkway North				
3	375mm DIA. Trunk Sewer	m	80	$ 462.00	$ 36,960.00
4	1200-1800 mm Maintenance Hole	m	80	$ 90.00	$ 7,200.00
5	525mm DIA. Trunk Sewer	m	220	$ 540.00	$ 118,800.00
6	1200-1800 mm Maintenance Hole	m	220	$ 90.00	$ 19,800.00
7	600mm DIA. Trunk Sewer	m	50	$ 600.00	$ 30,000.00
8	1200-1800 mm Maintenance Hole	m	50	$ 90.00	$ 4,500.00
9	1200mm DIA. Trunk Sewer	m	235	$ 600.00	$ 141,000.00
10	1200-1800 mm Maintenance Hole	m	235	$ 90.00	$ 21,150.00
SUB-TOTAL					$ 437,110.00
Construction Contingency (30%)					$ 131,133.00
SUB-TOTAL					$ 568,243.00
Engineering Fee Estimate (20%)					$ 113,648.60
TOTAL P7-OUTLET CONSTRUCTION COST					$ 681,891.60

P7 PUMP STATION (PS7)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station - Includes 400mm Discharge Pipe to Drain	L.S	1	$ 800,000.00	$ 800,000.00
2	Cost of 60kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	L.S	1	$ 96,000.00	$ 96,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	2-450mm Discharge Pipes to Little River	m	60	$ 480.00	$ 28,800.00
SUB-TOTAL					$ 1,005,200.00
Contingency (30%)					$ 301,560.00
SUB-TOTAL					$ 1,306,760.00
Engineering Fees (20%)					$ 261,352.00
TOTAL PS7 PUMP STATION CONSTRUCTION COST					$ 1,568,112.00

Sandwich South Master Servicing Plan
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Date: Aug, 2022

P8 STORMWATER POND CONSTRUCTION COST ESTIMATE

Item No.	Description	Unit	Estimated Quantity	Unit Price	Amount
P8 Pond					
1	Pond Excavation and Grading	m^3	196,654	$ 35.00	$ 6,882,890
2	Pond Landscaping (shrubs, trees, etc.)	m	1,497	$ 2,783.95	$ 4,166,181.18
3	Pond Outlet to Pump Station				
	a) Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
	b) Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	c) 525mm Pond Outlet Conduit to the Pump Station	m	50	$ 540.00	$ 27,000.00
4	Transportation of Soil Off-Site	m^3	196,654	$ 40.00	$ 7,866,159.60
5	Restoration (Topsoil and Hydroseed and Sod)	m^2	22,448	$ 10.00	$ 224,475.00
6	Recreational Trail	m	1,497	$ 720.00	$ 1,077,480.00
SUB-TOTAL					$ 20,335,935.43
Construction Contingency (30%)					$ 6,100,780.63
SUB-TOTAL					$ 26,436,716.05
Engineering Fee Estimate (20%)					$ 5,287,343.21
TOTAL P8 POND CONSTRUCTION COST					$ 31,724,059.26

STORM SEWER P8_OUTLET 1 - Along County Road 42					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	Country Road 42				
3	1650mm DIA. Trunk Sewer	m	565	$ 3,000.00	$ 1,695,000.00
4	2400 - 3600mm Maintenance Hole (for 1650mm Trunk Sewer)	m	565	$ 156.00	$ 88,140.00
5	3000mm DIA. Trunk Sewer	m	608	$ 7,800.00	$ 4,742,400.00
6	2400 - 3600mm Maintenance Hole (for 3000mm Trunk Sewer)	m	608	$ 156.00	$ 94,848.00
7	2550mm DIA. Trunk Sewer	m	525	$ 6,600.00	$ 3,465,000.00
8	2400 - 3600mm Maintenance Hole (for 3000mm Trunk Sewer)	m	525	$ 156.00	$ 81,900.00
9	2400mm DIA. Trunk Sewer	m	895	$ 6,000.00	$ 5,370,000.00
10	2400 - 3600mm Maintenance Hole (for 3000mm Trunk Sewer)	m	895	$ 156.00	$ 139,620.00
11	2250mm DIA. Trunk Sewer	m	1,440	$ 4,800.00	$ 6,912,000.00
12	2400 - 3600mm Maintenance Hole (for 3000mm Trunk Sewer)	m	1,440	$ 156.00	$ 224,640.00
SUB-TOTAL					$ 22,905,298.00
Construction Contingency (30%)					$ 6,871,589.40
SUB-TOTAL					$ 29,776,887.40
Engineering Fee Estimate (20%)					$ 5,955,377.48
TOTAL P8_OUTLET 1 CONSTRUCTION COST - County Road 42					$ 35,732,264.88

STORM SEWER P8_OUTLET 2 - Along Airport Road					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	Along Airport Road				
3	3000mm DIA. Trunk Sewer	m	1,290	$ 13,800.00	$ 17,802,000.00
4	2400 - 3600mm Maintenance Hole (for 3000mm Trunk Sewer)	m	1,290	$ 156.00	$ 201,240.00
5	2400mm DIA. Trunk Sewer	m	435	$ 13,800.00	$ 6,003,000.00
6	2400 - 3600mm Maintenance Hole (for 3000mm Trunk Sewer)	m	435	$ 156.00	$ 67,860.00
SUB-TOTAL					$ 24,165,850.00
Construction Contingency (30%)					$ 7,249,755.00
SUB-TOTAL					$ 31,415,605.00
Engineering Fee Estimate (20%)					$ 6,283,121.00
TOTAL P8_OUTLET 2 CONSTRUCTION COST - Along Airport Road					$ 37,698,726.00

STORM SEWER P8_OUTLET 3-Lauzon Parkway North					
1	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
2	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	250	$ 227.00	$ 56,750.00
	Lauzon Parkway North				
3	900mm DIA. Trunk Sewer	m	430	$ 1,020.00	$ 438,600.00
4	1200-1800 mm Maintenance Hole (for 900mm Trunk Sewer)	m	430	$ 90.00	$ 38,700.00
5	1050mm DIA. Trunk Sewer	m	401	$ 1,440.00	$ 577,440.00
6	1200-1800 mm Maintenance Hole (for 1050mm Trunk Sewer)	m	401	$ 90.00	$ 36,090.00
SUB-TOTAL					$ 1,182,580.00
Construction Contingency (30%)					$ 354,774.00
SUB-TOTAL					$ 1,537,354.00
Engineering Fee Estimate (20%)					$ 307,470.80
TOTAL P8_OUTLET 3 CONSTRUCTION COST -Lauzon Parkway North					$ 1,844,824.80

P8 PUMP STATION(PS8)					
1	Construct Storm Pump Station: - Structural, Mechanical and Electrical - Installation and Coordination of Hydro Service for Pump Station - Includes 400mm Discharge Pipe to Drain	L.S	--	$ 2,640,000.00	$ 2,640,000.00
2	Cost of 250kW, 3P, 60Hz DG set with standard enclosure for supply, installation, testing and commissioning at site	EA	1	$ 216,000.00	$ 216,000.00
3	Precast Channel Outlet Headwall, Including Grate and Safety Rail	EA	1	$ 35,000.00	$ 35,000.00
4	Erosion Protection of New Outlet Channel: - Including Cable Concrete, Rip Rap, and Filter Cloth	m^2	200	$ 227.00	$ 45,400.00
5	2-450mm Discharge Pipes to Little River	m	75	$ 480.00	$ 36,000.00
SUB-TOTAL					$ 2,972,400.00
Contingency (30%)					$ 891,720.00
SUB-TOTAL					$ 3,864,120.00
Engineering Fees (20%)					$ 772,824.00
TOTAL PS8 PUMP STATION CONSTRUCTION COST					$ 4,636,944.00

Sandwich South Master Servicing Plan
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SANITARY TRUNK SEWERS
Date: Feb, 2023

PHASE 1 CR42 SPA (9TH CONCESSION FROM BASELINE ROAD TO COUNTY ROAD 42)

Description	Unit	Estimated Quantity	Unit Price	Amount
Sanitary Sewer - 750mm diameter	m	865	$ 840	$ 726,600.00
Concrete Manholes - (1200mm to 1800mm)	m	865	$ 90	$ 77,850.00
SUBTOTAL				$ 804,450.00
Construction Cost Contingency (30%)				$ 241,335.00
TOTAL CONSTRUCTION COST				$ 1,045,785.00
Engineering Fee Estimate (20%)				$ 209,157.00
TOTAL PROJECT COST				$ 1,254,942.00

PHASE 2 - CR42 SPA (10th CONCESSION ROAD FROM COUNTY ROAD 42 to C4 ROAD)

Description	Unit	Estimated Quantity	Unit Price	Amount
Sanitary Sewer - 675mm diameter	m	905	$ 750	$ 678,750.00
Sanitary Sewer - 750mm diameter	m	1280	$ 840	$ 1,075,200.00
Sanitary Sewer - 825mm diameter	m	75	$ 960	$ 72,000.00
Concrete Manholes - (1200mm to 1800mm)	m	2260	$ 90	$ 203,400.00
SUBTOTAL				$ 2,029,350.00
Construction Cost Contingency (30%)				$ 608,805.00
TOTAL CONSTRUCTION COST				$ 2,638,155.00
Engineering Fee Estimate (20%)				$ 527,631.00
TOTAL PROJECT COST				$ 3,165,786.00

PHASE 2 CR42 SPA (9TH CONCESSION FROM BASELINE ROAD TO C4 ROAD)

Description	Unit	Estimated Quantity	Unit Price	Amount
Sanitary Sewer - 600mm diameter	m	905	$ 630	$ 570,150.00
Concrete Manholes - (1200mm to 1800mm)	m	905	$ 90	$ 81,450.00
SUBTOTAL				$ 651,600.00
Construction Cost Contingency (30%)				$ 195,480.00
TOTAL CONSTRUCTION COST				$ 847,080.00
Engineering Fee Estimate (20%)				$ 169,416.00
TOTAL PROJECT COST				$ 1,016,496.00

PHASE 2 CR42 SPA (9TH CONCESSION FROM C4 ROAD TO HWY 401)

Description	Unit	Estimated Quantity	Unit Price	Amount
Sanitary Sewer - 525mm diameter	m	1700	$ 570	$ 969,000.00
Concrete Manholes - (1200mm to 1800mm)	m	1700	$ 90	$ 153,000.00
SUBTOTAL				$ 1,122,000.00
Construction Cost Contingency (30%)				$ 336,600.00
TOTAL CONSTRUCTION COST				$ 1,458,600.00
Engineering Fee Estimate (20%)				$ 291,720.00
TOTAL PROJECT COST				$ 1,750,320.00

PHASE 2 CR42 SPA (10TH CONCESSION FROM C4 ROAD TO HWY 401 ROAD)

Description	Unit	Estimated Quantity	Unit Price	Amount
Sanitary Sewer - 600mm diameter	m	1640	$ 630	$ 1,033,200.00
Concrete Manholes - (1200mm to 1800mm)	m	1640	$ 90	$ 147,600.00
SUBTOTAL				$ 1,180,800.00
Construction Cost Contingency (30%)				$ 354,240.00
TOTAL CONSTRUCTION COST				$ 1,535,040.00
Engineering Fee Estimate (20%)				$ 307,008.00
TOTAL PROJECT COST				$ 1,842,048.00

PHASE 2 CR42 SPA (COUNTY ROAD 42 FROM LAUZON PARKWAY TO CITY LIMITS)

Description	Unit	Estimated Quantity	Unit Price	Amount
375mm Trunk Sewer	m	775	$ 540	$ 418,500.00
450mm Trunk Sewer	m	445	$ 540	$ 240,300.00
Concrete Manholes - (1200mm to 1800mm)	m	1220	$ 90	$ 109,800.00
SUBTOTAL				$ 768,600.00
Construction Cost Contingency (30%)				$ 230,580.00
TOTAL CONSTRUCTION COST				$ 999,180.00
Engineering Fee Estimate (20%)				$ 199,836.00
TOTAL PROJECT COST				$ 1,199,016.00

PHASE 2 CR42 SPA (LAUZON PARKWAY FROM CANADIAN PACIFIC RAILROAD TO SERVICE ROAD B)

Description	Unit	Estimated Quantity	Unit Price	Amount
Lauzon Parkway - 375mm Trunk Sewer	m	880	$ 540	$ 475,200.00
Concrete Manholes - (1200mm to 1800mm)	m	880	$ 90	$ 79,200.00
SUBTOTAL				$ 554,400.00
Construction Cost Contingency (30%)				$ 166,320.00
TOTAL CONSTRUCTION COST				$ 720,720.00
Engineering Fee Estimate (20%)				$ 144,144.00
TOTAL PROJECT COST				$ 864,864.00

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Date: Aug, 2022

7TH CONCESSION ROAD	**EXISTING ROAD IMPROVEMENTS**
Improvements to 7th Concession Corridor - From Baseline Road to C4	
Length of Road Improvements (m)	950 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

7TH CONCESSION ROAD		**EXISTING ROAD IMPROVEMENTS**		
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	950	$ 5.00	$ 4,750.00
Full Depth Asphalt Removal	m	950	$ 125.00	$ 118,750.00
Sawcutting Existing Pavement	m	950	$ 1.00	$ 950.00
Signage Removal	m	950	$ 5.00	$ 4,750.00
SUBTOTAL				**$ 130,000.00**
Roadwork				
Earth Excavating and Grading	m	950	$ 120.00	$ 114,000.00
Supply and Place Compacted Granular "A"	m	950	$ 350.00	$ 332,500.00
Asphalt Pavement (105mm)	m	950	$ 250.00	$ 237,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	950	$ 270.00	$ 256,500.00
Local Storm Sewer	m	950	$ 840.00	$ 798,000.00
Concrete Manholes	m	950	$ 90.00	$ 85,500.00
Precast Catchbasins and Leads	m	950	$ 100.00	$ 95,000.00
Subdrains (2 lanes)	m	950	$ 60.00	$ 57,000.00
Concrete Curb and Gutter (2 lanes)	m	950	$ 90.00	$ 85,500.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA Warning Pads)	m	950	$ 75.00	$ 71,250.00
Driveway Restoration a) Asphalt	m	950	$ 320.00	$ 304,000.00
Topsoil, Hydraulic Seed and Mulch	m	950	$ 100.00	$ 95,000.00
Traffic Control During Construction	m	950	$ 100.00	$ 95,000.00
Streetlighting	m	950	$ 400.00	$ 380,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	950	$ 125.00	$ 118,750.00
SUBTOTAL				**$ 3,200,000.00**
Construction Cost Total				**$ 3,400,000.00**
Construction Cost Contingency (30%)				**$ 1,100,000.00**
Subtotal				**$ 4,500,000.00**
Engineering Fee Estimate (20%)				**$ 900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**EXISTING ROAD IMPROVEMENTS**		**$ 5,400,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

8TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS

Improvements to 8th Concession Corridor from rural to urban cross section between County Road 42 to C3. Boundary road between East Pelton and CR42

Length of Road Improvements (m)	725 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

8TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	725	$ 5.00	$ 3,625.00
Full Depth Asphalt Removal	m	725	$ 125.00	$ 90,625.00
Sawcutting Existing Pavement	m	725	$ 1.00	$ 725.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	725	$ 5.00	$ 3,625.00
SUBTOTAL				**$ 100,000.00**
Roadwork				
Earth Excavating and Grading	m	725	$ 120.00	$ 87,000.00
Supply and Place Compacted Granular "A"	m	725	$ 350.00	$ 253,750.00
Asphalt Pavement (105mm)	m	725	$ 250.00	$ 181,250.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	725	$ 270.00	$ 195,750.00
Local Storm Sewer	m	725	$ 840.00	$ 609,000.00
Concrete Manholes	m	725	$ 90.00	$ 65,250.00
Precast Catchbasins and Leads	m	725	$ 100.00	$ 72,500.00
Subdrains (2 lanes)	m	725	$ 60.00	$ 43,500.00
Concrete Curb and Gutter (2 lanes)	m	725	$ 90.00	$ 65,250.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA Warning Pads)	m	725	$ 75.00	$ 54,375.00
Driveway Restoration a) Asphalt	m	725	$ 320.00	$ 232,000.00
Topsoil, Hydraulic Seed and Mulch	m	725	$ 100.00	$ 72,500.00
Traffic Control During Construction	m	725	$ 100.00	$ 72,500.00
Streetlighting	m	725	$ 400.00	$ 290,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	725	$ 125.00	$ 90,625.00
6th Conc. Culvert and Habitat Crossing (4 lane width)	LS	1	$ 1,440,000.00	$ 1,440,000.00
SUBTOTAL				**$ 2,500,000.00**
Construction Cost Total				**$ 2,600,000.00**
Construction Cost Contingency (30%)				**$ 800,000.00**
Subtotal				**$ 3,400,000.00**
Engineering Fee Estimate (20%)				**$ 700,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 4,100,000.00**

Sandwich South Master Servicing Plan
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Date: Aug, 2022

8TH CONCESSION ROAD	**EXISTING ROAD IMPROVEMENTS**

Improvements to 8th Concession Corridor from rural to urban cross section, from C3 to E/W Arterial Road. Boundary road between East Pelton and County Road 42

Length of Road Improvements (m)	620 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

8TH CONCESSION ROAD	**EXISTING ROAD IMPROVEMENTS**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	620	$ 5.00	$ 3,100.00
Full Depth Asphalt Removal	m	620	$ 125.00	$ 77,500.00
Sawcutting Existing Pavement	m	620	$ 1.00	$ 620.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	620	$ 5.00	$ 3,100.00
SUBTOTAL				**$ 90,000.00**
Roadwork				
Earth Excavating and Grading	m	620	$ 120.00	$ 74,400.00
Supply and Place Compacted Granular "A"	m	620	$ 350.00	$ 217,000.00
Asphalt Pavement (105mm)	m	620	$ 250.00	$ 155,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	620	$ 270.00	$ 167,400.00
Local Storm Sewer	m	620	$ 840.00	$ 520,800.00
Concrete Manholes	m	620	$ 90.00	$ 55,800.00
Precast Catchbasins and Leads	m	620	$ 100.00	$ 62,000.00
Subdrains (2 lanes)	m	620	$ 60.00	$ 37,200.00
Concrete Curb and Gutter (2 lanes)	m	620	$ 90.00	$ 55,800.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	620	$ 75.00	$ 46,500.00
Driveway Restoration a) Asphalt	m	620	$ 320.00	$ 198,400.00
Topsoil, Hydraulic Seed and Mulch	m	620	$ 100.00	$ 62,000.00
Traffic Control During Construction	m	620	$ 100.00	$ 62,000.00
Streetlighting	m	620	$ 400.00	$ 248,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	620	$ 125.00	$ 77,500.00
SUBTOTAL				**$ 2,200,000.00**
Construction Cost Total				**$ 2,300,000.00**
Construction Cost Contingency (30%)				**$ 700,000.00**
Subtotal				**$ 3,000,000.00**
Engineering Fee Estimate (20%)				**$ 600,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 3,600,000.00**

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8TH CONCESSION ROAD	**EXISTING ROAD IMPROVEMENTS**

8th Concession Corridor from rural to urban cross section, from E/W Arterial Road to HWY 401 Road. Boundary road between East Pelton and County Road 42

Length of Road Improvements (m)	1025	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

8TH CONCESSION ROAD	**EXISTING ROAD IMPROVEMENTS**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1025	$ 5.00	$ 5,125.00
Sawcutting Existing Pavement	m	1025	$ 1.00	$ 1,025.00
Signage Removal	m	1025	$ 5.00	$ 5,125.00
SUBTOTAL				**$ 20,000.00**
Roadwork				
Earth Excavating and Grading	m	1025	$ 120.00	$ 123,000.00
Supply and Place Compacted Granular "A"	m	1025	$ 350.00	$ 358,750.00
Asphalt Pavement (105mm)	m	1025	$ 250.00	$ 256,250.00
Local Storm Sewer	m	1025	$ 840.00	$ 861,000.00
Concrete Manholes	m	1025	$ 90.00	$ 92,250.00
Precast Catchbasins and Leads	m	1025	$ 100.00	$ 102,500.00
Subdrains (2 lanes)	m	1025	$ 60.00	$ 61,500.00
Concrete Curb and Gutter (2 lanes)	m	1025	$ 90.00	$ 92,250.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1025	$ 75.00	$ 76,875.00
Driveway Restoration a) Asphalt	m	1025	$ 320.00	$ 328,000.00
Topsoil, Hydraulic Seed and Mulch	m	1025	$ 100.00	$ 102,500.00
Traffic Control During Construction	m	1025	$ 100.00	$ 102,500.00
SUBTOTAL				**$ 2,800,000.00**
Construction Cost Total				**$ 2,900,000.00**
Construction Cost Contingency (30%)				**$ 900,000.00**
Subtotal				**$ 3,800,000.00**
Engineering Fee Estimate (20%)				**$ 800,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 4,600,000.00**

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C1 ROAD	NEW ROAD CONSTRUCTION

[North-South Road] Between 7th Concession and C2. Construct road from C3 Road intersection to Future E-W Arterial Road intersection.

Length of Road Improvements (m)	640	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C1 ROAD	NEW ROAD CONSTRUCTION			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	640	$ 120.00	$ 76,800.00
Supply and Place Compacted Granular "A"	m	640	$ 350.00	$ 224,000.00
Asphalt Pavement (105mm)	m	640	$ 250.00	$ 160,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	640	$ 270.00	$ 172,800.00
Local Storm Sewer	m	640	$ 840.00	$ 537,600.00
Concrete Manholes	m	640	$ 90.00	$ 57,600.00
Precast Catchbasins and Leads	m	640	$ 100.00	$ 64,000.00
Subdrains (2 lanes)	m	640	$ 60.00	$ 38,400.00
Concrete Curb and Gutter (2 lanes)	m	640	$ 90.00	$ 57,600.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA Warning Pads)	m	640	$ 75.00	$ 48,000.00
Driveway Restoration a) Asphalt	m	640	$ 320.00	$ 204,800.00
Topsoil, Hydraulic Seed and Mulch	m	640	$ 100.00	$ 64,000.00
Traffic Control During Construction (Residential)	m	640	$ 100.00	$ 64,000.00
Streetlighting (Residential)	m	640	$ 225.00	$ 144,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	640	$ 125.00	$ 80,000.00
SUBTOTAL				**$ 2,200,000.00**
Construction Cost Total				**$ 2,200,000.00**
Construction Cost Contingency (30%)				**$ 700,000.00**
Subtotal				**$ 2,900,000.00**
Engineering Fee Estimate (20%)				**$ 600,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 3,500,000.00**

Sandwich South Master Servicing Plan
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Date: Aug, 2022

C1 ROAD	**NEW ROAD CONSTRUCTION**
[North-South Road] Between 7th Concession and C2. Construct road from E-W Arterial Road intersection to 8th Concession Road intersection.	
Length of Road Improvements (m)	1700 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

C1 ROAD	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1700	$ 120.00	$ 204,000.00
Supply and Place Compacted Granular "A"	m	1700	$ 350.00	$ 595,000.00
Asphalt Pavement (105mm)	m	1700	$ 250.00	$ 425,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1700	$ 270.00	$ 459,000.00
Local Storm Sewer	m	1700	$ 840.00	$ 1,428,000.00
Concrete Manholes	m	1700	$ 90.00	$ 153,000.00
Precast Catchbasins and Leads	m	1700	$ 100.00	$ 170,000.00
Subdrains (2 lanes)	m	1700	$ 60.00	$ 102,000.00
Concrete Curb and Gutter (2 lanes)	m	1700	$ 90.00	$ 153,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA Warning Pads)	m	1700	$ 75.00	$ 127,500.00
Driveway Restoration a) Asphalt	m	1700	$ 320.00	$ 544,000.00
Topsoil, Hydraulic Seed and Mulch	m	1700	$ 100.00	$ 170,000.00
Traffic Control During Construction (Residential)	m	1700	$ 100.00	$ 170,000.00
Streetlighting (Residential)	m	1700	$ 225.00	$ 382,500.00
Street Trees (In Boulevard / 12m spacing each side)	m	1700	$ 125.00	$ 212,500.00
SUBTOTAL				**$ 5,700,000.00**
Construction Cost Total				**$ 5,700,000.00**
Construction Cost Contingency (30%)				**$ 1,800,000.00**
Subtotal				**$ 7,500,000.00**
Engineering Fee Estimate (20%)				**$ 1,500,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 9,000,000.00**

Date: Aug, 2022

C2 ROAD	**NEW ROAD CONSTRUCTION**

[North-South Road] Between C1 and 8th Concession. Construct road from C3 intersection to Future E-W Arterial Road intersection.

Length of Road Improvements (m)	1000	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C2 ROAD	**NEW ROAD CONSTRUCTION**

DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1000	$ 120.00	$ 120,000.00
Supply and Place Compacted Granular "A"	m	1000	$ 350.00	$ 350,000.00
Asphalt Pavement (105mm)	m	1000	$ 250.00	$ 250,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1000	$ 270.00	$ 270,000.00
Local Storm Sewer	m	1000	$ 840.00	$ 840,000.00
Concrete Manholes	m	1000	$ 90.00	$ 90,000.00
Precast Catchbasins and Leads	m	1000	$ 100.00	$ 100,000.00
Subdrains (2 lanes)	m	1000	$ 60.00	$ 60,000.00
Concrete Curb and Gutter (2 lanes)	m	1000	$ 90.00	$ 90,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1000	$ 75.00	$ 75,000.00
Driveway Restoration a) Asphalt	m	1000	$ 320.00	$ 320,000.00
Topsoil, Hydraulic Seed and Mulch	m	1000	$ 100.00	$ 100,000.00
Traffic Control During Construction (Residential)	m	1000	$ 100.00	$ 100,000.00
Streetlighting (Residential)	m	1000	$ 225.00	$ 225,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1000	$ 125.00	$ 125,000.00
SUBTOTAL				**$ 3,400,000.00**
Construction Cost Total				**$ 3,400,000.00**
Construction Cost Contingency (30%)				**$ 1,100,000.00**
Subtotal				**$ 4,500,000.00**
Engineering Fee Estimate (20%)				**$ 900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**NEW ROAD CONSTRUCTION**		**$ 5,400,000.00**

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C3 ROAD	**NEW ROAD CONSTRUCTION**

[East-West Road] Between Baseline Road and C4. Construct road from 7th Concession intersection to 8th Concession intersection.

Length of Road Improvements (m)	1400 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

C3 ROAD	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1400	$ 120.00	$ 168,000.00
Supply and Place Compacted Granular "A"	m	1400	$ 350.00	$ 490,000.00
Asphalt Pavement (105mm)	m	1400	$ 250.00	$ 350,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1400	$ 270.00	$ 378,000.00
Local Storm Sewer	m	1400	$ 840.00	$ 1,176,000.00
Concrete Manholes	m	1400	$ 90.00	$ 126,000.00
Precast Catchbasins and Leads	m	1400	$ 100.00	$ 140,000.00
Subdrains (2 lanes)	m	1400	$ 60.00	$ 84,000.00
Concrete Curb and Gutter (2 lanes)	m	1400	$ 90.00	$ 126,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1400	$ 75.00	$ 105,000.00
Driveway Restoration a) Asphalt	m	1400	$ 320.00	$ 448,000.00
Topsoil, Hydraulic Seed and Mulch	m	1400	$ 100.00	$ 140,000.00
Traffic Control During Construction (Residential)	m	1400	$ 100.00	$ 140,000.00
Streetlighting (Residential)	m	1400	$ 225.00	$ 315,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1400	$ 125.00	$ 175,000.00
SUBTOTAL				**$ 4,700,000.00**
Construction Cost Total				**$ 4,700,000.00**
Construction Cost Contingency (30%)				**$ 1,500,000.00**
Subtotal				**$ 6,200,000.00**
Engineering Fee Estimate (20%)				**$ 1,300,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 7,500,000.00**

Date: Aug, 2022

C4 ROAD	**NEW ROAD CONSTRUCTION**

[East-West Road] Between C3 and Proposed E-W Arterial Road. Construct road from 7th Concession intersection to 8th Concession intersection.

Length of Road Improvements (m)	1400	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C4 ROAD	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1400	$ 120.00	$ 168,000.00
Supply and Place Compacted Granular "A"	m	1400	$ 350.00	$ 490,000.00
Asphalt Pavement (105mm)	m	1400	$ 250.00	$ 350,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1400	$ 270.00	$ 378,000.00
Local Storm Sewer	m	1400	$ 840.00	$ 1,176,000.00
Concrete Manholes	m	1400	$ 90.00	$ 126,000.00
Precast Catchbasins and Leads	m	1400	$ 100.00	$ 140,000.00
Subdrains (2 lanes)	m	1400	$ 60.00	$ 84,000.00
Concrete Curb and Gutter (2 lanes)	m	1400	$ 90.00	$ 126,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1400	$ 75.00	$ 105,000.00
Driveway Restoration a) Asphalt	m	1400	$ 320.00	$ 448,000.00
Topsoil, Hydraulic Seed and Mulch	m	1400	$ 100.00	$ 140,000.00
Traffic Control During Construction (Residential)	m	1400	$ 100.00	$ 140,000.00
Streetlighting (Residential)	m	1400	$ 225.00	$ 315,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1400	$ 125.00	$ 175,000.00
SUBTOTAL				**$ 4,700,000.00**
Construction Cost Total				**$ 4,700,000.00**
Construction Cost Contingency (30%)				**$ 1,500,000.00**
Subtotal				**$ 6,200,000.00**
Engineering Fee Estimate (20%)				**$ 1,300,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 7,500,000.00**

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C5 ROAD	NEW ROAD CONSTRUCTION

[North-South Road] Between 8th Concession Road and 9th Concession Road. Construct road from County Road 42 intersection to Baseline Road intersection.

Length of Road Improvements (m)	760	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C5 ROAD	NEW ROAD CONSTRUCTION			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	760	$ 120.00	$ 91,200.00
Supply and Place Compacted Granular "A"	m	760	$ 350.00	$ 266,000.00
Asphalt Pavement (105mm)	m	760	$ 250.00	$ 190,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	760	$ 270.00	$ 205,200.00
Local Storm Sewer	m	760	$ 840.00	$ 638,400.00
Concrete Manholes	m	760	$ 90.00	$ 68,400.00
Precast Catchbasins and Leads	m	760	$ 100.00	$ 76,000.00
Subdrains (2 lanes)	m	760	$ 60.00	$ 45,600.00
Concrete Curb and Gutter (2 lanes)	m	760	$ 90.00	$ 68,400.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	760	$ 75.00	$ 57,000.00
Driveway Restoration a) Asphalt	m	760	$ 320.00	$ 243,200.00
Topsoil, Hydraulic Seed and Mulch	m	760	$ 100.00	$ 76,000.00
Traffic Control During Construction (Residential)	m	760	$ 100.00	$ 76,000.00
Streetlighting (Residential)	m	760	$ 225.00	$ 171,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	760	$ 125.00	$ 95,000.00
SUBTOTAL				**$ 2,600,000.00**
Construction Cost Total				**$ 2,600,000.00**
Construction Cost Contingency (30%)				**$ 800,000.00**
Subtotal				**$ 3,400,000.00**
Engineering Fee Estimate (20%)				**$ 700,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 4,100,000.00**

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Date: Aug, 2022

C6 ROAD PHASE 1	**NEW ROAD CONSTRUCTION**
[East-West Road] Between County Road 42 and Baseline Road. Construct road from C5 intersection to C7 Road.	
Length of Road Improvements (m)	1080 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

C6 ROAD PHASE 1	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1080	$ 120.00	$ 129,600.00
Supply and Place Compacted Granular "A"	m	1080	$ 350.00	$ 378,000.00
Asphalt Pavement (105mm)	m	1080	$ 250.00	$ 270,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1080	$ 270.00	$ 291,600.00
Local Storm Sewer	m	1080	$ 840.00	$ 907,200.00
Concrete Manholes	m	1080	$ 90.00	$ 97,200.00
Precast Catchbasins and Leads	m	1080	$ 100.00	$ 108,000.00
Subdrains (2 lanes)	m	1080	$ 60.00	$ 64,800.00
Concrete Curb and Gutter (2 lanes)	m	1080	$ 90.00	$ 97,200.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1080	$ 75.00	$ 81,000.00
Driveway Restoration a) Asphalt	m	1080	$ 320.00	$ 345,600.00
Topsoil, Hydraulic Seed and Mulch	m	1080	$ 100.00	$ 108,000.00
Traffic Control During Construction (Residential)	m	1080	$ 100.00	$ 108,000.00
Streetlighting (Residential)	m	1080	$ 225.00	$ 243,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1080	$ 125.00	$ 135,000.00
SUBTOTAL				**$ 3,700,000.00**
Construction Cost Total				**$ 3,700,000.00**
Construction Cost Contingency (30%)				**$ 1,200,000.00**
Subtotal				**$ 4,900,000.00**
Engineering Fee Estimate (20%)				**$ 1,000,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 5,900,000.00**

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C7 ROAD PHASE 1	**NEW ROAD CONSTRUCTION**

[North-South Road] Between C6 and Future Lauzon Parkway. Construct road from County Road 42 intersection to Baseline Road intersection.

Length of Road Improvements (m)	1050	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C7 ROAD PHASE 1	**NEW ROAD CONSTRUCTION**

DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1050	$ 120.00	$ 126,000.00
Supply and Place Compacted Granular "A"	m	1050	$ 350.00	$ 367,500.00
Asphalt Pavement (105mm)	m	1050	$ 250.00	$ 262,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1050	$ 270.00	$ 283,500.00
Local Storm Sewer	m	1050	$ 840.00	$ 882,000.00
Concrete Manholes	m	1050	$ 90.00	$ 94,500.00
Precast Catchbasins and Leads	m	1050	$ 100.00	$ 105,000.00
Subdrains (2 lanes)	m	1050	$ 60.00	$ 63,000.00
Concrete Curb and Gutter (2 lanes)	m	1050	$ 90.00	$ 94,500.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1050	$ 75.00	$ 78,750.00
Driveway Restoration a) Asphalt	m	1050	$ 320.00	$ 336,000.00
Topsoil, Hydraulic Seed and Mulch	m	1050	$ 100.00	$ 105,000.00
Traffic Control During Construction (Residential)	m	1050	$ 100.00	$ 105,000.00
Streetlighting (Residential)	m	1050	$ 225.00	$ 236,250.00
Street Trees (In Boulevard / 12m spacing each side)	m	1050	$ 125.00	$ 131,250.00
6th Conc. Culvert Crossing	LS	1	$ 1,440,000.00	$ 1,440,000.00
SUBTOTAL				**$ 5,000,000.00**
Construction Cost Total				**$ 5,000,000.00**
Construction Cost Contingency (30%)				**$ 1,500,000.00**
Subtotal				**$ 6,500,000.00**
Engineering Fee Estimate (20%)				**$ 1,300,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**NEW ROAD CONSTRUCTION**		**$ 7,800,000.00**

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C8 ROAD	**NEW ROAD CONSTRUCTION**	
[North-South] Between Future Lauzon Parkway and 10th Concession/County Road 17		
Length of Road Improvements (m)	1000	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C8 ROAD	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1000	$ 120.00	$ 120,000.00
Supply and Place Compacted Granular "A"	m	1000	$ 350.00	$ 350,000.00
Asphalt Pavement (105mm)	m	1000	$ 250.00	$ 250,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1000	$ 270.00	$ 270,000.00
Local Storm Sewer	m	1000	$ 840.00	$ 840,000.00
Concrete Manholes	m	1000	$ 90.00	$ 90,000.00
Precast Catchbasins and Leads	m	1000	$ 100.00	$ 100,000.00
Subdrains (2 lanes)	m	1000	$ 60.00	$ 60,000.00
Concrete Curb and Gutter (2 lanes)	m	1000	$ 90.00	$ 90,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1000	$ 75.00	$ 75,000.00
Driveway Restoration a) Asphalt	m	1000	$ 320.00	$ 320,000.00
Topsoil, Hydraulic Seed and Mulch	m	1000	$ 100.00	$ 100,000.00
Traffic Control During Construction (Residential)	m	1000	$ 100.00	$ 100,000.00
Streetlighting (Residential)	m	1000	$ 225.00	$ 225,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1000	$ 125.00	$ 125,000.00
SUBTOTAL				**$ 3,400,000.00**
Construction Cost Total				**$ 3,400,000.00**
Construction Cost Contingency (30%)				**$ 1,100,000.00**
Subtotal				**$ 4,500,000.00**
Engineering Fee Estimate (20%)				**$ 900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 5,400,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

BASELINE ROAD	**EXISTING ROAD IMPROVEMENTS**
Traffic Calming and Road Improvements on Baseline Road between 7th Concession Road and 8th Concession Road	
Length of Road Improvements (m)	1400 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

BASELINE ROAD		**EXISTING ROAD IMPROVEMENTS**		
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1400	$ 5.00	$ 7,000.00
Full Depth Asphalt Removal	m	1400	$ 125.00	$ 175,000.00
Sawcutting Existing Pavement	m	1400	$ 1.00	$ 1,400.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	1400	$ 5.00	$ 7,000.00
SUBTOTAL				**$ 200,000.00**
Roadwork				
Earth Excavating and Grading	m	1400	$ 120.00	$ 168,000.00
Supply and Place Compacted Granular "A"	m	1400	$ 350.00	$ 490,000.00
Asphalt Pavement (105mm)	m	1400	$ 250.00	$ 350,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1400	$ 270.00	$ 378,000.00
Local Storm Sewer	m	1400	$ 840.00	$ 1,176,000.00
Concrete Manholes	m	1400	$ 90.00	$ 126,000.00
Precast Catchbasins and Leads	m	1400	$ 100.00	$ 140,000.00
Subdrains (2 lanes)	m	1400	$ 60.00	$ 84,000.00
Concrete Curb and Gutter (2 lanes)	m	1400	$ 90.00	$ 126,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA Warning Pads)	m	1400	$ 75.00	$ 105,000.00
Driveway Restoration a) Asphalt	m	1400	$ 320.00	$ 448,000.00
Topsoil, Hydraulic Seed and Mulch	m	1400	$ 100.00	$ 140,000.00
Traffic Control During Construction	m	1400	$ 100.00	$ 140,000.00
Streetlighting	m	1400	$ 400.00	$ 560,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1400	$ 125.00	$ 175,000.00
Traffic Calming	L.S		$ 150,000.00	$ 150,000.00
SUBTOTAL				**$ 4,800,000.00**
Construction Cost Total				**$ 5,000,000.00**
Construction Cost Contingency (30%)				**$ 1,500,000.00**
Subtotal				**$ 6,500,000.00**
Engineering Fee Estimate (20%)				**$ 1,300,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**EXISTING ROAD IMPROVEMENTS**		**$ 7,800,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Mar, 2023

9TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS
Improvements to 9th Concession Corridor - From County Road 42 to Baseline Road	
Length of Road Improvements (m)	900 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

9TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS			
DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	900	$ 5.00	$ 4,500.00
Full Depth Asphalt Removal	m	900	$ 125.00	$ 112,500.00
Sawcutting Existing Pavement	m	900	$ 1.00	$ 900.00
Signage Removal	m	900	$ 5.00	$ 4,500.00
SUBTOTAL				**$ 130,000.00**
Roadwork				
Earth Excavating and Grading	m	900	$ 120.00	$ 108,000.00
Supply and Place Compacted Granular "A"	m	900	$ 350.00	$ 315,000.00
Asphalt Pavement (105mm)	m	900	$ 250.00	$ 225,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	900	$ 270.00	$ 243,000.00
Local Storm Sewer	m	900	$ 840.00	$ 756,000.00
Concrete Manholes	m	900	$ 90.00	$ 81,000.00
Precast Catchbasins and Leads	m	900	$ 100.00	$ 90,000.00
Subdrains (2 lanes)	m	900	$ 60.00	$ 54,000.00
Concrete Curb and Gutter (2 lanes)	m	900	$ 90.00	$ 81,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA Warning Pads)	m	900	$ 75.00	$ 67,500.00
Driveway Restoration a) Asphalt	m	900	$ 320.00	$ 288,000.00
Topsoil, Hydraulic Seed and Mulch	m	900	$ 100.00	$ 90,000.00
Traffic Control During Construction	m	900	$ 100.00	$ 90,000.00
Streetlighting	m	900	$ 400.00	$ 360,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	900	$ 125.00	$ 112,500.00
SUBTOTAL				**$ 3,000,000.00**
Construction Cost Total				**$ 3,200,000.00**
Construction Cost Contingency (30%)				**$ 1,000,000.00**
Subtotal				**$ 4,200,000.00**
Engineering Fee Estimate (20%)				**$ 900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 5,100,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

FROM ENVIRONMENTAL STUDY REPORT
COUNTY ROAD 42 - WALKER ROAD TO CITY / COUNTY BOUNDARY (City of Windsor) - WIDEN FROM 2 TO 4 LANES (2021)

Location	Estimated Cost (2022 $M)
Walker Road Intersection Improvements	$ 850,000.00
Walker Road to 7th Concession Road and Baseline Road - Build 4 Lanes	$ 2,370,000.00
7th Concession Road and Baseline Road Roundabout	$ 4,910,000.00
7th Concession Road to 8th Concession Road - Build 4 Lanes	$ 6,100,000.00
8th Concession Road Roundabout	$ 4,910,000.00
8th Concession Road to 9th Concession Road - Build 4 Lanes	$ 8,130,000.00
9th Concession Road Roundabout	$ 4,910,000.00
9th Concession Road to Lauzon Parkway - Build 4 Lanes	$ 6,100,000.00
Lauzon Parkway to City/County Boundary - Build 4 Lanes	$ 5,250,000.00
TOTAL	**$ 43,530,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Feb, 2023

FROM ENVIRONMENTAL STUDY REPORT
E-W ARTERIAL- WALKER ROAD TO 10TH CONCESSION ROAD/ COUNTY ROAD 17

Location	Estimated Cost (2022 $M)
Walker Road Intersection Improvements	$ 800,000.00
Walker Road to 4490 7th Concession Road Roundabout Access- Build 2 Lanes	$ 1,700,000.00
4490 7th Concession Road Roundabout Access	$ 4,660,000.00
Future Collector Road Roundabout	$ 3,730,000.00
Future Collector Road Roundabout to 8th Concession Road- Build Lanes	$ 1,530,000.00
8th Concession Road Roundabout	$ 3,730,000.00
8th Concession Road to 9th Concession Road- Build 2 Lanes	$ 4,910,000.00
9th Concession Road Roundabout	$ 3,730,000.00
9th Concession Road Roundabout to Lauzon Parkway - Build 2 Lanes	$ 1,700,000.00
E-W Arterial and Lauzon Parkway Intersection (Cost included in Lauzon Parkway	$ 7,790,000.00
Lauzon Parkway to 10th Concession Road/ County Road17- Build 2 Lanes	$ 1,870,000.00
10th Concession Road/ County Road 17 Roundabout	$ 3,730,000.00
TOTAL	**$ 39,880,000.00**

Sandwich South Master Servicing Plan

Functional Design Report - Cost Estimates

Date: Aug, 2022

FROM ENVIRONMENTAL STUDY REPORT
LAUZON PARKWAY - FOREST GLADE DRIVE TO HIGHWAY 401
(City of Windsor) INTERIM BUILD 4 LANES

Location	Estimated Cost (2022 $M)
Twin Oaks Drive to Service Road B - 4 Lanes	$ 11,170,000
Service Road B - Intersection	$ 3,220,000
Service Road B to CR42 - 4 Lanes	$ 10,500,000
County Road 42 Intersection Improvements	$ 9,480,000
County Road 42 to Baseline Road - 4 Lanes	$ 5,930,000
Baseline Road Intersection Improvements	$ 4,910,000
Baseline Road to E-W Arterial - 4 Lanes	$ 4,400,000
E-W Arterial Intersection Improvements	$ 7,790,000
E-W Arterial to Highway 401 Interchange - 4 Lanes	$ 4,070,000
TOTAL	$ 61,470,000

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Feb, 2022

C5 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**

[North-South Road] Between 8th Concession Road and 9th Concession Road. Construct road from Baseline Road intersection to E/W Arterial intersection.

Length of Road Improvements (m)	1000	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C5 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1000	$ 120.00	$ 120,000.00
Supply and Place Compacted Granular "A"	m	1000	$ 350.00	$ 350,000.00
Asphalt Pavement (105mm)	m	1000	$ 250.00	$ 250,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1000	$ 270.00	$ 270,000.00
Local Storm Sewer	m	1000	$ 840.00	$ 840,000.00
Concrete Manholes	m	1000	$ 90.00	$ 90,000.00
Precast Catchbasins and Leads	m	1000	$ 100.00	$ 100,000.00
Subdrains (2 lanes)	m	1000	$ 60.00	$ 60,000.00
Concrete Curb and Gutter (2 lanes)	m	1000	$ 90.00	$ 90,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1000	$ 75.00	$ 75,000.00
Driveway Restoration a) Asphalt	m	1000	$ 320.00	$ 320,000.00
Topsoil, Hydraulic Seed and Mulch	m	1000	$ 100.00	$ 100,000.00
Traffic Control During Construction (Residential)	m	1000	$ 100.00	$ 100,000.00
Streetlighting (Residential)	m	1000	$ 225.00	$ 225,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1000	$ 125.00	$ 125,000.00
Pond Bridge, 6th Drain Culvert and Habitat Crossing	LS	1	$ 5,708,000.00	$ 5,708,000.00
SUBTOTAL				**$ 9,100,000.00**
Construction Cost Total				**$ 9,100,000.00**
Construction Cost Contingency (30%)				**$ 2,800,000.00**
Subtotal				**$ 11,900,000.00**
Engineering Fee Estimate (20%)				**$ 2,400,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 14,300,000.00**

C4 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**
[East-West Road] Between Baseline Road and Future E-W Arterial Road. Construct road from 8th Concession Road to 10th Concession Road	
Length of Road Improvements (m)	2750 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

C4 ROAD PHASE 2 — **NEW ROAD CONSTRUCTION**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork				
Earth Excavating and Grading	m	2750	$ 120.00	$ 330,000.00
Supply and Place Compacted Granular "A"	m	2750	$ 350.00	$ 962,500.00
Asphalt Pavement (105mm)	m	2750	$ 250.00	$ 687,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	2750	$ 270.00	$ 742,500.00
Local Storm Sewer	m	2750	$ 840.00	$ 2,310,000.00
Concrete Manholes	m	2750	$ 90.00	$ 247,500.00
Precast Catchbasins and Leads	m	2750	$ 100.00	$ 275,000.00
Subdrains (2 lanes)	m	2750	$ 60.00	$ 165,000.00
Concrete Curb and Gutter (2 lanes)	m	2750	$ 90.00	$ 247,500.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	2750	$ 75.00	$ 206,250.00
Driveway Restoration a) Asphalt	m	2750	$ 320.00	$ 880,000.00
Topsoil, Hydraulic Seed and Mulch	m	2750	$ 100.00	$ 275,000.00
Traffic Control During Construction (Residential)	m	2750	$ 100.00	$ 275,000.00
Streetlighting (Residential)	m	2750	$ 225.00	$ 618,750.00
Street Trees (In Boulevard / 12m spacing each side)	m	2750	$ 125.00	$ 343,750.00
SUBTOTAL				**$ 9,300,000.00**
Construction Cost Total				**$ 9,300,000.00**
Construction Cost Contingency (30%)				**$ 2,800,000.00**
Subtotal				**$ 12,100,000.00**
Engineering Fee Estimate (20%)				**$ 2,500,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**NEW ROAD CONSTRUCTION**		**$ 14,600,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

[East-West Road] Between County Road 42 and Baseline Road - Construct road from C7 Road to Lauzon Parkway. Need for this optional road segment shall be confirmed as development proceeds and transportation network needs are more defined.

C6 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**
Length of Road Improvements (m)	410 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

C6 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	410	$ 120.00	$ 49,200.00
Supply and Place Compacted Granular "A"	m	410	$ 350.00	$ 143,500.00
Asphalt Pavement (105mm)	m	410	$ 250.00	$ 102,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	410	$ 270.00	$ 110,700.00
Local Storm Sewer	m	410	$ 840.00	$ 344,400.00
Concrete Manholes	m	410	$ 90.00	$ 36,900.00
Precast Catchbasins and Leads	m	410	$ 100.00	$ 41,000.00
Subdrains (2 lanes)	m	410	$ 60.00	$ 24,600.00
Concrete Curb and Gutter (2 lanes)	m	410	$ 90.00	$ 36,900.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	410	$ 75.00	$ 30,750.00
Driveway Restoration a) Asphalt	m	410	$ 320.00	$ 131,200.00
Topsoil, Hydraulic Seed and Mulch	m	410	$ 100.00	$ 41,000.00
Traffic Control During Construction (Residential)	m	410	$ 100.00	$ 41,000.00
Streetlighting (Residential)	m	410	$ 225.00	$ 92,250.00
Street Trees (In Boulevard / 12m spacing each side)	m	410	$ 125.00	$ 51,250.00
Pond Bridge, Little River Culvert	LS	1	$5,708,000.00	$ 5,708,000.00
SUBTOTAL				**$ 7,100,000.00**
Construction Cost Total				**$ 7,100,000.00**
Construction Cost Contingency (30%)				**$ 2,200,000.00**
Subtotal				**$ 9,300,000.00**
Engineering Fee Estimate (20%)				**$ 1,900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 11,200,000.00**

C6 ROAD PHASE 3 — NEW ROAD CONSTRUCTION

[East-West Road] Between County Road 42 and Baseline Road. Construct road from Future Lauzon Parkway intersection to 10th Concession/County Road 17.

Length of Road Improvements (m)	490	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C6 ROAD PHASE 3 — **NEW ROAD CONSTRUCTION**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork				
Earth Excavating and Grading	m	490	$ 120.00	$ 58,800.00
Supply and Place Compacted Granular "A"	m	490	$ 350.00	$ 171,500.00
Asphalt Pavement (105mm)	m	490	$ 250.00	$ 122,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	490	$ 270.00	$ 132,300.00
Local Storm Sewer	m	490	$ 840.00	$ 411,600.00
Concrete Manholes	m	490	$ 90.00	$ 44,100.00
Precast Catchbasins and Leads	m	490	$ 100.00	$ 49,000.00
Subdrains (2 lanes)	m	490	$ 60.00	$ 29,400.00
Concrete Curb and Gutter (2 lanes)	m	490	$ 90.00	$ 44,100.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	490	$ 75.00	$ 36,750.00
Driveway Restoration a) Asphalt	m	490	$ 320.00	$ 156,800.00
Topsoil, Hydraulic Seed and Mulch	m	490	$ 100.00	$ 49,000.00
Traffic Control During Construction (Residential)	m	490	$ 100.00	$ 49,000.00
Streetlighting (Residential)	m	490	$ 225.00	$ 110,250.00
Street Trees (In Boulevard / 12m spacing each side)	m	490	$ 125.00	$ 61,250.00
Pond Bridge	LS	1	$4,268,000.00	$ 4,268,000.00
SUBTOTAL				**$ 6,000,000.00**
Construction Cost Total				**$ 6,000,000.00**
Construction Cost Contingency (30%)				**$ 1,800,000.00**
Subtotal				**$ 7,800,000.00**
Engineering Fee Estimate (20%)				**$ 1,600,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 9,400,000.00**

Date: Feb, 2023

C7 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**

[North-South Road] Between C6 and Future Lauzon Parkway. Construct road from Baseline Road intersection to East-West Arterial intersection.

Length of Road Improvements (m)	1000	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

C7 ROAD PHASE 2	**NEW ROAD CONSTRUCTION**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork				
Earth Excavating and Grading	m	1000	$ 120.00	$ 120,000.00
Supply and Place Compacted Granular "A"	m	1000	$ 350.00	$ 350,000.00
Asphalt Pavement (105mm)	m	1000	$ 250.00	$ 250,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1000	$ 270.00	$ 270,000.00
Local Storm Sewer	m	1000	$ 840.00	$ 840,000.00
Concrete Manholes	m	1000	$ 90.00	$ 90,000.00
Precast Catchbasins and Leads	m	1000	$ 100.00	$ 100,000.00
Subdrains (2 lanes)	m	1000	$ 60.00	$ 60,000.00
Concrete Curb and Gutter (2 lanes)	m	1000	$ 90.00	$ 90,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1000	$ 75.00	$ 75,000.00
Driveway Restoration a) Asphalt	m	1000	$ 320.00	$ 320,000.00
Topsoil, Hydraulic Seed and Mulch	m	1000	$ 100.00	$ 100,000.00
Traffic Control During Construction (Residential)	m	1000	$ 100.00	$ 100,000.00
Streetlighting (Residential)	m	1000	$ 225.00	$ 225,000.00
Street Trees (In Boulevard / 12m spacing each side)	m	1000	$ 125.00	$ 125,000.00
SUBTOTAL				**$ 3,400,000.00**
Construction Cost Total				**$ 3,400,000.00**
Construction Cost Contingency (30%)				**$ 1,100,000.00**
Subtotal				**$ 4,500,000.00**
Engineering Fee Estimate (20%)				**$ 900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**NEW ROAD CONSTRUCTION**			**$ 5,400,000.00**

Date: Mar, 2023

9TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS

Improvements to 9th Concession Corridor from rural to urban cross section between Baseline Road to E-W Arterial Road.

Length of Road Improvements (m)	1000	m
Number of Lanes	2	
Residential or Arterial/Collector Road	Arterial/Collector	
Road Surface	Asphalt	
Future Bike Lanes	Yes	
Existing Street Lights	No	
Traffic Signals	Yes	

9TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1000	$ 5.00	$ 5,000.00
Sawcutting Existing Pavement	m	1000	$ 1.00	$ 1,000.00
Signage Removal	m	1000	$ 5.00	$ 5,000.00
SUBTOTAL				**$ 20,000.00**
Roadwork				
Earth Excavating and Grading	m	1000	$ 120.00	$ 120,000.00
Supply and Place Compacted Granular "A"	m	1000	$ 350.00	$ 350,000.00
Asphalt Pavement (105mm)	m	1000	$ 250.00	$ 250,000.00
Local Storm Sewer	m	1000	$ 840.00	$ 840,000.00
Concrete Manholes	m	1000	$ 90.00	$ 90,000.00
Precast Catchbasins and Leads	m	1000	$ 100.00	$ 100,000.00
Subdrains (2 lanes)	m	1000	$ 60.00	$ 60,000.00
Concrete Curb and Gutter (2 lanes)	m	1000	$ 90.00	$ 90,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1000	$ 75.00	$ 75,000.00
Driveway Restoration a) Asphalt	m	1000	$ 320.00	$ 320,000.00
Topsoil, Hydraulic Seed and Mulch	m	1000	$ 100.00	$ 100,000.00
Traffic Control During Construction (Residential)	m	1000	$ 100.00	$ 100,000.00
Pond Bridge, 6th Concession and Habitat Crossing (4 lane width)	LS	1	$ 7,956,000.00	$ 7,956,000.00
SUBTOTAL				**$ 10,500,000.00**
Construction Cost Total				**$ 10,600,000.00**
Construction Cost Contingency (30%)				**$ 3,200,000.00**
Subtotal				**$ 13,800,000.00**
Engineering Fee Estimate (20%)				**$ 2,800,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**EXISTING ROAD IMPROVEMENTS**		**$ 16,600,000.00**

Date: Mar, 2023

9TH CONCESSION ROAD — EXISTING ROAD IMPROVEMENTS

Improvements to 9th Concession Corridor from rural to urban cross section between E-W Arterial Road to Highway 401.

Length of Road Improvements (m)	1200 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

9TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1200	$ 5.00	$ 6,000.00
Sawcutting Existing Pavement	m	1200	$ 1.00	$ 1,200.00
Signage Removal	m	1200	$ 5.00	$ 6,000.00
SUBTOTAL				**$ 20,000.00**
Roadwork				
Earth Excavating and Grading	m	1200	$ 120.00	$ 144,000.00
Supply and Place Compacted Granular "A"	m	1200	$ 350.00	$ 420,000.00
Asphalt Pavement (105mm)	m	1200	$ 250.00	$ 300,000.00
Local Storm Sewer	m	1200	$ 840.00	$ 1,008,000.00
Concrete Manholes	m	1200	$ 90.00	$ 108,000.00
Precast Catchbasins and Leads	m	1200	$ 100.00	$ 120,000.00
Subdrains (2 lanes)	m	1200	$ 60.00	$ 72,000.00
Concrete Curb and Gutter (2 lanes)	m	1200	$ 90.00	$ 108,000.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1200	$ 75.00	$ 90,000.00
Driveway Restoration a) Asphalt	m	1200	$ 320.00	$ 384,000.00
Topsoil, Hydraulic Seed and Mulch	m	1200	$ 100.00	$ 120,000.00
Traffic Control During Construction (Residential)	m	1200	$ 100.00	$ 120,000.00
SUBTOTAL				**$ 3,100,000.00**
Construction Cost Total				**$ 3,200,000.00**
Construction Cost Contingency (30%)				**$ 1,000,000.00**
Subtotal				**$ 4,200,000.00**
Engineering Fee Estimate (20%)				**$ 900,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 5,100,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

BASELINE ROAD	**EXISTING ROAD IMPROVEMENTS**
Improvement to urban cross-section of Baseline Rd (8th Concession to 9th Concession Road)	
Length of Road Improvements (m)	1365 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

BASELINE ROAD	**EXISTING ROAD IMPROVEMENTS**			
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1365	$ 5.00	$ 6,825.00
Full Depth Asphalt Removal	m	1365	$ 125.00	$ 170,625.00
Sawcutting Existing Pavement	m	1365	$ 1.00	$ 1,365.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	1365	$ 5.00	$ 6,825.00
SUBTOTAL				**$ 190,000.00**
Roadwork				
Earth Excavating and Grading	m	1365	$ 120.00	$ 163,800.00
Supply and Place Compacted Granular "A"	m	1365	$ 350.00	$ 477,750.00
Asphalt Pavement (105mm)	m	1365	$ 250.00	$ 341,250.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1365	$ 270.00	$ 368,550.00
Local Storm Sewer	m	1365	$ 840.00	$ 1,146,600.00
Concrete Manholes	m	1365	$ 90.00	$ 122,850.00
Precast Catchbasins and Leads	m	1365	$ 100.00	$ 136,500.00
Subdrains (2 lanes)	m	1365	$ 60.00	$ 81,900.00
Concrete Curb and Gutter (2 lanes)	m	1365	$ 90.00	$ 122,850.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1365	$ 75.00	$ 102,375.00
Driveway Restoration a) Asphalt	m	1365	$ 320.00	$ 436,800.00
Topsoil, Hydraulic Seed and Mulch	m	1365	$ 100.00	$ 136,500.00
Traffic Control During Construction (Residential)	m	1365	$ 100.00	$ 136,500.00
Streetlighting (Residential)	m	1365	$ 225.00	$ 307,125.00
Street Trees (In Boulevard / 12m spacing each side)	m	1365	$ 125.00	$ 170,625.00
SUBTOTAL				**$ 4,600,000.00**
Construction Cost Total				**$ 4,800,000.00**
Construction Cost Contingency (30%)				**$ 1,500,000.00**
Subtotal				**$ 6,300,000.00**
Engineering Fee Estimate (20%)				**$ 1,300,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 7,600,000.00**

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Functional Design Report - Cost Estimates

Date: Aug, 2022

BASELINE ROAD	EXISTING ROAD IMPROVEMENTS
Improvement to urban cross-section of Baseline Rd (9th Concession to Lauzon Parkway)	
Length of Road Improvements (m)	1170 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

BASELINE ROAD **EXISTING ROAD IMPROVEMENTS**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1170	$ 5.00	$ 5,850.00
Full Depth Asphalt Removal	m	1170	$ 125.00	$ 146,250.00
Sawcutting Existing Pavement	m	1170	$ 1.00	$ 1,170.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	1170	$ 5.00	$ 5,850.00
SUBTOTAL				**$ 160,000.00**
Roadwork				
Earth Excavating and Grading	m	1170	$ 120.00	$ 140,400.00
Supply and Place Compacted Granular "A"	m	1170	$ 350.00	$ 409,500.00
Asphalt Pavement (105mm)	m	1170	$ 250.00	$ 292,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1170	$ 270.00	$ 315,900.00
Local Storm Sewer	m	1170	$ 840.00	$ 982,800.00
Concrete Manholes	m	1170	$ 90.00	$ 105,300.00
Precast Catchbasins and Leads	m	1170	$ 100.00	$ 117,000.00
Subdrains (2 lanes)	m	1170	$ 60.00	$ 70,200.00
Concrete Curb and Gutter (2 lanes)	m	1170	$ 90.00	$ 105,300.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1170	$ 75.00	$ 87,750.00
Driveway Restoration a) Asphalt	m	1170	$ 320.00	$ 374,400.00
Topsoil, Hydraulic Seed and Mulch	m	1170	$ 100.00	$ 117,000.00
Traffic Control During Construction (Residential)	m	1170	$ 100.00	$ 117,000.00
Streetlighting (Residential)	m	1170	$ 225.00	$ 263,250.00
Street Trees (In Boulevard / 12m spacing each side)	m	1170	$ 125.00	$ 146,250.00
SUBTOTAL				**$ 4,000,000.00**
Construction Cost Total				**$ 4,200,000.00**
Construction Cost Contingency (30%)				**$ 1,300,000.00**
Subtotal				**$ 5,500,000.00**
Engineering Fee Estimate (20%)				**$ 1,100,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**EXISTING ROAD IMPROVEMENTS**		**$ 6,600,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

BASELINE ROAD	**EXISTING ROAD IMPROVEMENTS**
Improvement to urban cross-section of Baseline Rd (Lauzon Parkway to 10th Concession Road)	
Length of Road Improvements (m)	550 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

BASELINE ROAD		**EXISTING ROAD IMPROVEMENTS**		
DESCRIPTION	**UNIT**	**EST. QTY.**	**UNIT PRICE**	**AMOUNT**
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	550	$ 5.00	$ 2,750.00
Full Depth Asphalt Removal	m	550	$ 125.00	$ 68,750.00
Sawcutting Existing Pavement	m	550	$ 1.00	$ 550.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	550	$ 5.00	$ 2,750.00
SUBTOTAL				**$ 80,000.00**
Roadwork				
Earth Excavating and Grading	m	550	$ 120.00	$ 66,000.00
Supply and Place Compacted Granular "A"	m	550	$ 350.00	$ 192,500.00
Asphalt Pavement (105mm)	m	550	$ 250.00	$ 137,500.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	550	$ 270.00	$ 148,500.00
Local Storm Sewer	m	550	$ 840.00	$ 462,000.00
Concrete Manholes	m	550	$ 90.00	$ 49,500.00
Precast Catchbasins and Leads	m	550	$ 100.00	$ 55,000.00
Subdrains (2 lanes)	m	550	$ 60.00	$ 33,000.00
Concrete Curb and Gutter (2 lanes)	m	550	$ 90.00	$ 49,500.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	550	$ 75.00	$ 41,250.00
Driveway Restoration a) Asphalt	m	550	$ 320.00	$ 176,000.00
Topsoil, Hydraulic Seed and Mulch	m	550	$ 100.00	$ 55,000.00
Traffic Control During Construction (Residential)	m	550	$ 100.00	$ 55,000.00
Streetlighting (Residential)	m	550	$ 225.00	$ 123,750.00
Street Trees (In Boulevard / 12m spacing each side)	m	550	$ 125.00	$ 68,750.00
SUBTOTAL				**$ 1,900,000.00**
Construction Cost Total				**$ 2,000,000.00**
Construction Cost Contingency (30%)				**$ 600,000.00**
Subtotal				**$ 2,600,000.00**
Engineering Fee Estimate (20%)				**$ 600,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -		**EXISTING ROAD IMPROVEMENTS**		**$ 3,200,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

10TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS
Improvement to urban cross-section of 10th Concession Road from County Road 42 to Baseline Road.	
Length of Road Improvements (m)	1292 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

10TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS			
DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	1292	$ 5.00	$ 6,460.00
Full Depth Asphalt Removal	m	1292	$ 125.00	$ 161,500.00
Sawcutting Existing Pavement	m	1292	$ 1.00	$ 1,292.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	1292	$ 5.00	$ 6,460.00
SUBTOTAL				**$ 180,000.00**
Roadwork				
Earth Excavating and Grading	m	1292	$ 120.00	$ 155,040.00
Supply and Place Compacted Granular "A"	m	1292	$ 350.00	$ 452,200.00
Asphalt Pavement (105mm)	m	1292	$ 250.00	$ 323,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	1292	$ 270.00	$ 348,840.00
Local Storm Sewer	m	1292	$ 840.00	$ 1,085,280.00
Concrete Manholes	m	1292	$ 90.00	$ 116,280.00
Precast Catchbasins and Leads	m	1292	$ 100.00	$ 129,200.00
Subdrains (2 lanes)	m	1292	$ 60.00	$ 77,520.00
Concrete Curb and Gutter (2 lanes)	m	1292	$ 90.00	$ 116,280.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	1292	$ 75.00	$ 96,900.00
Driveway Restoration a) Asphalt	m	1292	$ 320.00	$ 413,440.00
Topsoil, Hydraulic Seed and Mulch	m	1292	$ 100.00	$ 129,200.00
Traffic Control During Construction (Residential)	m	1292	$ 100.00	$ 129,200.00
Streetlighting (Residential)	m	1292	$ 225.00	$ 290,700.00
Street Trees (In Boulevard / 12m spacing each side)	m	1292	$ 125.00	$ 161,500.00
SUBTOTAL				**$ 4,100,000.00**
Construction Cost Total				**$ 4,300,000.00**
Construction Cost Contingency (30%)				**$ 1,300,000.00**
Subtotal				**$ 5,600,000.00**
Engineering Fee Estimate (20%)				**$ 1,200,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 6,800,000.00**

Sandwich South Master Servicing Plan
Functional Design Report - Cost Estimates

Date: Aug, 2022

10TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS
Improvement to urban cross-section of 10th Concession Road from Baseline Road to C4 Road.	
Length of Road Improvements (m)	608 m
Number of Lanes	2
Residential or Arterial/Collector Road	Arterial/Collector
Road Surface	Asphalt
Future Bike Lanes	Yes
Existing Street Lights	No
Traffic Signals	Yes

10TH CONCESSION ROAD	EXISTING ROAD IMPROVEMENTS			
DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	AMOUNT
Roadwork Removals				
Clearing, Grubbing, Stripping of Topsoil and Tree Removal	m	608	$ 5.00	$ 3,040.00
Full Depth Asphalt Removal	m	608	$ 125.00	$ 76,000.00
Sawcutting Existing Pavement	m	608	$ 1.00	$ 608.00
Streetlighting Removal	m	0	$ 25.00	$ -
Signage Removal	m	608	$ 5.00	$ 3,040.00
SUBTOTAL				**$ 90,000.00**
Roadwork				
Earth Excavating and Grading	m	608	$ 120.00	$ 72,960.00
Supply and Place Compacted Granular "A"	m	608	$ 350.00	$ 212,800.00
Asphalt Pavement (105mm)	m	608	$ 250.00	$ 152,000.00
Additional Cost for Bicycle Lanes (2) - Asphalt	m	608	$ 270.00	$ 164,160.00
Local Storm Sewer	m	608	$ 840.00	$ 510,720.00
Concrete Manholes	m	608	$ 90.00	$ 54,720.00
Precast Catchbasins and Leads	m	608	$ 100.00	$ 60,800.00
Subdrains (2 lanes)	m	608	$ 60.00	$ 36,480.00
Concrete Curb and Gutter (2 lanes)	m	608	$ 90.00	$ 54,720.00
Concrete Sidewalk (1.5m wide - Incl. Granular Base and AODA	m	608	$ 75.00	$ 45,600.00
Driveway Restoration a) Asphalt	m	608	$ 320.00	$ 194,560.00
Topsoil, Hydraulic Seed and Mulch	m	608	$ 100.00	$ 60,800.00
Traffic Control During Construction (Residential)	m	608	$ 100.00	$ 60,800.00
Streetlighting (Residential)	m	608	$ 225.00	$ 136,800.00
Street Trees (In Boulevard / 12m spacing each side)	m	608	$ 125.00	$ 76,000.00
SUBTOTAL				**$ 2,000,000.00**
Construction Cost Total				**$ 2,100,000.00**
Construction Cost Contingency (30%)				**$ 700,000.00**
Subtotal				**$ 2,800,000.00**
Engineering Fee Estimate (20%)				**$ 600,000.00**
TOTAL CONSTRUCTION COST ESTIMATE FOR -	**EXISTING ROAD IMPROVEMENTS**			**$ 3,400,000.00**

Appendix F - 8

Sandwich South Secondary Plan Area Site - Specific Development Manual

Appendix F - 9

Supplementary Waterfowl Adaptive Mitigation Plan

Memo

To: Patrick Winter, P.Eng., Project Manager, City of Windsor

From: Caitlin Vandermeer, Dillon Consulting Limited
Laura Herlehy, P.Eng., Dillon Consulting Limited

cc: Phil Roberts

Date: May 17, 2023

Subject: Supplementary Waterfowl Adaptive Mitigation Plan for Stormwater Management Facilities Sandwich South Master Planning Area

Our File: 19-9817

The purpose of this document is to supplement the functional design of the stormwater management facilities proposed to service the Sandwich South Master Planning Area, as well as the proposed Natural Environment system is required to protect, preserve and, where appropriate, enhance the natural environment. This document should be reviewed in conjunction with the Sandwich South Master Servicing Plan report which provides additional context on the overall serving strategy for the Sandwich South (SS) Area.

Necessary due diligence and engineering shall be completed to ensure that the designs meet Transport Canada's requirements, the airport has been consulted through the design process and that the ponds do not pose additional safety risk associated with bird hazards. This plan focuses on risks associated with stormwater management facilities and does not address waterfowl mitigation required for other land uses such as park lands or for other open areas.

1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by the City of Windsor (City) to complete a Master Servicing Plan for the Sandwich South (SS) area which will provide a framework for future infrastructure required to meet the growing needs of the community. The Sandwich South Master Servicing Plan (SSMSP) is building upon the stormwater management (SWM) recommendations that were developed through the Upper Little River Watershed and Master Drainage and Stormwater Management Plan Environmental Assessment (ULRMP) plan, 2023. As a result of the ULRMP, several linear stormwater management facilities are proposed within the SS area to support residential, institutional, industrial and commercial development. The SWM facilities were proposed to be regional wet ponds that provide both quality and quantity control of runoff to meet the design criteria outlined in the Windsor/Essex Region Stormwater Management Standards Manual (2018) as well as to attenuate flows to acceptable release rates determined in the ULRMP.

Through the SSMSP, refinement to the SWM strategy has resulted in the recommendation to propose a hybrid approach where dry ponds are proposed in areas that are within the identified Windsor International Airport's Primary Hazard Zone.

It is understood that SWM ponds, especially those that have permanent standing water pools have the potential to attract waterfowl and are identified as a hazardous when in the vicinity of airports per Transportation Canada Aviation guidelines such as the Canadian Aviation Regulations (CARs). See Section 2 below for additional context on regulatory requirements. Windsor International Airport (noted herein as "WIA") is located within the SS study area and therefore precautionary and active management of waterfowl is required to mitigate risks of collisions that pose hazard to human health and safety. WIA is 813 hectares (ha) and is located, north of County Road 42, east of the existing Canadian National Railway's Pelton Spur line, south of Rhodes Drive and west of Lauzon Parkway.

Currently, WIA conducts regular monitoring within and adjacent to the airport lands to meet the CAR requirements and to facilitate safe operation of the airport. The introduction of SWM facilities to the area will require additional monitoring and continued management throughout the lifetime of these facilities. It is necessary to consider the long-term operational needs of the ponds as it relates to waterfowl mitigation and is discussed in more detail in this document.

The purpose of this memo is to provide a framework for mitigation, monitoring, and adaptive management for the long-term use of SWM ponds proposed to service the SS area. The proposed monitoring outlined herein is intended to build upon monitoring and mitigation currently being applied by the WIA.

1.1 Existing Conditions

The SS area is approximately 25.4 km^2 (2,540 ha) in size and sits within the Little River watershed along the southeastern region of the City of Windsor. The area is considered the largest portion of undeveloped land within the City boundary, bound by Highway 401 to the south, Walker Road and the Canadian National (CN) Rail to the West, the Town of Tecumseh municipal boundary to the east and the EC Row Expressway to the North (the Study Area; Attachment A - Figure 1).

The Study Area is currently dominated by agricultural lands with scattered residential homes. Natural heritage features (woodlands, watercourses, fish habitat, wetlands, etc.) are limited, however, tend to be localized to the Little River watercourse. In addition, several municipal drains exist within agricultural fields and along existing roadways which conveys runoff from the watershed downstream to the Little River drain and eventually to Lake St. Clair. It is not the purpose of the drains to provide quality control and they do not contain standing water for long periods of time. While there are Provincially Significant Wetlands (PSW) swamp communities present directly within WIA lands, there are limited aquatic habitats present within the SS area that would attract waterfowl or other wildlife to WIA. Although minimal natural habitat is present, it is noted that two wet SWM ponds are present within the broader landscape outside of the Study Area to the north (Central Avenue) and west (Captain John Wilson), respectively (Attachment A – Figure 1); the WIA monitors these ponds as part of their monthly risk assessment activities to manage waterfowl hazards.

1.2 Proposed Conditions

As mentioned previously, to facilitate the proposed land use for the SSMSP area, several open water SWM ponds are proposed to occur along the existing municipal drains including Little River watercourse, 6th Concession Drain and the proposed 7th Concession drain re-alignment (Attachment A – Figure 1). In addition to the construction of the linear SWM ponds, the adjacent drains are also proposed to be modified to be suitable for the future urbanization of this area. The side slopes and depths of the municipal drains were set to allow sufficient capacity to provide conveyance of drainage under interim and proposed conditions. The proposed SWM plan is detailed in the SSMSP Stormwater Management Report (Appendix D) being completed for the SSMSP. Public safety has also been considered as the proposed SWM ponds will be recreational corridors that will have active transportation linkages and natural environment areas. While the widening of drains may increase the observable surface area of water within drains, it is anticipated that flow within the drains will be temporary for the purposes of drainage of lands after rain events and not to contain permanent standing water.

The proposed SWM ponds are to be constructed on the landscape via a phased approach to follow the construction of developable areas based on the established land use plan found in the related Secondary Plans. It is anticipated that the SWM ponds located, south of Baseline Road, within the East Pelton Secondary Plan area (P1), and adjacent to Lauzon Parkway, north of CR42 (P7 and P8) will be required first (Attachment A – Figure 1). The remaining SWM ponds will be added to the landscape as development continues within the East Pelton and Country Road 42 Secondary Plan Areas. The SWM Ponds outside of the two secondary plan areas will be constructed in the future as development areas expand and the necessary planning studies have been completed to support that development. Exact timing of pond construction is not known and it is anticipated that the full build out of the area will take more than 20 years.

Both wet and dry SWM ponds have the potential to attract waterfowl, therefore, recommendations included in this report apply to both types of facilities.

2.0 Aviation Perspective

Transport Canada regulates airports and aerodromes through legislated regulations (Canadian Aviation Regulations (CAR's)) and policy, standards and practices (TP) manuals. Wildlife control and mitigation is one of many legislated considerations in the operation of an airport. CAR's Part III – Aerodromes, Airports and Heliports, Division III – Airport Wildlife Planning and Management, Section 302.304(1) Risk Analysis (Attachment A), outlines the Airport Operators obligations to undertake a risk assessment of hazards presented by wildlife and wildlife attractions.

Stormwater retention ponds are known wildlife attractants. Transport Canada's TP1247E – Land Use in the Vicinity of Aerodromes, Part III – Bird Hazards and Wildlife, Section 3.2 - Hazardous Land-use Acceptability, Table 1 – Hazardous Land-use Acceptability by Hazard Zone (Attachment B), identifies SWM ponds as being a potentially low level of risk in secondary and special hazard zones but not a land use for primary hazard zones.

Portions of the proposed SWM facilities fall within the primary hazard zone of the Windsor Airport. That zone being defined in TP1247E as, generally enclosed airspace in which aircraft are at or below altitudes of 1500 feet AGL (457 meters above ground level). These are the altitudes most populated by hazardous birds, and at which collisions with birds have the potential to result in the greatest damage.

Of the WIA runways, the proposed SWM features are in closest proximity to Runway 12-30/RWY 30 approach, which has a northwest/southeast alignment. RWY 30 is Windsor's primary runway for passenger carriers operating turbo prop, regional and corporate jet aircraft as well as recreational and training aircraft use. The approach surface for RWY 30, as protected by the Airport Registered Zoning (AZR), is a 50:1 surface extending 10,000 feet from the pavement threshold. This is the second most used approach at Windsor Airport and aircraft using this approach could legally be less than 200 feet AGL (Above Ground Level) crossing over some of the proposed SWM features. Circuits for landing RWY 12 or 30 are all below 1000 feet AGL. Refer to Attachment A - Figure 3, which illustrates these boundaries.

Stormwater features in our region are known to attract waterfowl, herons and gulls. Species of principal interest due to their abundance, behaviour and size are Canada Goose (Branta canadensis maxima), Mallard Duck (Anas platyrhynchos), Great Blue Heron (Ardea herodias) and Ring-billed Gull (Larus delawarensis). These species rank high in wildlife hazard risk from North American birdstrike databases, TP11500 – Wildlife Control Procedures Manual and the Windsor Airport Wildlife Control Plan risk assessment database (Attachment D – Species Hazard Ranking).

These species rely on access to open water for both feeding and safety and often are in close proximity for breeding and fledging young. These species are grazers with gulls and herons being "grubbers", eating a variety of turf, soil and aquatic insects, invertebrates and small vertebrates. These species for the most part prefer open wetland and grassland habitats are not adept to swamp wetlands or course habitat features.

3.0 Waterfowl Adaptive Mitigation Plan

The waterfowl adaptive mitigation plan was developed to follow guidelines provided in the 2018 *Template for the Development of an Airport Wildlife Management Plan* by Transport Canada and considered risk assessment parameters currently in use by the WIA. Additional documents, current research, government protocols, and best management practices, used for the development of this plan are listed below:

- Land Use in the Vicinity of Aerodromes, Ninth Edition, Transport Canada (2013);
- Wildlife Control Procedures Manual. Transport Canada Aerodromes Standards Branch (2015);
- Landscape Design Guidelines for Stormwater Facilities. City of Hamilton (May 2009);
- Wildlife Hazard Mitigation, Federal Aviation Administration, United States Department of Transportation (August, 2020);
- Airport Wildlife Management. Bulletin No. 38. Transport Canada (2007);
- 2005 Sustainability Report for Toronto Pearson International Airport;

- Bird Control at Schiphol, Amsterdam Airport Schipol (2019);
- Wildlife at Airports; Wildlife Damage Management Technical Series. U.S. Department of Agriculture, Animal and Plant Health Inspection Service (February 2017);
- Waterbird Deterrent Techniques. Exxon Biomedical Sciences, Inc. Marine Spill Response Corporation (1994);
- Upper Little River Watershed Master Drainage and Stormwater Management Plan, Environmental Assessment Environmental Study Report (Stantec, 2017 DRAFT); and,
- Bird Use of Stormwater Management Ponds: Decreasing Avian Attractants on Airports. Landscape and Urban Planning (Blackwell et al., 2008).

While the SWM ponds will be considered infrastructure owned by the City, risk assessment parameters and existing monitoring practises of WIA will need to be considered for the development of a waterfowl adaptive mitigation plan to ensure congruence.

As part of the risk assessment, WIA has several zones it uses to monitor avian species, as shown on Figure 1 (Attachment A):

Zone of No Tolerance – Runway areas within the Airport lands. Waterfowl are not permitted and are removed immediately.

Zone of No Confidence – Airport and private lands located adjacent to the runway areas. Wildlife officers monitor and remove waterfowl as necessary.

Zone of Monitoring – Lands present within a 2-4 km radius from the airport lands. All features containing habitat supportive of waterfowl (i.e., wetlands, SWM ponds etc.,) within this radius are monitored monthly by airport staff. Bird populations are monitored and removed if it is determined that they present danger to the airport.

The majority of the proposed SWM ponds are located within the Zone of Monitoring, however, two ponds, P1 and P3, overlap with the Zone of No Confidence (Attachment A – Figure 1).

While interactions with all species are documented by WIA, the key target species that have the potential to cause harm and hazards to human health and safety at the airport due to collisions are Canada Geese (*Branta canadensis*) and Ring-billed Gulls (*Larus delawarensis*). As such, the waterfowl adaptive mitigation plan has been developed to consider the behaviour and life history of these species. In addition, the waterfowl adaptive mitigation plan considers the existing and future conditions in the land use plan proposed for the Study Area.

In accordance with guidance documents provided by Transport Canada (2018), the following objectives are to be considered when developing a wildlife/waterfowl adaptive mitigation plan for SWM ponds within the vicinity of the airport:

- Determine and implement waterfowl management actions;

- Establish a monitoring program for all aspects of the monitoring program, including performance monitoring and annual reporting;
- Describe the roles and responsibilities; and
- Establish communication procedures with respect to wildlife hazards.

Descriptions for each of the objectives are provided in Section 3.1 below.

3.1 Waterfowl Management Actions

As mentioned above, direct bird strikes and hazards due to waterfowl would be limited to interactions with infrastructure and vehicles within the airport lands, however, mitigation is required in the greater SS area as a precaution to prevent the aggregation of waterfowl. In accordance with guidance recommendations provided by Transport Canada (2018), passive or active management measures were considered for the proposed SWM ponds. In the event that waterfowl do enter the proposed SWM ponds despite this, a notification system should be in place in order to communicate potential bird strikes.

Passive and active management measures fall within the following four principals of wildlife management:

1. Habitat Modification;
2. Wildlife Exclusion;
3. Behavior Modification; and
4. Physical Removal.

Habitat modifications incorporate engineering and landscaping designs to create spaces that are unappealing to waterfowl. The designs consider the life history patterns and preferences of key target species (Canada Geese and Ring-billed Gulls). Designed areas may limit the available habitat for foraging and nesting, or restrict terrestrial movement or space needed for flight (or takeoff/landing). The habitat modifications are considered passive management measures as they are integrated into the long-term function of the proposed SWM ponds.

Conversely, wildlife exclusion, behaviour modification, and physical removals are considered active management measures because effort is required to disperse wildlife. Wildlife exclusion refers to the application of netting or fencing which prevent access to areas. Behaviour modifications include the deployment of predator decoys, amplified distress calls, loud concussion Moises, laser light, falcons or dogs, and reflective flagging as a measure to deter wildlife by making areas appear unsafe. Finally, physical removals include acts to trap and relocate waterfowl from high risk areas to areas outside of the zone of monitoring.

The four principals outlined above present a hierarchy in management, with habitat modification identified as the first step to mitigation. The three remaining active strategies are intended to be employed as supplementary or temporary deterrents. To this end, it is anticipated that the majority of SWM pond wildlife management will be achieved by habitat modification.

3.1.1 Passive Management

Passive management consisting of habitat modifications for the SWM pond designs included several engineering and landscaping elements described in the following subsections.

SWM Pond Design

A representative cross section of the proposed SWM pond layout is provided in Attachment A – Figure 2.1 and Figure 2.2. It is noted that the dimensions provided in the cross section are considered variable and that the size of individual ponds may increase or decrease depending on the pond location within the landscape. Details pertaining to permanent pools only apply to wet ponds. The dimensions identified in this plan are considered approximate and are subject to adjustment during detailed design, however, the general shape and location on the landscape is assumed to be accurate for the purposes of the SSMSP.

The scale and dimensions of the ponds have been designed in accordance with the design criteria identified in the ULRMP (Stantec, Draft 2017). Details regarding the volume, outflow and quality criteria can be referenced in the SSMSP Stormwater Management Report. The geometric configuration of the SWM ponds have been established to accommodate the SWM criteria and to reduce the attractiveness of the ponds to waterfowl. The configurations and designs are generally in-line with the high-level recommendations provided in the ULRMP (Stantec, Draft 2017); which proposed a system of interconnected permanent pools surrounded by heavily vegetated plantings. Adapting from this schematic, SWM pond designs were adjusted in order to meet the feasible servicing needs of the Study Area, as well as to reduce the visible size of available open water. Based on additional research and guidance documents, long-linear ponds were chosen instead of the concept plans proposed in the ULRMP to reduce pond perimeter and area of open water (Blackwell et al, 2008). Furthermore, the orientation of the proposed SWM ponds on the landscape are positioned perpendicular to Runway 12-30 reducing the habitat footprint in the critical operational area of the runway.

As depicted in the cross-section, included in Attachment A, ponds P2, P4, P5-P8 have both permanent pools and active storage areas. Permanent pools are anticipated to contain water year-round, whereas the active storage areas are intended to collect and temporarily store stormwater during rain events. The permanent pool width has been kept to a maximum width of 15 m along all linear ponds. Considerations for narrowing the permanent pool further was reviewed, however, based on the total volume requiring settlement reduction to the permanent pool volume was not possible. Draw down period of 48 hours within the active storage area for the 1:100 year storm to ensure the area of open water is minimized during large rainfall events. For a 1:100 year storm events, the maximum water level is approximately 0.5 m to 2.5 m below the top of bank, the remaining pond volume is considered surplus for storm events more severe than a 1:100 year storm.

In the proposed cross-section, the side slopes of the permanent pool were designed to have steep slopes (1.5:1) to ensure the collected stormwater is deep and prevents the growth of emergent and floating vegetation (food for waterfowl). The deep water storage has a two-fold design benefit, as wading and swimming species are deterred from areas containing deeper water, as it is difficult to observe underwater predators. The sloped edges of the permanent pool and active storage areas provide uneasy staging and nesting conditions for waterfowl as visibility is reduced and predator detection is limited. This deviates from the pond design proposed in the ULRMP (Stantec, Draft 2017) report, where larger flat areas were proposed at the permanent pool water level. Those areas would promote growth of plantings that these species eat and provide places for nesting and therefore have been eliminated from the functional design. More narrow, heavy planted benching areas will be incorporated at 50 m intervals along the length of the pond as a mechanism to provide additional woody vegetation for the purposes of limiting the appearance of a visual water runway to geese and gulls during flight. Finally, outlets and pump stations will be designed to have the functionality to completely drain permanent pools for maintenance as well as for waterfowl mitigation purposes.

For Dry ponds, measures to mitigate growth of attractive vegetation along the bottom surfaces shall be implemented along with all other screening measures described.

In summary, engineering design elements have been incorporated into the proposed SWM pond designs to achieve waterfowl management in the following ways:

- Linear SWM ponds limit the area of surface water visible to flying waterfowl;
- Linear SWM ponds provide insecure habitat to foraging and nesting waterfowl (cannot hide in open habitat; closer access to predators along banks);
- Benching provide along SWM pond length will add additional vegetation to break-up the appearance of a ‘visual runway’ from the sky;
- Deep permanent pools prevent growth of submergent aquatic vegetation (food for ducks);
- Deep permanent pools provide habitat insecurity as waterfowl cannot easily detect underwater predators;
- Fast draw-down period (48 hours) in active storage areas limit open water available during storm periods; and
- Design outlets and pump stations will have the functionality to drain permanent pools for maintenance and as extreme waterfowl mitigation.

Landscaping

Typical SWM pond designs in parks and residential areas may include grassed areas that are regularly mowed; these types of SWM ponds and associated landscaping are preferred by geese as the mowed grass provides a source of food, and clear line of site for observing predators. Mowed grassed areas are also preferred by ducks and geese as they provide a clear pathway for movement and flight take off.

Conversely, Blackwell et al. (2008), The City of Hamilton (2009), and the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (2017) recommends that woody vegetation be planted within the active storage area of the SWM pond as a mechanism to deter geese and ducks by providing a difficult terrain to navigate, as well as to provide limited canopy cover over the permanent pool to further reduce the visibility of open water from the sky.

Edges of the active storage area are tapered to gradually descend toward the permanent pool, the maximum depth of the active storage area is 2.7 m, including freeboard. As mentioned above, the active storage area is meant to collect surface flows up to the 1:100 year storm event. As such, woody species chosen to be planted within the active storage area have been chosen based on their ability to withstand periodic flooding, and to grow tall enough so that they would not be completely submerged during large storm events. The shrub and willow species chosen are also preferred as the height achieved at maturity does not exceed the allowable height within the runway approach surface.

A list of species included in the planting detail include the following:

- Bebb's Willow;
- Peach-leaved Willow;
- Pussy Willow;
- Button Willow;
- Red-osier Dogwood;
- Gray Dogwood;
- Eastern Ninebark;
- Nannyberry and other Viburnum species; and
- Cloudberry.

Woody vegetation should be planted fairly densely (0.5 m on the center) in order to provide an effective deterrent to waterfowl. It is intended that these plantings will be naturalized so regular maintenance by the City of Windsor is not anticipated.

A representative detail for plantings proposed within a 20 m length of the active storage area is provided in Attachment B – Detail 1. Renderings of the planting plan illustrated as a cross-section of the SWM ponds and proposed benching are also provided in Attachment B – Details 2 and 3. It is intended that the plans provided in Attachment B can be extrapolated to cover the length of the SWM pond. A high-level costing list has been included alongside the planting plan detail to provide an approximate cost for the landscaping designs; it is noted that larger stock (35 mm Cal. B.B. trees and 50 mm ht. 3 shrubs) have been included in this estimate because these trees will take less time to reach maturity. Cost estimates for smaller stock may be less, however, will take longer to provide maximum canopy cover over the active and permanent pools.

As it is anticipated that the species identified for planting the active storage area will take between two and five years to mature in height. Interim measures such as netting and cabling are recommended for mitigation before sufficient canopy cover to the permanent pool can be achieved (Refer to Table 1 for a list of all the measures). Wherever possible, SWM ponds should be placed adjacent to areas with mature trees (hedgerows, woodlands, swamps, etc.) in order to make use of the existing canopy cover. The placement of SWM ponds adjacent to retained natural heritage features should be located outside of buffers assigned to protect the ecological form and function. It is noted that a 30 m buffer is typically assigned to PSWs, whereas a minimum 15 m buffer is applied to the top of bank of watercourses such as the Little River; buffer areas are intended to be planted with natural vegetation to provide additional protection to the retained features. For this reason, trails, access roads and pathways associated with the SWM pond designs may not be permitted within buffer areas.

It is generally recommended that the conditions of the SWM ponds be monitored by the City once per month during the growing season (April – October) to ensure the passive management mitigation is established and is working effectively to restrict available habitat. Maintenance for the proposed SWM ponds should be conducted so that disturbance to the planted vegetation within the active storage area is minimized. Dredging within the permanent pool should be conducted outside of the migratory and breeding windows for waterfowl so that potential impacts to the canopy cover. Dredged materials/raked algae should be taken offsite so that potential food sources for waterfowl are removed.

For future maintenance of the permanent pool area, lane ways and clear areas will need to be accommodated in planting plans; it is anticipated that laneways to access the permanent pool will be required every 50 m along the length of the SWM ponds. Refer to the Waterfowl Mitigation Pond Segment Plan Figure included in Attachment B. It is recommended that access paths as well as areas adjacent to maintenance corridors be planted using Canada "Certified" seed or "Canada No. Lawn Grass Mixture" which were specifically developed to deter geese. The composition of the grass seed mixtures consists of the below ratio:

- 45% RTF Rhizominous Tall Fescue;
- 20% Kent Creeping Red Fescue;
- 25% Primary Perrennial Ryegrass;
- 5% Shark Creeping Bentgrass; and,
- 5% Leo Birdsfoot Trefoil.

It is recommended that grassed areas be allowed to naturalized and not mowed as another deterrent to limit terrestrial geese movement.

The addition of armor landscaping stones to the edges of SWM pond blocks and outside of the planted woody vegetation should also be included in planting details. Large rocks are difficult for ducks and geese to navigate around by foot and are considered a deterrent. In addition, chain link fencing may be installed along the edge of woody vegetation of the active storage areas to prevent terrestrial movement of waterfowl and geese into the SWM pond area.

Muskrat Management

While Muskrat (*Ondatra zibethicus*) are not a target species, the life history and habits of this aquatic mammal may provide reciprocal benefits to waterfowl. Muskrat build mounds with stalks and reeds of emergent vegetation at entrances to burrows which are excavated along the banks of watercourses, wetlands, and in urban settings. The external mounds of vegetation provide ideal nesting sites for waterfowl. As such, additional mitigation should be considered to manage and mitigate their presence within municipal infrastructure as a mechanism to prevent the mutual attraction of waterfowl to these areas.

To remove or mitigate Muskrat habitat, it is recommended that chain-link fencing be applied horizontally to the ground surface along the interface of the active storage area and permanent pool. The metal fencing will prevent burrowing and therefore deter Muskrat from inhabiting the SWM Ponds. While permanent pools have been sized to prevent the growth of aquatic vegetation, invasive species including Common Reed (*Phragmites australis*) are known to be pervasive throughout Southern Ontario and therefore should be anticipated to occur overtime. The spacing of holes for the metal chain-link fencing will not prevent the growth of woody species identified in planting plans for the active storage area.

3.1.2 Active Management

Active management mitigation is intended to exclude or remove waterfowl from the proposed SWM ponds. These active mitigation measures are intended to supplement the passive management strategies incorporated into the designs for the SWM ponds and associated landscaping.

As it is understood that residential, business park, commercial and institutional land uses are proposed within the SS area, the active management mitigation discussed herein is limited to devices and techniques that are unlikely to disturb the public (i.e. pyro techniques, gas cannons, report shells, loud sirens/bangers). In addition, active management mitigation that would be able to coexist with the proposed plantings in the active storage areas of the SWM pond would be preferred. Descriptions of, and details for the active management mitigation identified as a good fit for the proposed SWM ponds are described in Table 1.

For any of the active management mitigations chosen, it is recommended that signage be posted along trails and access roads to SWM pond blocks to notify the public of the mitigation in use in order to provide awareness and to reduce vandalism.

Table 1: Supplementary SWM Pond Active Management Mitigation for Waterfowl Deterrents

Deterrent	Description	Wildlife Management Principal	Advantages	Disadvantages	Materials and Approximate Cost (assumes 20 m length of SWM pond)	Anticipated Monitoring Schedule	Recommendation
Tension Wire/ Netting Suspended Over Pulley System	Cable pulley system installed using wooden poles to suspend netting over active storage and permanent pool areas of SWM ponds to exclude waterfowl from landing. Netting can be deployed year round or be lowered or raised seasonally, depending on need.	Wildlife Exclusion	• Effective exclusion achieved. • Can be deployed seasonally or year-round as needed. • Can be combined with other mitigation techniques. • Does not interfere with quality of life for neighboring residents (no light or sound emitted).	• Large installation required to set up; not easy to take down once installed. • Requires monthly monitoring and maintenance to ensure working properly. • Maintenance may be difficult once vegetation matures to full height • Structures may be prone to unwanted vegetation growth (vines). • In rare cases, birds may become tangled in netting (can be mitigated with flags/reflective tape).	4 poles, each approximately 8 m high and supported in a concrete base. Assumes panels for 20 m length of pond, 45 m wide will cover area of 900 m^2. One pole will be installed on each corner in a rectangular shape. Each pair of poles will support 4.8 mm diameter stainless steel cables (4 cables total = two 45 m, two 20 m) which will support monofilaments (40 lb test fishing line) spaced approximately 2 m intervals along the cables (10 monofilaments stretched over the active and permanent ponds over the 20 m length; 225 m). Each stainless-steel cable will be attached at the north end to a fixed eye strap with a carbine hook. The cable panel's tension will be adjustable through a system of boom bails attached to a "T' track. A similar system has been deployed by the City of Ottawa for two pedestrian beaches; see Attachment C for detailed drawings). <u>Cost Estimate for Key Components</u> 8 m Wooden Poles: $350 each x 4 = $1400 Concrete (320 lbs total – 80 lbs per post): $600 130 m of 4.8 mm stainless steel cable: $200 450 m 40 lb monofilament: $60 Initial set up: 1 week: 40 hours of labour Monitoring by City Staff – one 10 hour day per month (120 hours of labour).	Can be used year-round (weather permitting). Peak season this system should be deployed is during the migratory and breeding seasons (April-November). System should be monitored by City Staff once a month when deployed to ensure no damage. Inspections may be required more often following periods of bad weather.	Recommended for ponds as interim mitigation while woody vegetation in active storage area matures. Recommended for open areas or areas where no other natural woody vegetation exists (i.e. retained hedgerows, forests, swamps).
Flags, Reflective tape	Flags consisting of either opaque plastic (red, orange or black) or reflective materials installed using stakes or on wires/cables over permanent and active storage areas.	Behaviour Modification	• Can be deployed simultaneously with netting (above) • Humane deterrent for waterfowl • Effective deterrent against waterfowl • Does not make noise • Cheap to replace	• Can become damaged/removed due to poor weather May be visually distracting to pedestrians during the day time.	Reflective bunting safety flags (45 flags per 30 m roll; orange - $30 each). For a 20 m length of pond it is recommended that two 30 m rolls of flags be spaced 5 m apart across the 15 m width of the permanent pool (90 flags per 20 m stretch).	General inspection should occur once a year alongside installation and deployment of greater cable system.	Recommended for open areas or areas reported to have high volumes of waterfowl. Recommended to be deployed alongside cable pulley system.

Deterrent	Description	Wildlife Management Principal	Advantages	Disadvantages	Materials and Approximate Cost (assumes 20 m length of SWM pond)	Anticipated Monitoring Schedule	Recommendation
	Movement of flags/reflective surfaces scares waterfowl, as well as indicates placement of netting suspended over SWM ponds.				Cost for two rolls: $60	If flags are installed independently they should be inspected by City staff once every month to ensure they are in place; inspections may be required more often in times of bad weather.	
Lights/lasers	Low-level solar powered strobe lights installed along the edges of the permanent pool. Lights emit a series of quick flashes every two seconds with 360-degree coverage. Lights are to be installed at "goose height" for the purposes of deterring them. Geese have sensitive eyes and cannot sleep when lights are deployed.	Behaviour Modification	- Highly effective; self-sufficient. - Easy to install and replace. - Humane deterrent for geese. - Installation within the areas of woody vegetation would reduce the amount of light seen in residential areas and roads.	- Installation/placement of lights are limited to SWM pond interior; cannot be installed near roadways. - Lights may attract pedestrians to ponds at night. - Additional signage may be required to inform residents.	Industrial Geese Deterrent Strobe Lights: $400/unit. One recommended for every 100 m length of SWM pond.	Should be inspected monthly by City staff to ensure lights remain installed in place and solar batteries are working effectively.	Recommended for SWM ponds located away from residential subdivisions to not disturb residents. May be used in interior sections of ponds located away from residential areas or roadways.
Predator Decoys and Light Deterrents	May consist of plastic models of coyotes or alligators. Coyote decoys can be installed within or adjacent to the active storage areas. Alligator decoys may be deployed within the permanent pools. Low level lights mimicking predator eyes/eye shine may also be deployed for nocturnal deterrents.	Behaviour Modification	- Effective for short-term deployment. - Easily mobile; can be relocated efficiently.	- Decoy needs to be moved around to new areas to be seen as effective. - High habituation rate - May be subject to vandalism/theft.	Terrestrial Coyote Decoy: $150/unit Floating Alligator Decoy: $70/unit Solar powered Predator Eye Lights: $110/ 4 units 1 decoy recommended per 2 ha of SWM pond	Should be inspected/moved by City staff once every two weeks while in use to reduce likelihood of habituation by waterfowl.	Should not be used for long-term use. Should be deployed as interim measure for other mitigation/deterrents.

Deterrent	Description	Wildlife Management Principal	Advantages	Disadvantages	Materials and Approximate Cost (assumes 20 m length of SWM pond)	Anticipated Monitoring Schedule	Recommendation
Falconry	A trained bird of prey (falcon, hawk or eagle) is released in the area by a handler for the purposes of scaring and expelling waterfowl from an area.	Behaviour Modification	- Effective for short term deployment and removal. - Can be used as needed. - No monitoring required.	- Expensive and laborious; requires contractor to be on site. - Likely requires repeat visits to achieve success. - Permitting may be required for the handling of falcons/use of drones.	Up to $1200.00 - $2500.00 or more per visit by a licenced professional.	No monitoring required.	Recommended as needed to remove waterfowl detected within SWM Ponds.
Drones	A drone is maneuvered by an operator over a SWM pond for the purposes of scaring or expelling waterfowl from an area.						
Capture and Release	A licensed wildlife control officer will trap and remove nuisance waterfowl and release them to areas well outside of the jurisdiction of the airport	Physical Removal	- Ensures direct removal nuisance wildlife from area. - Can be used as needed as last resort.	- Cannot guarantee waterfowl will not return after trapping and removal. - Expensive - Permitting may be required for handling, trapping and transporting waterfowl. - Unpopular with the general public.	Up to $5,000 – $7,000 or more per visit by licenced wildlife professional. Dependent on the level of effort and amount of geese.	No monitoring required; unless otherwise stated in required permits.	Recommended as needed to remove persistent waterfowl detected within SWM Ponds.

As noted in Table 1, several mitigation/deterrent techniques are proposed based on the existing conditions associated with anticipated location of each individual SWM pond within the SSMSP Area. A matrix which outlines appropriate active management strategies per ponds identified in Attachment A – Figure 1 is provided in Table 2. In addition, the active management techniques may be deployed as supplementary mitigation, as needed, to provide cover during periods of maintenance or to improve deterrence methods as a form of adaptive management. The supplementary active management mitigation may also be used to remove waterfowl should they be detected within SWM ponds during regular monitoring.

Table 2: Active Management Strategies SWM Pond Matrix

Active Management Strategies	Stormwater Ponds[1]										Notes
	East Pelton (EP)		Baseline Road/County Road 42 SPA (CR42SPA)				Little River		Lauzon Parkway		
	EP North (P1)	EP South (P2)	CR42SPA West (P3)	CR42SPA Central (P3)	CR42SPA East (P3)	CR42SPA SE (P6)	East Little River (P4)	West Little River (P5)	Lauzon Parkway East (P7)	Lauzon Parkway East (P8)	
	Dry	Wet	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Wet	
Wildlife Exclusion											
Tension Wire/Netting Suspended Over Pulley System	---	✓	---	---	---	✓	---	✓	---	✓	Temporary installment recommended for wet ponds throughout Study Area except for areas where existing woody vegetation (woodland, hedgerows) are being retained.
Landscaping stones, fencing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Appropriate for use throughout Study Area.
Behaviour Modification											
Flags, Reflective Tape	---	✓	---	---	---	✓	✓	✓	✓	✓	Appropriate for use throughout Study Area. May not be necessary for dry ponds.
Lights/Lasers	---	---	---	---	✓	✓	---	✓	✓	✓	Recommended in SWM ponds located away from residential land uses
Predator Decoys and light deterrents	---	✓	---	---	-	✓	✓	✓	✓	✓	Appropriate for use throughout Study Area. May not be necessary for dry ponds.
Falconry/Drones	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Appropriate for use throughout Study Area.
Physical Removal											
Capture and Release	---	---	---	---	✓	✓	✓	✓	✓	✓	Recommended for use in SWM ponds located away from residential land uses.

1- Pond names depicted on Figure 1 of Attachment A

Notification System

To maintain congruency with monitoring conducted by WIA, the identification of waterfowl within the additional SWM ponds proposed within the Zone of No Confidence and Zone of Monitoring should continue to be carried out by the WIA Staff. Should waterfowl be observed within the SWM Ponds, the City should be notified by WIA and be required to remove waterfowl via active management techniques. The City would be responsible for confirming to WIA that they have been successful in excluding/removing waterfowl from the area; the City would also be responsible for recording all occurrences of waterfowl identified within the proposed SWM pond.

For SWM ponds proposed to be located within the 'Zone of Monitoring' monitored by WIA, monitoring for the presence of waterfowl is required. Should gulls, ducks or geese be observed by the City or WIA, the observances must be documented and the waterfowl potentially removed. Notification of this activity must be provided to WIA for due diligence purposes.

3.2 Adaptive Mitigation Plan

Monitoring Methods

As mentioned above, the majority of SWM ponds are proposed to be located within the Zone of Monitoring. WIA is required to monitor features providing potential habitat once per month as part of their risk assessment. To maintain congruency with existing monitoring plans of the airport, monitoring of the new ponds should be conducted once per month to observe and document the presence of waterfowl. Similarly, monthly monitoring should also be conducted within the SWM ponds to ensure that landscaping and engineering designs (habitat modifications) are working effectively. Monthly monitoring will consist of single site visits to each feature/SWM pond to visibly assess if waterfowl are present (species and number), evidence of woody vegetation dieback, or damage to the SWM ponds is present. Key performance indicators (KPI) to be assessed during monthly monitoring will evaluate the effectiveness of the wildlife management initiatives by their ability to deter and exclude waterfowl from the Zone of No Confidence and Zone of Monitoring through active and passive management. In short, the City will aim to continually improve waterfowl management mitigation through the implementation of the wildlife management hierarchy for the purposes of reducing the occurrence of waterfowl on City-owned lands within the vicinity of the airport.

Adaptive Management

The management of waterfowl will be dependent on the location of SWM ponds within the Study Area. Two SWM ponds, pond P1 and P3, are proposed within the Primary Hazard Zone and in line with the approach area of runway 12-30 (Attachment A – Figure 1). The remaining ponds (P4, P5, P6 P7, P8) are located within the 2km-4 km outer radius in the Zone of Monitoring.

Based on this plan and alignment with ongoing monitoring of WIA, waterfowl observed in SWM ponds within the Zone of No Confidence or runway approach surface along Baseline Road will be immediately removed by supplemental active management measures (exclusion, behavioural management, and physical removal). On the other hand, waterfowl observed as a result of monthly monitoring within the greater Zone of Monitoring will be documented and continually monitored. Monitoring may increase in frequency if necessary, and deterrents and removals may be applied on a site-by site basis as determined by a Wildlife Management Officer. The management of waterfowl present within features of the Zone of Monitoring will be initiated by the number of waterfowl observed and the frequency of SWM pond use.

Supplementary active management mitigation should be deployed to the target SWM pond as a mechanism for preventing further aggregations of waterfowl. The additional mitigation (Table 1 and Table 2) will be chosen based on the behaviour of the offending species, the adjacent land uses, and degree of habituation. The SWM pond and new mitigation will be monitored closely and checked after initial deployment to ensure waterfowl are deterred. Should waterfowl persist within the SWM ponds after this period, a new or additional mitigation should be deployed. It is recommended that installed mitigation remain in place during the spring (March –May) and fall migration windows (September - November), as these are considered high risk time periods when waterfowl are expected to travel through the SSMSP area in high numbers.

Outside of the migration windows, deployed temporary mitigation may be removed/halted for select SWM ponds should it be determined through monitoring that waterfowl have been successfully excluded and are no longer present within or in lands adjacent to the zone of no confidence.

As a last measure, SWM ponds may be temporarily drained in circumstances where waterfowl mitigation has failed until persistent waterfowl have been removed/displaced.

Reporting

A record of waterfowl removals, and adaptive management will be recorded as part of a wildlife management log. The log will list the detection events including start and finish times, the numbers and species present, as well as the methods used for removal. In addition, the logs will report any changes or maintenance to the passive management mitigation associated with the SWM pond engineering or landscaping.

A summary of the wildlife management logs will be produced once a month in order to discuss any environmental changes that may have occurred, or changes that may lead to wildlife hazard conditions that may increase risk to the adjacent airport lands. The monthly summary reports will be provided to WIA for review to assist with their risk assessment initiatives.

3.2.1 Outcomes and Lessons Learned

There are two cumulative effects to consider to which there is very little opportunity to predict outcome once a SWM feature is constructed. How mitigation of these affects has been implemented locally at the other SWM ponds in the area has been included as Case History below. These notes have been provided by former WIA staff involved in these mitigation activities.

One is the cumulative effects of SWM ponds is multiple or extensive habitats combining to attract wildlife acerbating a problem of overall management. How ponds in the vicinity of open grassland (airfield), agricultural land or other natural or man-made wetlands interact to support wildlife. For reference, Figures in Attachment A, show the existing stormwater management ponds located in the vicinity of the Windsor Airport. Central Pond is located at the southeast corner of Grand Marais and Central Avenue

Case History: The creation of a SWM pond at Grand Marais and Central Avenue caused an immediate wildlife hazard from Canada Goose loafing overnight on the safety of the open pond and flying the short distance over the E.C. Row Expressway to graze by day on the grassland along Runway 07-25. This situation was eventually mitigated by mechanically pumping down the pond until trees and course vegetation could be established. Now with appropriate cover, the pond is no longer attractive to geese and the proximity to foraging at the airport is dissolved.

The second cumulative effect is called Founder's Effect. This occurs when geese and ducks do manage to successfully nest and fledge young on or in the vicinity of a pond to which the fledged birds return as breeding adults. It is the main reason that relatively small populations of Canada Geese so quickly become burgeoning populations on single ponds.

Case History: The Captain Wilson Park SWM Pond and associated manicured turf grass fields surrounding the pond, in the course of 5 years saw a population of 3 nesting pair develop into 226 individual birds. This situation is managed with periodic round up and re-location of geese in an attempt to immediately reduce the number of birds in the vicinity of the airport and to by-pass Founder's Affect in relocated juvenile birds.

3.3 Roles and Responsibilities

The proposed SWM ponds are to be constructed on the landscape via a phased approach to follow the phased construction of developable areas detailed on the established of the land use plan. Section 1.2 of this memo indicated that the SWM ponds located south of Baseline Road to the far west within the East Pelton Secondary Plan area (P1), as well as the pond located adjacent to the Lauzon Parkway (P7 and P8) will occur first (Attachment A – Figure 1). The remaining SWM ponds will be added to the landscape as development continues within the East Pelton and Country Road 42 Secondary Plan Area, to the east along County Road 42 Secondary Plan Area and along the Little River.

As it is intended that the ownership of the SWM pond infrastructure will be conveyed from individual land owners (the proponents) to the City, it is understood that responsibility for and management of the ponds will change over time as development within the Study Area continues through the Construction, Post-Construction and Implementation Phases. The following sections recommend monitoring and reporting procedures. The actual procedures should be developed by the City and WIA collaboratively and updated throughout implementation based on lessons learned.

Design

Detailed design of the stormwater management facilities shall follow the most current Transport Canada, airport and regional guidelines. Each pond has a unique location, orientation and proximity to the airport runways. The design shall consider site specific elements such as, but not limited to, plane altitudes, flight paths, bird migration patterns, maintenance access. In addition to the typical municipal review, the designs shall be reviewed with Transport Canada and the Airport to confirm that the designs satisfy mitigation requirements listed herein.

Construction and Post-Construction Phase

Construction of the SWM ponds are intended to be carried out by proponents of each development application. As part of the construction phase, it is anticipated that initial monitoring of the SWM ponds and landscaping will be carried out by the proponent as part of an Environmental Monitoring Program (EMP) to ensure the constructed infrastructure and plantings are successful. The length of the construction and post-construction monitoring periods are to be determined as part of the draft plan and detailed design process; however, it is anticipated that construction monitoring will occur during the active construction period, and post-construction monitoring will be required for at least three years once construction is complete.

Since habitat modification is a key component of the engineering and landscaping designs, monthly waterfowl and SWM pond monitoring should be included and carried out as part of the EMPs by the proponent during the construction and post-construction phases.

During the construction and three-year (minimum) post-construction period, supplementary mitigation or active management strategies will also be deployed as a responsibility of the proponent. Monthly monitoring reports which detail waterfowl mitigation and monitoring shall be provided to the City by proponents on a monthly basis to provide a record of adaptive management taken at each SWM pond. Monitoring and mitigation carried out by individual proponents should be documented by a Wildlife Management Officer, nominated by the City, who will act as the conduit of information between proponents, the City, and WIA.

Implementation Phase

Following the completion of the EMP and post-construction monitoring period, it is anticipated that the ponds will be conveyed to the City for their long-term management. At this time, senior City staff/Wildlife Management Officer, will be responsible for coordinating, supervising and the overall management of the waterfowl management plan on a long-term and a daily basis at the site-specific level. This will include the co-ordination of training, safety assurance and ensuring that the necessary equipment is available. Senior City Staff will also be responsible for conveying monitoring results to operations managers at WIA.

The Wildlife Management Officer should be responsible at a minimum for:

1. Establishment and maintenance of the Waterfowl Management Log (e.g., details on wildlife numbers and activity; mitigation measures undertaken, adaptive management requirements, and monthly summaries);
2. Co-ordination of the monitoring program;
3. Ensure that the City's monitoring operations are consistent with the requirements of WIA;
4. Ensure plantings included in the active storage areas of the proposed SWM ponds are maintained and healthy as expected;
5. Undertake deterrent activities;
6. Ensure all activities are undertaken following standard practices and safety protocols; and
7. Identify equipment, resource and training needs.

3.3.1 Communication Procedures

The following communication procedures should be established for the purposes of waterfowl management by the City:

1. Waterfowl detection information will be provided directly from monitoring staff to the Waterfowl Management Officer of the City.
2. The Waterfowl Management Officer will be responsible for ensuring that updated information is provided to WIA immediately if an urgent situation arises and on a regular basis depending on the conditions, or when requested by WIA. WIA will also relay any information received regarding waterfowl observations to monitoring staff and the City in a timely manner.
3. WIA will provide information to pilots on current wildlife hazards and will ask pilots to report any waterfowl observations to the airport.
4. Waterfowl activity will be regularly updated by the City in daily logs and monthly summary memos.

4.0 Closure

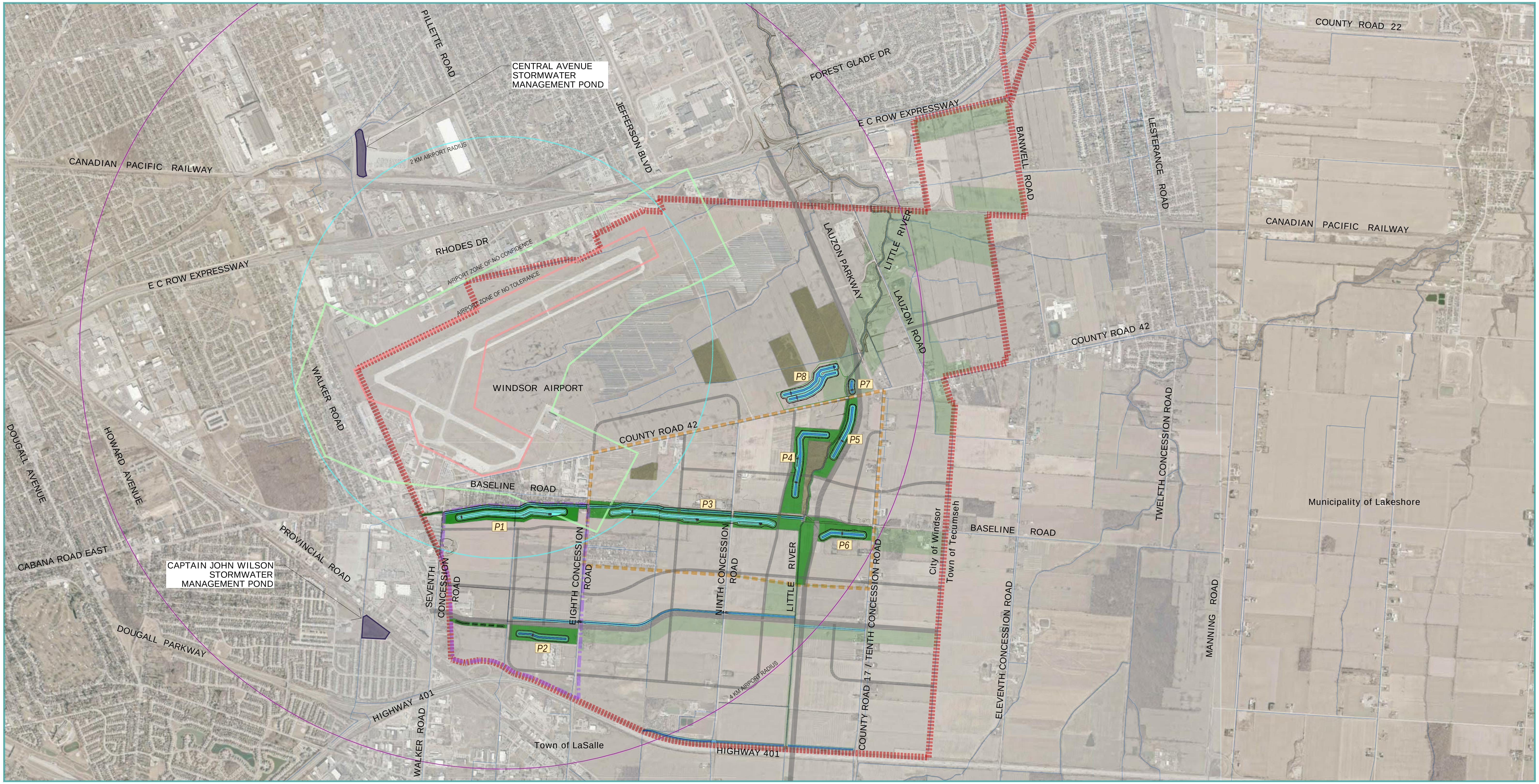
The recommendations of this document will be incorporated into the development standards that will become part of the minimum design standards and implementation plan for this area. This document shall be reviewed regularly by the City of Windsor and Winsor International Airport staff to confirm that the implementation, monitoring and maintenance recommended above are providing sufficient mitigation to meet safety requirements throughout the life cycle of these facilities.

Regards,

Caitlin Vandermeer, P.Eng. Senior Biologist	Laura Herlehy, P.Eng. Project Engineer

Attachment A

Figures



🟥 STUDY AREA

▬ EAST PELTON SPA

▬ CR42 SPA

▬ FUTURE COLLECTOR AND ARTERIAL ROADS

▨ EXISTING STORMWATER MANAGEMENT PONDS

🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR

▨ NATURAL HERITAGE AREA

P1 TYPICAL POND NAME

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

▨ STORMWATER MANAGEMENT POND - ACTIVE STORAGE

▬ MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

AIRPORT ZONES LEGEND

○ 2 KM RADIUS FROM AIRFIELD CENTRE (WILDLIFE CONTROL ZONE)

○ 4 KM RADIUS FROM AIRFIELD CENTRE (WILDLIFE CONTROL ZONE)

▬ ZONE OF NO TOLERANCE

▬ ZONE OF NO CONFIDENCE

SANDWICH SOUTH MASTER SERVICING PLAN

FIGURE 1

Waterfowl Adaptive Mitigation Plan

STORMWATER MANAGEMENT STRATEGY
WINDSOR AIRPORT MONITORING

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

CREATED BY: RBH
CHECKED BY: LMH
DESIGNED BY: DCR
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE
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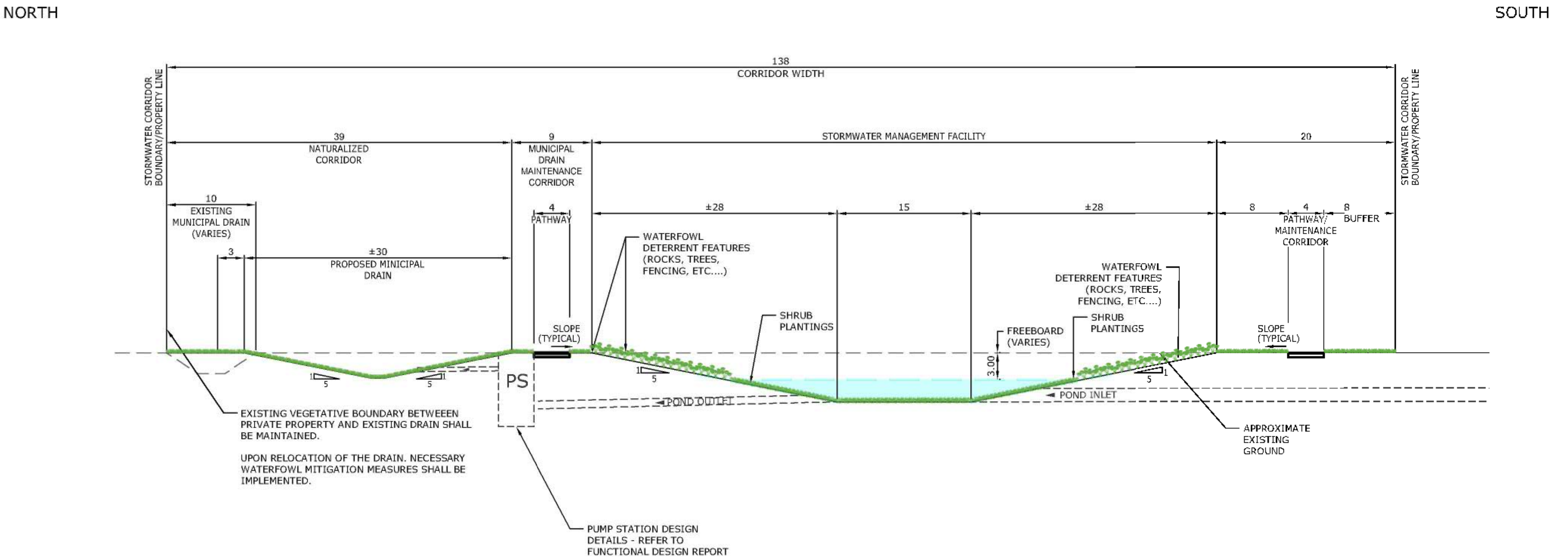
STATUS: FINAL

PROJECT: 19-9817

DATE: April 11, 2023

File Location: c:\pw working directory\projects 2019\32rbh\dms90713\199817-02-swm-pnds_airport.dwg April, 11, 2023 7:07 AM



EAST PELTON NORTH (P1)

SANDWICH SOUTH MASTER SERVICING PLAN

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

P1-STORMWATER MANAGEMENT
CORRIDOR (DRY POND)
FIGURE 2.1

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

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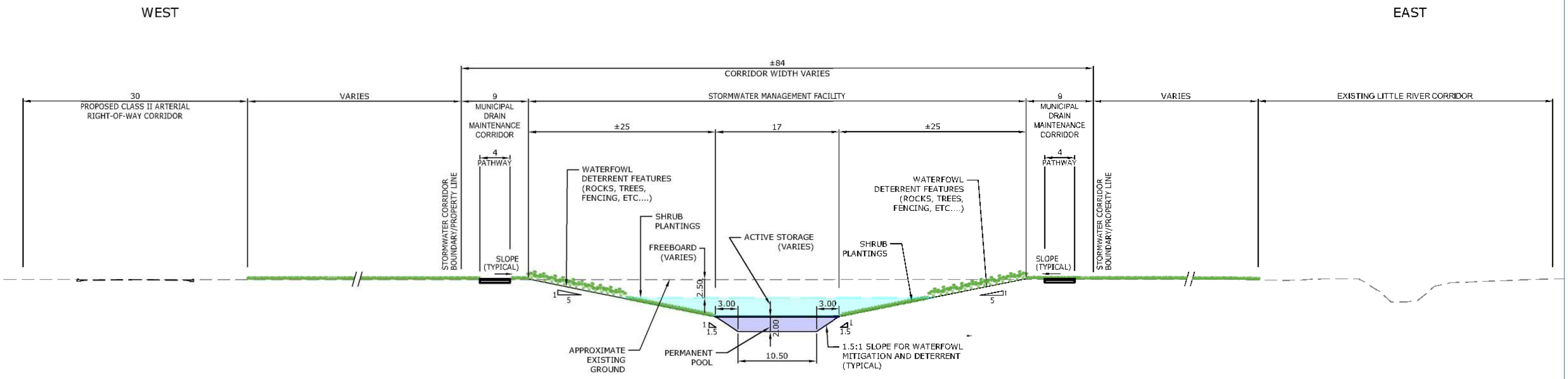

CR42SPA NW (P4)

🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL

🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE

SANDWICH SOUTH MASTER SERVICING PLAN

STORMWATER MANAGEMENT CORRIDOR WITH OFFLINE FOREBAY

FIGURE 2.2

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX

MAP CREATED BY: DCR
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

SCALE
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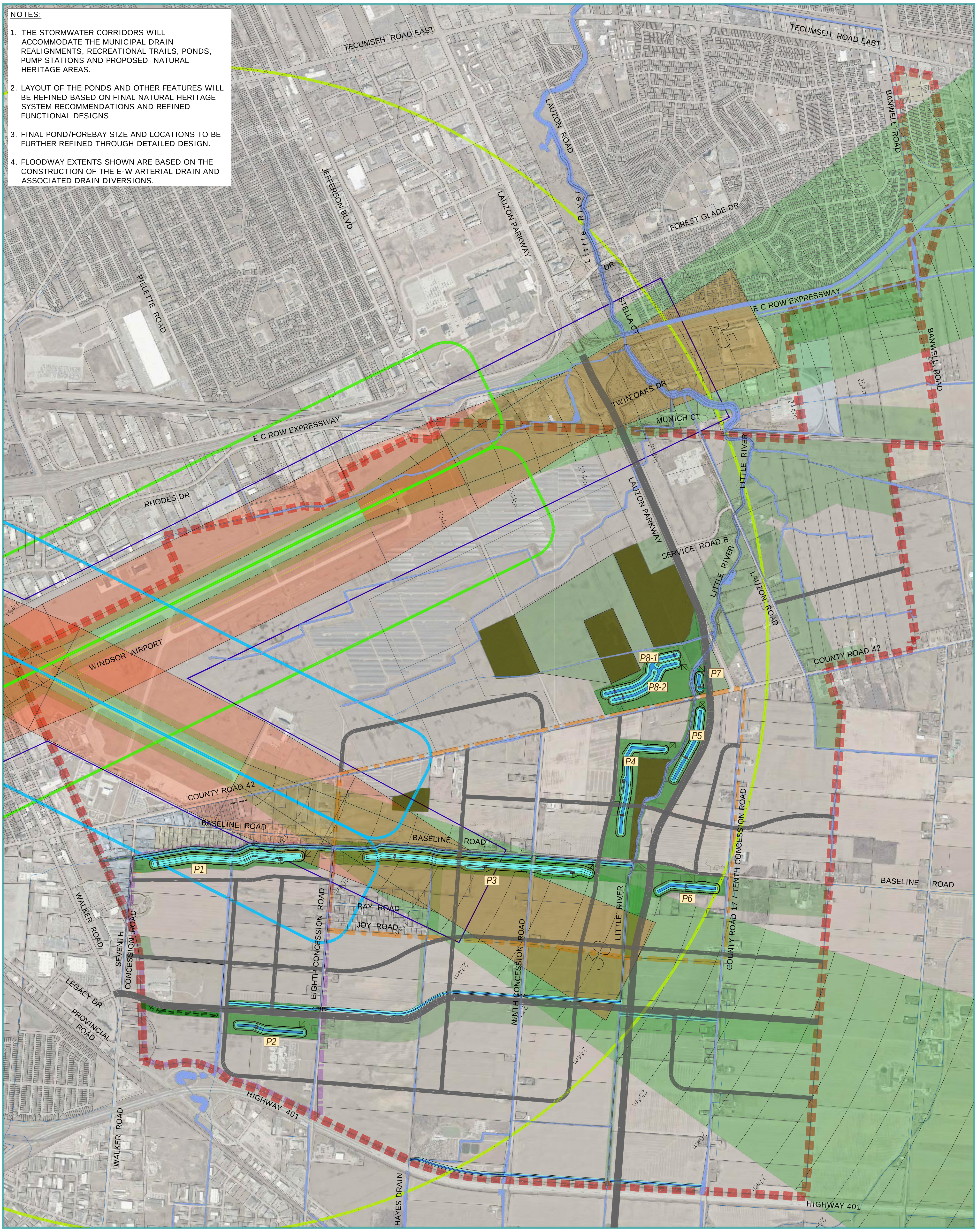
STATUS: FINAL PROJECT: 19-9817 DATE: March 27, 2023



NOTES:

1. THE STORMWATER CORRIDORS WILL ACCOMMODATE THE MUNICIPAL DRAIN REALIGNMENTS, RECREATIONAL TRAILS, PONDS, PUMP STATIONS AND PROPOSED NATURAL HERITAGE AREAS.
2. LAYOUT OF THE PONDS AND OTHER FEATURES WILL BE REFINED BASED ON FINAL NATURAL HERITAGE SYSTEM RECOMMENDATIONS AND REFINED FUNCTIONAL DESIGNS.
3. FINAL POND/FOREBAY SIZE AND LOCATIONS TO BE FURTHER REFINED THROUGH DETAILED DESIGN.
4. FLOODWAY EXTENTS SHOWN ARE BASED ON THE CONSTRUCTION OF THE E-W ARTERIAL DRAIN AND ASSOCIATED DRAIN DIVERSIONS.

SANDWICH SOUTH MASTER SERVICING PLAN

🟥 STUDY AREA
🟪 EAST PELTON SPA
🟧 CR42 SPA
➡ TRUNK STORM SEWER
🟦 1:100 YEAR FLOODWAY EXTENTS
⬛ FUTURE COLLECTOR AND ARTERIAL ROADS
🟫 NATURAL HERITAGE AREA
P1 TYPICAL POND NAME

🟩 OPEN SPACE / STORMWATER MANAGEMENT CORRIDOR
⇦ PROPOSED STORM SEWER DRAINAGE
☒ STORMWATER PUMP STATION
🟦 STORMWATER MANAGEMENT POND- PERMANENT POOL
🟦 STORMWATER MANAGEMENT POND - ACTIVE STORAGE
🟦 MUNICIPAL DRAIN RELOCATION OR NEW DRAIN

AIRPORT ZONES LEGEND

○ 4 KM DIAMETER FROM AIRFIELD CENTRE (WILDLIFE CONTROL ZONE)
○ TYPICAL TRAFFIC PATTERN (East-West)
○ TYPICAL TRAFFIC PATTERN (North-South)
▭ OBSTACLE LIMITATION SURFACES (OLS)

AIRPORT ZONE OVERLAY

FIGURE 3

MAP DRAWING INFORMATION:
DATA PROVIDED BY CITY OF WINDSOR 2019, MNRF 2019, TOWN OF TECUMSEH 2019, *ESSEX REGION CONSERVATION AUTHORITY 2019, **COUNTY OF ESSEX 2019

MAP CREATED BY: RBH
MAP CHECKED BY: LMH
MAP COORDINATE SYSTEM: NAD 1983 CSRS UTM Zone 17N

*DEM - CGVD28:78 DEM SURFACE DERIVED BY ERCA BASED ON MNRF LIDAR - DIGITAL TERRAIN MODEL (2016-18). COPYRIGHT ERCA, 2019. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO. (WWW.ONTARIO.CA/PAGE/OPEN-GOVERNMENT-LICENCE-ONTARIO)

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SCALE: 1:12500
STATUS: FINAL
PROJECT: 19-9817

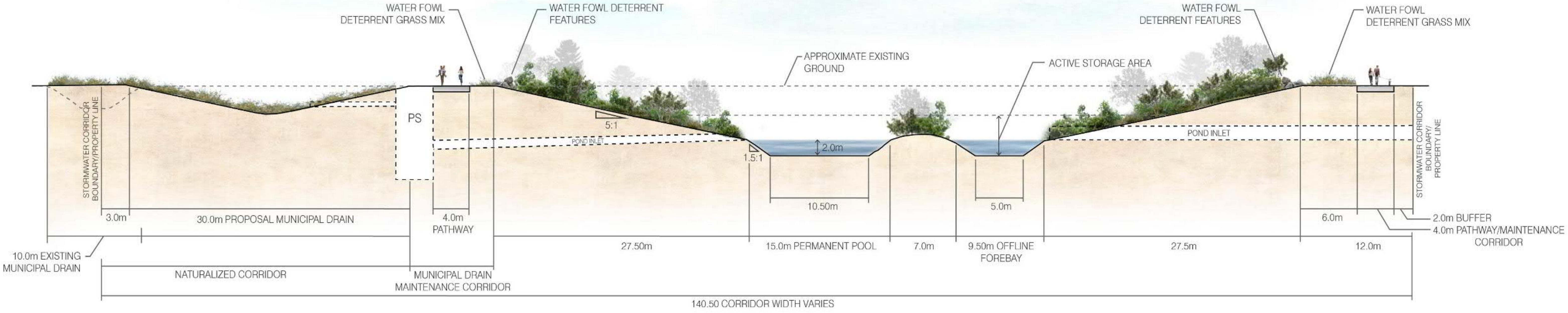
DATE: April 18, 2023

File Location: c:\pw working directory\projects 2019\32rbh\dms90713\199817-02-swm-ponds.dwg April, 18, 2023 1:00 PM

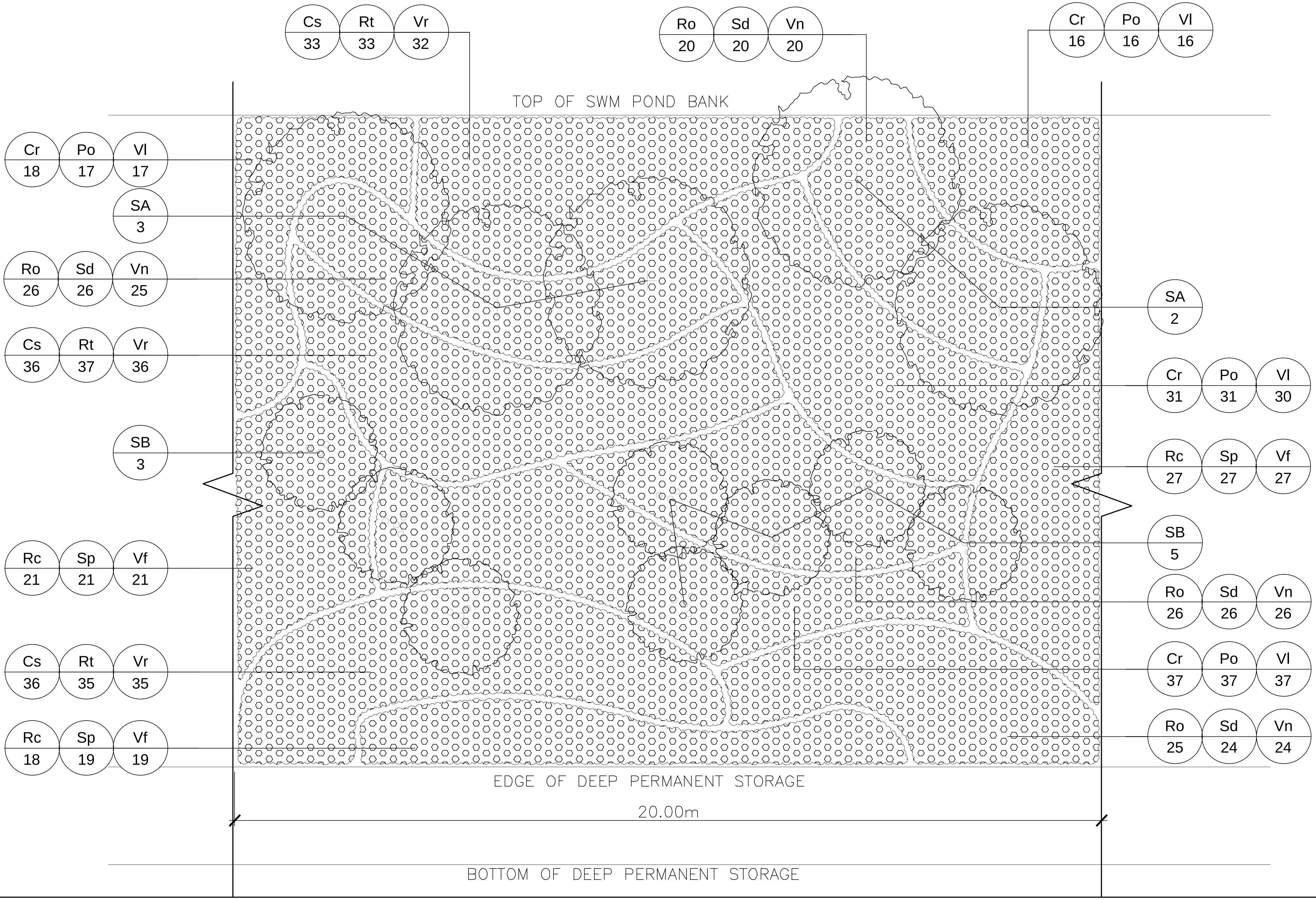
Attachment B

Landscaping Planting Plans and Approximate Costs, Cross-Section Renderings

Sandwich South Master Servicing Plan
Typical Stormwater Management Pond Cross Section



SEE FIGURE L2 FOR PLANTING DETAILS, PLANT SCHEDULE AND MAINTENANCE RECOMMENDATIONS



PLOT DATE: 2022-07-15 @ 12:39:40 PM PLOT SCALE: 1:25.4 PLOT STYLE: DILLON-STD-HALF.CTB

SANDWICH SOUTH MASTER SERVICING PLAN

Cr 16 PLANT CODE
PLANT QUANTITY

PROPOSED SHRUBS

PROPOSED TREE

PROPOSED MULTI STEM TREE

SUPPLEMENTARY WATERFOWL ADAPTIVE MITIGATION PLAN FOR STORMWATER MANAGEMENT FACILITIES
20M SWM POND PLANTING CELL

FIGURE L1

THE CITY OF WINDSOR ONTARIO, CANADA

DILLON CONSULTING

0 1m 4m

SCALE 1:100

STATUS: FINAL

PROJECT: 19-9817

DATE: July 15, 2022

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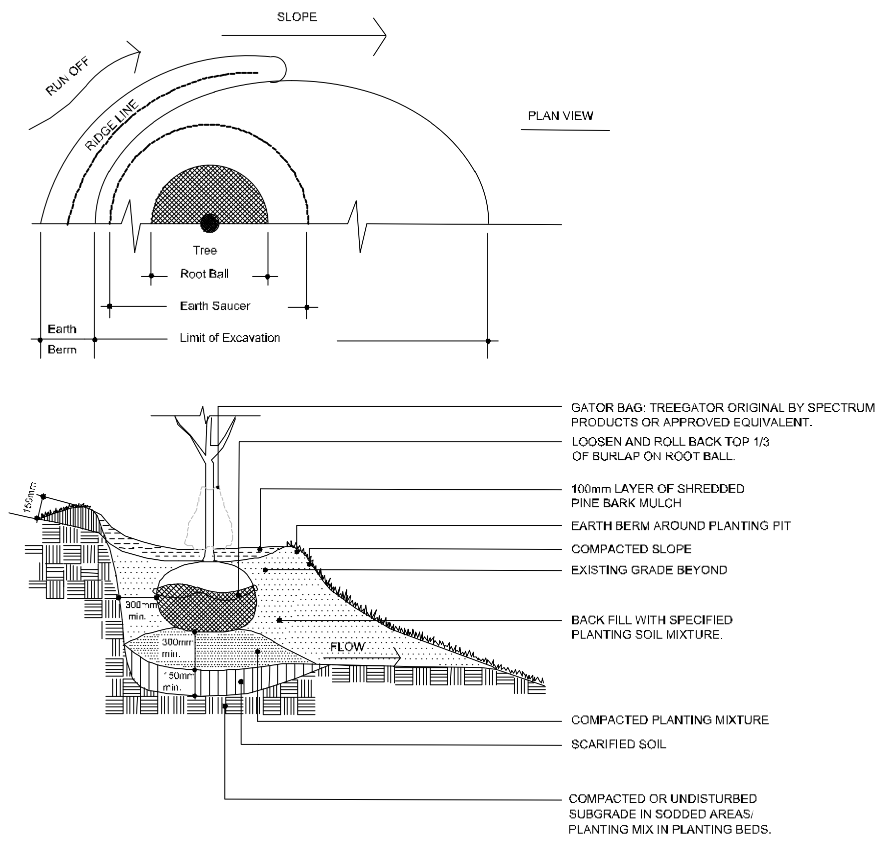
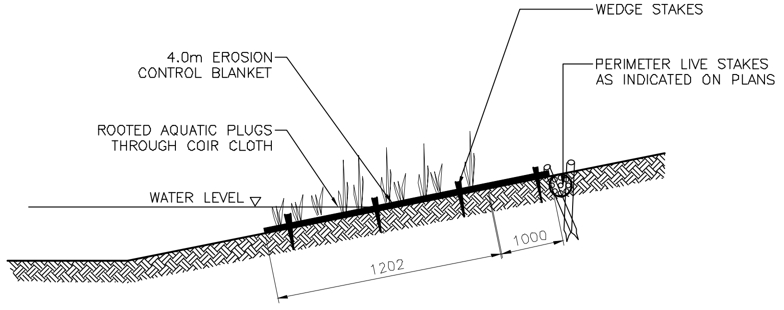


1 L1 DECIDUOUS TREE PLANTING ON A SLOPE
NTS



NOTE:
CURLEX® NETFREE™ 100% BIODEGRADABLE EROSION CONTROL BLANKETS SHALL BE USED FOR ALL EROSION CONTROL.

2 L1 FLOOD FRINGE AQUATIC PLANTING
NTS

MASTER PLANT LIST

CODE	BOTANICAL NAME	COMMON NAME	QTY	SIZE	COND.	SPACING
MULTI-STEM TREES						
SA	Salix amygdaloides	PEACH-LEAVED WILLOW	5	35mm cal.	B.B.	4.0m O.C.
SB	Salix bebbiana	BEBB'S WILLOW	8	35mm cal.	B.B.	4.0m O.C.
DECIDUOUS SHRUBS						
Cr	Cornus racemosa	GRAY DOGWOOD	102	50cm ht.	3 gal.	0.5m O.C.
Cs	Cornus sericea	RED-OSIER DOGWOOD	105	50cm ht.	3 gal.	0.5m O.C.
Po	Physocarpus opulifolius	EASTERN NINEBARK	101	50cm ht.	3 gal.	0.5m O.C.
Rt	Rhus typhina	STAGHORN SUMAC	105	50cm ht.	3 gal.	0.5m O.C.
Rc	Rubus occidentalis	BLACK RASPBERRY	66	n/a	2 gal.	0.5m O.C
Ro	Rubus oderatus	FLOWERING RASPBERRY	97	n/a	2 gal.	0.5m O.C.
Sd	Salix discolor	PUSSY WILLOW	96	60cm ht.	3 gal.	0.5m O.C.
Sp	Spirea alba	MEADOWSWEET	67	n/a	2 gal.	0.5m O.C
Vl	Viburnum lentago	NANNYBERRY	100	50cm ht.	3 gal.	0.5m O.C.
Vn	Viburnum nudum	WILD RAISIN	95	n/a	2 gal.	0.5m O.C
Vf	Viburnum rafinesquianum	DOWNY ARROWWOOD	67	50cm ht.	3 gal.	0.5m O.C
Vr	Viburnum recognitum	SMOOTH ARROWWOOD	103	50cm ht.	3 gal.	0.5m O.C.

PLANTING NOTES:

1. PLANTINGS SHOULD BE AN ASYMMETRICAL, RANDOM MIX.
2. SPECIES SHOULD BE PLANTED TOGETHER IN GROUPS OF 5-7.
3. SEE INDIVIDUAL PLANT LISTS FOR RECOMMENDED PLANT SPACING.
4. ALL PLANT MATERIALS SHALL BE #1 NURSERY STOCK MEETING CANADIAN STANDARDS.
5. STAKE ALL DECIDUOUS TREES.
6. DIG ALL TREE PITS 500mm LARGER ALL AROUND THAN THE ROOT BALL AND PLACE TREE CENTRED IN PIT ON UNDISTURBED SOIL. BACKFILL WITH PARENT MATERIAL AND REPLACE DEBRIS (EG. BRICK, DRY WALL, ETC) WITH SCREENED TOPSOIL.
7. FOR GRADING AND DRAINAGE, SEE ENGINEERING PLANS.
8. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
9. ALL PLANT MATERIALS TO BE GUARANTEED FOR TWO GROWING SEASONS FROM THE DATE OF PROVISIONAL ACCEPTANCE.
10. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, ALL EXISTING UNDERGROUND UTILITIES WITHIN THE LIMITS OF THE CONSTRUCTION SITE SHALL BE LOCATED AND MARKED. ANY UTILITIES DAMAGES OR DISTURBED DURING CONSTRUCTION SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE OWNER AT NO ADDITIONAL COST.
11. PLANT MATERIALS TO BE INSTALLED AS SHOWN; SUBSTITUTIONS ALLOWED ONLY AFTER CONSULTATION WITH THE LANDSCAPE CONSULTANT.

MAINTENANCE NOTES:

1. MINIMUM MAINTENANCE REQUIREMENTS SHALL FOLLOW THE MOST CURRENT EDITIONS OF THE WINDSOR/ESSEX REGION STORMWATER MANAGEMENT STANDARDS MANUAL AND THE TRCA - INSPECTION AND MAINTENANCE GUIDE FOR STORMWATER MANAGEMENT PONDS AND CONSTRUCTED WETLANDS
2. MAINTENANCE SCHEDULE SHALL CONTINUE FOR A PERIOD OF NOT LESS THAN TWO (2) YEARS AFTER SUBSTANTIAL PERFORMANCE OF THE WORK HAS BEEN GRANTED.
3. VEGETATION SHALL BE INSPECTED AFTER EVERY SIGNIFICANT RAIN EVENT (I.E. 25 YEAR STORM OR GREATER) TO ENSURE SUFFICIENT FUNCTIONING OF THE POND.
4. PLANTED AREAS OF SWM PONDS SHALL BE INSPECTED AND HAVE WEEDS AND OTHER INVASIVE MATERIALS (i.e. Phragmites australis ssp. australis) REMOVED ON A MONTHLY BASIS.
5. SCHEDULE PHRAGMITES REMOVALS TO COINCIDE WITH ANY PLANNED SEDIMENT REMOVALS.
6. TRASH AND DEBRIS WITHIN THE SWM POND SHALL BE PROMPTLY REMOVED ON A WEEKLY BASIS.
7. IF OIL/SHEEN IS OBSERVED, IT SHOULD BE REMOVED IMMEDIATELY BY USE OF OIL-ABSORBENT PADS OR A PROFESSIONAL WITH A VACUUM TRUCK. SPECIAL DISPOSAL REQUIREMENTS MAY APPLY.
8. APPLY BARLEY STRAW ON THE DRY LAND SURROUNDING THE POND AT A RATE OF 1KG PER 1000m2 OF SWM POND AREA TO INHIBIT ALGAE GROWTH.
9. IF ALGAL MATTS DEVELOP OVER 10% OF THE WATER SURFACE OR MORE, THEY SHOULD BE REMOVED USING A RAKE AND DISPOSED OF OFF SITE. ALGAE SHOULD NOT BE LEFT ON SITE.
10. IF MOWING IS TO OCCUR NEAR THE SWM PONDS, CUT GRASS TO 4-6 INCHES IN HEIGHT, MINIMUM. COLLECT GRASS CUTTINGS AND REMOVE FROM SITE, DO NOT MULCH.
11. AVOID USE OF FERTILIZERS, PESTICIDES AND HERBICIDES IN OR NEAR SWM PONDS.

SANDWICH SOUTH MASTER SERVICING PLAN

SUPPLEMENTARY WATERFOWL ADAPTIVE MITIGATION
PLAN FOR STORMWATER MANAGEMENT FACILITIES
20M SWM POND PLANTING CELL

FIGURE L2

Cr 16 — PLANT CODE / PLANT QUANTITY
PROPOSED SHRUBS
PROPOSED TREE
PROPOSED MULTI STEM TREE

THE CITY OF WINDSOR ONTARIO, CANADA
DILLON CONSULTING

STATUS: FINAL
PROJECT: 19-9817
DATE: July 15, 2022

City of Windsor

South Sandwich SWM Pond planting cell (20mx15m)

Dillon Consulting
13/04/2022

Opinion of Probable Costs

ITEM	DESCRIPTION	UNIT	EST. QTY	UNIT COST	ITEM COST
OPINION OF PROBABLE COSTS					
1.0	**Plantings**				
1.1	Planting medium to 300mm depth	m2	300	$ 50.00	$ 15,000.00
1.2	Fine grading	m2	300	$ 5.00	$ 1,500.00
1.3	**Trees (35mm Cal. B.B.)**				
1.3.1	Salix amygdaloides	Ea.	5	$ 550.00	$ 2,750.00
1.3.2	Salix bebbiana	Ea.	8	$ 550.00	$ 4,400.00
1.4	**Shrubs (50mm ht. 3 gal)**				
	Cornus racemosa	Ea.	102	$ 30.00	$ 3,060.00
	Cornus sericea	Ea.	105	$ 27.00	$ 2,835.00
	Physocarpus opulifolius	Ea.	101	$ 30.00	$ 3,030.00
	Rhus typhina	Ea.	105	$ 27.00	$ 2,835.00
	Salix discolor	Ea.	96	$ 27.00	$ 2,592.00
	Viburnum lentago	Ea.	100	$ 30.00	$ 3,000.00
	Viburnum rafinesquianum	Ea.	67	$ 30.00	$ 2,010.00
	Viburnum recognitum	Ea.	103	$ 30.00	$ 3,090.00
1.5	**Shrubs (2 gal.)**				
	Rubus occidentalis	Ea.	66	$ 24.00	$ 1,584.00
	Rubus oderatus	Ea.	97	$ 24.00	$ 2,328.00
	Spirea alba	Ea.	67	$ 25.00	$ 1,675.00
	Viburnum nudum	Ea.	95	$ 42.00	$ 3,990.00
				Estimated Construction Development Costs	**$ 55,679.00**
				10% Contingency	**$ 5,567.90**
				Total Costs including 10% Contingency	$ 61,246.90

Attachment C

Example Pulley and Cable System

Manual

Stantec

CITY OF OTTAWA
GULL MANAGEMENT FACILITIES
(MOONEY'S BAY & BRITANNIA BEACH)

OPERATIONS & MAINTENANCE MANUAL

Prepared for:

City of Ottawa
Surface Operations Branch

Prepared by:

Stantec Consulting Ltd.
1505 Laperrière Avenue
Ottawa, Ontario, K1Z 7T1

October 2003

020A

TABLE OF CONTENTS

1. INTRODUCTION

The beaches of the City of Ottawa have been subject to closures over the years due to higher than accepted pollution counts. One of the main sources of pollution has been bird droppings - specifically gull droppings.

From studies and monitoring, it has been shown that gulls tend to assemble and occupy areas adjacent to beaches and parks, places where people tend to gather and discard residual foodstuffs, and upon flight takeoffs, defecate over the beach or water depositing the source of pollution. It became necessary to find how to eliminate or at least minimize this source of pollution.

From research, it was found that the congregation of gulls at beaches, and thus their droppings, could be controlled. The main controlling device was a series of parallel overhead monofilament lines strung over an area of beach/water, which deterred the gulls from over flying the protected area.

The task then became the design and implementation of this type of facility at Ottawa's beaches. This has come to be called "Gull Management Facility" or its acronym "GMF".

In the early 1990's, a rectangular system of gull wiring, approximately 26,000 m^2 (400m x 65 m), was erected over the beach at Mooney's Bay covering a strip of beach and swimming area. Between the late 1990's and 2002, an "L" shaped system of gull wiring, approximately 22,000 m^2 was erected over the beach and swimming area at Britannia Beach with a possible future extension of 5,000 m^2. The results of these two installations have been lower pollution counts, fewer beach closures and a greater use of these two beaches.

Due to river flow and ice conditions and bird migration habits, there are only a few days when the water based poles and wiring can be installed and removed. They must be installed after the spring freshet and removed in late summer before the fall bird migration. Installation and disassembly of the system, together with the in-use conditions, causes wear-and-tear on the system. This creates the need for a maintenance program to ensure all components of the system are available at time of reinstatement and that the system components are in good working order. This cyclic installation and removal of the system creates the need for an operations program to ensure the system components are stored systematically and contractors are retained and scheduled to install and disassemble the facilities.

This operations and maintenance manual is intended to be a guide to describe and maintain the components and the annual operations of the facilities in detail and be in the possession of the City staff who is responsible for the maintenance and operations of the gull management facilities.

2. PURPOSE

The purpose of the gull management facilities is to deter gulls from polluting the bathing areas at City beaches. The overhead monofilament wiring interferes with gulls that are flying in the area and they shortly avoid the area. This Manual provides direction to City staff and contractors about the operations associated with the implementation, maintenance and storage of the various components of the GMF systems, including drawings describing the GMFs and the work involved in repairing, installing and removing them.

Planning for the installation each year must start before spring to allow time for contracts to be awarded, procurement of wiring and repair of damaged poles, cables and footings.

3. RESPONSIBILITIES OF CITY STAFF

3.1. Mooney's Bay

There are only a few days in April when river levels are low enough to install the poles in dry working conditions and the earliest date varies from year to year, depending on the time and duration of the spring freshet. Starting the beginning of April, inspect the foundation location every few days. When they are above the water level, start installing the poles. Parks Canada usually starts the installation of the stop logs at Hog's Back Dam the last Monday in April, so the water level is raised to the summer level over the next few days. Pole installation must be completed by this time, if it is to be done in dry working conditions. If the work is not done by this time, the remaining poles will have to be installed underwater using qualified divers and a barge.

3.2. Britannia Beach

The pole foundations are always under water. There are only a few weeks in April and May when river levels are low enough to install poles without problems with high water and ice. The earliest date varies from year to year, depending on the time and duration of the spring freshet. Starting in mid-April, check the water level every few days. Generally, there are two peaks, the second one occurring in May. When it appears that the water level is low enough, pole installation should begin.

3.3. Both Beaches

The wires must be installed by the first weekend in June, when the beach is first opened. Contact the Area Manager in the Community Services Branch for further information. It is efficient to coordinate the installation of the GMF system(s) with the installation of the beach buoy lines.

3.4. Removal

There are only a few days in late summer to complete the removal of the wiring. Generally, the beaches are closed the third week in August, but continue to be used until Labour Day. Start the removal immediately after this date. The wiring must be completely removed by September 9, when the fall bird migration starts. If the wiring is not completely removed by this date, migrating birds will likely become entangled and killed, which may jeopardize the overhead wiring program. The poles should be removed by mid-November to avoid being frozen in place. If this occurs, the remaining poles will likely be damaged by ice during the spring freshet.

As indicated earlier, the GMF components are erected and installed in the spring and disassembled and taken down and stored in late summer. Actual dates will be determined by the City staff responsible for the organization of the actions associated with the operations and maintenance of the facilities. These actions require planning and scheduling to implement on time and within budget.

The sequence of events required each year include:

1. Solicit quotations from interested and experienced contractors to erect/install and disassemble/takedown including loading at and transporting from storage site and transporting to and offloading at storage site. Request for quotation should include erection/installation and disassembly/takedown approximate dates.
2. Evaluate quotations and experience of contractors and select a contractor.
3. Coordinate and assist contractor with his tasks at storage site.
4. Monitor installation, in-use period and takedown operations. Arrange for removal, disposal and reinstatement of ruptured monofilament during in use period.
5. Should a bird become entangled in the wires, it is imperative that it be IMMEDIATELY removed and disposed of. Failure to remove entangled birds will result in substantial negative public relations. This is the responsibility of the Zone Supervisor(s) in Surface Operations.

6. Upon takedown and return to storage area dispose of all monofilament and procure and identify new monofilament in accordance with the tables of monofilament lengths appended to this manual. Closely inspect the condition of all steel components returned to storage and repair as required. Repairs will typically include cleaning corrosion by wire brush or mechanical grinding and touching up exposed area with a durable zinc coating.
7. Procure all other components and materials that have worn out or reached the end of their useful life.
8. Place all components and materials clearly identified and carefully protected in the storage area.

The individual facilities and their installation and dismantling details are described in the following sections of this manual and are separated according to the beach location.

Specifications and erection/installation and dismantling/storage procedures are described in subsequent sections of this manual and separate attachments of these will be provided for inclusion in the "Request for Quotation" packages.

4. DESCRIPTION OF THE SYSTEM

This section describes the component parts of the gull management systems at each location.

4.1. Mooney's Bay

This facility covers approximately 26,000 m^2 of beach and swimming area and consists of seven panels of monofilament in a 425m long by 70m wide rectangular configuration supported by sixteen poles, seven poles situated in the water and nine poles situated on land (see Figure A1 in Appendix A). Approximately 25m of beach and 45m of water are covered.

Each pole is approximately eight meters high and supported in a concrete base (see Figure A4). The onshore poles remain in place year around and are bolted to the concrete bases. The offshore poles are supported in sleeves in the concrete bases.

Each panel consists of four poles laid out in a roughly rectangular footprint. Each pair of poles support parallel 4.8mm diameter stainless steel cables, which in turn support monofilaments (40 lb test fishing line) spaced at approximately 3m intervals along the cables. Each panel of stainless steel cables and monofilament is independent from adjacent panels except for the common poles they share.

Each stainless steel cable is attached at its north end to a fixed eyestrap with a carbine hook, with no adjustment capability (see Figure A4). The cable runs up the pole through a boom bail and crosses to the next pole south, through a boom bail and down the pole and is attached to a 'T' track assembly that is adjustable to increase or decrease cable tension and sag in the system. Attached to the cables at specified intervals (nominally 3m) are pairs of retaining rings with swivel clips to attach the ends of the monofilament. The retaining rings allow the swivel clips to move freely around the cable without allowing the monofilament to slide along the cable.

The monofilaments are cut in lengths to the nearest centimeter (held tight but not over-stretched) with brass fishing leaders at each end to connect to the swivel clips. The lengths of the monofilament are important in order to maintain equal tension in each monofilament and thus each monofilament has an alphanumeric identification and specified location along the cable (see Figure A3).

4.2. Britannia Beach

This facility covers approximately 22,000m^2 of beach and swimming area and consists of five panels of monofilament in an "L" shaped configuration supported by twelve poles, five poles situated in the water and seven poles situated on land. The policy has been to leave the seven land-based poles in place all year and only remove, store and reinstate the five water-based poles, including the "boot" at pole location P3. The "boot" is described in the next paragraph. The water-based poles are removed to prevent damage from ice (see Figure B1 in Appendix B).

All poles with the exception of P1 are supported by approximately 1200mm diameter concrete caissons of variable length (see Figure B2). Steel sleeves, 900 mm deep, are embedded in the top of the caissons to receive the poles. At pole location P1 a 2000 mm deep steel sleeve is embedded into bedrock. At pole location P3, because of an inaccuracy in setting the sleeve, a "boot" was fabricated to rectify the non-plumb position of the sleeve (see Figure B3). This "boot" consists of an upper and lower section. The sections are not co-linear by design. The upper section, of similar diameter as the sleeve in the caisson, receives the pole while the lower section, of similar diameter as the pole fits into the sleeve. Orientation of the "boot" is critical to ensure pole is plumb.

The sleeve openings in the five water-based pole locations are covered with a steel cover plate with handle and neoprene gasket when the poles are not in place. Location of water-based poles is normally found using metal detectors. Inserted at the bottom of the sleeves are "sleeve inserts" needed to receive the "pole tip assembly" to concentrically position the base of the poles due to the difference in the inside diameter of the sleeve and the outside diameter of the pole. These can remain in place in the off-season.

The pole is concentrically positioned at the top of the sleeve with the adjustable "ring flange/wedge assembly" (see Figure B2 & B3). These components at the water-based pole locations must also be removed, stored and reinstated with the poles. The "sleeve inserts" and "pole tip assemblies" are in place at all land-based poles. The various terms for the components are described and detailed on the drawings that form part of this manual.

The poles are fabricated from variable height DN200 STD Pipe lower section with 3.5m height DN150 STD Pipe upper section to provide approximate clearances of 9m above average summer water levels and beach. Some components are attached to the poles to facilitate lifting the poles and stringing the cables that support the monofilament. These attachments include the "halo assembly" to attach the pulley block and tackles to, lift lugs to facilitate lifting the pole and T-tracks, sliders and eyestraps to secure fixed and tensioning ends of the cables. Carbine hooks at ends of cable permit securing the cables to the poles and fastening clips and stop clips on the cables permit securing the ends of the monofilament to the cables using fishing line leaders.

5. ERECTION OF THE SYSTEM

Both systems have their similarities and differences. One major difference is the considerably heavier poles at Britannia Beach. Another major difference results from the lowered water level of the Rideau River from late Fall to mid Spring which leaves the water based pole foundations at Mooney's Bay Beach in the dry. Typically, at both locations, the land based poles are left in place and the water based poles are removed and stored over the winter.

Refer to drawings included in Appendix A (Mooney's Bay) or Appendix B (Britannia Beach) in conjunction with the procedures outlined below.

5.1. Mooney's Bay

First locate the concrete foundations for the seven offshore poles. With the lowered water level comes the opportunity to inspect the exposed areas of the concrete caissons and repair any conditions that may be deemed detrimental to the durability and/or functioning of the system.

Having located all pole foundations, remove the steel covers for storage during beach season, and thoroughly clean out each of the steel sleeves. Each of the poles should be rigged with 6mm rope passing through the boom rails prior to erection. This rope will later be attached to the cables and used to erect the wiring (see Figure A4 in Appendix A). The poles can then be inserted into corresponding sleeves using appropriate lifting equipment (pole OS7 weighs approximately 150kg). Note that not all of the poles are identical – pole OS1 requires a "steel sleeve adapter" which should be installed directly into the foundation sleeve (see Figure A2). Also the poles at OS1 and OS7 are steel, whereas poles at locations OS2 to OS6 are aluminum. Poles should be oriented in the sleeves such that the T-tracks and sliders are on the north side of the pole.

The next stage is the connection of monofilaments to the cables. New monofilament line should be procured and used each year, and should be 178N (40lb) "Berkley XT" type. Cables should be laid out on the beach in their approximate locations, and the fastening clips, stop clips, and fishing line leaders attached as shown on Figure A4. Monofilaments should be cut to the lengths shown on Figure A3 – it may be easier to pre-measure and label monofilaments prior to arrival at the site. Care is needed to ensure that monofilament lines do not become entangled or break.

The system is best installed one bay at a time, starting at the ends (Bays 'A and 'G') and working towards the central bay (Bay 'D'). Attach the rope through boom rails to each end of the cable, and slowly raise the cable sufficiently that the carbine hook can be attached to the eyestrap on the "fixed" pole (the eyestrap should be on the south side of each pole, so the north end of the cable is raised first). The rope attached to this end can then be removed. The rope on the opposite end of the cable is then used to raise the system into position, using the sliders and micro-track assemblies attached to each of the poles to tension the cable and secure it in position. This process is then repeated for each of the bays. Final adjustment may be required to ensure sufficient tension in each of the cables.

Following installation any debris should be removed, and the beach area left in a clean and safe condition.

5.2. Britannia Beach

Unlike Mooney's Bay Beach, the water-based poles at Britannia Beach are permanently under 1.5m to 3.0m of water and must be located each spring. Locating the foundations is done by coordinated survey directing divers with metal detection devices. Further research is also being conducted to install "homing" devices in the sleeves of the foundations to facilitate the locating of the foundations.

Once located, remove the steel covers for storage during the beach season and clean out the sleeves. Four of the five water based pole foundations, P1, P5, P7 and P9, are similar. Pole foundation P3 is different as a result of an undetected movement of the steel sleeve at the time concrete was being placed in the caisson. To remedy the out of plumb sleeve, a sleeve adaptor or "boot" as it has been termed, was designed and fabricated to insert into the caisson sleeve (see Figure B3 in Appendix B). The "boot" consists of a lower piston that is inserted into the caisson sleeve and an upper sleeve into which the pole is inserted. The alignment of the lower piston and upper sleeve is designed to offset the tilt in the caisson sleeve and the orientation of the "boot" is key. For quality control of the placement of the "boot", it will be required to position the "boot" using a level to ensure it is plumb and then score the "boot" flange and top of caisson with markings which can simply be aligned at subsequent installations.

It should be noted that correct positioning and alignment of the "boot" at this point is critical to ensure that the pole can be installed vertical and the system rigged correctly.

Poles should be rigged with rope through the pulleys attached to the halos prior to erection (see Figure B5). Erect the poles, which are identified, at their respective locations using a barge with lifting device on board. Use of mechanical land equipment that could leak oil or gas into the water is strictly prohibited.

Procure new monofilament, cut to specified lengths and fit ends with fishing line leaders and identify line in accordance with the Tables shown on Figure B4 in Appendix B.

Lay out cables, which are identified as to location, on the beach, attach the fastening clips and stop clips at the specified intervals along the cable and attach the pre-measured monofilament, to the cables with fishing line leaders. Pull the assembly between the pairs of poles and attach cable ends to the suspended ropes and hoist into position. One end of each cable is tied off at the eye strap and the other end is tensioned to the correct elevation and horizontal sag at the slider in T-track. These locations are designated "E" and "S", respectively, in Figure B5 in Appendix B. This procedure is repeated at each bay.

6. DISMANTLING THE SYSTEM

The GMF systems should be dismantled at each location according to the following procedures. Note that the timing of dismantling the wiring is critical (see section 3.4).

6.1. Mooney's Bay

The system is dismantled one bay at a time, starting at the central bay (Bay 'D') and working towards the end bays.

- Lower each cable to the slackest setting on the sliders.
- Attach the rope to the adjustable cable ends and lower the bay to working height.
- Lower the fixed end in a similar fashion.
- Detach the monofilament ends and clips.
- Lower, detach and label the cables.
- Inspect and report any damage to all hardware.
- Remove and label the offshore poles and the steel insert from footing OS1.
- Store the poles at the Mooney's Bay Beach confection area, as directed by the Zone Supervisor.

6.2. Britannia Beach

The system is dismantled one bay at a time in the reverse order it was erected.

- Tie ropes to each end of the cables and lower the cables.
- Detach the monofilament and clips from the cables.
- Inspect the clips and cable for damage and discard the monofilament. Damaged clips, cable and monofilament should be procured and stored for the following season's installation.
- Identify undamaged cables and store.
- Remove the offshore poles using the same methods used to erect them. Remove the "boot" at P3.
- Retrieve from storage and place steel covers over the caisson sleeve openings.
- Transport poles, boot, cables, etc., to the City of Ottawa's Swansea Road Yard for storage.
- Inspect poles for damage and make necessary repairs to the poles in conditions suitable for the type of repair required.

7. CONTACTS

GMF Operation & Maintenance and Beach Maintenance:

Jean Demers, Zone Supervisor (Surface Operations)
City of Ottawa,
1595 Telesat Court,
Gloucester, ON, K1B 1B6
Tel: 580-2424 ext. 12067,
Cell: 720-9045.

Beach Operation:

Judy Bates, Area Manager (Community Services Branch)
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495 Richmond Road,
Ottawa, ON, K2A 4B2
Tel: 724-4199 ext. 23166

Bathing Area Water Quality:

Martha Robinson, Environmental Health Analyst (Health and Long Term Care)
City of Ottawa,
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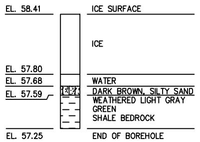
Tel: 724-4122 ext. 23658

River Water Quality:

Jane Scott, Program Manager (Water Environment Protection Program)
City of Ottawa Utility Services,
800 Green Creek Drive,
Gloucester, ON, K1J 1A6
Tel: 580-2424 ext. 22857

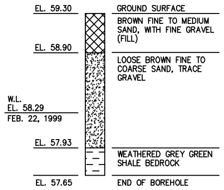
APPENDIX A

DRAWINGS – MOONEY'S BAY GMF



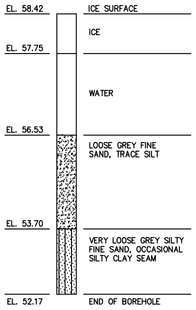
BOREHOLE NO.99-1

N.T.S.



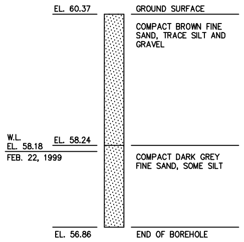
BOREHOLE NO.99-2

N.T.S.



BOREHOLE NO.99-3

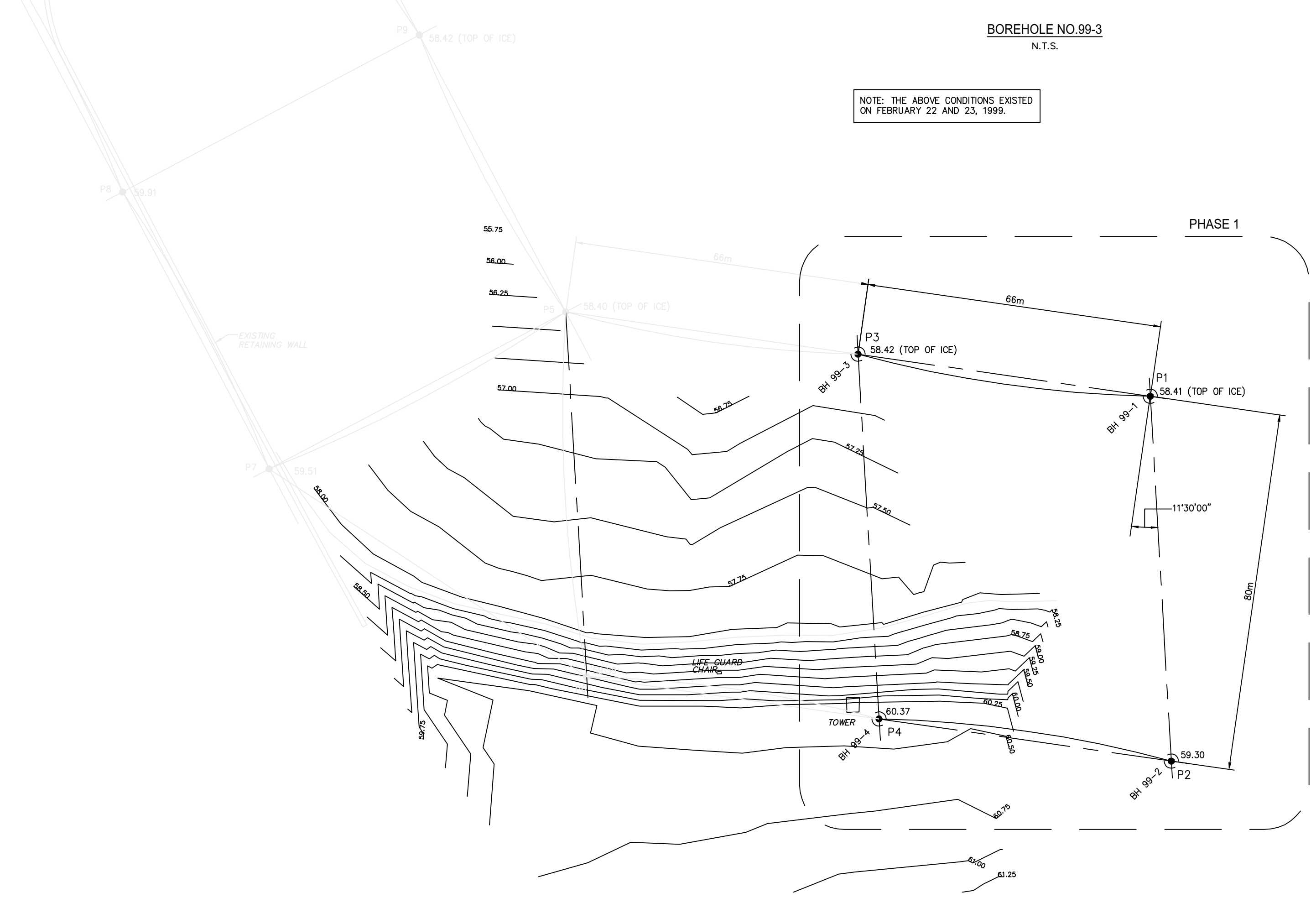
N.T.S.



BOREHOLE NO.99-4

N.T.S.

NOTE: THE ABOVE CONDITIONS EXISTED ON FEBRUARY 22 AND 23, 1999.



SITE PLAN

1:500

Stantec

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The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing – any errors or omissions shall be reported to Stantec Consulting Ltd.without delay.

General Notes

1. THE SUCCESSFUL TENDERER SHALL BE REQUIRED TO PROVIDE DOCUMENTATION DEMONSTRATING EXPERIENCE IN THIS TYPE OF WORK.
2. THE SITE CONDITIONS AND ICE THICKNESSES GIVEN IN THE BOREHOLE LOGS EXISTED ON FEBRUARY 22 AND 23, 1999. THE CONTRACTOR SHOULD NOT EXPECT THAT CONDITIONS WILL BE SIMILAR AT THE TIME THE WORK IS DONE.
3. THE CONTRACTOR SHALL VERIFY THE CONDITIONS AT THE TIME OF CONSTRUCTION AND MAKE WHATEVER MODIFICATIONS ARE REQUIRED TO UNDERTAKE THE WORK IN THE WATER. IN THE EVENT THE ICE IS DEEMED UNACCEPTABLE TO SUPPORT THE CONSTRUCTION EQUIPMENT IT MAY BE PERMISSIBLE TO DELAY THE WORK IN THE WATER UNTIL SUCH TIME WHEN A BARGE COULD BE USED TO CONVEY THE CONSTRUCTION EQUIPMENT TO THE WATER LOCATIONS.

Construction Notes

1. THE FOLLOWING SUGGESTIONS ARE MADE FOR INFORMATION PURPOSES ONLY.
2. AT FOUNDATION LOCATIONS P3 AND P4, STEEL LINERS SHALL BE DRIVEN A MINIMUM 1 METRE BELOW THE SPECIFIED BOTTOM OF CAISSONS AND SHOULD EXTEND ABOVE THE ICE/GROUND LEVEL AT LOCATIONS P3 AND P4, RESPECTIVELY. MATERIAL SHALL BE EXCAVATED TO THE SPECIFIED BOTTOM OF CAISSONS AND SONOTUBE FORMS INSTALLED. SET AND SECURE THE REINFORCING STEEL AND STEEL SLEEVE ASSEMBLY. PLACE CONCRETE BY TREMIE METHOD AND EXTRACT STEEL LINER. CUT–OFF SONOTUBE FORM AT TOP OF CAISSON LEVEL. COVER HOLE WITH STEEL PLATE AND NEOPRENE GASKET.
3. AT FOUNDATION LOCATION P2, EXCAVATE TO APPROVED ROCK SURFACE. PLACE SAND BAG BERM AND REMOVE WATER. DRILL 37mm DIA. HOLES TO A MINIMUM 800mm DEPTH AND SET BENT 30M DOWELS WITH SPIRAL TIE A MINIMUM 750mm EMBEDMENT AND GROUT USING A NON–SHRINK GROUT SUCH AS SIKA 212 OR APPROVED EQUAL. SET SONOTUBE FORM AND STEEL SLEEVE ASSEMBLY AND PLACE CONCRETE IN THE DRY TO THE SPECIFIED LEVEL. COVER WITH STEEL PLATE AND NEOPRENE GASKET.
4. AT FOUNDATION LOCATION P1, CORE DRILL THE ROCK TO THE SPECIFIED DEPTH. GROUT THE STEEL SLEEVE WITH A NON–SHRINK GROUT SUCH AS SIKA 212 OR APPROVED EQUAL. PLACE GROUT LEVELING PAD ON ROCK SURFACE TO THE TOP OF SLEEVE FLANGE PLATE. COVER HOLE WITH STEEL PLATE AND NEOPRENE GASKET.
5. PLUMBNESS OF FOUNDATIONS, THE SLEEVES IN PARTICULAR, IS OF PRIME IMPORTANCE AND NO TOLERANCE IS SPECIFIED OR PERMISSIBLE.
6. CONTRACTOR SHALL SUBMIT PROPOSED CONSTRUCTION PROCEDURES TO THE ENGINEER FOR REVIEW.

0			
Revision	By	Appd.	Date

0 ISSUED FOR TENDER	G.A.M.		99.02.26
Issued	By	Appd.	Date

File Name: 6862–001.DWG	T.J.N.	G.A.M.	G.A.M.	99.02.26
	Dwn.	Chkd.	Dsgn.	Date

Permit/Seal

G.I.A.McROBIE

Client/Project

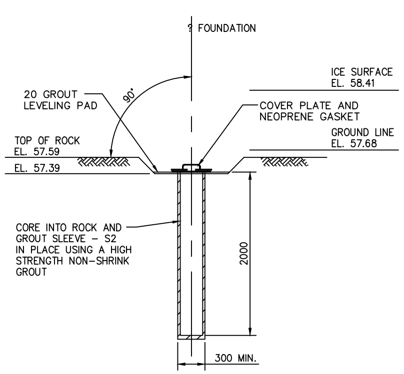
[illegible]

BRITANNIA BEACH
GULL MANAGEMENT FACILITY
Ottawa, Ontario

Title

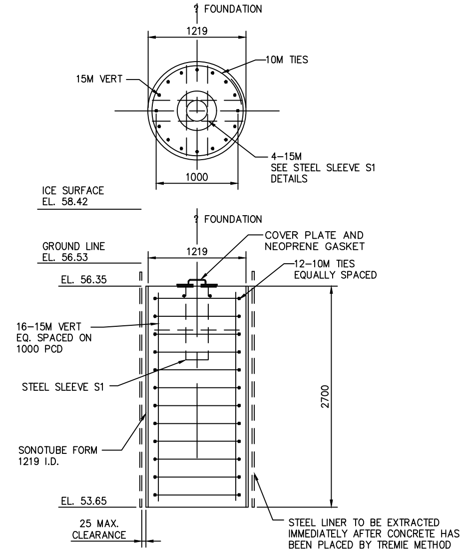
PHASE 1 - FOUNDATIONS
GENERAL ARRANGMENT

Project No.	Scale	
S6862	AS SHOWN	
Drawing No.	Sheet	Revision
6862-P1-001	1 of 2	0



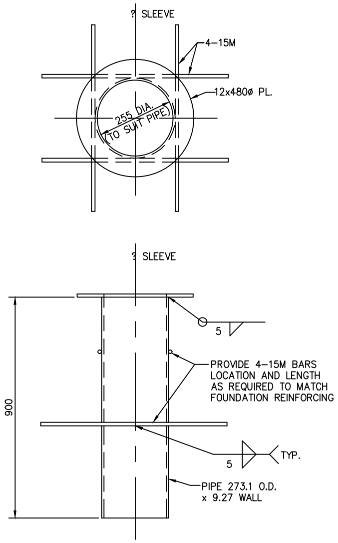
FOUNDATION P1

1: 30



FOUNDATION P3

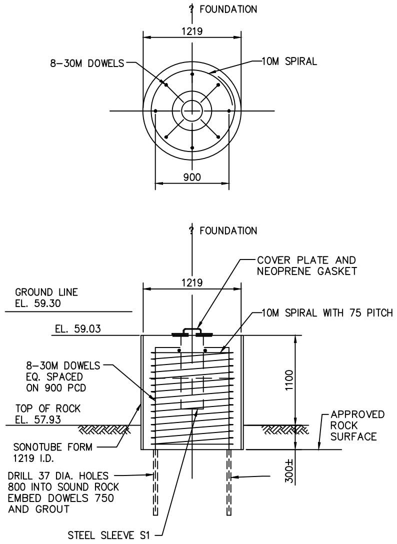
1: 30



STEEL SLEEVE - S1

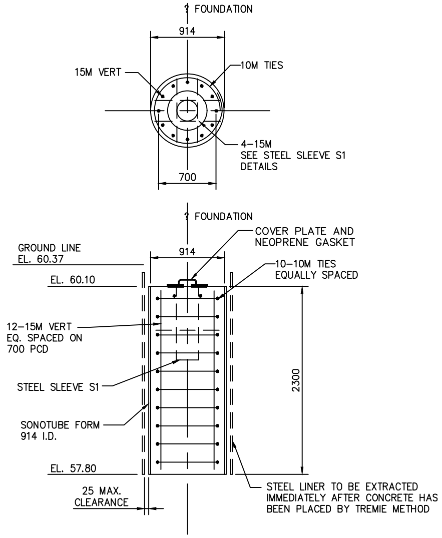
1:10

(3 REQUIRED)



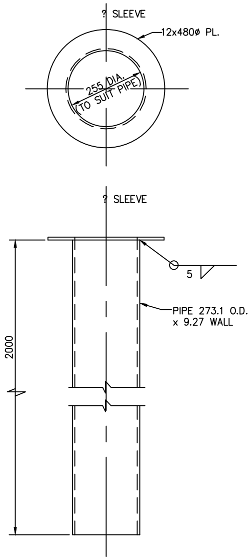
FOUNDATION P2

1: 30



FOUNDATION P4

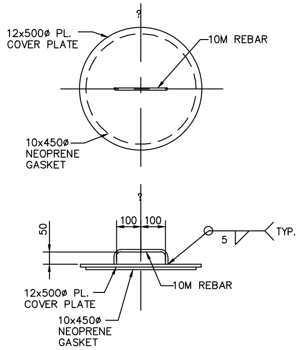
1: 30



STEEL SLEEVE - S2

1:10

(1 REQUIRED)



COVER PLATE AND NEOPRENE GASKET

1:10

(4 OF EACH REQUIRED)

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Legend

Notes

1. CLASS OF CONCRETE SHALL BE 30 MPa.
2. REINFORCING STEEL SHALL BE GRADE 400.
3. CLEAR COVER TO REINFORCING STEEL SHALL BE 100mm ± 20mm
4. STEEL SLEEVE S2 AND DOWELS SHALL BE GROUTED IN PLACE USING A NON-SHRINK HIGH STRENGTH GROUT SUCH AS SIKA 212 OR APPROVED EQUAL.
5. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
6. SLEEVES SHALL BE STEEL PIPE SECTIONS TO ASTM A53, GRADE 240 (Fy = 240 MPa) ALL REMAINING STEEL SHALL BE IN ACCORDANCE WITH CAN/CSA G40.21 M92, GRADE 260W OR APPROVED EQUAL.
7. WELDING SHALL BE IN ACCORDANCE WITH CSA STANDARD W59, LATEST EDITION.

	By	Appd.	Date
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Revision			

	By	Appd.	Date
0 ISSUED FOR TENDER	G.A.M.		99.02.26
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	Dwn.	Chkd.	Dsgn.	Date

Permit/Seal

G.A.McROBIE

Client/Project

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BRITANNIA BEACH
GULL MANAGEMENT FACILITY

Ottawa, Ontario

Title

PHASE 1 - FOUNDATIONS
DETAILS

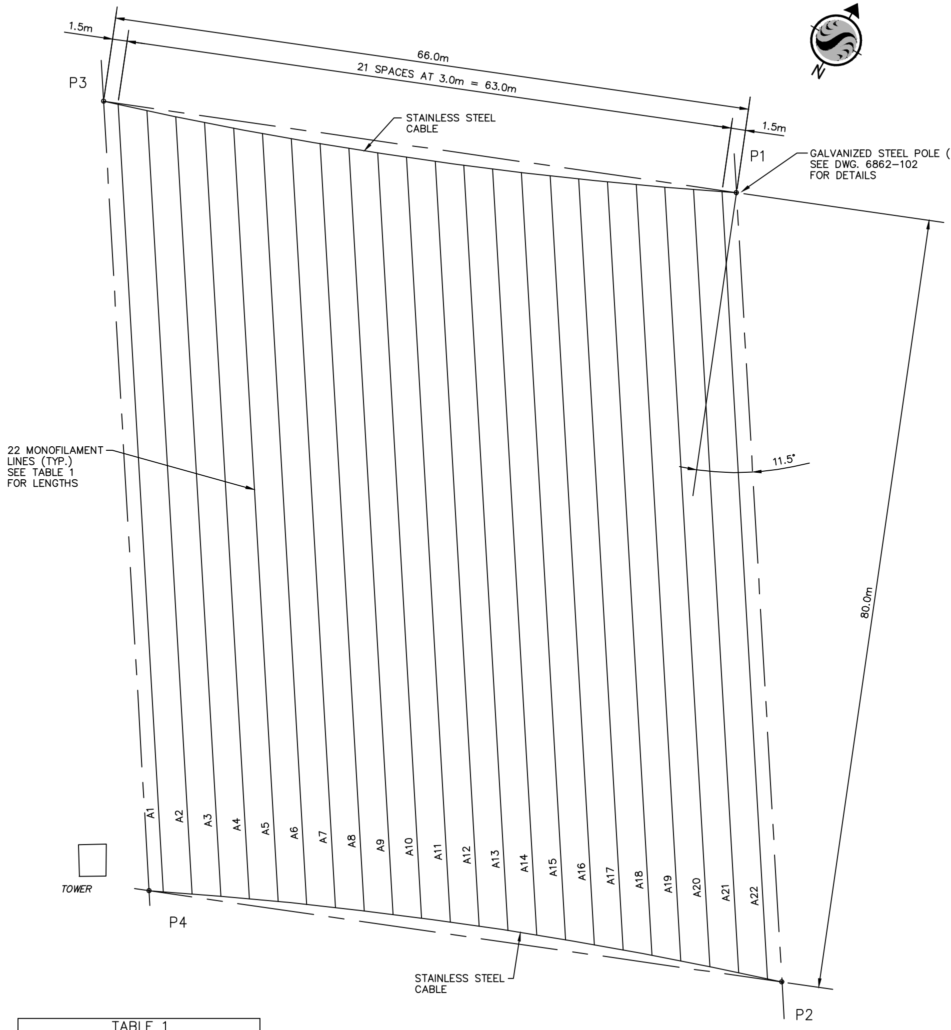
Project No. S6862

Scale AS SHOWN

Drawing No. 6862-P1-002

Sheet 2 of 2

Revision 0

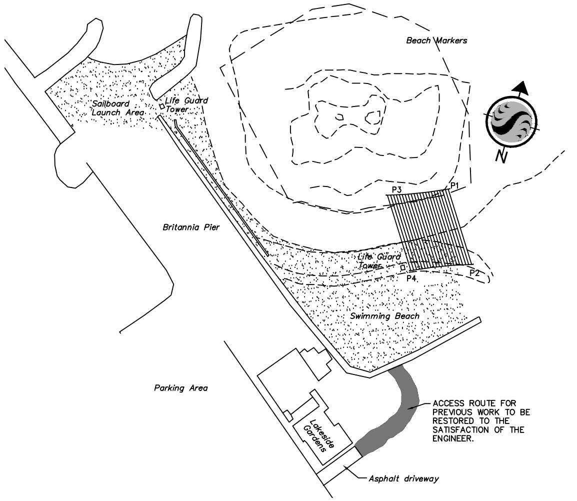


MESH LAYOUT

1:250

TABLE 1	
MONOFILAMENT NO.	LENGTH (m)
A1	81.635
A2	81.585
A3	81.487
A4	81.337
A5	81.139
A6	80.891
A7	80.593
A8	80.247
A9	79.849
A10	79.403
A11	78.907
A12	78.907
A13	79.403
A14	79.849
A15	80.247
A16	80.593
A17	80.891
A18	81.139
A19	81.337
A20	81.487
A21	81.585
A22	81.635

NOTE: REFER TO DRAWINGS 6826-P1-001 AND 002 FOR DETAILS AND LOCATION OF FOUNDATIONS.



SITE PLAN

N.T.S.

SCOPE OF WORK

1. LOCATE POLE FOUNDATIONS WITH THE USE OF A METAL DETECTOR. (THE ENGINEER WILL PROVIDE APPROXIMATE LOCATIONS.) REMOVE SAND BAGS AND STEEL COVERS, ENSURE SLEEVES ARE COMPLETELY CLEAN OF SILT, SAND, DEBRIS, ETC PRIOR TO INSTALLATION OF SLEEVE INSERTS AND POLES. STEEL COVERS SHALL BE STORED FOR REUSE UPON DISASSEMBLY OF OVERHEAD WIRING SYSTEM AND REMOVAL OF POLES IN THE FALL AT THE DIRECTION OF THE CITY.
2. SUPPLY, FABRICATION GALVANIZING AND INSTALLATION OF POLES P1, P2, P3 AND P4 C/W ALL ATTACHED PLATES, STIFFENERS, AND SLIDE-ON ATTACHMENTS, TO THE MATERIAL AND DIMENSIONS AS SPECIFIED AND DETAILED ON THESE DRAWINGS.
3. SUPPLY, FABRICATION, GALVANIZING AND INSTALLATION OF FOUR STEEL SLEEVE INSERTS AS SPECIFIED AND DETAILED ON DWG. NO. 6862-P1-102.
4. SUPPLY, FABRICATION, GALVANIZING AND INSTALLATION OF FOUR RING FLANGE/WEDGE ASSEMBLIES AS SPECIFIED AND DETAILED ON DWG. NO. 6862-P1-102.
5. SUPPLY AND INSTALLATION OF STAINLESS STEEL CABLE, STAINLESS STEEL HARDWARE FOR CABLE ATTACHMENTS, MONOFILAMENT LINE AND ADJUSTABLE CONNECTORS AS SPECIFIED AND DETAILED ON DWG. NO. 6862-P1-103.
6. RESTORE ACCESS ROUTE USED FOR PREVIOUS WORK AS SHOWN ON THE ABOVE SITE PLAN. WORK REQUIRED INCLUDES FINE GRADING, TOPSOIL AND SOD OF APPROXIMATELY 300m²
7. RESTORE ALL SURFACES USED AS WORKING AREAS OR ACCESS TO THE WORK, TO ORIGINAL CONDITION AND ACCEPTIBLE TO THE ENGINEER. (INCIDENTAL TO THE CONTRACT)
8. DISASSEMBLE OVERHEAD WIRING, REMOVE POLES AT WATER LOCATIONS AND REPLACE STEEL COVERS AND SAND BAGS. WIRING AND CABLE SHALL BE ROLLED INTO NEAT BALES AND STORED WITH POLES AT A LOCATION TO BE DETERMINED BY THE CITY. POLES AT BEACH LOCATIONS MAY BE LEFT IN PLACE.

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General Notes

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.

Construction Notes

Revision	By	Appd.	Date
0			

Issued	By	Appd.	Date

File Name: 6862-101.DWG	T.J.N.	G.A.M.	G.A.M.	99.04.22
	Dwn.	Chkd.	Dsgn.	Date

Permit/Seal

G.A.McROBIE

Client/Project

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VÀi?l?l»e» »d²
O½t½t¿aÉwÄa

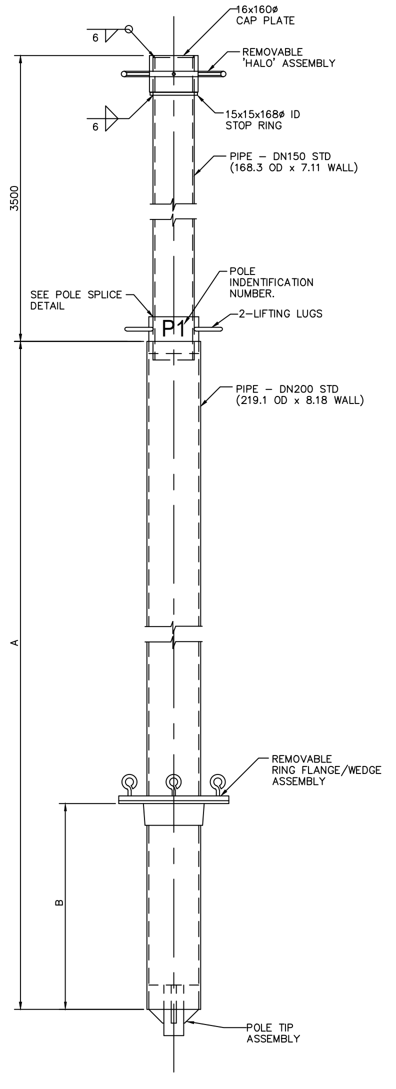
BRITANNIA BEACH
GULL MANAGEMENT FACILITY
Ottawa, Ontario

Title

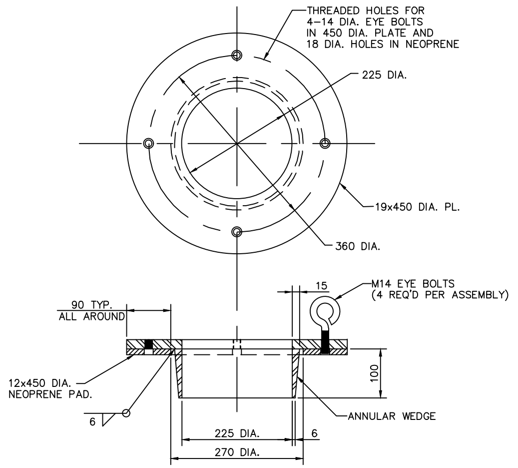
PHASE 1
OVERHEAD WIRING SYSTEM
MESH LAYOUT

Project No.	Scale
S6862	AS SHOWN

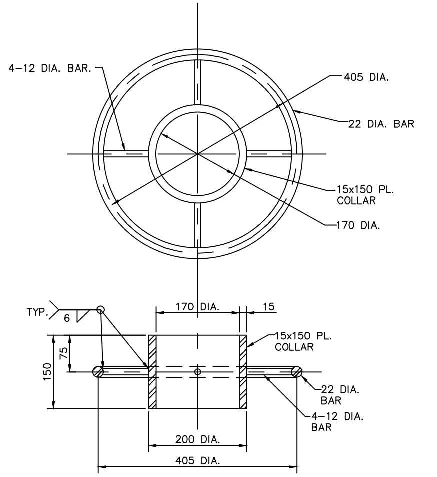
Drawing No.	Sheet	Revision
6862-P1-101	1 of 3	0



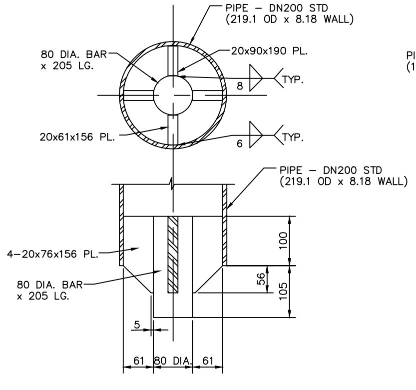
POLE DETAILS
(4 REQUIRED AS NOTED)
1:10



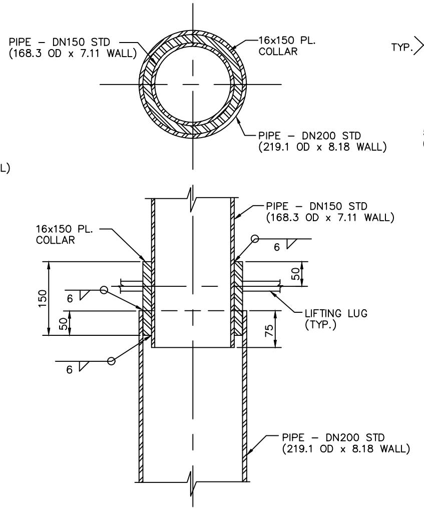
RING FLANGE/WEDGE ASSEMBLY
(4 REQUIRED)
1:5



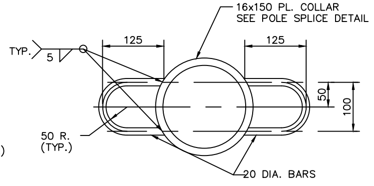
'HALO' ASSEMBLY
(4 REQUIRED)
1:5



POLE TIP ASSEMBLY
(4 REQUIRED)
1:5

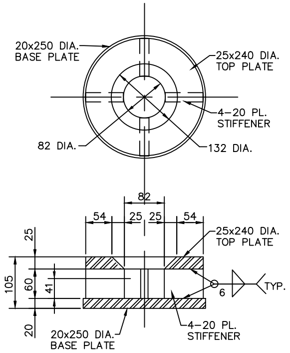


POLE SPLICE DETAIL
1:5



LIFTING LUG DETAILS
1:5

TABLE OF POLE DIMENSIONS		
POLE	'A'	'B'
P1	7680	1570
P2	6840	870
P3	8020	870
P4	5770	870



SLEEVE INSERT DETAILS
(4 REQUIRED)
1:5

Stantec Consulting Ltd.
400 – 1505 Laperriere
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Fax. (613) 722-2790
www.stantec.com

Notes

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. STEEL SHALL BE IN ACCORDANCE WITH CSA STANDARD G40.21M, LATEST EDITION, GRADE 300W.
3. PIPE SHALL BE IN ACCORDANCE WITH A.S.T.M. STANDARD A53, WITH A MINIMUM YIELD STRENGTH OF 205 MPa.
4. WELDING SHALL BE DONE IN ACCORDANCE WITH CSA STANDARD W59, LATEST EDITION. ELECTRODE CLASSIFICATION SHALL BE E480XX.
5. ALL STEEL, PIPE AND HARDWARE SHALL BE GALVANIZED IN ACCORDANCE WITH CSA STANDARD G164–M, LATEST EDITION. MINIMUM 600 g/m^2
6. NEOPRENE PADS SHALL BE 50 DUROMETRE HARDNESS AND SHALL BE FASTENED TO RING FLANGE/WEDGE ASSEMBLIES AFTER ASSEMBLIES HAVE BEEN GALVANIZED USING AN ADHESIVE COMPATIBLE WITH GALVANIZED SURFACES AND AS APPROVED BY THE NEOPRENE MANUFACTURER.
7. THE CONTRACTOR SHALL SUBMIT STEEL FABRICATION SHOP DRAWINGS FOR REVIEW BY THE ENGINEER PRIOR TO FABRICATION.
8. MILL CERTIFICATES FOR ALL STEEL USED SHALL BE SUBMITTED FOR REVIEW BY THE ENGINEER PRIOR TO FABRICATION.
9. POLE IDENTIFICATION NUMBERS SHALL BE PAINTED ON TWO SIDES OF THE POLE AT LOCATION SHOWN, AFTER GALVANIZING. NUMBERS SHALL BE 80mm IN HEIGHT AND SHALL BE BLACK IN COLOUR.

Revision	By	Appd.	Date
0			

Issued	By	Appd.	Date

File Name: 6862–102.DWG	T.J.N.	G.A.M.	G.A.M.	99.04.22
	Dwn.	Chkd.	Dsgn.	Date

Permit/Seal

G.A. McROBIE

Client/Project

C»i½t½y» »¢Äf VÀi?l?l»e» »d½ O½t½t¿aÉwÄ

BRITANNIA BEACH
GULL MANAGEMENT FACILITY

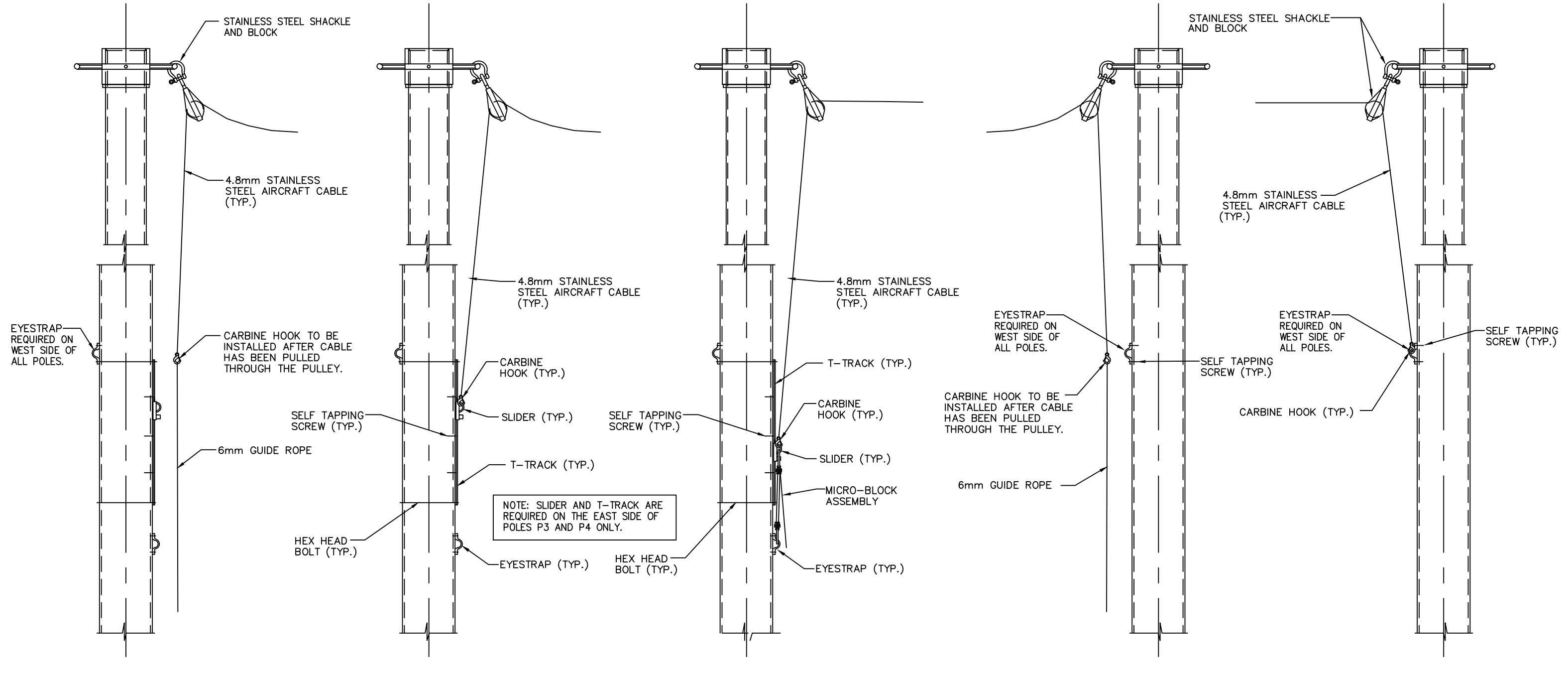
Ottawa, Ontario

Title

PHASE 1
OVERHEAD WIRING SYSTEM
POLE DETAILS

Project No.	Scale
S6862	AS SHOWN

Drawing No.	Sheet	Revision
6862-P1-102	2 of 3	0



NOTE: SLIDER AND T-TRACK ARE REQUIRED ON THE EAST SIDE OF POLES P3 AND P4 ONLY.

POLES P3 AND P4

POLES P1 AND P2

CABLE RIGGING

1:10

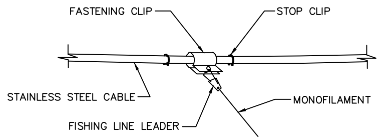
POLE AND CABLE INSTALLATION PROCEDURE

1. REMOVE COVERS FOR FOOTINGS (REFER TO DWG 6862-P1-002) AND CLEAN OUT STEEL SLEEVES. INSTALL STEEL SLEEVE INSERTS AS DETAILED ON DWG 6862-P1-102.
2. INSTALL 6mm GUIDE ROPE AND CABLE TENSIONING HARDWARE FOR EACH POLE.
3. ERECT POLES, INCLUDING ALL ASSEMBLIES AS SHOWN ON DWG. 6862-P1-102.
4. LAYOUT CABLE/MONOFILAMENT NETTING
5. FEED CABLE THROUGH PULLEYS AT POLES P1 AND P2. SECURE TO EYESTRAP USING A CARBINE HOOK.
6. FEED CABLE TROUGH PULLEYS AT POLES P3 AND P4. SECURE TO SLIDERS USING A CARBINE HOOK.

   NOTE: STEPS 5 AND 6 ARE TO BE PERFORMED SIMULTANEOUSLY.
7. INSTALL MICRO-BLOCK ASSEMBLIES.
8. TENSION CABLE USING MICRO-BLOCK ASSEMBLY AND SECURE SLIDER IN PLACE ONCE THE REQUIRED TENSION HAS BEEN REACHED.
9. REMOVE MICRO-BLOCK ASSEMBLIES.

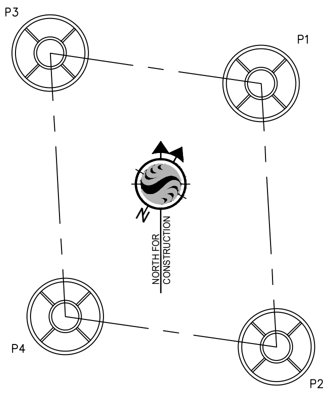
POLE AND CABLE REMOVAL PROCEDURE

1. INSTALL MIRCO-BLOCK ASSEMBLIES. (POLES P3 AND P4)
2. RELEASE SLIDER AND DETENSION CABLE USING THE MICRO-BLOCK ASSEMBLIES.
3. REMOVE CARBINE HOOK AND ATTACH 6mm ROPE TO CABLE. ALLOW CABLE TO PULL ROPE BACK THROUGH PULLEY SYSTEM.
4. REPEAT STEP 3 AT POLES P1 AND P2.
5. REMOVE POLES FROM FOUNDATIONS. USE EYE BOLTS ON THE RING FLANGE/WEDGE ASSEMBLIES TO LOOSEN POLES FROM FOUNDATION SLEEVES.
6. COVER FOUNDATIONS USING COVERS AS SHOWN ON DWG. 6862-P1-002.
7. STORE POLES, CABLES AND MONOFILAMENTS FOR REUSE.



TYPICAL MONOFILAMENT DETAIL

N.T.S



POLE AND HALO ORIENTATION

N.T.S

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Notes

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL HARDWARE, INCLUDING PULLEYS, CARBINES EYESTRAPS, SLIDERS AND T-TRACKS ARE TO BE STAINLESS STEEL.
3. CABLES SHALL BE 4.8mm (3/16") STAINLESS STEEL MULTI-STRAND AIRCRAFT CABLE.
4. MONOFILAMENT LINE SHALL BE 178 N (40 lb.) CLEAR "BERKLEY XT" LINE OR APPROVED EQUAL. REFER TO TABLE 1 ON DWG 6862-P1-101 FOR REQUIRED LENGTHS.
5. THE SUCCESSFUL CONTRACTOR SHALL SUBMIT ALL HARDWARE PRODUCT DATA SHEETS FOR REVIEW BY THE ENGINEER PRIOR TO PROCUREMENT. EQUAL OR BETTER ALTERNATIVES TO THE SPECIFIED OVERHEAD WIRING SYSTEM COMPONENTS MAY BE SUBMITTED FOR REVIEW BY THE ENGINEER. ALL STAINLESS STEEL COMPONENTS SHALL BE REQUIRED TO RESIST A WORKING LOAD OF 2 kN. (ULTIMATE LOAD OF 6 kN.)
6. NO WORK SHALL BE PERMITTED ON THE WEEKENDS.

0

Revision	By	Appd.	Date

Issued	By	Appd.	Date

File Name: 6862-103.DWG	T.J.N.	G.A.M.	G.A.M.	99.04.22
	Dwn.	Chkd.	Dsgn.	Date

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
G.ÎA.ÎMcROBIE
PROVINCE OF ONTARIO

Client/Project

C»i½t½y» »¢Äf VAi?l?l»e» »d½t½t¿aÉwÄa

BRITANNIA BEACH
GULL MANAGEMENT FACILITY

Ottawa, Ontario

Title

PHASE 1
OVERHEAD WIRING SYSTEM
WIRING INSTALLATION AND DETAILS

Project No.	Scale
S6862	AS SHOWN

Drawing No.	Sheet	Revision
6862-P1-103	3 of 3	0

Stantec

NO.	REVISION	BY	DATE
1	ISSUED FOR TENDER	G.A.M.	15.01.02

Xref Z:\STANDARD\636_Structural_EngStamps\SRgordm.dwg

NOTE:
The location of the utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned.
The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

BRITANNIA BEACH
GULL MANAGEMENT FACILITY

PHASE 2
GENERAL ARRANGEMENT

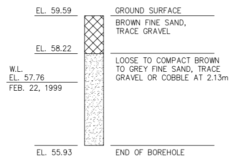
R.G. HEWITT, P.ENG.
Director Infrastructure Services

W. BENNETT, P.ENG.
Manager Construction Services

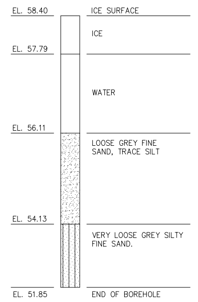
Dwn: C.L.D. Chkd: G.A.M. Des: C.L.D. Chkd: G.A.M.

Ottawa

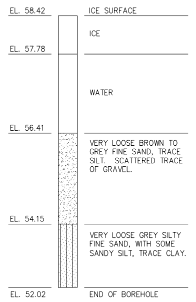
CONTRACT NO.
00902–75573–T01
DWG. NO.
S1
SHEET 1 OF 5
Date: JANUARY 2002
Scale: AS SHOWN



BOREHOLE NO.99-5
N.T.S.



BOREHOLE NO.99-6
N.T.S.



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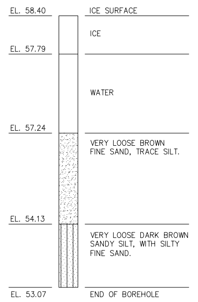

BOREHOLE NO.99-8
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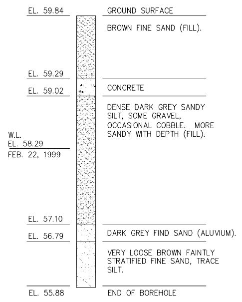

BOREHOLE NO.99-9
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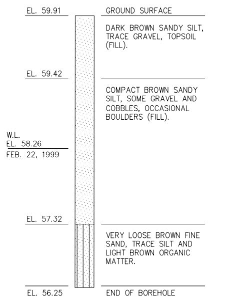
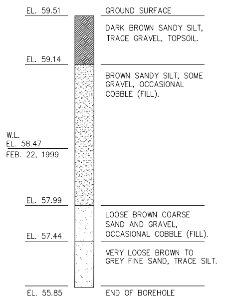
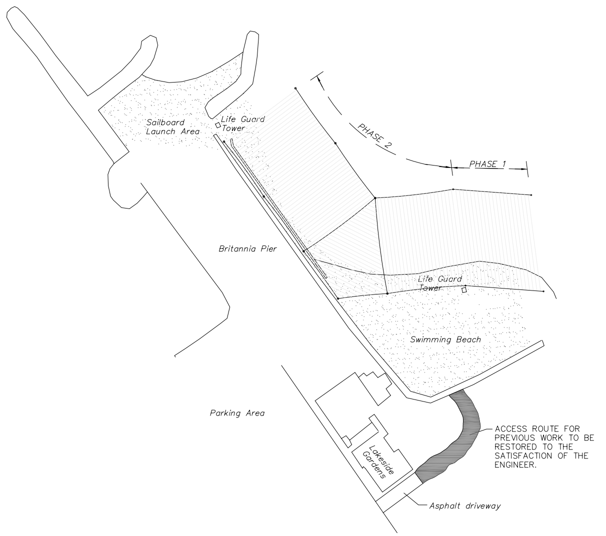


BOREHOLE NO.99-10
N.T.S.



BOREHOLE NO.99-11
N.T.S.



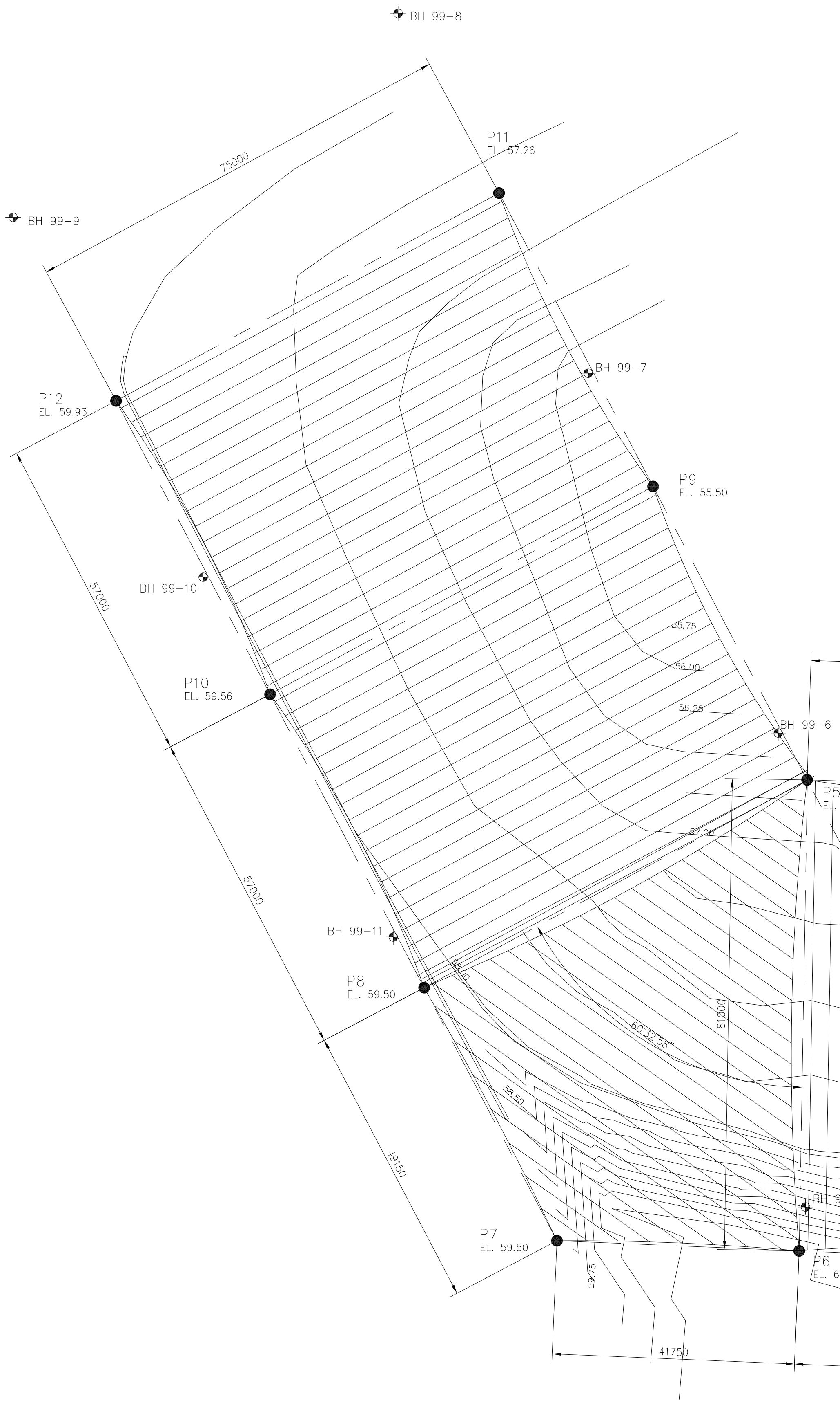
LOCATION PLAN
N.T.S.

General Notes

1. THE SITE CONDITIONS AND ICE THICKNESSES GIVEN IN THE BOREHOLE LOGS EXISTED ON FEBRUARY 22 AND 23, 1999. THE CONTRACTOR SHOULD NOT EXPECT THAT CONDITIONS WILL BE SIMILAR AT THE TIME THE WORK IS DONE.
2. THE CONTRACTOR SHALL VERIFY THE CONDITIONS AT THE TIME OF CONSTRUCTION.
3. FOUNDATIONS FOR POLES P5, P9 & P11 MUST BE INSTALLED FROM THE SURFACE OF THE ICE, AT A TIME WHEN SUFFICIENT THICKNESS OF ICE HAS FORMED TO SAFELY SUPPORT THE REQUIRED CONSTRUCTION LOADS.

Construction Notes

1. THE FOLLOWING SUGGESTIONS ARE MADE FOR INFORMATION PURPOSES ONLY.
2. STEEL LINERS SHALL BE DRIVEN A MINIMUM 1 METRE BELOW THE SPECIFIED BOTTOM OF CAISSONS AND SHOULD EXTEND ABOVE THE ICE/GROUND LEVEL AS APPROPRIATE. MATERIAL SHALL BE EXCAVATED TO THE SPECIFIED BOTTOM OF CAISSONS.
3. IF EXCAVATION FILLS WITH WATER ON DEWATERING, EXCAVATE A FURTHER 0.5m AND PLACE A TREMIE CONCRETE PLUG.
4. PLUMBNESS OF FOUNDATIONS, THE SLEEVES IN PARTICULAR, IS OF PRIME IMPORTANCE AND NO TOLERANCE IS SPECIFIED OR PERMISSIBLE.
5. CONTRACTOR SHALL SUBMIT PROPOSED CONSTRUCTION PROCEDURES TO THE ENGINEER FOR REVIEW.



SITE PLAN
1:500

NO.	REVISION	BY	DATE
1	ISSUED FOR TENDER	G.A.M.	15.01.02

NOTE:
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The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

BRITANNIA BEACH
GULL MANAGEMENT FACILITY

PHASE 2
FOUNDATION DETAILS

R.G. HEWITT, P.ENG.
Director Infrastructure Services

W. BENNETT, P.ENG.
Manager Construction Services

Dwn: H.S.D. Chkd: G.A.M. Des: C.L.D. Chkd: G.A.M.

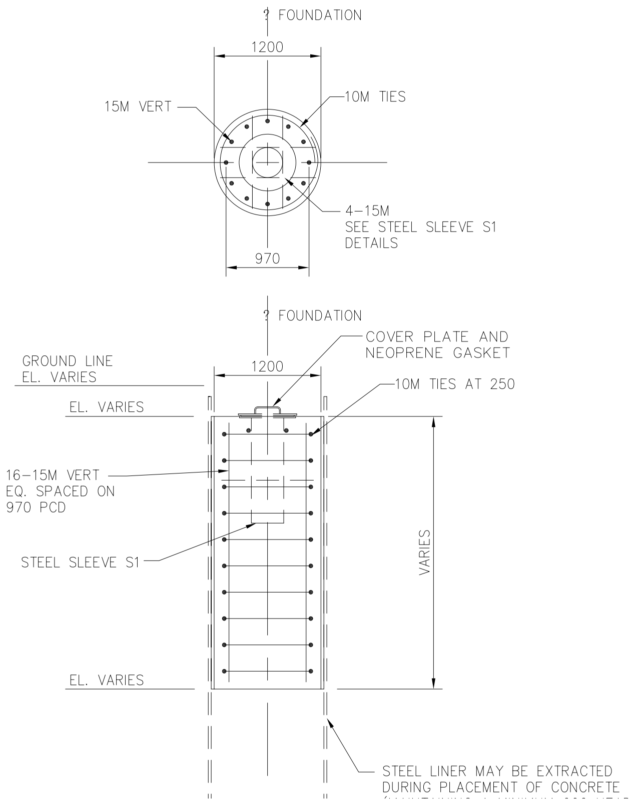
CONTRACT NO.
00902–75573–T01
DWG. NO.
S2
SHEET 2 OF 5
Date: JANUARY 2002
Scale: AS SHOWN

TABLE OF FOUNDATION DIMENSIONS & ELEVATIONS

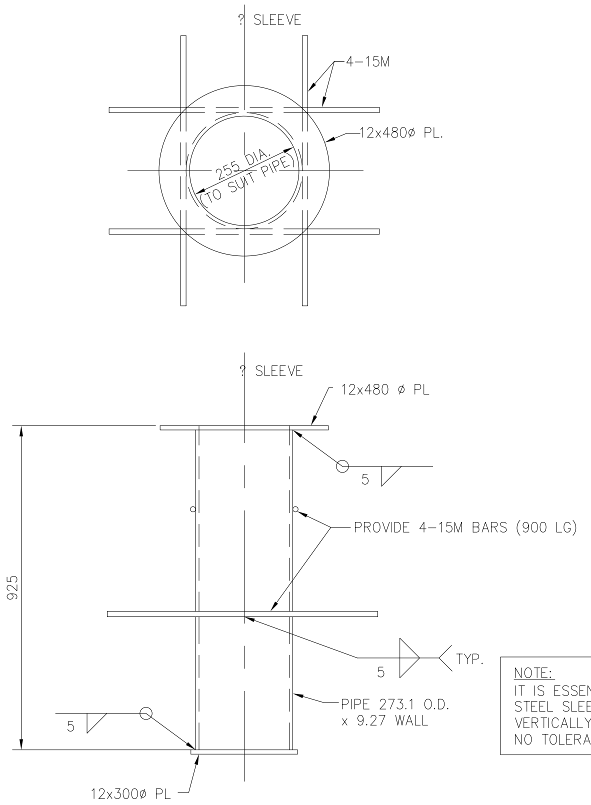
POLE	LOCATION	GROUND ELEVATION (m)	TOP OF FOUNDATION ELEVATION (m)	FOUNDATION DEPTH (m)	U/S FOUNDATION ELEVATION (m)
P5	OFFSHORE	56.45	56.20	2.70	53.50
P6	BEACH	60.19	59.90	2.70	57.20
P7	BEACH	59.50±	59.40	3.20	56.20
P8	BEHIND WALL	59.50	59.40	2.70	56.70
P9	OFFSHORE	55.50	55.25	2.70	53.55
P10	BEHIND WALL	59.56	59.45	2.70	56.75
P11	OFFSHORE	57.26	57.00	2.70	54.30
P12	BEHIND WALL	59.93	59.95	2.70	57.25

GENERAL NOTES:

1. CLASS OF CONCRETE SHALL BE 30 MPa, AIR ENTRAINED 5 TO 8%.
2. REINFORCING STEEL SHALL BE GRADE 400.
3. CLEAR COVER TO REINFORCING STEEL SHALL BE 100mm ± 20mm
4. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. SLEEVES SHALL BE STEEL PIPE SECTIONS TO ASTM A53, GRADE 240 (Fy = 240 MPa)
   ALL REMAINING STEEL SHALL BE IN ACCORDANCE WITH CAN/CSA G40.21 M92, GRADE 260W OR APPROVED EQUAL.
6. ALL STEEL SLEEVES ANDCOVER PLATES SHALL BE GALVANISED IN ACCORDANCE WITH CSA G164–M, MINIMUM 600g/m^2.
7. WELDING SHALL BE IN ACCORDANCE WITH CSA STANDARD W59, LATEST EDITION.
8. FOR LOCATION OF FOUNDATIONS, REFER TO DRAWING S1. THE ENGINEER WILL ASSIST WITH IDENTIFYING LOCATIONS IN THE FIELD IF REQUIRED.
9. FOUNDATIONS FOR POLES P5, P9 & P11 MUST BE INSTALLED FROM THE SURFACE OF THE ICE, AT A TIME WHEN SUFFICIENT ICE THICKNESS HAS FORMED TO SAFELY SUPPORT THE REQUIRED CONSTRUCTION LOADS.
10. NEOPRENE GASKET SHALL BE 50 DUROMETRE HARDNESS AND SHALL BE FASTENED TO THE COVER PLATE AFTER GALVANISING USING AN ADHESIVE COMPATIBLE WITH GALVANISED SURFACES AND APPROVED BY THE NEOPRENE MANUFACTURER.
11. COVER PLATE TO BE PLACED ON CAISSON FOLLOWING CONSTRUCTION.

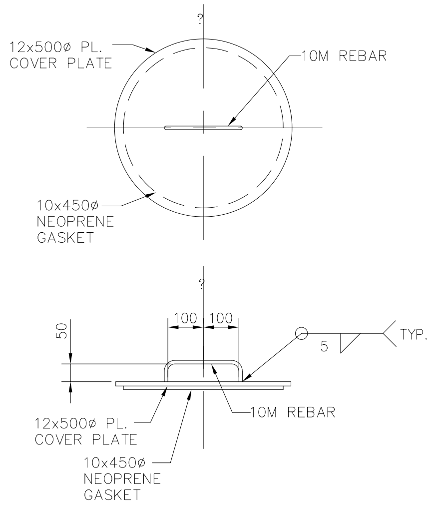


FOUNDATION
1:30



NOTE:
IT IS ESSENTIAL THAT THE STEEL SLEEVE IS INSTALLED VERTICALLY AT ALL LOCATIONS. NO TOLERANCES WILL BE PERMITTED.

STEEL SLEEVE - S1
1:10
(8 REQUIRED)



COVER PLATE AND NEOPRENE GASKET
1:10
(8 REQUIRED)

NO.	REVISION	BY	DATE
1	ISSUED FOR TENDER	G.A.M.	15.01.02

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BRITANNIA BEACH
GULL MANAGEMENT FACILITY

PHASE 2 – POLE DETAILS

R.G. HEWITT, P.ENG.
Director Infrastructure Services

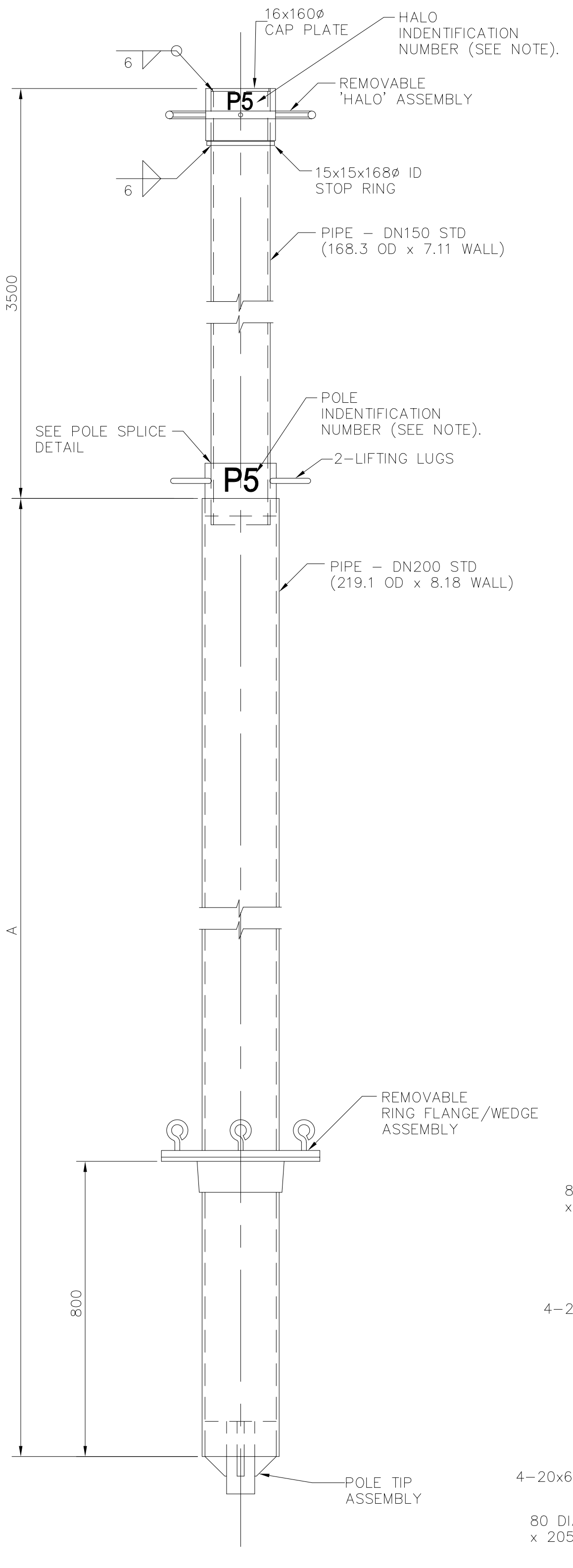
W. BENNETT, P.ENG.
Manager Construction Services

Dwn: C.L.D. Chkd: G.A.M. Des: C.L.D. Chkd: G.A.M.

CONTRACT NO.
00902–75573–T01

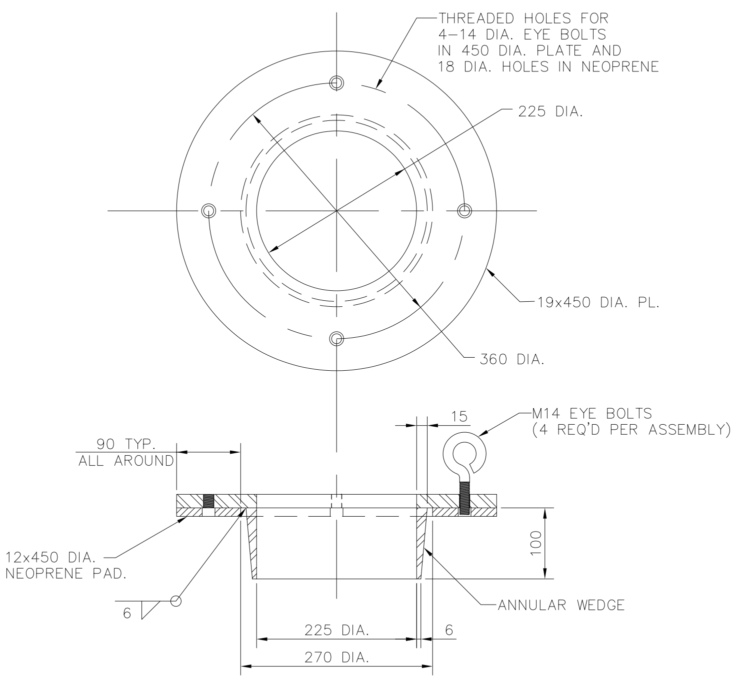
DWG. NO.
S3

SHEET 3 OF 5
Date: JANUARY 2002
Scale: AS SHOWN



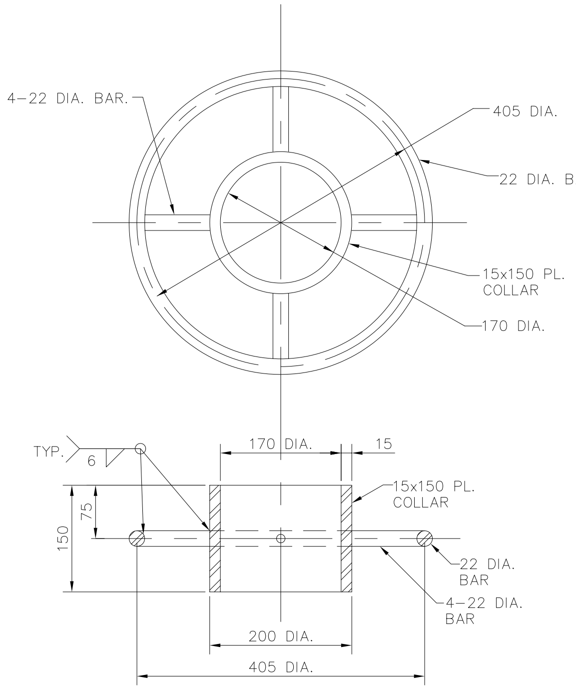
POLE DETAILS

(8 REQUIRED AS NOTED)
1:10



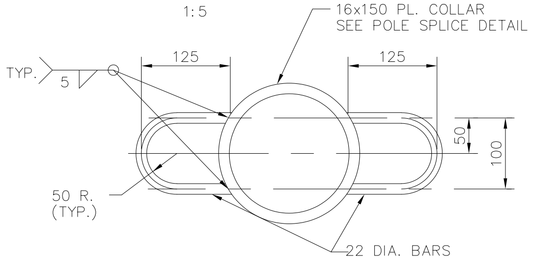
RING FLANGE/WEDGE ASSEMBLY

(8 REQUIRED)
1:5



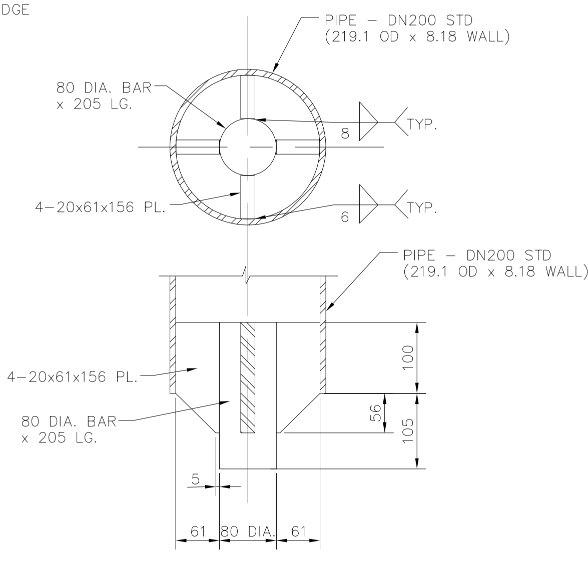
'HALO' ASSEMBLY

(8 REQUIRED)
1:5



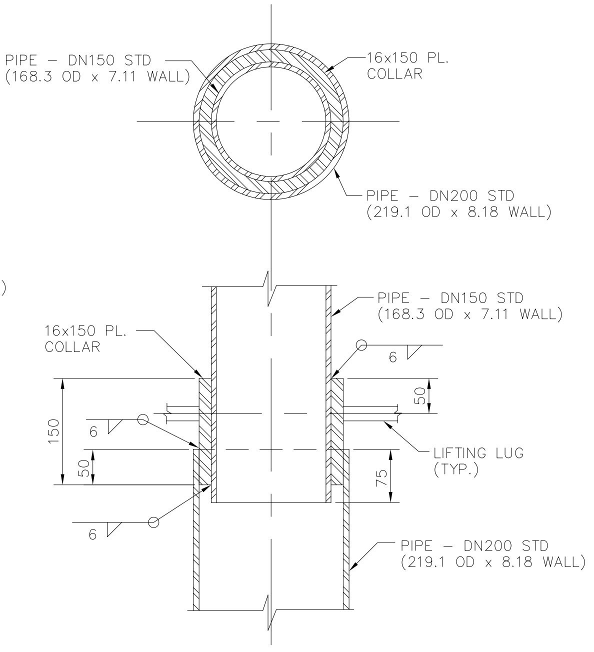
LIFTING LUG DETAILS

1:5



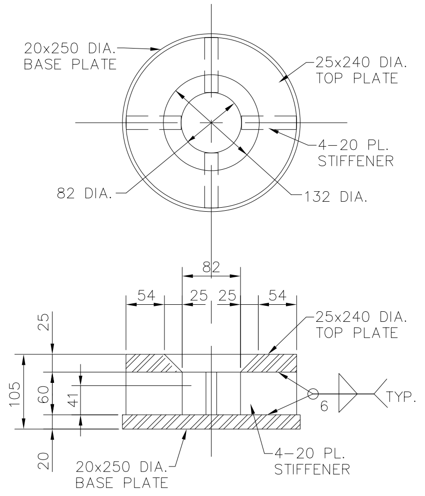
POLE TIP ASSEMBLY

(8 REQUIRED) 1:5



POLE SPLICE DETAIL

1:5



SLEEVE INSERT DETAILS

(8 REQUIRED) 1:5

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. STEEL SHALL BE IN ACCORDANCE WITH CSA STANDARD G40.21M, LATEST EDITION, GRADE 300W.
3. PIPE SHALL BE IN ACCORDANCE WITH A.S.T.M. STANDARD A53, WITH A MINIMUM YIELD STRENGTH OF 205 MPa.
4. WELDING SHALL BE DONE IN ACCORDANCE WITH CSA STANDARD W59, LATEST EDITION. ELECTRODE CLASSIFICATION SHALL BE E480XX.
5. ALL STEEL, PIPE AND HARDWARE SHALL BE GALVANIZED IN ACCORDANCE WITH CSA STANDARD G164–M, LATEST EDITION. MINIMUM 600 $g/m.^2$
6. NEOPRENE PADS SHALL BE 50 DUROMETRE HARDNESS AND SHALL BE FASTENED TO RING FLANGE/WEDGE ASSEMBLIES AFTER ASSEMBLIES HAVE BEEN GALVANIZED USING AN ADHESIVE COMPATIBLE WITH GALVANIZED SURFACES AND AS APPROVED BY THE NEOPRENE MANUFACTURER.
7. THE CONTRACTOR SHALL SUBMIT STEEL FABRICATION SHOP DRAWINGS FOR REVIEW BY THE ENGINEER PRIOR TO FABRICATION.
8. MILL CERTIFICATES FOR ALL STEEL USED SHALL BE SUBMITTED FOR REVIEW BY THE ENGINEER PRIOR TO FABRICATION.
9. POLE IDENTIFICATION NUMBERS SHALL BE PAINTED ON TWO SIDES OF THE POLE AT LOCATION SHOWN, AFTER GALVANIZING. NUMBERS SHALL BE 80mm IN HEIGHT AND SHALL BE BLACK IN COLOUR.
10. HALO IDENTIFICATION NUMBERS SHALL BE PAINTED ON TWO SIDES OF THE HALO AT LOCATION SHOWN, AFTER GALVANIZING. NUMBERS SHALL BE 40mm IN HEIGHT AND SHALL BE BLACK IN COLOUR.
11. NOTE THAT HALO ASSEMBLIES USED FOR POLES P3 AND P4 (PHASE 1) ARE NOW TO BE USED FOR POLES P10 AND P11. NEW HALO ASSEMBLIES ARE TO BE USED AT POLES P3 AND P4. HALO IDENTIFICATION NUMBERS SHOULD MATCH POLE IDENTIFICATION NUMBERS ACCORDINGLY.

TABLE OF POLE CHARACTERISTICS

POLE	'A'	WEIGHT (kg)
P5	8100	530
P6	5900	430
P7	6200	450
P8	6200	450
P9	9050	570
P10	6150	440
P11	7300	490
P12	5750	430

MONOFILAMENT NO.	LENGTH (m)
B1	80.839
B2	80.525
B3	80.268
B4	80.021
B5	79.830
B6	79.660
B7	79.524
B8	79.421
B9	79.351
B10	79.302
B11	79.310
B12	79.327
B13	79.389
B14	79.495
B15	79.624
B16	79.785
B17	79.979
B18	80.206
B19	80.467
B20	80.761
B21	81.087
B22	81.447

MONOFILAMENT NO.	LENGTH (m)
C1	4.733
C2	7.992
C3	11.294
C4	14.635
C5	18.011
C6	21.424
C7	24.872
C8	28.357
C9	31.877
C10	35.431
C11	39.022
C12	42.648
C13	46.309
C14	50.007
C15	53.739
C16	57.506
C17	61.309
C18	65.147
C19	69.308
C20	73.116
C21	76.941

MONOFILAMENT NO.	LENGTH (m)
D1	74.901
D2	74.613
D3	74.359
D4	74.137
D5	73.949
D6	73.794
D7	73.673
D8	73.584
D9	73.529
D10	73.507
D11	73.519
D12	73.563
D13	73.641
D14	73.752
D15	73.897
D16	74.074
D17	74.285
D18	74.529
D19	74.806

MONOFILAMENT NO.	LENGTH (m)
E1	74.901
E2	74.613
E3	74.359
E4	74.137
E5	73.949
E6	73.794
E7	73.673
E8	73.584
E9	73.529
E10	73.507
E11	73.519
E12	73.563
E13	73.641
E14	73.752
E15	73.897
E16	74.074
E17	74.285
E18	74.529
E19	74.806

MONOFILAMENT NO.	LENGTH (m)
F1	73.517
F2	62.886
F3	52.332
F4	41.851
F5	31.446
F6	21.116
F7	10.861

Stantec

NO.	REVISION	BY	DATE
1	ISSUED FOR TENDER	G.A.M.	15.01.02

Xref Z:\STANDARD\636_Structural_EngStamps\SRgordm.dwg

NOTE:
The location of the utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned.
The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

BRITANNIA BEACH
GULL MANAGEMENT FACILITY

PHASE 2 – CABLE AND
MONOFILAMENT ARRANGEMENT

R.G. HEWITT, P.ENG.
Director Infrastructure Services

W. BENNETT, P.ENG.
Manager Construction Services

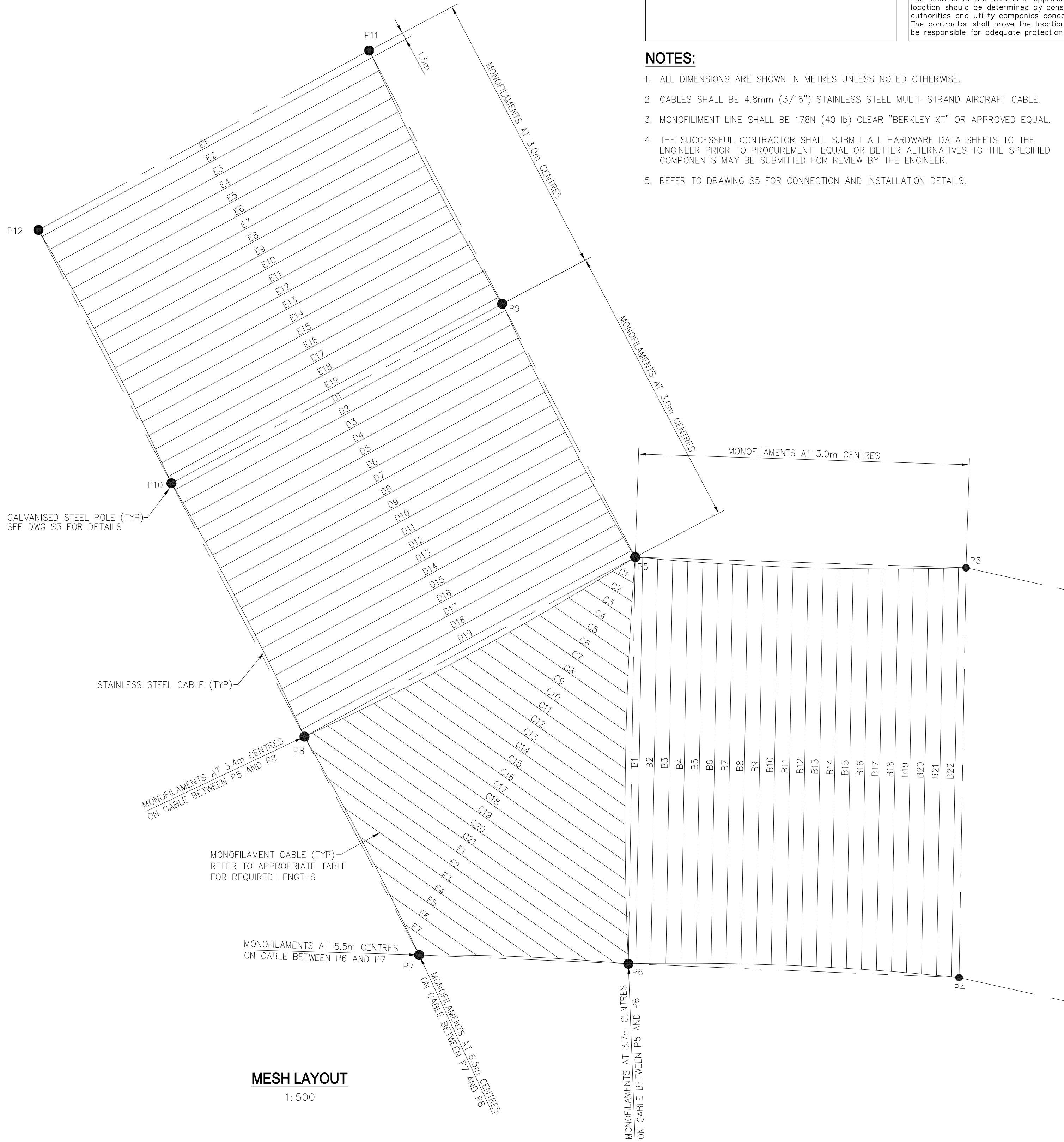
Dwn: C.L.D. Chkd: G.A.M. Des: C.L.D. Chkd: G.A.M.

Ottawa

CONTRACT NO.
00902–75573–T01
DWG. NO.
S4
SHEET 4 OF 5
Date: JANUARY 2002
Scale: AS SHOWN

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
2. CABLES SHALL BE 4.8mm (3/16") STAINLESS STEEL MULTI–STRAND AIRCRAFT CABLE.
3. MONOFILIMENT LINE SHALL BE 178N (40 lb) CLEAR "BERKLEY XT" OR APPROVED EQUAL.
4. THE SUCCESSFUL CONTRACTOR SHALL SUBMIT ALL HARDWARE DATA SHEETS TO THE ENGINEER PRIOR TO PROCUREMENT. EQUAL OR BETTER ALTERNATIVES TO THE SPECIFIED COMPONENTS MAY BE SUBMITTED FOR REVIEW BY THE ENGINEER.
5. REFER TO DRAWING S5 FOR CONNECTION AND INSTALLATION DETAILS.



MONOFILAMENTS AT 3.0m CENTRES

MONOFILAMENTS AT 3.0m CENTRES

MONOFILAMENTS AT 3.0m CENTRES

GALVANISED STEEL POLE (TYP)
SEE DWG S3 FOR DETAILS

STAINLESS STEEL CABLE (TYP)

MONOFILAMENTS AT 3.4m CENTRES
ON CABLE BETWEEN P5 AND P8

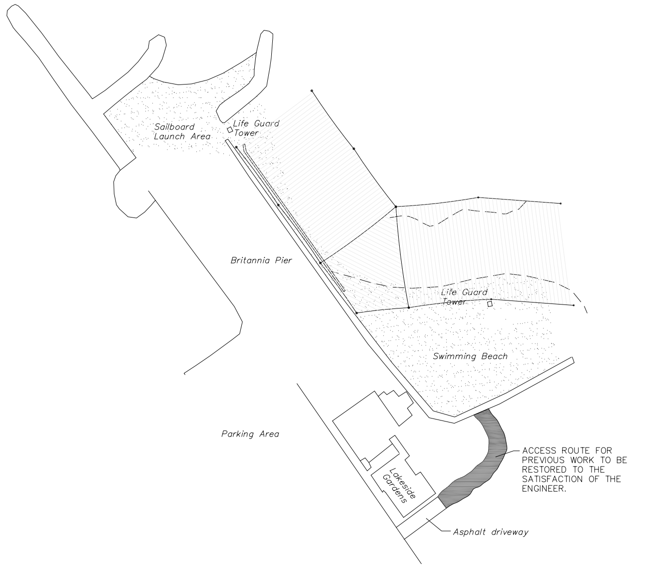
MONOFILAMENT CABLE (TYP)
REFER TO APPROPRIATE TABLE
FOR REQUIRED LENGTHS

MONOFILAMENTS AT 5.5m CENTRES
ON CABLE BETWEEN P6 AND P7

MONOFILAMENTS AT 6.5m CENTRES
ON CABLE BETWEEN P7 AND P8

MONOFILAMENTS AT 3.7m CENTRES
ON CABLE BETWEEN P5 AND P6

MESH LAYOUT
1:500



ACCESS ROUTE FOR PREVIOUS WORK TO BE RESTORED TO THE SATISFACTION OF THE ENGINEER.

Asphalt driveway

LOCATION PLAN
N.T.S.

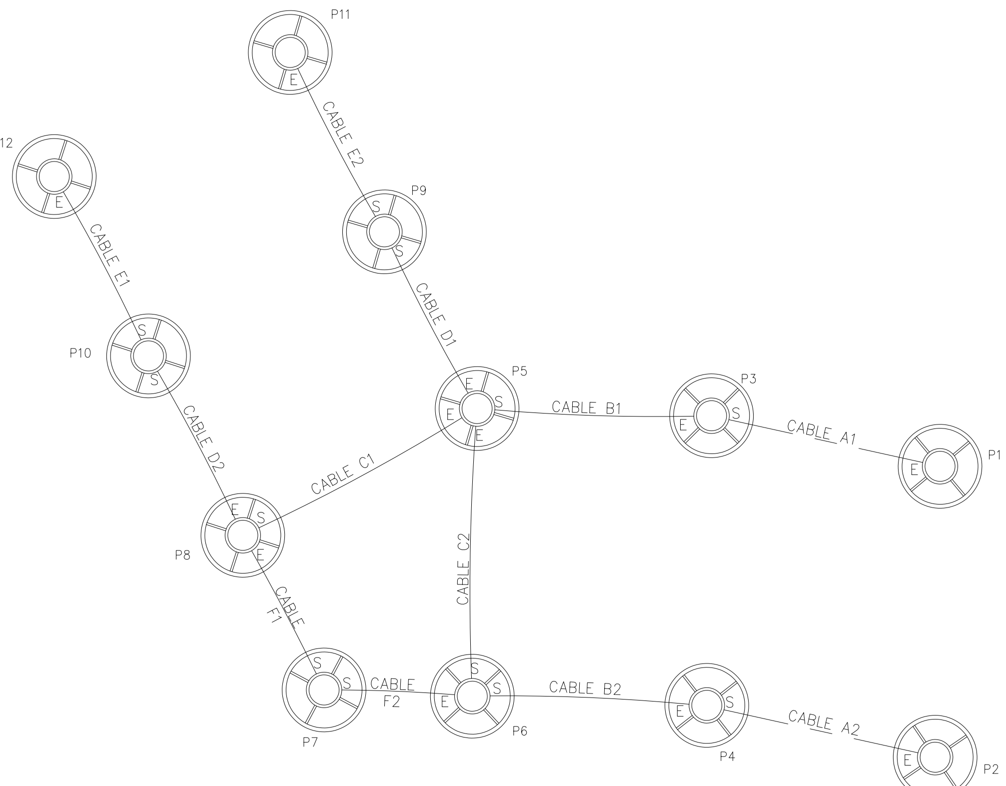


FIGURE 1 - HALO ORIENTATION, EYESTRAP & SLIDER LOCATIONS

N.T.S

Stantec

NO.	REVISION	BY	DATE
1	ISSUED FOR TENDER	G.A.M.	15.01.02

NOTE:
The location of the utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned.
The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

BRITANNIA BEACH
GULL MANAGEMENT FACILITY

PHASE 2
WIRING INSTALLATION DETAILS

R.G. HEWITT, P.ENG.
Director Infrastructure Services

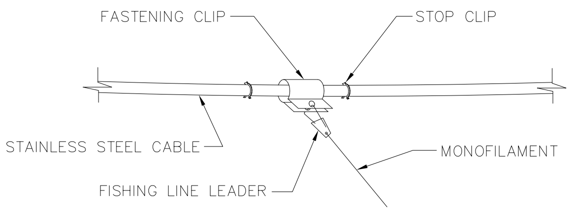
W. BENNETT, P.ENG.
Manager Construction Services

Dwn: C.L.D.
Chkd: G.A.M.
Des: C.L.D.
Chkd: G.A.M.

Ottawa
CONTRACT NO.
00902-75573-T01
DWG. NO.
S5
SHEET 5 OF 5
Date: JANUARY 2002
Scale: AS SHOWN

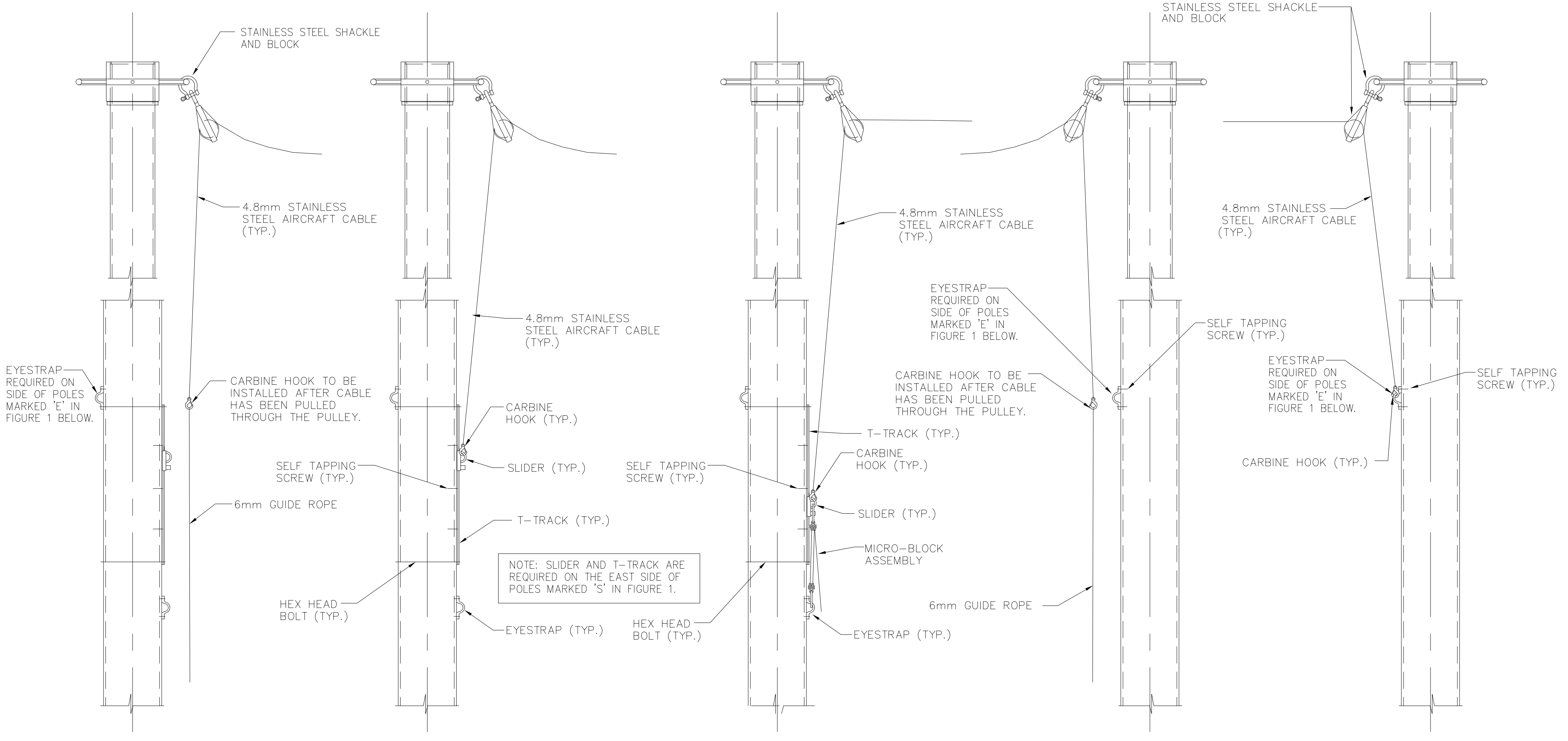
GENERAL NOTES

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL HARDWARE, INCLUDING PULLEYS, CARBINES, EYESTRAPS, SLIDERS AND T-TRACKS ARE TO BE STAINLESS STEEL.
3. CABLES SHALL BE 4.8mm (3/16") STAINLESS STEEL MULTI-STRAND AIRCRAFT CABLE.
4. MONOFILAMENT LINE SHALL BE 178 N (40 lb.) CLEAR "BERKELEY XT" LINE OR APPROVED EQUAL. REFER TO TABLES ON DRAWING S4 FOR REQUIRED LENGTHS.
5. THE SUCCESSFUL CONTRACTOR SHALL SUBMIT ALL HARDWARE PRODUCT DATA SHEETS FOR REVIEW BY THE ENGINEER PRIOR TO PROCUREMENT. EQUAL OR BETTER ALTERNATIVES TO THE SPECIFIED OVERHEAD WIRING SYSTEM COMPONENTS MAY BE SUBMITTED FOR REVIEW BY THE ENGINEER. ALL STAINLESS STEEL COMPONENTS SHALL BE REQUIRED TO RESIST A WORKING LOAD OF 2.4kN (ULTIMATE LOAD OF 6.0kN).
6. NO WORK SHALL BE PERMITTED ON THE WEEKENDS.
7. NOTE THAT ALL HARDWARE RELATING TO P1 TO P4 HAS ALREADY BEEN COMPLETED UNDER PHASE 1. THESE POLES ARE SHOWN HERE FOR COMPLETENESS.
8. FOR FIRST INSTALLATION OF PHASE 2 ONLY, HALO ASSEMBLIES FROM POLES P3 & P4 ARE TO BE TRANSFERRED TO POLES P11 & P12 REPECTIVELY. (REFER TO DRAWING 3 FOR MORE INFORMATION).



TYPICAL MONOFILAMENT DETAIL

N.T.S



NOTE: SLIDER AND T-TRACK ARE REQUIRED ON THE EAST SIDE OF POLES MARKED 'S' IN FIGURE 1.

POLES WITH SLIDERS AND T-TRACKS (POLES P3 TO P10 - SEE ABOVE)

POLES WITH EYESTRAPS (P1 TO P8, P11 - SEE ABOVE)

CABLE RIGGING

1:10

POLE AND CABLE INSTALLATION PROCEDURE

1. REMOVE COVERS FOR FOOTINGS (REFER TO DWG S2) AND CLEAN OUT STEEL SLEEVES. INSTALL STEEL SLEEVE INSERTS AS DETAILED ON DWG S3.
2. INSTALL 6mm GUIDE ROPE AND CABLE TENSIONING HARDWARE FOR EACH POLE.
3. ERECT POLES, INCLUDING ALL ASSEMBLIES AS SHOWN ON DWG. S3.
4. LAYOUT CABLE/MONOFILAMENT NETTING
5. FEED CABLE THROUGH PULLEYS AT POLES MARKED 'E'. SECURE TO EYESTRAP USING A CARBINE HOOK.
6. FEED CABLE TROUGH PULLEYS AT POLES MARKED 'S'. SECURE TO SLIDERS USING A CARBINE HOOK.

   NOTE: STEPS 5 AND 6 ARE TO BE PERFORMED SIMULTANEOUSLY AT ALL POLES.
7. INSTALL MICRO-BLOCK ASSEMBLIES.
8. TENSION CABLE USING MICRO-BLOCK ASSEMBLY AND SECURE SLIDER IN PLACE ONCE THE REQUIRED TENSION HAS BEEN REACHED.
9. REMOVE MICRO-BLOCK ASSEMBLIES.

POLE AND CABLE REMOVAL PROCEDURE

1. INSTALL MIRCO-BLOCK ASSEMBLIES. (POLES MARKED 'S')
2. RELEASE SLIDER AND DETENSION CABLE USING THE MICRO-BLOCK ASSEMBLIES.
3. REMOVE CARBINE HOOK AND ATTACH 6mm ROPE TO CABLE. ALLOW CABLE TO PULL ROPE BACK THROUGH PULLEY SYSTEM.
4. REPEAT STEP 3 AT POLES MARKED 'E'.
5. REMOVE POLES FROM FOUNDATIONS. USE EYE BOLTS ON THE RING FLANGE/WEDGE ASSEMBLIES TO LOOSEN POLES FROM FOUNDATION SLEEVES.
6. REMOVE STEEL SLEEVE INSERTS FROM STEEL SLEEVES.
7. COVER FOUNDATIONS USING COVERS AS SHOWN ON DWG S2.
8. STORE POLES, SLEEVE INSERTS, CABLES AND MONOFILAMENTS FOR REINSTALLATION THE FOLLOWING SEASON.

ALTERNATIVE PROCEDURES (REFER TO CITY OF OTTAWA).

1. POLES AT BEACH AND LAND LOCATIONS MAY REMAIN IN PLACE YEAR-ROUND.
2. STEEL SLEEVE INSERTS MAY REMAIN IN SLEEVES OVER WINTER, BUT ARE REMOVABLE TO FACILITATE CLEANING DURING POLE INSTALLATION.

Attachment D

Species Hazard Ranking

Appendix D – Species Hazard Ranking

US / Canada Hazard Ranking Comparison

Species (Group)	Hazard Rank (USDA / FAA[1])	Hazard Rank (CAR's 322.302)	Hazard Rank (TP 11500)	Mass Rank (by kg)
White-tailed Deer	1	1	1*	1
Vultures	2	18	16	14
Geese (Swans)	3	2	1	3
Cranes	4	10	8	8
Osprey	5	n/a	n/a	7
Pelicans	6	n/a	n/a	5
Ducks	7	5	4	11
Hawks (buteos)	8	4	3	13
Eagles	9	9	7	6
Rock Dove	10	8	6	17
Gulls	11	3	2	15
Herons	12	17	15	9
Mourning Doves	13	16	14	19
Owls	14	7	5	12
Coyote	15	6	2*	2
American Kestrel	16	19	17	18
Shorebirds	17	12	10	21
Crows - Ravens	18	14	12	16
Blackbirds / E. Starling	19	13	11	20
Sparrows	20	11	9	22
Swallows	21	15	13	23
Wild Turkeys	n/a	20	n/a	4
Cormorants	n/a	21	n/a	10

(n/a - not assigned a hazard ranking)

*(TP11500 ranks birds and mammals separately)

Species (Group) (USDA / FAA)	Damage Ranking	Major Damage Ranking	Effect on Flight Ranking	Composite Ranking	Relative Hazard Score
White-tailed Deer	1	1	1	1	100
Vultures	2	2	2	2	63
Geese (Swans)	3	3	4	3	52
Cranes	4	4	7	4	48
Osprey	6	5	3	5	50
Pelicans	5	7	5	6	44
Ducks	7	6	8	7	37
Hawks (buteos)	9	13	10	8	25
Eagles	8	15	9	9	31
Rock Dove	11	8	11	10	24
Gulls	10	11	13	11	22
Herons	12	14	12	12	22
Mourning Doves	14	9	17	13	17
Owls	13	12	19	14	16
Coyote	15	17	6	15	20
American Kestrel	16	10	16	16	14
Shorebirds	17	19	14	17	12
Crows - Ravens	18	16	15	18	12
Blackbirds / E. Starling	19	18	18	19	9
Sparrows	20	21	290	20	4
Swallows	21	20	21	21	2

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[1] As prescribed by Dr. Richard Dolbeer, USDA for US Federal Aviation Administration

Appendix F - 10

Stormwater Management Pond

Stage Storage Tables

EAST PELTON NORTH (West) POND-P1 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.800	3,880.71	N/A	N/A	0.00	N/A	0.00
184.000	4,413.69	0.200	829.44	829.44	828.87	828.87
184.500	5,762.67	0.500	2544.09	3373.53	2536.61	3365.47
185.000	7,130.40	0.500	3223.27	6596.80	3217.21	6582.68
185.500	8,523.53	0.500	3913.48	10510.28	3908.31	10490.99
186.000	9,921.82	0.500	4611.34	15121.62	4606.91	15097.90
186.500	11,348.79	0.500	5317.65	20439.27	5313.66	20411.56
187.000	12,791.25	0.500	6035.01	26474.28	6031.42	26442.98
187.500	14,252.33	0.500	6760.90	33235.18	6757.60	33200.58

EAST PELTON NORTH (Central) POND-P1 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.200	4,575.43	N/A	N/A	0.00	N/A	0.00
183.500	5,493.78	0.300	1510.38	1510.38	1508.28	1508.28
184.000	7,012.50	0.500	3126.57	4636.95	3118.86	4627.14
184.500	8,546.94	0.500	3889.86	8526.81	3883.54	8510.68
185.000	10,069.24	0.500	4654.05	13180.86	4648.85	13159.53
185.500	11,590.83	0.500	5415.02	18595.88	5410.56	18570.09
186.000	13,115.53	0.500	6176.59	24772.46	6172.66	24742.75
186.500	14,642.36	0.500	6939.47	31711.94	6935.97	31678.72
187.000	16,170.00	0.500	7703.09	39415.03	7699.93	39378.66
187.500	17,690.57	0.500	8465.14	47880.17	8462.30	47840.95

EAST PELTON NORTH (East) POND-P1 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPT H (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.000	12,990.04	N/A	N/A	0.00	N/A	0.00
183.500	15,312.78	0.500	7075.70	7075.70	7067.75	7067.75
184.000	17,652.86	0.500	8241.41	15317.11	8234.48	15302.23
184.500	20,013.86	0.500	9416.68	24733.79	9410.51	24712.74
185.000	22,394.83	0.500	10602.17	35335.97	10596.60	35309.33
185.500	24,793.70	0.500	11797.13	47133.10	11792.05	47101.38
186.000	27,214.63	0.500	13002.08	60135.18	12997.38	60098.77
186.500	29,653.54	0.500	14217.04	74352.22	14212.68	74311.45
187.000	32,111.19	0.500	15441.18	89793.41	15437.11	89748.56
187.500	34,589.72	0.500	16675.23	106468.64	16671.39	106419.95

EAST PELTON SOUTH POND-P2 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
183.900	6,849.70	N/A	N/A	0.00	N/A	0.00
184.400	9,219.32	0.500	4017.25	4017.25	4002.61	4002.61
184.900	11,628.20	0.500	5211.88	9229.14	5200.24	9202.86
185.400	14,076.32	0.500	6426.13	15655.27	6416.39	15619.25
185.900	16,563.69	0.500	7660.00	23315.27	7651.57	23270.83
186.400	19,090.30	0.500	8913.50	32228.76	8906.03	32176.85
186.900	21,656.16	0.500	10186.62	42415.38	10179.88	42356.73
187.400	24,261.27	0.500	11479.36	53894.74	11473.19	53829.92
187.900	26,905.62	0.500	12791.72	66686.46	12786.02	66615.95
188.400	29,589.22	0.500	14123.71	80810.17	14118.39	80734.34
188.900	32,312.06	0.500	15475.32	96285.49	15470.33	96204.67
189.340	34,740.63	0.440	14751.59	111037.08	14748.37	110953.03

CR42SPA SOUTH (West) POND-P3 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
181.400	9,102.41	N/A	N/A	0.00	N/A	0.00
181.700	10,784.01	0.300	2982.96	2982.96	2979.40	2979.40
182.200	13,599.75	0.500	6095.94	9078.91	6082.35	9061.75
182.700	16,438.51	0.500	7509.56	16588.47	7498.36	16560.11
183.200	19,297.13	0.500	8933.91	25522.38	8924.37	25484.48
183.700	22,170.21	0.500	10366.84	35889.22	10358.53	35843.01
184.200	25,070.47	0.500	11810.17	47699.39	11802.74	47645.76
184.500	26,815.91	0.300	7782.96	55482.35	7781.49	55427.25

CR42SPA SOUTH (Central) POND-P3 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
180.700	10,374.44	N/A	N/A	0.00	N/A	0.00
181.200	13,034.73	0.500	5852.29	5852.29	5839.65	5839.65
181.700	15,693.05	0.500	7181.94	13034.24	7171.67	13011.33
182.200	18,347.37	0.500	8510.10	21544.34	8501.47	21512.79
182.700	21,006.91	0.500	9838.57	31382.91	9831.07	31343.87
183.200	23,665.72	0.500	11168.16	42551.07	11161.56	42505.43
183.700	26,325.13	0.500	12497.71	55048.78	12491.81	54997.24
184.200	28,974.38	0.500	13824.88	68873.66	13819.59	68816.83
184.500	30,574.26	0.300	8932.30	77805.95	8931.22	77748.05

CR42SPA SOUTH (East) POND-P3 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
180.200	10,727.84	N/A	N/A	0.00	N/A	0.00
180.700	13,089.50	0.500	5954.33	5954.33	5944.55	5944.55
181.200	15,466.11	0.500	7138.90	13093.24	7130.65	13075.20
181.700	17,864.31	0.500	8332.61	21425.84	8325.41	21400.61
182.200	20,282.10	0.500	9536.60	30962.45	9530.21	30930.82
182.700	22,721.44	0.500	10750.89	41713.33	10745.12	41675.93
183.200	25,176.72	0.500	11974.54	53687.87	11969.29	53645.23
183.700	27,653.46	0.500	13207.54	66895.42	13202.70	66847.93
184.200	30,152.40	0.500	14451.46	81346.88	14446.96	81294.89
184.500	31,657.09	0.300	9271.42	90618.30	9270.51	90565.40

CR42SPA NW POND-P4 ACTIVE STORAGE						
ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
179.000	14,192.63	N/A	N/A	0.00	N/A	0.00
179.500	18,887.59	0.500	8270.05	8270.05	8242.15	8242.15
180.000	24,122.42	0.500	10752.50	19022.56	10725.85	18968.00
180.500	28,429.63	0.500	13138.01	32160.57	13123.28	32091.28
181.000	32,775.33	0.500	15301.24	47461.81	15288.37	47379.65
181.500	37,159.54	0.500	17483.72	64945.52	17472.25	64851.90
182.000	41,582.23	0.500	19685.44	84630.97	19675.08	84526.99
182.500	46,043.43	0.500	21906.41	106537.38	21896.95	106423.93
183.000	50,543.11	0.500	24146.63	130684.02	24137.90	130561.83
183.500	55,081.30	0.500	26406.10	157090.12	26397.97	156959.80

CR42SPA EAST POND-P5 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
178.000	8,515.21	N/A	N/A	0.00	N/A	0.00
178.500	11,187.10	0.500	4925.58	4925.58	4910.41	4910.41
179.000	13,898.26	0.500	6271.34	11196.92	6259.09	11169.50
179.500	16,648.68	0.500	7636.73	18833.65	7626.39	18795.90
180.000	19,438.36	0.500	9021.76	27855.41	9012.76	27808.66
180.500	22,267.31	0.500	10426.42	38281.83	10418.41	38227.07
181.000	25,135.51	0.500	11850.70	50132.53	11843.47	50070.54
181.500	28,042.98	0.500	13294.62	63427.15	13288.00	63358.53
182.000	30,989.71	0.500	14758.17	78185.33	14752.04	78110.57
182.500	33,975.71	0.500	16241.36	94426.68	16235.63	94346.21
183.000	37,000.96	0.500	17744.17	112170.85	17738.79	112085.00

CR42SPA SE POND-P6 ACTIVE STORAGE

ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
179.300	6,691.24	N/A	N/A	0.00	N/A	0.00
179.800	8,810.36	0.500	3875.40	3875.40	3863.27	3863.27
180.300	10,968.66	0.500	4944.76	8820.16	4934.91	8798.19
180.800	13,166.14	0.500	6033.70	14853.86	6025.34	14823.53
181.300	15,402.79	0.500	7142.23	21996.09	7134.92	21958.46
181.800	17,678.63	0.500	8270.36	30266.44	8263.82	30222.28
182.300	19,993.65	0.500	9418.07	39684.51	9412.14	39634.42
182.800	22,347.84	0.500	10585.37	50269.88	10579.91	50214.33
183.300	24,741.22	0.500	11772.27	62042.15	11767.19	61981.52
183.800	27,173.78	0.500	12978.75	75020.90	12974.00	74955.52
184.300	29,645.51	0.500	14204.82	89225.72	14200.34	89155.86
184.500	30,645.18	0.200	6029.07	95254.79	6028.79	95184.66

LAUZON PARKWAY & CR42 INTERSECTION POND-P7 ACTIVE STORAGE						
ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
179.100	1,751.72	N/A	N/A	0.00	N/A	0.00
179.600	2,376.07	0.500	1031.95	1031.95	1027.99	1027.99
180.100	3,039.69	0.500	1353.94	2385.89	1350.54	2378.53
180.600	3,742.56	0.500	1695.56	4081.45	1692.52	4071.05
181.100	4,484.70	0.500	2056.81	6138.26	2054.02	6125.07
181.600	5,266.10	0.500	2437.70	8575.96	2435.08	8560.15
182.100	6,086.76	0.500	2838.21	11414.17	2835.74	11395.89
182.600	6,946.68	0.500	3258.36	14672.53	3255.99	14651.88

LAUZON PARKWAY & CR42 INTERSECTION POND-P8 ACTIVE STORAGE						
ELEV	AREA (sq. m)	DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)
178.000	19,477.08	N/A	N/A	0.00	N/A	0.00
178.500	25,452.93	0.500	11232.50	11232.50	11199.24	11199.24
179.000	31,467.49	0.500	14230.11	25462.61	14203.55	25402.79
179.500	37,520.76	0.500	17247.06	42709.67	17224.89	42627.68
180.000	43,612.73	0.500	20283.37	62993.04	20264.29	62891.97
180.500	49,743.42	0.500	23339.04	86332.08	23322.24	86214.21
181.000	55,912.82	0.500	26414.06	112746.14	26399.04	112613.25
181.500	64,361.67	0.500	30068.62	142814.77	30043.86	142657.11
182.000	67,915.17	0.500	33069.21	175883.98	33065.23	175722.34
182.500	71,512.38	0.500	34856.89	210740.86	34853.02	210575.36
183.000	75,152.25	0.500	36666.16	247407.02	36662.39	247237.76