ASSESSMENT OF ADEQUACY OF PUBLIC SERVICES
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CLARIDGE HOMES
MER BLEUE PHASE 1
MER BLEUE URBAN EXPANSION AREA

CITY OF OTTAWA

Prepared for CLARIDGE HOMES
by IBI Group
November 15, 2021

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1 INTRODUCTION

1.1 Purpose

The purpose of this report is to investigate and confirm the Adequacy of Public Services for Claridge's first Phase of their Mer Bleue Urban expansion Area lands in support of their application for Draft Plan Approval. This report will review major municipal infrastructure including water supply, wastewater collection and stormwater collection and management. This report will also include a Sedimentation and Erosion Control Plan. A review of transportation components will be the subject of a separate report.

Phase 1 of Claridge's lands are comprised of approximately 46.41 Ha located between Mer Bleue Road and Tenth Line Road. AOV Surveyors have prepared a Preliminary Draft Plan which demonstrates the functionality of the subject lands based on comments received during the pre-consultation process with City staff, refer to **Appendix A** for a copy of the draft plan.

This report will provide stakeholders with conceptual level layout of the proposed development sufficient to support the re-zoning and Draft Plan approval of the subject lands.

1.2 Background

When the Official Plan was reviewed in 2009, City Council and the Ontario Municipal Board (OMB) approved OPA 76 which included a number of urban expansion areas. The Mer Bleue Urban Expansion Area (MBUEA) was part of the approximately 850 Ha of lands identified by council to support the projected population growth for Ottawa to the year 2031. The subject land is part of the MBUEA. In 2013, a Land Owners group initiated a Community Design Plan (CDP) for the MBUEA.

1.3 Previous Studies

The inclusion of the MBUEA within the new urban lands created the overall project need of guiding the development of these lands to meet the goal of Council to accommodate projected growth. To achieve this goal several Studies/Reports were completed:

The Mer Bleue Expansion Area 10 Master Servicing Study, report dated December 2017 deals specifically with servicing including water supply, wastewater services and stormwater services to achieve the urbanization, (MSS).

The Mer Bleue Area 10 Urban Expansion Area, Environmental Management Plan (EMP).

In addition to the above noted studies the following guidelines were utilized in the preparation of this report:

City of Ottawa Sewer Design Guidelines, October 2012 including all current updates.

City of Ottawa Design Guidelines-Water Distribution, July 2010 including all current updates

MOE Stormwater Management Planning and Design Manual, March 2003.

There have been minor revisions to the City of Ottawa Design Guidelines since the approval of the MSS in 2017 and this report will include those changes with regards to servicing the subject parcel.

1.4 Subject Property

The MBUEA is located in the South of the Orleans East Urban Community (EUC), between Mer-Bleue Road and Tenth Line Road. It is south of the Avalon West Community and north of the Notre Dame Des Champs (NDDC) community. The subject property is approximately 46.4Ha of the 210Ha MBUEA. It is bound to the north by Mattamy's proposed Summerside West residential development, to the south by existing Wall Road, to the east by Tenth Line Road and to the west by future phases. Refer to **Figure 1.1** below for the key map.

The proposed development will include a mixture of single and street town residential units. The development will also include a community park, one commercial block, and a SWM block. The proposed draft plan of subdivision for the subject property is included in **Appendix A**.

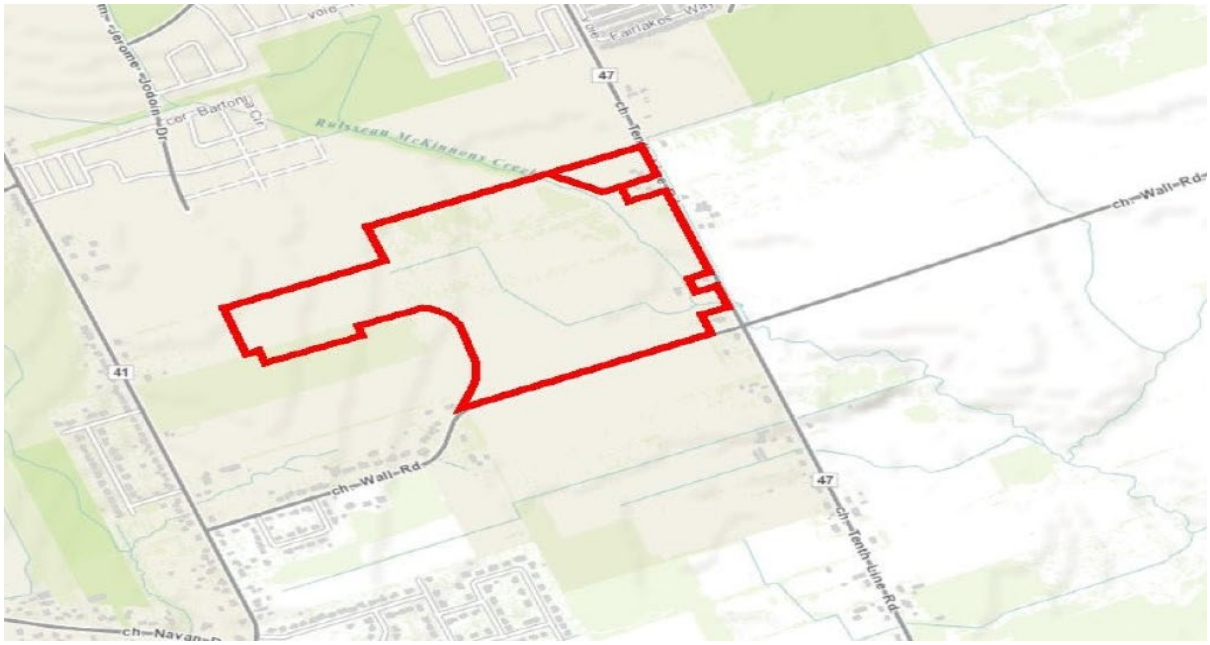


Figure 1.1 – Key Map of Subject Lands

1.5 Existing Topography

The subject property is generally flat with slight slope from west to east towards McKinnon's Creek, the portion of the property on the east side of McKinnon's generally slopes from east to west. Contours for Phase 1 West range between 86 and 85 meters. Contours for the Phase 1 East range between 87 and 86.5 meters. Since these lands were actively farmed various farm ditches cross the property and discharge into McKinnon's Creek. **Figure 1.2,** which is included in **Appendix A**, shows the general topography of the subject property.

All surface drainage from the property flows to McKinnon's Creek, where it is conveyed under Tenthline Road and Wall Road via existing culverts.

1.6 Geotechnical Considerations

The following geotechnical investigation report has been prepared by Golder Associates Ltd.

- Report No. 13-1121-0123 Rev #1 June 2017 for the CDP Lands
- Technical Memo Dated July 2018 from the CDP Lands;

Among other items, the report/memo comments on the following:

- Site grading
- Foundation design
- Pavement design
- Sub-surface Conditions
- Groundwater Control
- Seismic design
- Corrosion potential
- Trees
- Site Servicing

In general, the subsurface profile encountered topsoil, underlain by sandy soil, overlying a thick deposit of sensitive silty clay.

One of the critical recommendations from that study included defining the grade raise restriction for the CDP Lands. The report noted a basic grade raise limit of 1.0m, and provided additional limits if supplemental measures were employed. After additional consolidation testing Golder provided a technical memo revising the basic grade raise limit to 1.1m. The report also identified additional investigation would be required at detail design stage to confirm the preliminary recommendations.

A copy of the report and technical memo are included in **Appendix E**.

1.7 Watercourses and Setbacks

McKinnon's Creek bisects the north east quadrant of the subject property. This section of McKinnon's creek was previously enhanced in 2008 to support flows from the Avalon West SWM pond. A recommendation of the 2017 MSS was that this section of the creek was to be further reviewed to determine if additional enhancement would further benefit the upstream infrastructure. This review was recently completed, see IBI report dated May of 2019, "Mer Bleue Urban Expansion Area McKinnon's Creek Stage 1 Evaluation of Enhancement Concepts for Upper Reach". That report provided recommendations to lower this section of the creek and provide an increase in longitudinal slope.

The EMP supporting the CDP identified the requirement to provide a development setback consisting of the greater of 15 m from the top-of-slope or 30 m from the normal high water mark within the urban area for the McKinnon's Creek corridor. **Figure 1.3** in **Appendix A** illustrates the current proposed enhancement of McKinnon's Creek and demonstrates that the setback requirements have been respected for the proposed corridor.

1.8 Pre-Consultation

A pre-consultation meeting was held on September 28, 2018. The meeting notes can be found in **Appendix A**, along with a follow up memo from Parks and Facilities Planning Branch. The following are some of the topics reviewed and discussed, for a full list please see meeting notes:

- Potential enhancements of Upper reach of McKinnon's Creek to be evaluated and based on results detail design of the enhance to be designed as one
- Drainage Engineer's works on McKinnon's Creek on-going
- Avalon West SWM Pond drainage area under review
- Various Studies required to support proposed development, including but not limited to:
  - TIA
  - Planning Rationale
  - Pedestrian Circulation Plan

- Area Park Plan
- Assessment of Adequacy of Public Services Report
- Noise Feasibility Study
- Phase 1 ESA
- TCR
- Geotechnical Report
- Servicing and SWM design briefs
- EIS

It should be noted that in addition to the pre-consultation meeting, a series of meetings and discussions have occurred with the South Nation Conservation Authority, and the Drainage Engineer. No pre-consultation meeting was held with the Ministry of Environment at this time, a meeting will be arranged prior to the start of detail design.

2 WATER DISTRIBUTION

2.1 Existing Conditions

The subject site is located within Pressure Zone 2E of the City of Ottawa's water distribution system. City staff have noted that no specific upgrades to any existing or proposed piping or pumping is required to service these expansion lands. **Appendix B** contains Figure 3 from the MBUEA MSS which illustrates the existing water distribution system adjacent to the study area and shows the 2E water pressure zone boundary which runs through the center of the study area and follows the north and west boundaries. The main feed for Pressure Zone 2E is the Innes Road elevated storage tank at Belcourt Boulevard. There is a strong network of watermains which services the Neighbourhood 4 community to the northeast of the study area. A 610 mm watermain on Innes Road extends from the elevated tank at Belcourt Boulevard east with 406 mm watermains branching south on Tenth Line Road, Esprit Drive and Portobello Boulevard. A network of 406 mm and 305 mm watermains extend south up to the north east corner of the study area. Currently, there is an existing 406mm and 152 mm watermain on Tenth Line Road along a portion of the east boundary of the study area.

Directly north of the study area is the Summerside West development which is presently under development. Completion of this development will provide a network of local and 305 mm watermain connections between the proposed development and the water network in this area.

The opportunity exists to expand the City water network through Phase 1 lands and connect to the NDDC community, (an existing 150mm watermain is located within the Wall Road ROW), which currently has water supply, and connection of the local networks will provide greater overall redundancy in the system.

2.2 Design Criteria

2.2.1 Water Demands

The watermains for the subject site are proposed to be sized based on Tables 4.1 and 4.2 of the City of Ottawa Design Guidelines – Water Distribution, and based on the 2021-03 TSB with updated demands, and are summarized as follows:

- Single Family 3.4 person per unit
- Townhouse and Semi-Detached 2.7 person per unit
- Average Apartment 1.8 person per unit
- Residential Average Day Demand 280 l/cap/day
- Residential Peak Daily Demand 700 l/cap/day
- Residential Peak Hour Demand 1,540 l/cap/day
- ICI Average Day Demand 50,000 l/gross ha/day
- ICI peak Daily Demand 75,000 l/gross ha/day
- ICI Peak Hour Demand 135,000 l/gross ha/day

Fire flow requirements for the subject site shall be calculated by the Fire Underwater Survey and in accordance with Technical Bulletin ISDTB-2014-02. The following "C" valves will be used in the design of the watermain pipes.

PIPE DIAMETER (MM)	C-FACTOR
150	100
200 to 250	110
300 to 600	120
Over 600	130

A watermain demand calculation sheet is included in **Appendix B** and the total water demands are summarized as follows:

Average Day	11.55 l/s
Maximum Day	23.58 l/s
Peak Hour	48.71 l/s

2.2.2 System Pressure

The 2010 City of Ottawa Water Distribution Design Guidelines states that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.
Maximum Pressure	Maximum pressure at any point in the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls may be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

2.3 Proposed Water Distribution System

2.3.1 Hydraulic Model

The recommended water distribution system illustrated in the MSS was hydraulically modeled by Stantec. See Appendix F in Mer Bleue Urban Expansion Area 10 MSS Report - (Dated 2017 November), which contains Stantec's detail report regarding the water network analysis.

Based on the existing hydraulic grade line in Zone 2E, operating pressures in the Mer Bleue Expansion Study Area (MBESA) development are not anticipated to drop below 276 kPa (40 psi) or exceed 552 kPa (80 psi). Hydraulic modelling results show that during basic day conditions and peak hour conditions, the proposed system is capable of operating between the objective pressure ranges or 345–483 kPa (50-70 psi). During emergency conditions, the proposed system is capable of providing sufficient fire flow while maintaining a residual pressure of 138 kPa (20 psi) using the proposed pipe layout and sizing.

A reliability analysis was also performed by Stantec to examine critical watermain breaks on the future 406 mm diameter watermains on Mer Bleue and Tenth Line. Hydraulic modelling results showed that the proposed layout and sizing is capable of providing basic day plus fire flow while

maintaining a residual pressure of 138 kPa (20 psi) in the system under these critical watermain breaks.

Although no facility upgrades are required for the MBESA, the future 406 mm diameter watermains on Mer Bleue and Tenth Line are required to service the MBESA.

2.3.2 Phase 1 Proposed Water Plan

Figure 2.1 in **Appendix B** illustrates the conceptual Water Distribution System for Phase 1. The network utilizes a typical hierarchy of watermain sizes to provide necessary domestic and fire flows to support the development. The conceptual network includes extension of 400mm diameter water trunk along Tenth Line Road which is interconnected to the development via a 300mm dia main along Wall Road.

At detail design stage for the study area, updated boundary conditions will be obtained from the City of Ottawa and a detailed hydraulic analysis will be completed to confirm the proposed water network can provided the required flows in accordance with the City of Ottawa, MOECP, and Fire Underwriters.

3 WASTEWATER DISPOSAL

3.1 Existing Conditions and Previous Studies

The proposed sanitary outlet for the MBUEA is the existing Tenth Line Pump Station (TLPS) located immediately north of the study area on the west side of Tenth Line Road, as illustrated in **Figure 4** of the MBUEA MSS a copy is included in **Appendix C. Figure 4** also illustrates the existing wastewater system within the area.

The Tenth Line pump station has a design capacity of 425 l/s, and discharges wastewater via dual (305 & 406 mm Ø) forcemains to the upper reach of the Cumberland Trunk (900 mm Ø) located on South Field Way. This facility is currently operating under interim conditions and is currently fitted up to accommodate approximately 50% of its approved capacity.

Adjacent to the study area, there are several buildings with existing private sewage disposal systems. Ultimately, these private systems will need to be decommissioned, all in accordance with MOE requirements, regardless of whether or not the building is retained or demolished under the new lotting fabric of the CDP.

During the development of the preferred wastewater plan for the MBUEA MSS an attribute deemed desirable to include in the preferred plan was the ability to service adjacent lands. The road pattern was designed to provide a linkage to the lots currently developed along Wall Road, and a linkage was also provided to the North Park subdivision currently being developed. Houses within both these areas currently use private sewage disposal systems to deal with their wastewater.

The Wall Road and North Park areas consists of approximately 150 homes within 24.7 Ha. Based on 3.4 p/u, this is a population of approximately 510 persons.

In addition to the above, the potential exists that special zoning would allow for future expansion of the servicing limits boundary to the south west for the inclusion of approximately 49.1 Ha. If this was to occur, based on a density of 65 p/Ha, a population of 3,191 could be realized within these lands. The proposed wastewater system has been sized to accommodate this possible scenario.

The sanitary sewer servicing strategy for the MBUEA development area includes a new pump station in subsequent phases to accommodate the southern portion of the MBUEA lands, future external expansion lands to the south, Wall Road, and the West Park subdivision to the south-west. By utilizing a new pump station at this location a significant reduction in deep trunks in poor soil conditions can be achieved. The proposed road pattern also provides for a connection to existing neighbourhoods which are on private system. These linkages allow for the possible expansion into these developed lands and adjacent vacant lands. The sanitary pump station for this development will be located in the southeast corner of the development adjacent to the proposed southern stormwater management pond. Refer to MBUEA MSS Report (Dated 2017 November) figure 8.2.2 for pump station details. The pump station is not required for the serviceability of the Phase 1 development lands.

3.2 Design Criteria

The sanitary flows for the subject lands are determined based on current City of Ottawa design criteria as per Technical Bulletin ISTB-2018-01, which includes, but is not limited to the following:

3.2.1 Design Flow:

The estimated wastewater flows from the subject site are based on the revised City of Ottawa design criteria. Among other items, these include:

- Average residential flow = 280 l/c/d

- Peak residential flow factor = (Harmon Formula) x 0.80
- Average commercial flow = 28,000 l/s/ha
- Average institutional flow = 28,000 l/s/ha
- Peak ICI flow factor = 1.5 if ICI area is ≤ 20% total area
  1.0 if ICI area is > 20% total area
- Inflow and Infiltration Rate = 0.33 l/s/ha
- Minimum Full Flow Velocity = 0.60 m/s
- Maximum Full Flow Velocity = 3.0 m/s
- Minimum Pipe Size = 200 mm diameter

Population (Residential)	3.4 persons per single family unit
	2.7 persons per semi or townhouse unit
	1.8 persons per apartment unit

3.3 Proposed Wastewater Disposal System

With consideration the MSS level network of sanitary sewers and trunks to service the MBUEA, the Phase 1 sanitary servicing layout is provided **Figure 3.1** in **Appendix C**. **Figure 3.2** illustrates the conceptual tributary area for the trunks and main lines, a sanitary sewer design sheet for the trunk sewers is included in **Appendix C.** The conceptual layout closely follows the intent of the MSS, with the Mattamy lands north of Phase 1 being considered as external tributary flows through the main trunks within the proposed draft plan. The Phase 1 plan consists of extending the trunk main from the existing TLPS south on Tenth Line Road until it is redirected internal to the subject lands. A future twin 200mm forcemain is anticipated further south on Tenth Line Road to service future Phases within the MBUEA, and external lands to the south.

To contain the sanitary HGL during catastrophic failure at the existing pump station, several sanitary overflows were installed along the existing system, see previously noted **Figure 4** from the MSS for the location of the overflows. These overflows would convey the sanitary flow to the connected storm sewer to prevent basement flooding should an infrequent event occur. As part of the detail design of the proposed sanitary sewer system for Phase 1 it is envisioned a new sanitary overflow as noted in **Figure 3.1** may result in the existing overflows being redundant, to which end they may be removed, or kept as emergency backup. Detailed modelling at detail design will confirm requirements.

4 STORMWATER MANAGEMENT

4.1 Objective

The purpose of this section is to present an overview of the proposed stormwater management servicing for Phase 1 of the Claridge development, including the dual drainage system concept (minor and major system), stormwater management facility, and improvements to McKinnon's Creek.

4.2 Synopsis of previous reports

In December of 2017, IBI Group completed the "Mer Bleue Urban Expansion Area 10 Master Servicing Study", henceforth referred to as the MSS. That study outlined the overall stormwater management servicing for the Mer Bleue area, including the conceptual stormwater management facilities and recommended Mer Bleue McKinnon's Creek improvements downstream of Wall Rd. to accommodate the proposed MBUEA development.

In May of 2019, IBI Group completed the "Mer Bleue Urban Expansion Area McKinnon's Creek Stage 1 Evaluation of Enhancement Concepts for Upper Reach", henceforth referred to as the Upper Reach report. That study outlined the proposed enhancements to McKinnon's Creek from the outlet of the existing Avalon West SWMF to upstream of Navan Rd.

In October 2021, IBI completed the "Mer Bleue Urban Expansion Area Northern Stormwater Management Facility" Design Brief. The brief outlines the design constraints and regulatory requirements, along with the hydrologic and Hydraulic evaluation of the proposed SWMF.

4.3 Existing Conditions

Lands within the study area have been actively farmed and are serviced by a series of swales and ditches which have been constructed over the years to assist, primarily, the farming of these lands. Other ditches were constructed to facilitate the construction and operation of existing municipal roads within and abutting the study area. The vast majority of these drainage features discharge into McKinnon's Creek. **Figure 5** in **Appendix D** is taken from the MBUEA MSS and illustrates the location of these swales. It also illustrates the location of the existing SWM facility located immediately north of the study area. This SWM pond (Avalon West) was constructed to service the development lands to the north (Neighbourhood 5). The pond has since been expanded to accommodate Phase 4 of the adjacent Summerside West development. In addition, a small 4.4 Ha area within the proposed Draft Plan will also drain via Summerside West Phase 4 to the expanded pond. The pond outlets to McKinnon's Creek which at the time of the original SWM pond construction was channelized to facilitate the conveyance from Pond 5.

While not located within Phase 1, several municipal drains are located in the area. The Tasse Regimbald Municipal Drain and the Lalonde Cleroux Municipal Drain are located in the southern portion of the MBUEA CDP area. These Drains currently provide drainage for the southern portion of the CDP site, south of Wall Road. These Drains, or portions thereof, will be formally closed in accordance with the Municipal Drainage Act to allow for the orderly development of the lands within the CDP. The Ottawa Front Municipal Drain currently provides drainage for a small portion of the western edge of the CDP lands along Mer Bleue Road. The previously noted **Figure 5** illustrates the location of the existing Municipal Drains adjacent to the subject lands. In addition the MBUEA Land Owners Group has petitioned the City of Ottawa to commence the process of creating a Municipal Drain (under the Drainage Act) along the McKinnon's Creek corridor from the limits of the Avalon West SWM pond to the confluence with the existing Richard Clarke MD downstream of Smith Rd).

4.4 Overall Stormwater Management System

As outlined within the MSS, the overall stormwater management system proposed for the MBUEA consists of a hierarchy of storm sewers which collect stormwater runoff from the development area and utilize end of pipe treatment facilities before discharging into the recommended stormwater outlet which is approximately 2400 m of enhanced McKinnon's Creek.

The Phase 1 development will be serviced by the proposed stormwater management facility (identified as the Northern SWMF in the MSS), which will discharge to the improved McKinnon's Creek downstream of Wall Rd. The following sections provides a description of how the proposed system will function. The proposed stormwater system incorporates standard urban drainage design and stormwater management features that can be summarized as follows:

- A dual drainage concept;
- Major system conveyance with on-site detention;
- End of pipe stormwater Management Facility
- Improved McKinnon's Creek

4.5 Dual Drainage Design

The subject lands will be designed to be consistent with the findings of the MSS, City of Ottawa sewer design Guidelines (OSDG October 2012), the OSDG guidelines of September 2016 Technical Bulletin PIEDTB-2016-01, and the February 2014 Technical Bulletin ISDTP-2014-1.

The site will be designed with dual drainage features, accommodating minor and major system flows. During frequent storm events, the effective runoff of a catchment area is directly released via catch basin inlets to the network of storm sewers, called the minor system. During less frequent storm events, the balance of the flow (in excess of the minor flow) is accommodated by a system of street segments, and in some cases oversized storm sewers, called the major system.

Where possible, storage will be provided in street sags or low points within the roadway and once the maximum storage is utilized, the excess flow will cascade to the next downstream street sag. Inlet control devices (ICD's) will be proposed across the site to maximize the use of available on-site storage and control surcharge to the minor system.

The final design of the subject lands will demonstrate that minor system capture and major flow conveyance is consistent with the findings of the MSS and the Ottawa Sewer Design Guidelines.

4.5.1 Minor System

The minimum minor system capture of ICDs for the Phase 1 site will be based on 2 year SWMHYMO generated flows for all individual areas, with the exception of collector roads which will be based on a 5 year capture. The subject site will be modelled using SWMHYMO to confirm minor and major system flows. Hydrographs from the site will be downloaded to XPSWMM hydraulic model to confirm hydraulic grade line within the proposed storm sewers.

4.5.2 Major System

Inlet control devices (ICDs) will be proposed to control the surcharge in the minor system during infrequent storm events and maximize the use of available on site storage. Due to the relatively flat topography of the site, on-site storage will be maximized throughout the site. Surface runoff in excess of the minor system capture will cascade via street segments and rear yard swales to the outlets from the site.

4.6 End-of-Pipe SWM Facility

In accordance with the CDP, the Phase 1 lands will be tributary to the proposed SWMF identified as the Northern SWMF. The facility will be located at the northwest corner of the intersection of Tenth Line Rd. and Wall Rd. The proposed SWMF has been designed to provide water quality and quantity control of stormwater flows discharging to the enhanced McKinnon's Creek downstream. The SWMF is illustrated within **Figure 4.1** in **Appendix D**.

To address the water quality criteria of the subject site and receiving McKinnon's Creek, the proposed Mer Bleue SWM facility will be designed to provide an Enhanced Level of Protection. According to the MOE Stormwater Management Planning and Design Manual (March 2003), treatment volume is a function of drainage area, type of pond, urban imperviousness ratio, and Level of Protection. The Enhanced Level of Protection corresponds to end-of-pipe storage volumes required for the long-term average removal of 80% of total suspended solids.

The Conceptual SWM facility was sized to provide water quantity control to maintain pre-development flow rates in the receiving McKinnon's Creek downstream. The outflow from the North and South SWM facilities will discharge into a shared storm sewer and be conveyed to McKinnon's Creek. There will be no other flow contribution to the storm sewer other than the outflow from the two SWM facilities. The storm sewer is proposed to be a 1650 mm diameter pipe and connected to McKinnon's Creek at an invert of 79.40 m.

4.7 Improved McKinnon's Creek

As outlined within the MSS and refined within the Upper Reach report, in order to provide a sufficient outlet for the proposed stormwater solution, McKinnon's Creek is required to be deepened and rehabilitated from the outlet of the proposed Mer Bleue SWM facilities to approximately the unopened road allowance located approximately 2.4 kilometers downstream. The enhancement will include the deepening and widening of the creek to contain the 1:100 flood plain within the banks of the rehabilitated creek, and lower the 1:100 yr. level upstream to minimize the need for lightweight fill within the development area. The conceptual McKinnon's Creek enhancements are illustrated within **Figure 4.2** in **Appendix D**. All of the above works will form part of a larger overall Municipal Drain project the AJ Robinson is currently undertaking.

4.8 Hydrological Analysis

Hydrological analysis of the proposed dual drainage system of the subject site will be conducted using SWMHYMO. This technique offers a single storm event flow generation and routing. The primary focus of the hydrological analysis will be to evaluate surface flow and ponding conditions during the 100 year storm event in order to satisfy City of Ottawa Sewer Design Guidelines (2012) in terms of velocity x depth. The 2 and 5 year simulation will be performed to assure that after the storm is over there will be no ponding on local and collector streets.

4.8.1 Design Storms and Drainage Area Parameters

The following design parameters will be used in the evaluation of the stormwater management system for the subject site:

4.8.2 Design Storms

- 2 year, 5 year, and 100 year, 3 hour Chicago storm event with a 10 minute time step, including a 100 year + 20% 3hr Chicago storm per ISDTB-2012-1;
- July 1, 1979 and August 8, 1996 Historical storms as per the City of Ottawa Sewer Design Guidelines (2012).

- 100 year, 12 hour SCS type II storm event with a 20% increase in intensity, as per the Technical Bulletin ISDTB-2012-1

4.9 Storm Sewer Design Criteria

The minor system storm sewers for the subject site will be sized based on the rational method, applying standards of both the City of Ottawa and MOECC. Some of the key criteria for this site include the following:

- Sewer Sizing: Rational Method
- Design Return Period: 1:2 year (local streets)
  1:5 year (collector streets)
  1:10 year (arterial roads)
- Initial Time of Concentration 10 minutes
- Manning's: 0.013
- Minimum Velocity: 0.80 m/s
- Maximum Velocity: 3.00 m/s
- Minimum Slope:

PIPE DIAMETER (MM)	SLOPE (%)
250	0.432
300	0.34
375	0.25
450	0.195
525	0.16
600	0.132
675	0.113
750 and larger	0.1

- Runoff Coefficients (to be confirmed at detailed design stage):

LAND USE		RUNOFF COEFFICIENT
Residential	Low Density	0.65
	Medium Density	0.70
	High Density	0.80
Commercial		0.75
Green Space		0.30
Institutional		0.75
Park		0.20
Transitway		0.82
Arterial Road		0.82
Collector Road		0.82

Figure 4.3 illustrates the conceptual layout of the proposed minor system to service the Phase 1 lands. **Figure 4.4** illustrates the conceptual tributary area for the trunks and main lines, a storm sewer design sheet for the trunk sewers is included in **Appendix D.** The final layout and sizing will be confirmed during the detailed design process.

5 ROADS AND GRADING

Lot level grading for the proposed detail design of the development will be required to meet the City of Ottawa grading criteria, however, this is to be completed with consideration of the macro grading requirements which include but are not limited to the following: Overland Flow Routing, Storm and Sanitary HGL, and geotechnical grade raise limit.

5.1 Overland Flow Routing

Previous sections identified the proposed storm servicing will include overland routing of major storm runoff within the development. The conveyance route will be required to accommodate various major storm scenarios limiting ponding depth to 0.3 m, and the depth X velocity ratio of 0.6 m^2/s is not to be exceeded. A preliminary overland routing was established along the proposed street pattern to allow for the conveyance of major storm to the appropriate outlet per City of Ottawa Design Guidelines, final routing will be established at detail design.

5.2 Storm and Sanitary HGL

Previous sections noted the requirements for the design of the storm and sanitary systems. The key element impacting the macro grading is the City of Ottawa requirement for 0.3 m freeboard between the respective 1:100 yr. HGL and building underside of footing (USF). While each system was modelled separately in the MSS, the modelling was completed iteratively to establish a balance between the two systems. Two factors intertwined the systems, sanitary overflow into the storm system (at 1:100 yr. level), plus pipe crossing coordination. The resulting HGL's were added to the respective sewer servicing plans, and the USF's were noted respecting the governing HGL. A typical residential foundation depth of 2.89 m was used from USF to finished floor elevation. Detailed HGL modelling analysis will be completed for the respective systems at detail design stage and the results used to establish minimum USF.

5.3 Geotechnical Grade Raise

As part of the MSS Golder Associates completed an initial evaluation of the existing soils and identified a preliminary maximum permissible grade raise limit of 0.3 m. Subsequent to that report, Golder's has been undertaking a grade raise test pad program on-site. While the program is still ongoing at this point, Golder is able to issue their memo of July 16, 2018 in **Appendix E** which stipulates that the maximum permissible grade raise can be adjusted to 1.1 m (applicable to the entire site). In areas where the proposed grading exceeds the above noted limit several options exist including additional site specific testing/analysis to increase the limit or possibly use one of the following supplemental measures:

1. Expanded Polystyrene (EPS) light weight fill could be used to backfill beneath/within the garage and porches.
2. EPS light weight fill could be used to backfill around the foundation (in addition to item 1 above).
3. For areas requiring significantly more grade raise these areas could be preloaded.

Based on the above noted maximum grade raise, the macro grading should respect the grade raise requirement and note any areas of which exceed the allowable and which will require supplemental measures.

A detailed site specific geotechnical report to support detail design of the subject property will be completed in accordance with City of Ottawa guideline, and submitted with the detail design package.

5.4 Preliminary Grading

Based on the requirements of overland flow route continuity, storm and sanitary HGL, geotechnical permissible grade raise limit plus other factors, a conceptual macro grading plan has been prepared for the proposed draft plan and is illustrated in **Figure 5.1** in **Appendix E**.

Detailed grading plans will be submitted with the detailed design package and will follow the City of Ottawa guidelines which include but are not limited to the following:

- Grading of landscaped areas from 2% to 7%,
- Where required terracing not to exceed 3:1,
- Swales to be minimum 0.15m deep with typical 3:1 side slopes,
- Swales with slopes between 1% and 1.5% shall include perforated subdrains,
- Maximum driveway slopes 6%,
- Minimum freeboard from ponding to building opening 0.3m

6 SEDIMENT AND EROSION CONTROL PLAN

6.1 General

During construction, existing stream and conveyance systems can be exposed to significant sediment loadings. Although construction is only a temporary situation, it is proposed to introduce a number of mitigative construction techniques to reduce unnecessary construction sediment loadings. These will include:

- groundwater in trench will be pumped into a filter mechanism prior to release to the environment;
- bulkhead barriers will be installed at the nearest downstream manhole in each sewer which connects to an existing downstream sewer;
- seepage barriers will be constructed in any temporary drainage ditches;
- filter cloths will remain on open surface structure such as manholes and catchbasins until these structures are commissioned and put into use; and
- Silt fence on the site perimeter.

6.2 Trench Dewatering

Any trench dewatering using pumps will be discharged into a filter trap made up of geotextile filters and straw bales similar in design to the OPSD 219.240 Dewatering Trap. These will be constructed in a bowl shape with the fabric forming the bottom and the straw bales forming the sides. Any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filters as needed including sediment removal and disposal and material replacement as needed.

6.3 Bulkhead Barriers

At the first new manhole constructed within the development that is immediately upstream of an existing sewer a temporary bulkhead will be constructed to limit flow from the sewer to not exceed the peak design flow. In addition to controlling peak flow this bulkhead will trap any sediment carrying flows thus limiting construction-related contamination of existing sewers. The bulkheads will be inspected and maintained including periodic sediment removal as needed and removed prior to top course asphalt being laid.

6.4 Seepage Barriers

The presence of road side ditches along Tenthline Road and Wall Road necessitate the installation of seepage barriers. These barriers will consist of both the Light Duty Straw Bale Barrier as per OPSD 219.100 or the Light Duty Silt Fence Barrier as per OPSD 219.110. The barriers are typically made of layers of straw bales or geotextile fabric staked in place. All seepage barriers will be inspected and maintained as needed.

6.5 Surface Structure Filters

All catchbasins, and to a lesser degree manholes, convey surface water to sewers. However, until the surrounding surface has been completed these structures should be covered in some fashion to prevent sediment from entering the minor storm sewer system. Until landscape are sodded or until roads are asphalted and curbed, catchbasins and manholes will be constructed with geotextile filter bags located between the structure frame and cover respectively. These will stay in place and be maintained during construction and build until it is appropriate to remove same.

6.6 Stockpile Management

During construction of any development similar to that proposed by the Owner, both imported and native soils are stockpiled. Mitigative measures and proper management are required to prevent these materials entering the sewer systems or surrounding ditches.

During construction of the deeper municipal services, water, sewers and service connections, imported granular bedding materials are temporarily stockpiled on site. These materials are however quickly used up and generally before any catchbasins are installed.

The roadway granular materials are not stockpiled on site. They are immediately placed in the roadway and have little opportunity of contamination. Lot grading sometimes generates stockpiles of native materials. However, this is only a temporary event since the materials are quickly moved off site.

To assist in the control of transporting sediment off-site into municipal road side ditches and adjacent McKinnon's Creek, mud matts will be employed at the construction entrances. Additionally, an interceptor swale on both sides of McKinnon's creek will we constructed to intercept any surface runoff transporting sediment. The swale will convey the runoff to a sediment trap complete with dewatering facility such as OPSD 219.240, before discharging into McKinnon's Creek. The above is illustrated in **Figure 6** Erosion and Sediment Control Plan.

7 APPROVALS AND PERMIT REQUIREMENTS

7.1 City of Ottawa

The City of Ottawa will review all development documents including final working drawings and related reports. Upon completion, the City will approve the local watermains, and submit the sewer extension MOECP application under the transfer review program to the province and eventually issue a Commence Work Notification for servicing and utility works.

7.2 Province of Ontario

The Ministry of Environment Conservation and Parks (MOECP) will approve the local sewers and SWM facility under Section 53 of the Ontario Water Resources Act and issue an Environmental Compliance Approval. A Permit To Take Water may also need to be issued by the MOECP.

7.3 Conservation Authority

The South Nation Conservation Authority will be providing permits for works within the McKinnon's Creek corridor.

7.4 Federal Government

There are no required permits, authorizations or approvals needed expressly for Claridge's Phase 1 from the federal government. However, DFO approval will be required for Habitat compensation along the McKinnon's Creek corridor being completed by the Mer Bleue Owners Group.

7.5 Drainage Act

The City has appointed a Drainage Engineer to create a Municipal Drain under the Drainage Act along McKinnon's Creek, McKinnon's Creek Municipal drain will be the legal outlet for the MBUEA. In addition, as the MBUEA are developed two existing Municipal Drains are within the development area, these drains will be closed under the drainage act.

8 CONCLUSIONS AND RECOMMENDATIONS

Infrastructure necessary for the orderly development of Phase 1 of Claridge's Mer Bleue lands can be constructed or extended to adequately service the site. This includes but is not limited to the following:

- Watermains designed in accordance with City of Ottawa guidelines extending from Tenth Line Road, and the existing Summerside West development to provide domestic and fire flows in accordance with governmental requirements to service the proposed development.
- Sanitary sewers designed in accordance with City of Ottawa guidelines extending from the proposed Summerside development (discharging to the existing Tenth Line Sanitary pump station) will service the proposed development.
- SWM facility designed in accordance with City of Ottawa guidelines will service the proposed development, the SWM facility will be designed to provide 80% TSS removal and will discharge into McKinnon's Creek. An enhanced McKinnon's creek under the Drainage Act will become a Municipal drain to provide legal outlet for the SWM facility.
- Storm sewers designed in accordance with City of Ottawa guidelines will discharge into the proposed SWM facility
- Grading of the site will be design in accordance with City of Ottawa guidelines. Geotechnical constraints limit the Site to a 1.1m grade raise restriction at the dwellings otherwise supplemental measures are required. Finished grades along the road network will be design to assist in the conveyance of major storm runoff to the SWM facility.
- Sediment and erosion control measures employed during construction will minimize harmful impacts on surface water.

This report has provided supporting documentation demonstrating the subject lands can be developed in an orderly and effective manner and in accordance with the City of Ottawa's current level of service requirements.

From an assessment of major municipal infrastructure perspective, it is recommended that the development application for Claridge's Phase 1 of their MBUEA lands be accepted and that the development of the property move forward.

Report Prepared By:

Ryan Magladry, C.E.T
Project Manager

Demetrius Yannoulopoulos, P. Eng.
Director, Ottawa Office Lead

J:\116761_MerBleuePh1\5.2 Reports\5.2.2 Civil\5.2.2.1 Sewers\APSR #1\CTR_APSR_2018-12.docx\2021-11-18\KK

APPENDIX A

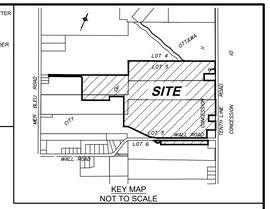
- Proposed Draft Plan
- Figure 1.2 Existing Topography
- Figure 1.3 Proposed McKinnon’s Creek Corridor
- Pre-consultation Meeting Notes
- Parks Pre-consultation Follow up

SUBJECT TO THE CONDITIONS, IF ANY, SET FORTH IN OUR LETTER DATED

_____

THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT.
THIS _____ DAY OF _____, 20__.

JEFF MCEWEN, P. ENG. MANAGER,
DEVELOPMENT REVIEW-EAST
PLANNING, INFRASTRUCTURE AND ECONOMIC
DEVELOPMENT DEPARTMENT, CITY OF OTTAWA



DRAFT PLAN OF SUBDIVISION OF

PART OF LOTS 5 And 6
CONCESSION 11
Geographic Township of Cumberland
CITY OF OTTAWA
Prepared by Annis , O'Sullivan , Vollebekk Ltd.

Scale 1 : 1250

Metric
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

Surveyor's Certificate

I CERTIFY THAT :

1. This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act and the Land Titles Act and the regulations made under them.
2. The survey was completed on the __ day of _____, 2019.

_____ Date

_____ V. Andrew Shelp
Ontario Land Surveyor

OWNER'S CERTIFICATE

This is to certify that we are the owners of the lands to be subdivided and that this plan was prepared in accordance with our instructions.

_____ Date

_____
Jim Burghout
CLARIDGE HOMES (MER BLEU) INC.
I have the authority to bind the corporation.

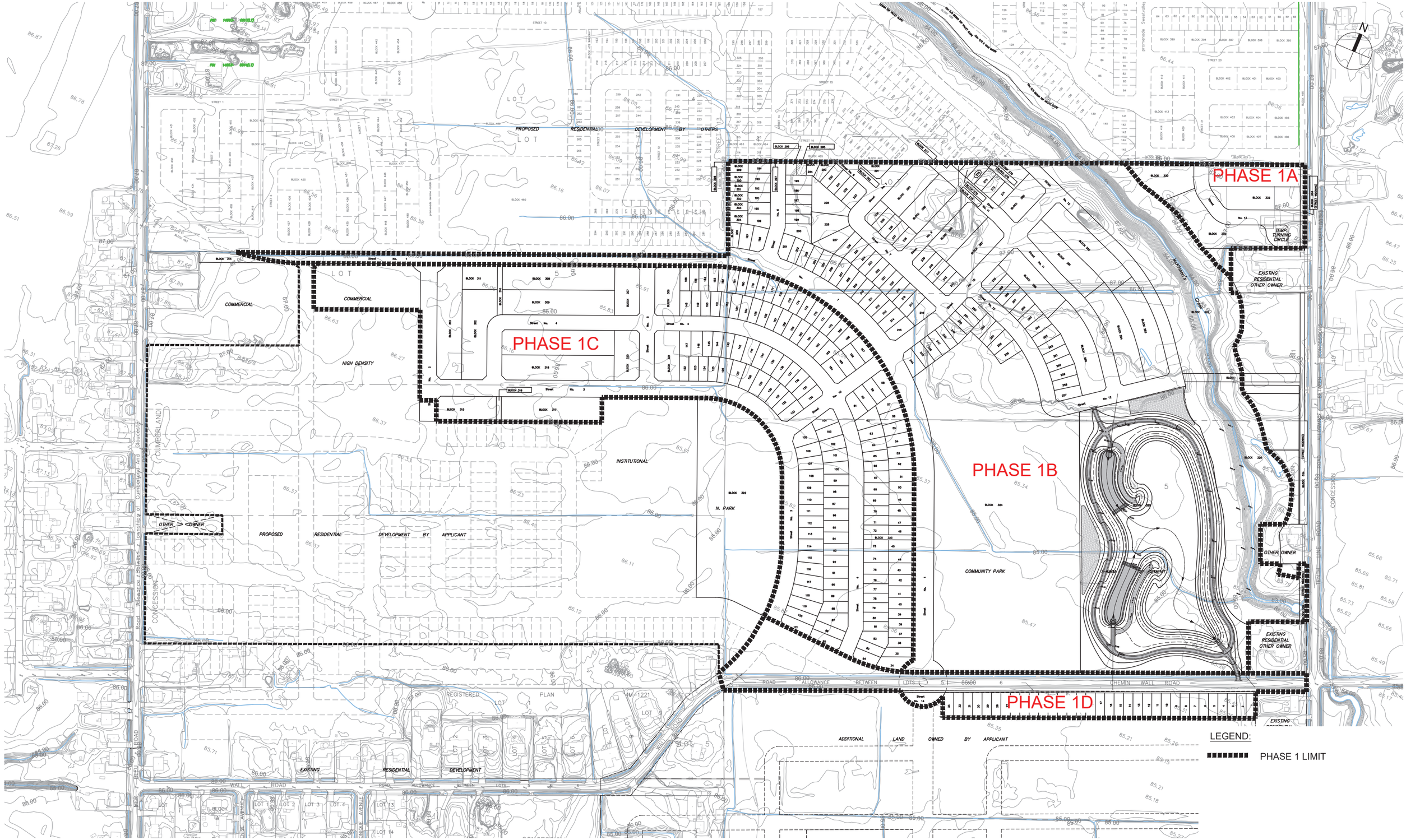
ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51-17 OF THE PLANNING ACT

(a) see plan
(b) see plan
(c) see plan
(d) single family, multi-family residential housing, park land, open space and storm water management
(e) see plan
(f) see plan
(g) see plan
(h) City of Ottawa
(i) see soils report
(j) see plan
(k) sanitary, storm sewers, municipal water, bell, hydro, cable and gas to be available
(l) see plan

REVISION SCHEDULE			
NO.	REVISION	DATE	BY
1	PLAN PREPARED	APR. 1, 2019	N

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

Job No. 17547-19 Dwg# Pl Ln 5 6 Cl 0U PHI DPS DI | N



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Project Title

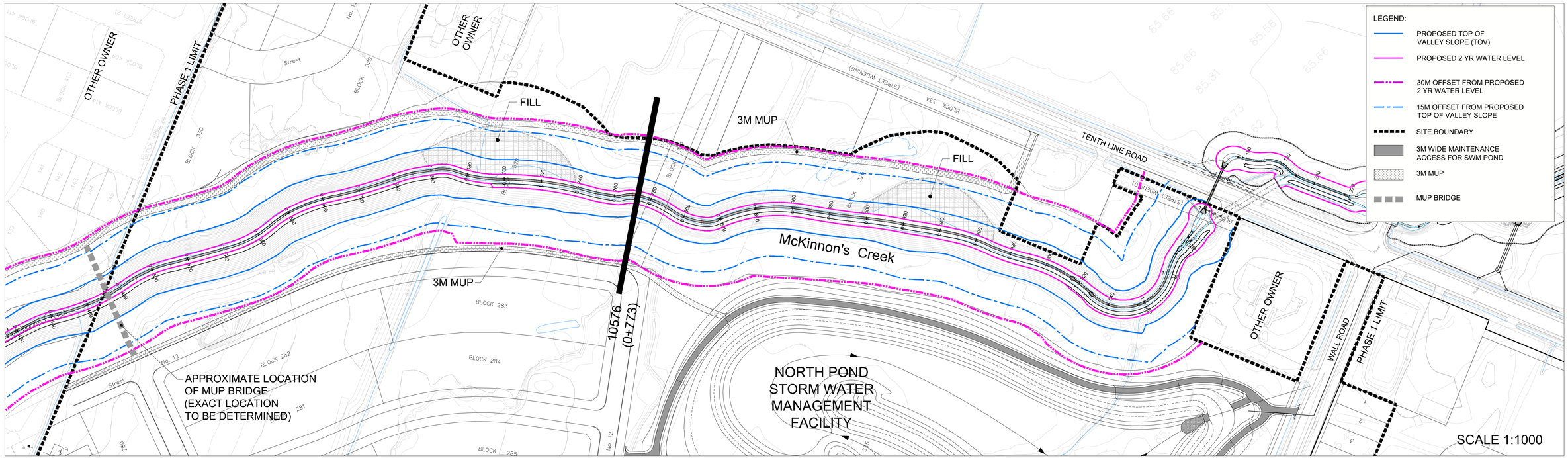
MER BLEUE
PHASE 1

Drawing Title

EXISTING TOPOGRAPHY

Sheet No.

FIGURE 1.2



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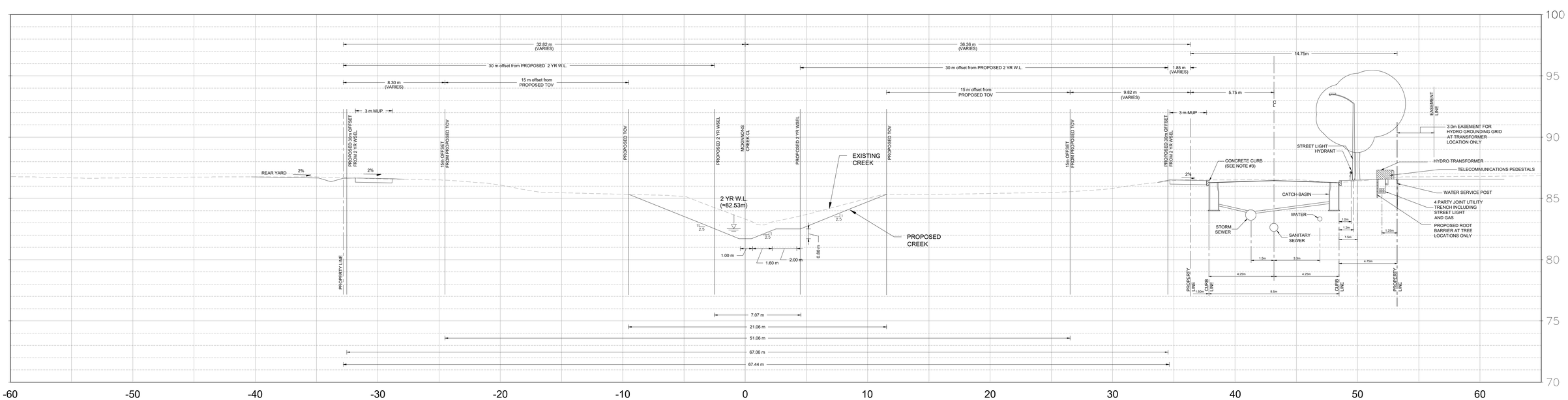


Scale	Project Title	Drawing Title	Sheet No.
IBI H = 1:150 V= 1:150	MER BLEUE DEVELOPMENT PHASE 1	MER BLEUE PROPOSED CORRIDOR	FIGURE 1.3

From: "Murshid, Shoma" <Shoma.Murshid@ottawa.ca>
Date: October 11, 2018 at 3:09:46 PM EDT
To: 'Jim Burghout' <jim.burghout@claridgehomes.com>
Cc: 'James Holland' <jholland@nation.on.ca>, "Boyer, Jennifer" <Jennifer.Boyer@ottawa.ca>, "Reed, Kerry" <kerry.reed@ottawa.ca>, "Curry, William" <William.Curry@ottawa.ca>, "White, Joshua (Planning)" <Joshua.White@ottawa.ca>, "Giles, Peter" <peter.giles1@ottawa.ca>, "'Vincent Denomme'" <vincent.denomme@claridgehomes.com>, "Young, Mark" <Mark.Young@ottawa.ca>, "Wood, Mary Ellen" <MaryEllen.Wood@ottawa.ca>
Subject: Pre-Consultation Follow Up for 2559 Mer Bleue Road - Zoning and Subdivision

Jim and Vincent,

Thank you for meeting with us this past September 28, 2018 to discuss your zoning by-law amendment and plan of subdivision requirements at 2559 Mer Bleue Road. The discussion was based on a proposal shown within the attached plan. This proposal will be triggering an Application for a New Development, Plan of Subdivision and a Major Zoning By-law Amendment. The plan of subdivision submission fee that will be applicable for 251 or more dwelling units plus non-residential uses has a corresponding planning fee of $81,935.56 PLUS Initial Engineering design Review and Inspection Fee of $10,000 (for infrastructure and landscaping value greater than $300K) Plus Initial Conservation Authority Fee of $3,610 + HST. The Zoning By-law Amendment Fee is $16,545.30 Plus an Initial Conservation Authority Fee of $360.00.

As multiple applications will be submitted at the same time, each planning fee will be reduced by 10%. Please note that if you make your applications in 2019, the planning fees are subject to change.

The following are required plans and reports, when both development review applications are submitted concurrently, for the applications to be deemed complete:

Draft Plan of Subdivision (10 plans + PDF) - please ensure creek block with proper setbacks are shown, as detailed in the EMP.

A CD containing the Draft Plan of Subdivision in AutoCAD or MicroStation CAD format (See technical requirements on application form).

Planning Rationale (4 copies + PDF) -Detailed report - including Design Statement, CDP requirements and targets, Integrated Environmental Review Statement summary, requested zoning's concept plan, zoning request, which should include tables, rationales for the rezoning and to what, and identification of any exceptions to requested zoning (if required), McKinnon's Creek corridor, buffer around creeks, woodland blocks, etc., discussion and status of the most recently submitted EMP, MSS and Drainage Act processes and implications for the area within this subdivision and zoning jurisdiction, including but not limited to describing the processes for updating hydraulic and hydrologic models for any modifications to McKinnon's Creek to demonstrate no negative impacts to upstream and downstream erosion and flooding

and acknowledgement of the current Regulation Limit under Ontario Regulation 170/06) – may be same document as the one submitted for Zoning By-law Amendment application
Concept Plan (3 copies + PDF) - which includes the proper McKinnon's Creek Corridor, MUP, and pedestrian footbridge(s)
Pedestrian Circulation & Connection Plan (3 copies + PDF) - may be combined with the Concept Plan

Community Transportation Study (7 copies + PDF) as per the approved and attached TIA Guidelines
Roadway Modification Plan (maybe required, depending on conclusions of the Community Transportation Study (If triggered, please contact us about the submission requirements regarding number of plans)
TCR (5 copies + PDF)
Area Park Plan (CDP Parks Master Plan) (5 copies+ PDF) (stand-alone document)
Functional Servicing Report (7 copies + PDF)
Sanitary Sewer Analysis for Area 10 (4 copies + PDF)
Geotechnical Report, with Limit of Development line included (4 + PDF)
Servicing and SWM Design Briefs (4 copies + PDF)
Survey Plan (2 copies + PDF)
Topographical Plan of Survey (2 copies + PDF)
McKinnon's Creek Corridor Concept Plan - showing full setbacks as detailed in Section 4-4 of the EMP; Multi-Use Pathway, landscaping, rehabilitation features and hazard limits of meander belt widths. This will include Cross –Sections at a minimum of 3 specific locations.
ToR* (5 copies + PDF)
Noise Feasibility Study (3 copies + PDF)
Phase 1 ESA (5 copies + PDF)
Environmental Impact Statement/Impact Assessment of Endangered Species (7 copies + PDF)
Creek Cross Sections (5 cross sections) (4 copies + PDF)
Corridor Concept Plan (5 copies + PDF)
Headwater Drainage Feature Assessment/ Aquatic Habitat Assessment (5 copies + PDF)

The following need to be taken into consideration when finalizing your draft plan of subdivision application:

Attached, you will find Parks comments.

East-west Collector street needs to be intersecting the locals at 90 degrees, as we discussed the other day.

Development should be set back 30 m from the normal high water mark or 15 m from top of bank, whichever is greater.

An EIS is required as the subject property is located within 30 m of an Urban Natural Feature as designated on Schedule B of the OP and located in or within 120 m of known or potential significant habitat for an endangered or threatened species. A survey for grassland birds and butternut will need to be completed and the butternut health assessment from 2014 will need to be updated. In addition to grassland birds, the EIS will need to focus on the wooded area on the east side of Mer Bleue Road identified on Schedule L1 of the City's Natural Heritage System Overlay for development proposed in or adjacent to the woodlot. The EIS will need to demonstrate that the proposed development will not result in negative impacts to the natural features or their ecological functions.

*A Terms of Reference for the McKinnon's Creek Corridor will need to be prepared not just for this parcel, but for the entire creek corridor from the SWM Pond Outlet to the end of the downstream rural portion.

Cross-section plans demonstrating that infrastructure (eg. Mixed Use Path, road right of ways, etc.) is excluded from within the McKinnon's Creek setbacks

A planting plan within the McKinnon's Creek corridor, as described in the EMP

Please note that prior to Draft Plan of Subdivision Approval, there are to be two Limit of Development lines on the Subdivision Plan layout. 1. One Limit of Development line shall be based upon current cross sections and geotechnical slope analysis. The second Limit of Development line shall show the conclusions of the ultimate scenario, where the required deepening of the overall creek would change the cross sections and or bank slope and would provide a secondary Limit of Development Line.

Besides providing standard information in a Functional Servicing Report (and subsequent Servicing and SWM Design Briefs) to demonstrate consistency with the Area 10 Master Servicing Study, the FSR and Design Briefs need to also provide the following information to demonstrate consistency with improvements required in McKinnons Creek:

1. Documentation to demonstrate compatibility of McKinnons Creek corridor Block with creek restoration requirements currently being developed through Mattamy's Summerside West development, as well as the Drainage Act process underway on McKinnons Creek; and
2. An Implementation Plan that details key pre-requisite milestones that must be completed during the planning, design, and construction of the Drainage Act works, to enable development approvals to be issued during the Planning Act process.

Another requirement Claridge and IBI should be aware of: the need for assessing the impact, and identification of any mitigation measures (such as LIDs) to avoid impacts to Sabourin Creek (located west of Mer Bleu Road) that could result from diverting 35 ha

away from it, to McKinnons Creek (primarily from Claridge's lands), as is discussed in Section 5.5.3.2 of the MSS:

The Ottawa Front Municipal Drain is located west of Mer Bleue Road, illustrated within **Figure 5** from the Existing Conditions Report (within **Appendix B**), and provides drainage for a small portion of the western edge of the subject site, approximately 35ha. The Ottawa Front MD continues in a southerly direction, crossing Navan Road and discharges to an area along the northern edge of the Mer Bleue Bog. This area is also the headwaters for the East Branch of the Savage Municipal Drain. It is anticipated that when this area is urbanized as part of the CDP it will become tributary to an end of pipe SWM facility to service the entire CDP area. It is also anticipated that the end of pipe SWM facilities that will service the urbanized CDP area will be tributary to McKinnons Creek. This would result in the removal of the tributary drainage area from the Ottawa Front Municipal Drain. Additional studies including but not limited to Hydrogeological, Geotechnical and/or Hydrological will be completed in support of the draft plan of subdivision for this area and will assess the impact of this redirection of tributary drainage area to the receiving Ottawa Front Municipal drain. The analysis will also identify if additional SWM (LIDs, etc.) will be required in this portion of the CDP to mitigate loss of frequent flows and/or baseflow (to Ottawa Front MD and downstream recipient Sabourin Creek).

The potential impact could largely be offset by a separate 30 ha diversion of drainage away from Mud Creek, into the Savage Municipal Drain as illustrated in the figure below that is sourced from an Area 10 MSS appendix:

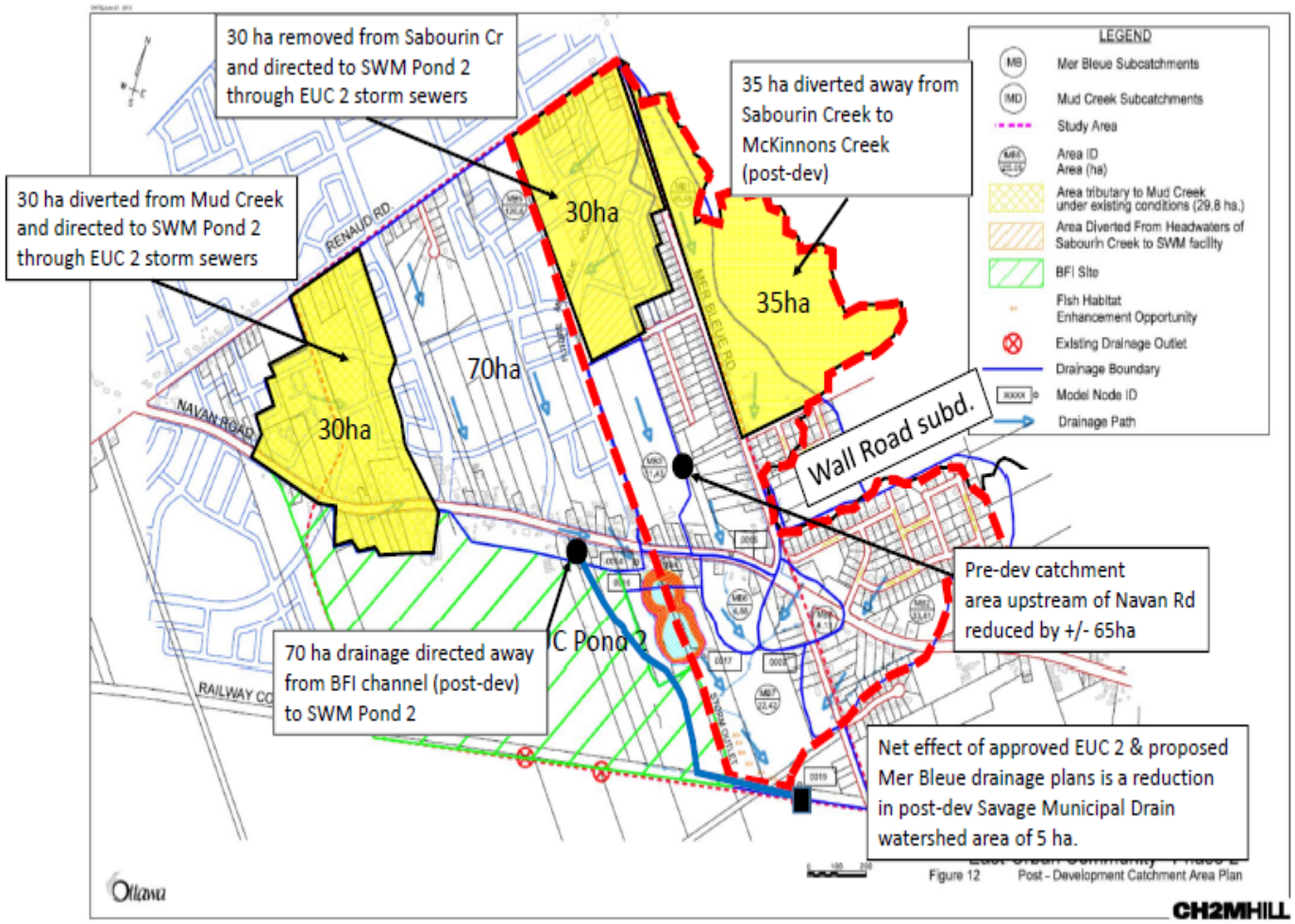


Figure 12 Post - Development Catchment Area Plan

Please do not hesitate to contact me should there be any questions or concerns related to the discussions and requirements above.

Regards,

Shoma Murshid, MCIP, RPP
File Lead, Planner II
Responsable de dossier, urbaniste II
City of Ottawa/ Ville d'Ottawa
Development Review (Suburban Services, East)/ Examen des projets d'aménagement (Services suburbains Est)
Planning, Infrastructure, and Economic Development Department/ Service de la planification, de l'infrastructure et du développement économique
110 Laurier Avenue West, 4th Floor, Ottawa ON K1P 1J1/ 110, avenue Laurier Ouest, 4e étage, Ottawa (Ontario) K1P 1J1
Mail Code/ Code de courrier : 01-14
Tel/ Tél: (613) 580-2424 ext. 15430
Fax/ Téléc. : (613) 580-4751
e-mail/ courriel : shoma.murshid@ottawa.ca
www.ottawa.ca

M E M O / N O T E D E S E R V I C E

To / Destinataire	Shoma Murshid, Planner Development Review East Branch	File/N° de fichier: Pre-consultation application
From / Expéditeur	Mary Ellen Wood, Planner Parks and Facilities Planning Branch	
Subject / Objet	Draft Plan of Subdivision & Zoning 2559 Mer Bleue - Claridge	Date: October 3, 2018

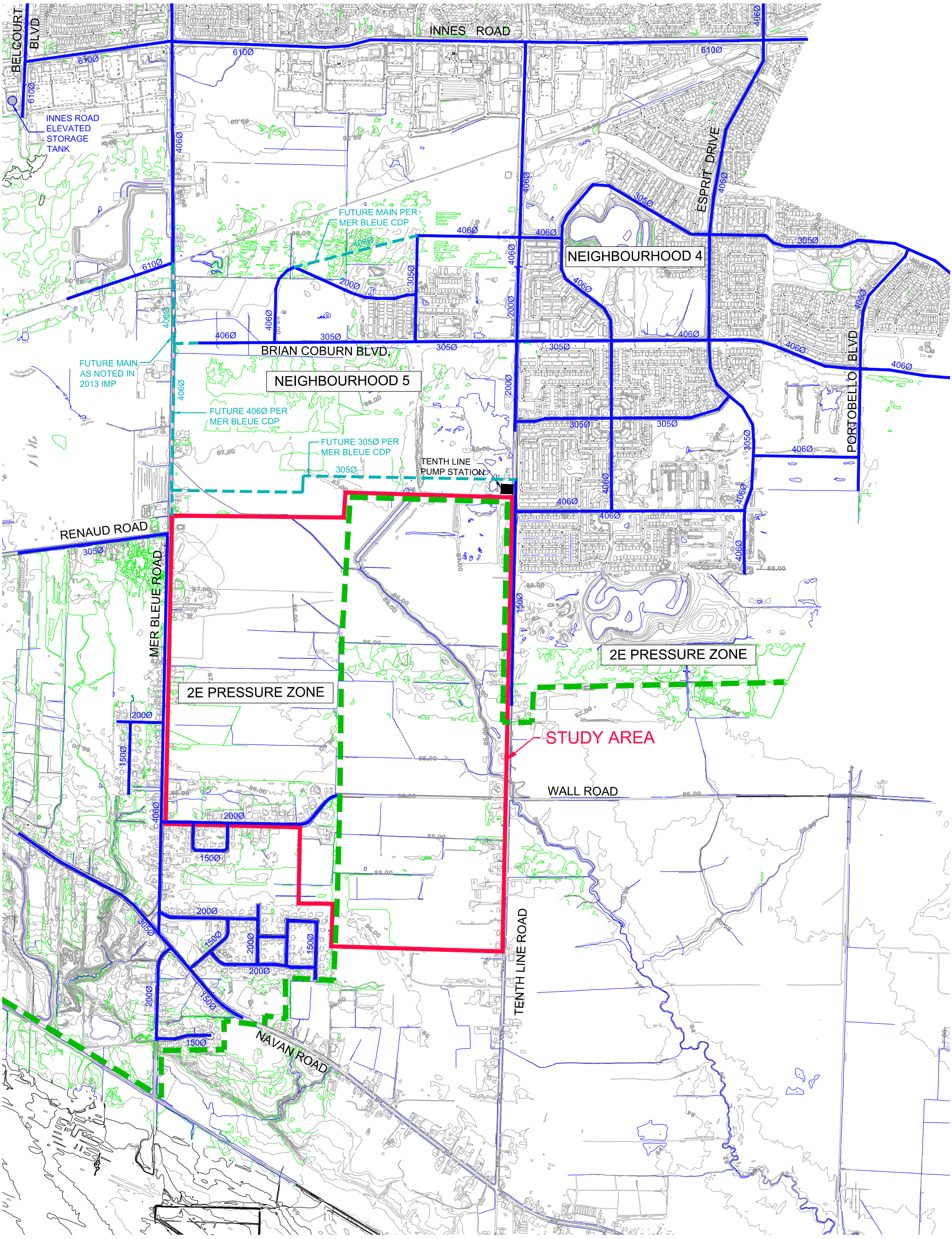
Below please find pre-consultation comments on the above-noted development applications:

1. The subject lands include the Community Park (6.473ha) and the Neighbourhood Park (2.283ha) as identified in the Mer Bleue Urban Expansion Area, Area Parks Plan (APP).
2. The proposed park blocks are appropriate in size and shape with adequate street frontage and consistent with the Area Parks Plan.
3. The City's Parkland Dedication By-law requirement of 1 hectare/300 units will be used to determine parkland dedication once unit counts are generated.
4. Parks does not accept parkland dedication of constraint land (land used for stormwater management facility). Please remove the dry pond from the Neighbourhood Park into a separate block on the draft plan.
5. Through the draft plan of subdivision process, please work with Park staff to develop Facility Fit Plans for the Community Park and Neighbourhood Park. Please use the Area Parks Plan as a starting point for the Fit Plans.
6. Note that sidewalks are required along all park frontages and sidewalk connections must connect into the existing pedestrian network.
7. As discussed at our pre-consultation meeting held Sept 28th, please ensure a 3m recreational pathway is included within the window street ROW along McKinnon's Creek.
8. Please investigate options to include a MUP connecting Tenth Lind Road to a pedestrian crossing over McKinnon's Creek and along the north-east side of McKinnon's Creek.
9. Please note draft conditions will be included regarding the timing, development and coordination of the dry pond pathway connections and landscaping to be coordinated with the park design (beside the Neighbourhood Park). Pathways and landscaping of the dry pond will be the responsibility of the developer and beyond the park budget.

10. Please coordinate the location of services and utilities (water, sanitary, storm and hydro) for the two park blocks with the Facility Fit Plans.
11. Parks Planning will provide a full suite of draft plan conditions for draft approval once an application is submitted and moves through the review process.
12. Zoning for the park blocks will need to be included at the time of the zoning by-law amendment to Parks and Open Space (O1).

APPENDIX B

- MSS figure 3, Existing Water Network
- Watermain Demand Calculation Sheet
- Figure 2.1 Phase 1 Conceptual Water Distribution



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IBI GROUP

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Project Title: MER BLEUE EXPANSION STUDY AREA

Drawing Title: WATER DISTRIBUTION INFRASTRUCTURE

Sheet No.: FIGURE 3

FEBRUARY 2014

IBI GROUP

IBI GROUP
333 PRESTON STREET
OTTAWA, ONTARIO
K1S 5N4

WATERMAIN DEMAND CALCULATION SHEET

PROJECT : **Mer Bleue Phase 1**
CLIENT : **Claridge Homes**

FILE: 116761-5.7
DATE PRINTED: 05-Nov-21
DESIGN: DY
PAGE: 1 OF 1

NODE	RESIDENTIAL				NON-RESIDENTIAL (ICI)			AVERAGE DAILY DEMAND (l/s)			MAXIMUM DAILY DEMAND (l/s)			MAXIMUM HOURLY DEMAND (l/s)			FIRE DEMAND (l/min)
	SINGLE FAMILY UNITS	TOWN HOUSE UNITS	MEDIUM DENSITY (ha)	POPULATION	INDUST. (ha)	COMM. (ha)	INSTIT. (ha)	RESIDENTIAL	ICI	TOTAL	RESIDENTIAL	ICI	TOTAL	RESIDENTIAL	ICI	TOTAL	
Phase 1	274	370		1930.60		2.85	6.30	6.26	5.30	11.55	15.64	7.94	23.58	34.41	14.30	48.71	15,000

POPULATION DENSITY

Single Family	3.4 persons/unit
Semi Detached & Townhouse	2.7 persons/unit
Medium Density	1.8 persons/unit

WATER DEMAND RATES

Residential	280 l/cap/day
ICI	50000 l/Ha/day

PEAKING FACTORS

Maximum Daily	
Residential	2.5 x avg. day
ICI	1.5 x avg. day
Maximum Hourly	
Residential	2.2 x max. day
ICI	1.8 x max. day

FIRE DEMANDS

Single Family	10,000 l/min (166.7 l/s)
Semi Detached & Townhouse	10,000 l/min (166.7 l/s)
Medium Density	15,000 l/min (250 l/s)

PHASE 1A

PHASE 1B

PHASE 1C

PHASE 1D

PROPOSED RESIDENTIAL DEVELOPMENT BY OTHERS

PROPOSED RESIDENTIAL DEVELOPMENT BY APPLICANT

EXISTING RESIDENTIAL DEVELOPMENT

EXISTING RESIDENTIAL OTHER OWNER

COMMERCIAL

HIGH DENSITY

INSTITUTIONAL

N. PARK

COMMUNITY PARK

ADDITIONAL LAND OWNED BY APPLICANT

TEMP. TURNING CIRCLE

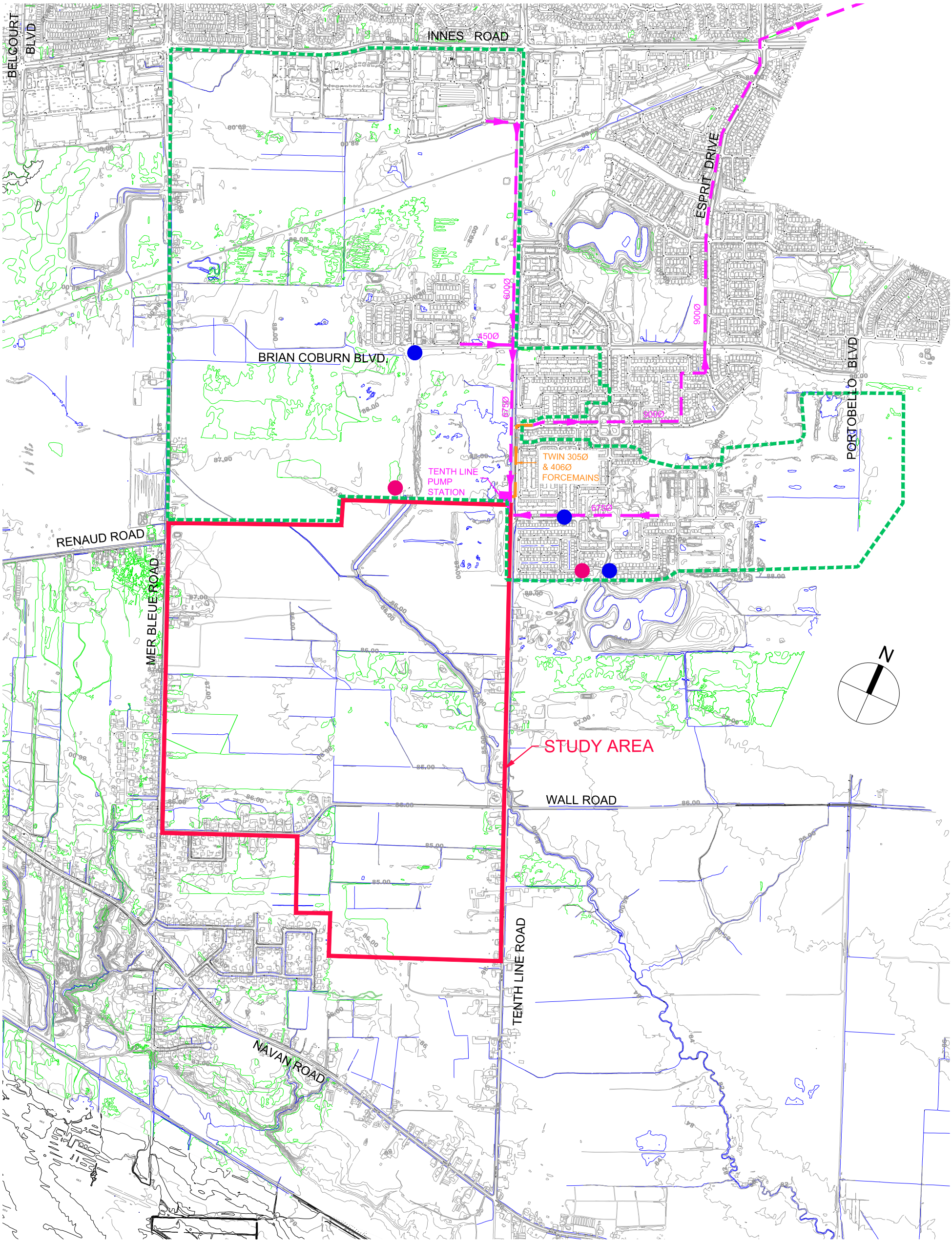
LEGEND:

- 200Ø — PROPOSED WATERMAIN c/w Ø
- 300Ø — PROPOSED WATERMAIN c/w Ø BY OTHERS
- 300Ø — EXISTING WATERMAIN c/w Ø
- PHASE 1 LIMIT

Scale	Project Title	Drawing Title	Sheet No.
1 : 4000	MER BLEUE PHASE 1	CONCEPTUAL WATER DISTRIBUTION SYSTEM	FIGURE 2.1

APPENDIX C

- MSS Figure 4, Existing Wastewater Collection System
- Figure 3.1 Phase 1 Conceptual Sanitary Sewers
- Figure 3.2 Phase 1 Conceptual Sanitary Tributary Areas
- Conceptual Sanitary Trunk Sewer Design Sheet



LEGEND:

- 305Ø — EXISTING SANITARY FORCEMAIN
- 900Ø — EXISTING TRUNK SANITARY SEWER
- EXISTING PUMP STATION CATCHMENT BOUNDARIES
- INTERIM SANITARY OVERFLOW
- ULTIMATE SANITARY OVERFLOW

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IBI GROUP

Scale: 1:15000

Project Title: MER BLEUE EXPANSION STUDY AREA

Drawing Title: WASTEWATER COLLECTION INFRASTRUCTURE

Sheet No.: FIGURE 4

FEBRUARY 2014

IBI GROUP
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Ottawa, Ontario K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

CONCEPTUAL SANITARY SEWER DESIGN SHEET

CLARIDGE HOMES PH1 MER BLEUE
ADEQUACY OF PUBLIC SERVICES REPORT
CITY OF OTTAWA
CLARIDGE HOMES

LOCATION				RESIDENTIAL							ICI AREAS							INFILTRATION ALLOWANCE			FIXED FLOW	TOTAL FLOW	PROPOSED SEWER DESIGN						
				EXTERNAL	AREA (pp/Ha)			POPULATION		PEAK FACTOR	PEAK FLOW	AREA (Ha)						PEAK FLOW	AREA (Ha)		FLOW			CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE CAPACITY	
STREET	AREA ID	FROM MH	TO MH	AREA (Ha)	LOW 65	MED 110	HIGH 85	IND	CUM		(L/s)	INSTITUTIONAL IND	INSTITUTIONAL CUM	COMMERCIAL IND	COMMERCIAL CUM	INDUSTRIAL IND	INDUSTRIAL CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(full) (m/s)	L/s	(%)
BY OTHERS	External Wall Road	MH550A	MH551A	1.49				164.0	164.0	4.00	2.13							0.00	1.49	1.49	0.49	0.00	2.62	20.24	74.50	200	0.35	0.624	17.63	87.07%
BY OTHERS	External 1	MH551A	MH571A	5.13				569.0	733.0	3.88	9.22			2.17	2.17			1.05	7.30	7.30	2.41	0.00	12.69	30.39	267.11	250	0.24	0.600	17.71	58.25%
BY OTHERS	External 2	MH571A	MH588A	7.39	0.83			698.1	1431.1	3.69	17.13				2.17			1.05	8.22	8.22	2.71	0.00	20.90	43.97	365.16	300	0.19	0.603	23.07	52.47%
	External 3	MH588A	MH591A	7.04	1.51			580.7	2011.7	3.58	23.36			0.68	2.85			1.39	9.23	9.23	3.05	0.00	27.80	43.97	224.33	300	0.19	0.603	16.18	36.79%
		MH700A	MH705A		2.77			180.1	180.1	4.00	2.33							0.00	2.77	2.77	0.91	0.00	3.25	30.39	444.12	250	0.24	0.600	27.14	89.31%
		MH705A	MH591A		8.38			544.7	724.8	3.89	9.13				0.00			0.00	8.38	8.38	2.77	0.00	11.89	30.39	388.99	250	0.24	0.600	18.50	60.87%
	External 4	MH591A	MH594A	0.59	14.65			971.8	3708.3	3.36	40.41				2.85			1.39	15.24	23.62	7.79	0.00	49.59	68.44	135.03	375	0.14	0.600	18.85	27.54%
	External 5	MH594A	MH595A	0.81	2.67			226.6	3934.9	3.34	42.59				2.85			1.39	3.48	27.10	8.94	0.00	52.92	68.44	79.47	375	0.14	0.600	15.52	22.68%
	External 6 & 7	MH595A	MH598A	4.15	5.77			718.2	4653.1	3.27	49.37				2.85			1.39	9.92	37.02	12.22	0.00	62.97	98.65	228.37	450	0.11	0.601	35.68	36.17%
								4653.1	TRUE																					

Design Parameters:

Residential			ICI Areas			
						Peak Factor
LOW	65	p/p/ha				
MED	110	p/p/ha	INST	28,000	L/Ha/day	1.5
HIGH	85	p/p/ha	COM	28,000	L/Ha/day	1.5
			IND	28,000	L/Ha/day	MOE Chart

Notes:

1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 280 L/day
3. Infiltration allowance: 0.33 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

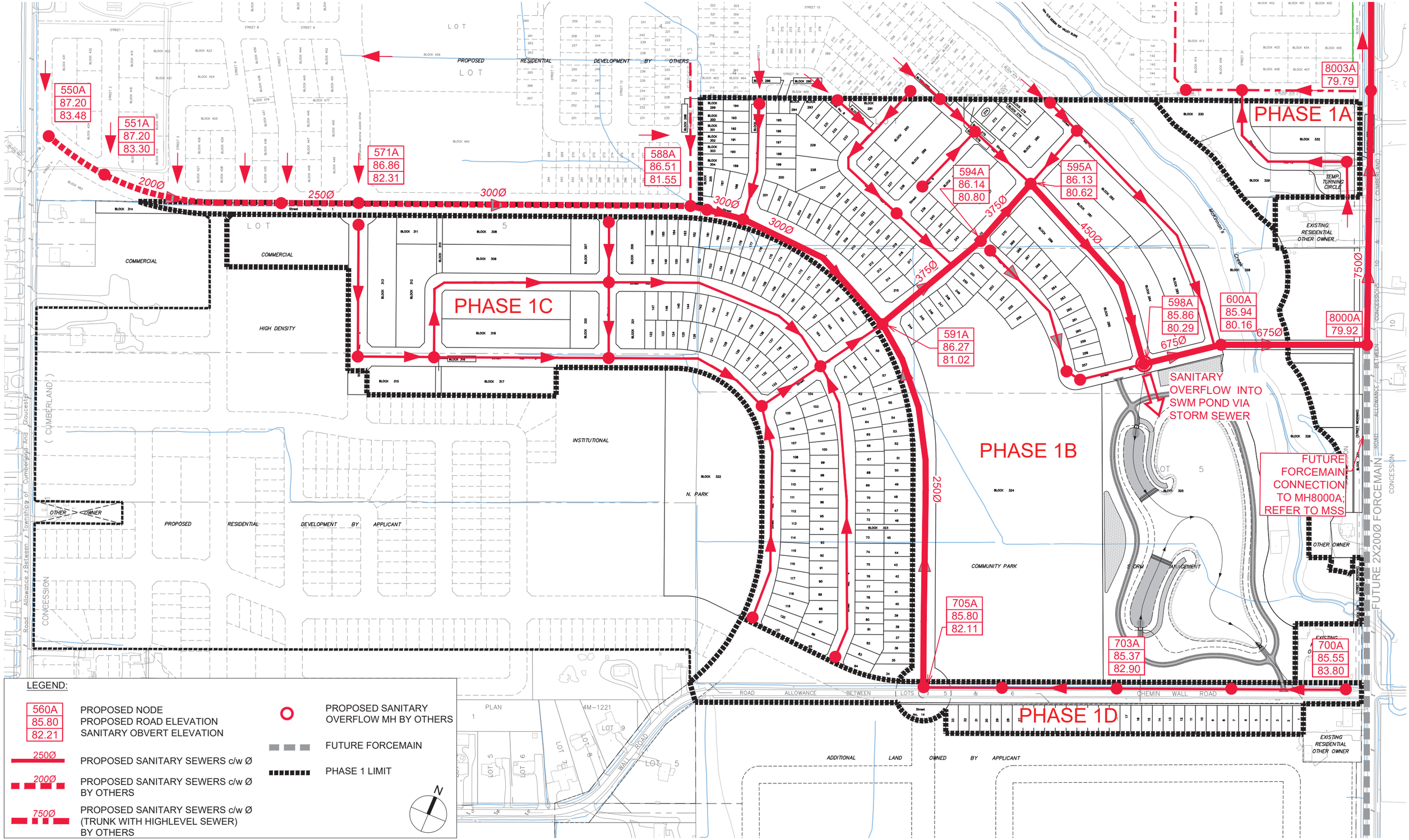
Designed: WZ

Checked: DY

Dwg. Reference: 116761-5.9

No.	Revision	Date

File Reference: 116761.5.7.1
Date: 2021-11-09
Sheet No: 1 of 1



LEGEND:

560A / 85.80 / 82.21	PROPOSED NODE PROPOSED ROAD ELEVATION SANITARY OBVERT ELEVATION
250Ø	PROPOSED SANITARY SEWERS c/w Ø
200Ø	PROPOSED SANITARY SEWERS c/w Ø BY OTHERS
750Ø	PROPOSED SANITARY SEWERS c/w Ø (TRUNK WITH HIGHLEVEL SEWER) BY OTHERS
	PROPOSED SANITARY OVERFLOW MH BY OTHERS
	FUTURE FORCEMAIN
	PHASE 1 LIMIT

IBI

Scale: 1 : 3500

Project Title: MER BLEUE PHASE 1

Drawing Title: CONCEPTUAL SANITARY SEWER SYSTEM

Sheet No.: FIGURE 3.1

EXTERNAL Wall Road Area : 1.49ha POP : 164

550A 87.20 83.48

551A 87.20 83.30

EXTERNAL Mattamy 1 Area : 5.13ha POP : 569.0

EXTERNAL Mattamy 2 Resi.: 2.92ha POP : 322.0 Inst.:2.60ha Park:1.87ha

571A 86.86 82.31

588A 86.51 81.55

EXTERNAL Mattamy 3 Area : 7.04ha POP : 482.5

EXTERNAL Mattamy 4 Area : 0.59ha POP : 19.6

EXTERNAL Mattamy 5 Area : 0.81ha POP : 53.0

EXTERNAL Mattamy 6 Area : 2.73ha POP : 178.0

EXTERNAL Mattamy 7 Area : 1.42ha POP : 93.0

594A 86.14 80.80

595A 86.13 80.62

598A 85.86 80.29

600A 85.94 80.16

8003A 79.79

8000A 79.92

591A 86.27 81.02

705A 85.80 82.11

703A 85.37 82.90

700A 85.55 83.80

POP : 54.0 Area : 0.83ha

POP : 98.2 Area : 1.51ha

POP : 161.9 Area : 2.49ha

POP : 173.6 Area : 2.67ha

POP : 447.2 Area : 5.77ha

POP : 790.4 Area : 12.16ha

POP : 544.7 Area : 8.38ha

POP : 180.1 Area : 2.77ha

POP : 91.8 Area : 1.13ha

200Ø 250Ø 300Ø 375Ø 450Ø 600Ø 675Ø 750Ø 250Ø

2.17ha IC COMMERCIAL

0.68ha IC COMMERCIAL

HIGH DENSITY

INSTITUTIONAL

COMMUNITY PARK

N. PARK

TEMP. TURNING CIRCLE

EXISTING RESIDENTIAL OTHER OWNER

SANITARY OVERFLOW INTO SWM POND VIA STORM SEWER

FUTURE FORCEMAIN CONNECTION TO MH8000A; REFER TO MSS

FUTURE 2X200Ø FORCEMAIN

PROPOSED RESIDENTIAL DEVELOPMENT BY OTHERS

PROPOSED RESIDENTIAL DEVELOPMENT BY APPLICANT

OTHER OWNER

ADDITIONAL LAND OWNED BY APPLICANT

ROAD ALLOWANCE BETWEEN LOTS 5 & 6 CONCESSION

CHEMIN WALL ROAD

CONCESSION 1 (FORMERLY IN THE TOWNSHIP OF CUMBERLAND)

Township of Cumberland And Gloucester

Between Road Allowance

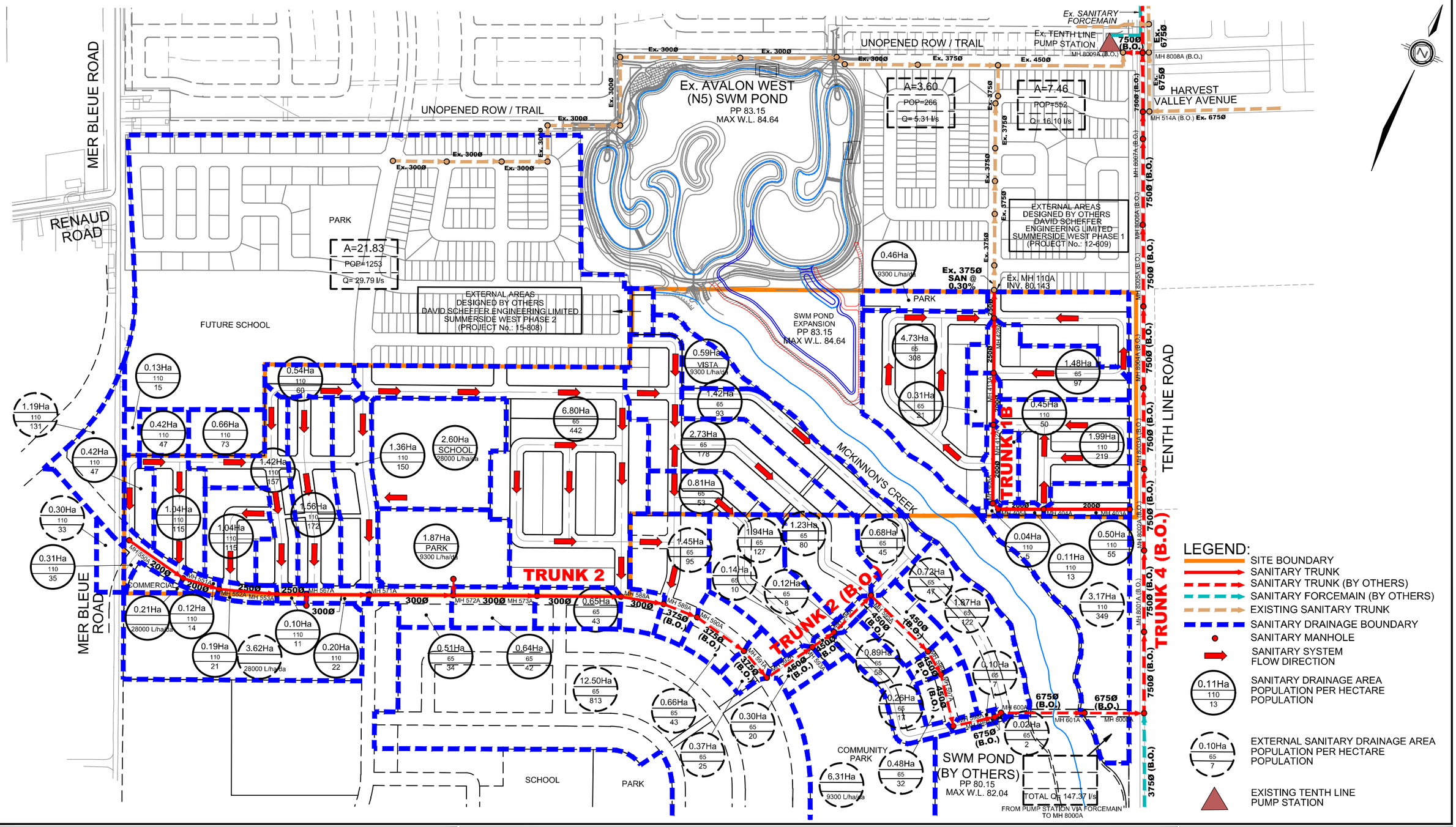
McKinnon's Creek

LEGEND:

- 560A / 85.80 / 82.21 — PROPOSED NODE, PROPOSED ROAD ELEVATION, SANITARY OBVERT ELEVATION
- 250Ø — PROPOSED SANITARY SEWERS c/w Ø
- 200Ø — PROPOSED SANITARY SEWERS c/w Ø BY OTHERS
- 750Ø — PROPOSED SANITARY SEWERS c/w Ø (TRUNK WITH HIGHLEVEL SEWER) BY OTHERS
- PROPOSED SANITARY OVERFLOW BY OTHERS
- SANITARY DRAINAGE AREAS
- FUTURE FORCEMAIN
- POP : 075 Area : 8.09ha — POPULATION AREA IN HECTARES
- PHASE 1 LIMIT

N

Scale	Project Title	Drawing Title	Sheet No.
1 : 3500	MER BLEUE PHASE 1	CONCEPTUAL SANITARY SEWER TRIBUTARY AREA	FIGURE 3.2



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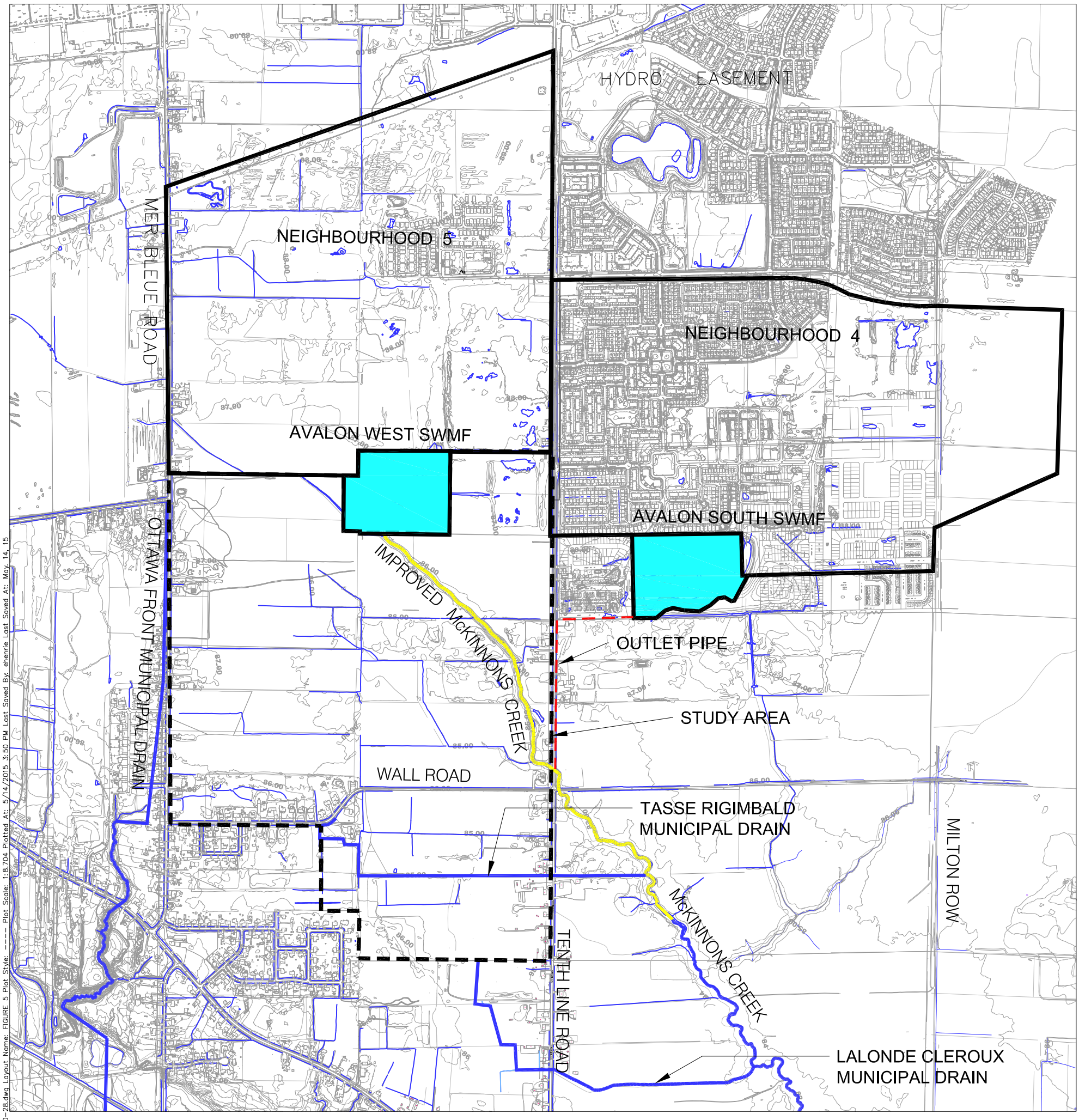
SUMMERSIDE WEST PHASES 4, 5 & 6
CONCEPTUAL SANITARY SERVICING
CITY OF OTTAWA

PROJECT No.:	15-766
SCALE:	1:5000
DATE:	NOVEMBER 2018
FIGURE:	4

APPENDIX D

- MSS Figure 5, Existing Stormwater Infrastructure
- Figure 4.1 Phase 1 SWMF
- Figure 4.2 Conceptual McKinnon's Creek Enhancements
- Figure 4.3 Phase 1 Conceptual Storm Sewers
- Figure 4.4 Phase 1 Conceptual Storm Tributary Areas
- Conceptual Storm Trunk Sewer Design Sheet



J:\34739-CumbServReport\5.9 Drawings\59swm\current\EMP FIGURES\34739-emp_figures-2014-10-28.dwg Layout Name: FIGURE 5 Plot Style: ---- Plot Scale: 1:8.704 Plotted At: 5/14/2015 3:50 PM Last Saved By: ehenrie Last Saved At: May. 14, 15

IBI GROUP

Scale: 1:15000

Project Title: MER BLEUE EXPANSION STUDY AREA

Drawing Title: STORMWATER INFRASTRUCTURE

Sheet No.: FIGURE 5

MAY 2015

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CONCEPTUAL STORM SEWER DESIGN SHEET
CLARIDGE HOMES PH1 MER BLEUE
ADEQUACY OF PUBLIC SERVICES REPORT
CITY OF OTTAWA
CLARIDGE HOMES

LOCATION				AREA (Ha)										RATIONAL DESIGN FLOW												SEWER DATA								
STREET	AREA ID	FROM	TO	EXTERNAL AC	C= 0.10	C= 0.20	C= 0.40	C= 0.65	C= 0.67	C= 0.70	C= 0.72	C= 0.80	C= 0.85	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (2yr) (L/s)	(%)
OUTLET #4: New Central SWM Pond (North)																																		
BY OTHERS	Wall Road, External 1	MH539	MH541							3.80			0.35	8.22	8.22	18.07	2.44	20.51	55.36	74.79	127.78	455.15	455.15	614.94	1,050.57	455.15	944.84	154.81	1050			0.11	1.057	489.69	51.83%
BY OTHERS	External 2	MH541	MH559							4.02				7.82	7.82	20.51	0.91	21.42	51.22	69.15	118.05	400.72	400.72	540.95	923.52	400.72	2,445.85	73.04	1500			0.11	1.341	2045.13	83.62%
BY OTHERS	External 3	MH559	MH576				1.87			1.36		2.60	0.87	12.56	12.56	21.42	4.07	25.49	49.86	67.28	114.84	626.39	626.39	845.36	1,442.86	626.39	3,153.62	348.70	1650			0.11	1.429	2527.23	80.14%
BY OTHERS	External 4	MH576	MH580							7.03		1.52		17.06	29.63	25.49	2.71	28.20	44.60	60.13	102.53	1,321.41	760.99	1,025.88	1,749.26	1,321.41	3,977.22	246.16	1800			0.11	1.514	2655.80	66.78%
		MH580	MH581							15.52				30.20	59.83	28.20	0.89	29.09	41.74	56.23	95.82	2,496.96	1,260.52	1,698.21	2,894.01	2,496.96	5,999.35	89.75	2100			0.11	1.678	3502.39	58.38%
	External 5	MH581	MH590							3.31				6.44	66.27	29.09	1.16	30.25	40.88	55.06	93.82	2,709.05	263.32	354.69	604.33	2,709.05	5,999.35	117.26	2100			0.11	1.678	3290.30	54.84%
	External 6 & 7	MH590	MH598				0.59			6.12				12.57	78.83	30.25	2.07	32.32	39.82	53.62	91.34	3,139.07	500.35	673.80	1,147.79	3,139.07	8,565.43	227.86	2400			0.11	1.834	5426.36	63.35%
		MH598	HW4							4.10				7.98	86.81	32.32	0.60	32.92	38.08	51.26	87.28	3,305.49	303.80	408.95	696.36	3,305.49	8,565.43	65.95	2400			0.11	1.834	5259.94	61.41%
					0.00	0.00	2.46	0.00	0.00	45.26	0.00	4.12	1.22	86.81	TRUE																				
OUTLET #5: New Central SWM Pond (South)																																		
		MH5040	MH5050	28.05						1.72				81.33	81.33	22.68	2.11	24.79	48.08	64.87	110.68	3,910.56	3,910.56	5,275.63	9,001.57	3,910.56	5,999.35	212.38	2100			0.11	1.678	2088.79	34.82%
		MH5050	MH5052							8.13				15.82	97.15	24.79	2.16	26.95	45.42	61.23	104.43	4,412.02	718.52	968.78	1,652.16	4,412.02	7,211.18	227.89	2250			0.11	1.757	2799.16	38.82%
		MH5052	HW5							1.68				3.27	100.42	26.95	0.68	27.63	43.00	57.95	98.78	4,318.07	140.58	189.45	322.94	4,318.07	7,211.18	71.69	2250			0.11	1.757	2893.10	40.12%
				28.05	0.00	0.00	0.00	0.00	0.00	11.53	0.00	0.00	0.00	100.42	TRUE																			

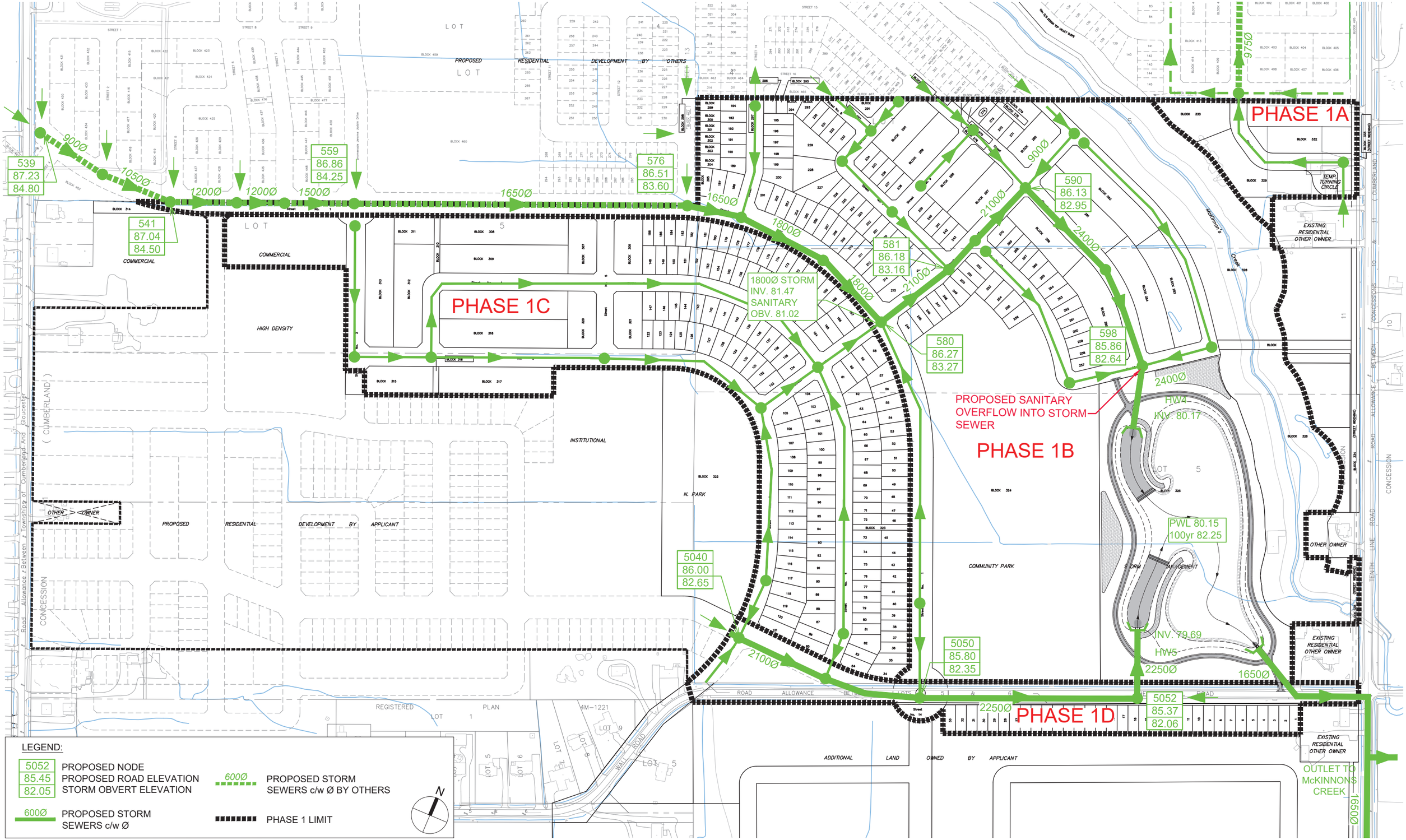
Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: RM & WZ
Checked: DY
Dwg. Reference: 116761-4.2

No.	Revision	Date
1.		
2.		

File Reference: 116761-5.7.1
Date: 2021-11-05
Sheet No: 1 of 1



J:\116761_MerBleuePh1\5.9 Drawings\59civil\current\Adequacy Report\Layout\FIGURE 4.3 CONCEPTUAL STORM SEWER SYSTEM.dwg Plotted At: 11/15/2021 Last Saved By: AmyZhuang Last Saved At: Nov. 8, 21

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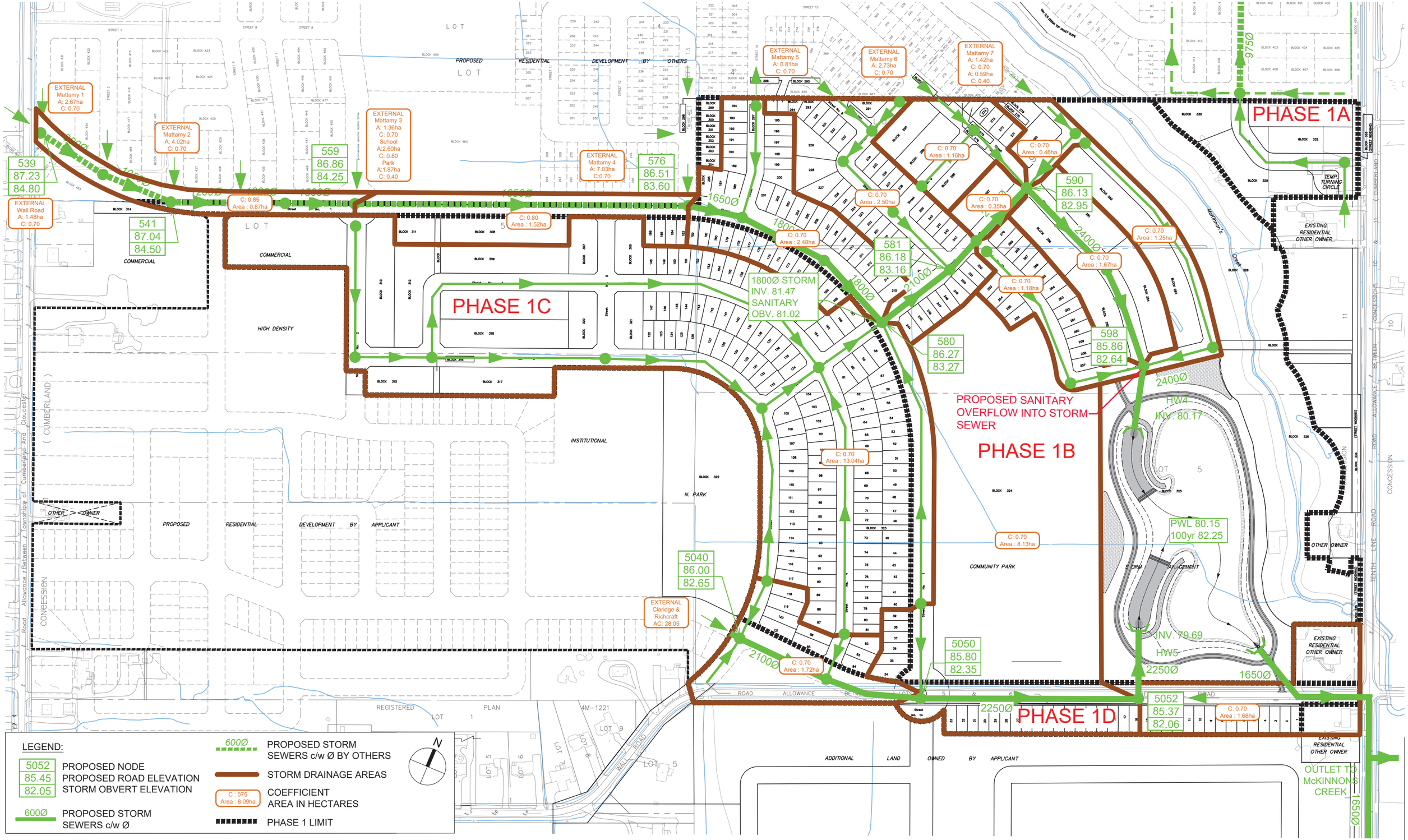
Scale
1 : 3500

Project Title
MER BLEUE
PHASE 1

Drawing Title
CONCEPTUAL STORM
SEWER SYSTEM

Sheet No.
FIGURE 4.3



Scale

1 : 3500

Project Title

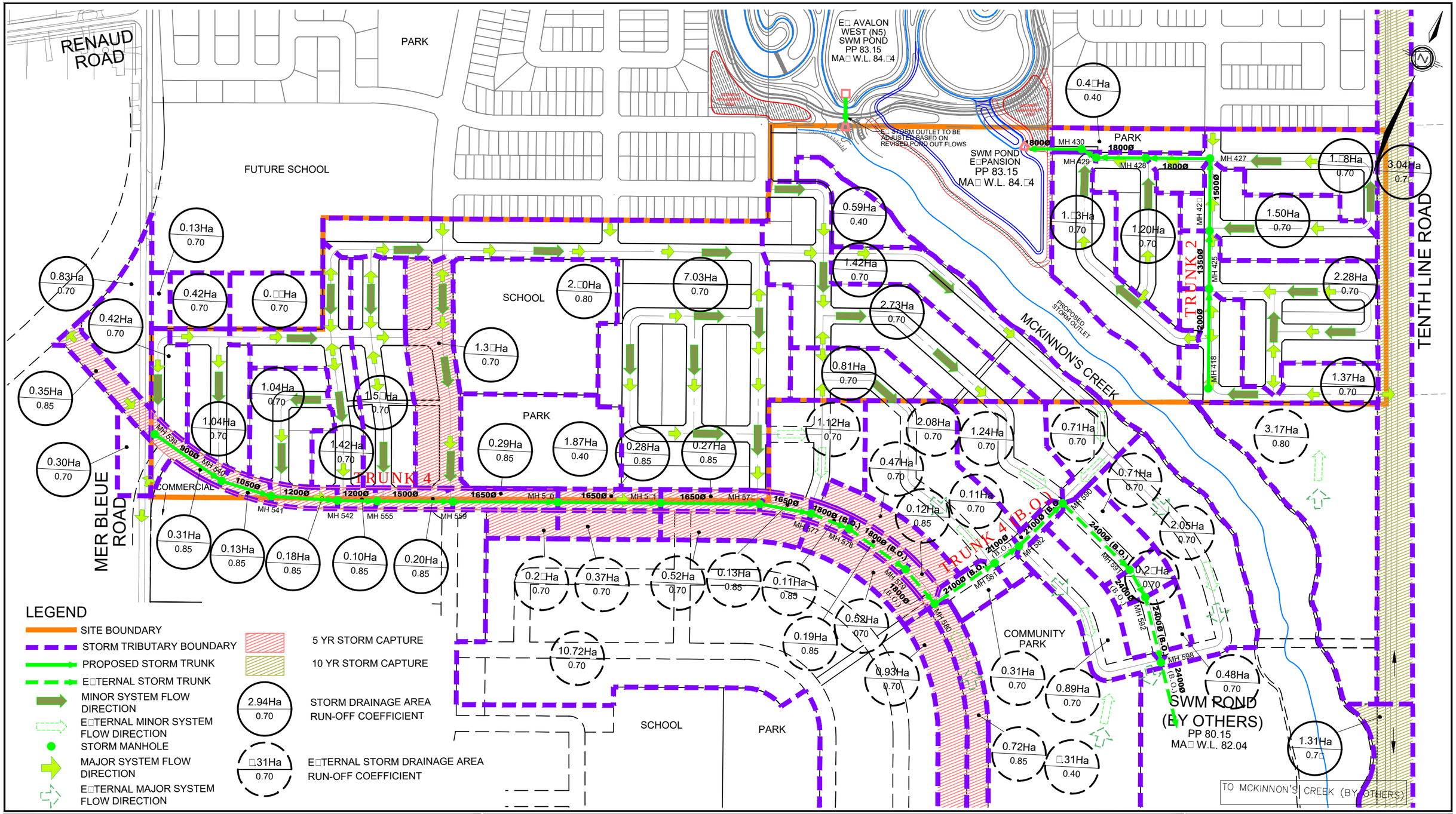
MER BLEUE
PHASE 1

Drawing Title

CONCEPTUAL STORM
SEWER TRIBUTARY AREAS

Sheet No.

FIGURE 4.4



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SUMMERSIDE WEST PHASES 4, 5 □ □
STORM SERVICING PLAN
CITY OF OTTAWA

PROJECT No.:	15-7□□
SCALE:	1:4000
DATE:	NOVEMBER 2018
FIGURE:	5

APPENDIX E

- Technical memo by Golder Dated July 2018
- Figure 5.1 – Conceptual Macro Grading
- Figure 6 – Conceptual Erosion and Sediment Control plan

GOLDER

TECHNICAL MEMORANDUM

DATE July 16, 2018 **Project No.** 13-1121-0123

TO Demetrius Yannoulopoulos
IBI Group

FROM Christine Ko, P.Eng. **EMAIL Christine_Ko@golder.com**

REVISED PERMISSIBLE GRADE RAISE
GEOTECHNICAL INVESTIGATION - COMMUNITY DESIGN PLAN
AREA 10 LANDS
OTTAWA, ONTARIO

This memo provides revised permissible grade raise guidelines for the proposed 'Area 10 Lands' development in Ottawa, Ontario.

The results of the preliminary geotechnical investigation for the Area 10 Lands development were provided in our report titled "*Geotechnical Input, Community Design Plan, Concession 10 Lands, Ottawa, Ontario*" dated June 2017 (report number 13-1121-0123 Rev-01). This memo should be read in conjunction with that report, and supersedes the previous Golder Associates' (Golder's) memos dated March 11, 2016 and August 31, 2016 relating to the permissible grade raises for this site.

Background

The study area occupies a parcel of land which extends from Tenth Line Road to Mer Bleue Road, in the east-west direction, and from about 1,200 metres north of Wall Road to about 600 metres south of Wall Road, in the north-south direction.

- In general, the subsurface conditions within the study area consist of discontinuous deposits of surficial sand and silty sand, generally less than about 1 metre thick, overlying a thick deposit of sensitive and compressible silty clay.
- Due to the limited capacity of the silty clay deposit at depth to support additional loads, the grade raises on this site will need to be restricted, to avoid excessive settlements of foundations and utilities. Based on the results of the preliminary geotechnical drilling investigation and laboratory testing program, it was initially recommended in the above referenced geotechnical report that the maximum permissible grade raise be restricted to no more than about 0.3 metres for this study area.
- Based on the preliminary design grading prepared by IBI Group (IBI), it is understood that this site will have finished grades which exceed the permissible value described above, and grade raises in the order of 1.0 to 1.6 metres are required. To limit/avoid the use of light weight fill materials, a 'test fill' program was undertaken to confirm the geotechnical assessment of the maximum permissible grade raises. The *calculated* permissible finished grade values were based on interpretation of laboratory test results as well as theoretical calculations of stresses and settlements. As such, there is an inherent potential for the

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actual permissible finished grade to be more than the calculated value. The test fill program allows for a direct measurement of the maximum permissible grade raises, without the uncertainty involved in a theoretical prediction.

Test Fill Program

- A test fill program was carried out at four areas (designated as A to D) across the site (as shown on the attached Figure 1).
- The objective of the test fill program was to test/confirm the magnitude of stress increase that can be applied to the subgrade soils (i.e., to the soft/compressible clay at depth) without inducing excessive settlements.
- Based on the measured unit weight for the fill used to construct the test pads, once spread and compacted by the bull-dozer tracks, and taking into account the 'efficiency' of the proposed test fill pad dimensions, future groundwater level lowering, and foundation loads, the following test fill heights above original ground level were constructed:

Design Grade Raise To Be Tested (metres)	Corresponding Surcharge (kilopascals)	Equivalent Test Fill Height (metres)
0.5	17	1.3
0.8	22	1.6
1.2	30	2.1
1.3	33	2.35[1]

Note: [1] The lowest test pad at each area was increased to 2.35 metres in height in February 2016 to assess the potential maximum permissible grade raise.

Settlement Monitoring

The following provides comments on the settlement monitoring program:

- The subgrade settlements were monitored to evaluate the magnitude of settlement that occurred once the fill was placed and the rate of any on-going settlements. Since the magnitude of the settlement was expected to be relatively small, at least over short time periods, the survey methods/equipment was selected so as to have an accuracy of +/- 2 millimetres. Annis O'Sullivan Vollebekk Ltd. (AOV) Ontario Land Surveyors carried out the settlement monitoring.
- Two settlement plates were placed at each of the test fill piles. The installation of the settlement plates occurred prior to the placement of the fill so that all of the settlements were captured by the settlement monitoring.
- A set of baseline/reference readings was taken for each settlement plate prior to any fill placement.
- A survey benchmark was established for each test pile location.

- The settlement plate (rod) elevations were collected every week during the first month after completion of filling and the frequency was then reduced to bi-weekly, and then a monthly basis thereafter.

Results

The results of the test filling program are provided on the attached Figures 2A to 2D and are summarized below:

- For the 2.1 metres high test pads (equivalent to 1.2 metres of design grade raise):
  - The settlements were measured from February 2015 to May 2018.
  - During that period, a maximum settlement of about 22 millimetres was measured, with many of the settlement monitoring points moving less than 15 millimetres. The majority of the settlement occurred before August 2016 and there has been limited, although some, ongoing settlement.
  - This magnitude of settlement is considered acceptable for standard house design and construction, but the ongoing movement (although limited) will limit the permissible grade raise to less than 1.2 metres.
- For the 2.35 metres high test pads (equivalent to 1.3 metres of design grade raise):
  - The settlements were measured from March 2016 to May 2018.
  - During that period, a maximum settlement of about 32 millimetres was measured and the settlements appear to be ongoing without signs of slowing. It is recommended that the height of these test pads be reduced to an equivalent of 2.1 metres high test fill and monitoring of these test pads be continued to confirm that the settlement has in fact ceased.
- Based on the results of the test fill program, it is our opinion that the maximum permissible grade raise for this site can be increased to at least **1.1 metres**.

Grading Exceedance

If the grading restrictions determined during the test fill program cannot be accommodated, the following additional options could be considered:

- The above permissible grade raise values are based on the use of conventional exterior soil backfill such as silty sand and sand (with a unit weight not exceeding of 19.5 kilonewtons per cubic metre). The permissible grade raise values could be increased by:
  - Using lighter weight soil backfill such as silty clay present on this site for exterior fill (with a unit weight not exceeding 17.5 kilonewtons per cubic metre); and,
  - Using 50 millimetre nominal size clear stone "surge" as garage and porch backfill (with a unit weight not exceeding 15.5 kilonewtons per cubic metre).
  - Based on preliminary analyses, the maximum permissible grade raise at the house can be increased by about 0.1 to 0.2 metres, which will yield a potential maximum grade raise of about 1.2 to 1.3 metres for this site.
- Expanded Polystyrene (EPS) light weight fill could also be used to backfill beneath/within the garages and porches. By using EPS beneath/within the garages and porches, in conjunction of using lighter weight soil backfill, the net effect of the basement unloading can be utilized.

- Based on preliminary analyses, this will increase the maximum permissible grade raise at the house up to about 0.7 metres, which will yield a potential maximum grade raise of about 1.8 metres for this site. But, this will have to be confirmed on a case by case basis.

- The backfilling requirement and the corresponding permissible grade are provided in the table below:

Table 1: Design Grade Raise and Backfilling Requirements

Design Grade Raise at Garage (m)	Front Exterior Backfill	Garage/Porch Backfill	Backfill Between Houses	Rear Exterior Backfill[5]
1.1	Conventional soil backfill[1]	Conventional soil backfill	Conventional soil backfill[1]	Conventional soil backfill[1]
1.2	Lighter weight soil backfill[2]	Lighter weight soil backfill[2]	Lighter weight soil backfill[2]	Lighter weight soil backfill[2]
1.3	Lighter weight soil backfill[2]	'Surge' clear stone[3]	Lighter weight soil backfill[2]	Lighter weight soil backfill[2]
1.5	Lighter weight soil backfill[2]	0.6 m EPS Geofoam and Remainder with Lighter weight soil backfill[4]	Lighter weight soil backfill[2]	Lighter weight soil backfill[2]
1.8	Lighter weight soil backfill[2]	EPS Geofoam	Lighter weight soil backfill[2]	Lighter weight soil backfill[2]

Notes: [1] Conventional soil backfill means nominally compacted silty sand or sand with unit weight not exceeding 19.5 kN/m^3.
[2] Lighter weight soil backfill means nominally compacted silty clay with unit weight not exceeding 17.5 kN/m^3.
[3] 50 mm nominal size clear stone (surge) to have a unit weight not exceeding 15.5 kN/m^3.
[4] EPS Geofoam thickness may be limited to 0.6 m only provided lighter weight soil backfill with unit weight not exceeding 17.5 kN/m^3 is used.
[5] Assume rear exterior grade raise is same or less than the design grade at garage.

- EPS light weight fill could also be used to backfill around the foundations (and not just beneath/within the garages and porches) to accommodate additional required grade raises, in excess of the above-specified values.

- For areas requiring significantly more grade raise, the area could be pre-loaded. This would involve placing fill material on the site to above what would be required for site grading, and allowing the settlements to take place. Once a sufficient amount of settlement had occurred, the excess fill material would be removed and the house construction could proceed. Instrumentation would need to be installed (i.e., settlement plates) to monitor the settlement and to establish when sufficient settlements had occurred such that house construction could proceed. To reduce the time required for the pre-loading, and limit the post-preload creep settlements, it is likely that a temporary surcharge above the existing grade would be needed. Wick drains could also potentially be used to accelerate the settlements. However, the pre-load time could be months or years.

- Additional geotechnical guidelines would need to be provided if any of the above options are selected.

Closure

We trust that this memo provides sufficient information for your present requirements. If you have any questions concerning this memo, please contact the undersigned.

Yours truly,

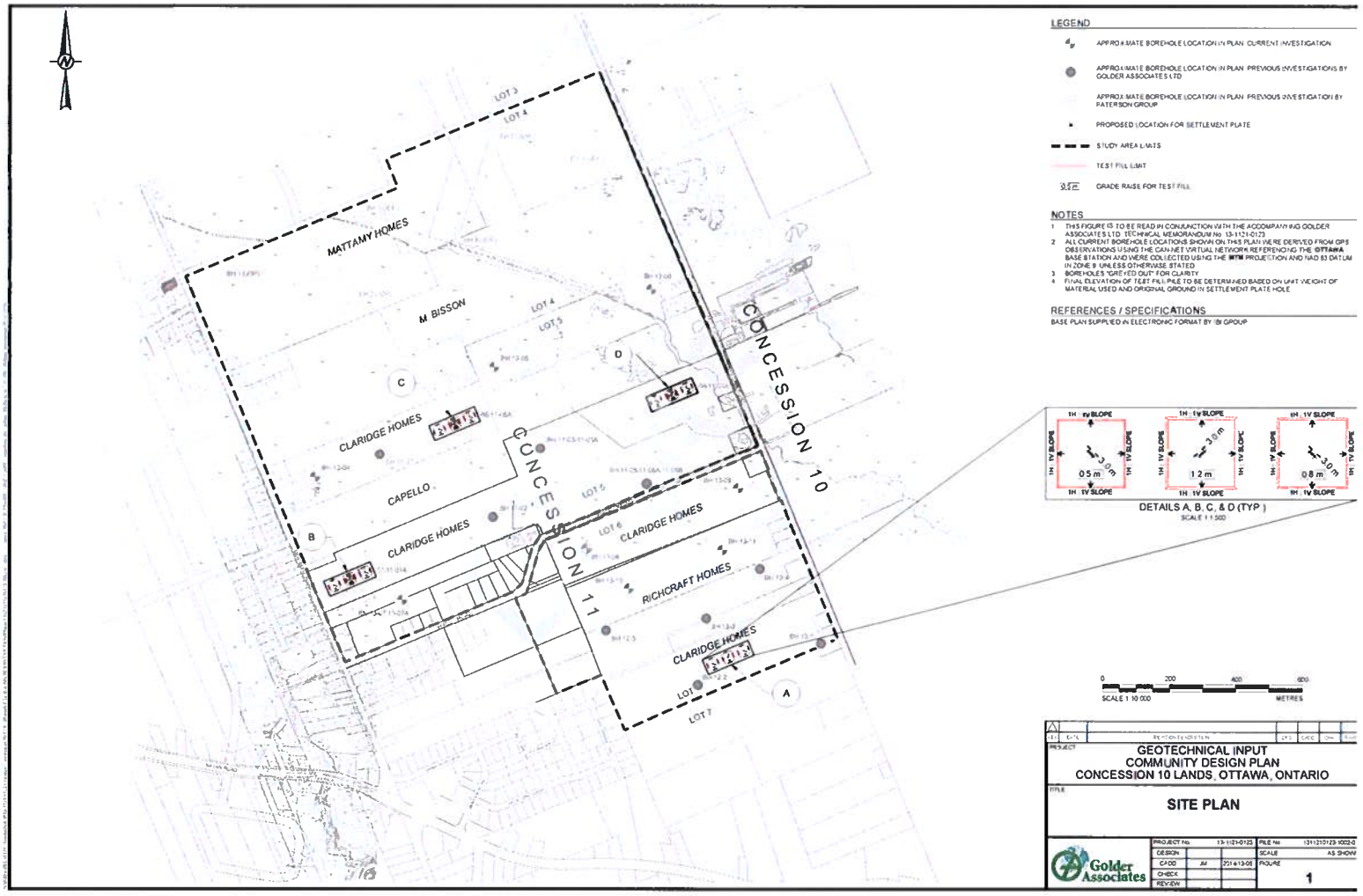
GOLDER ASSOCIATES LTD.

Christine Ko, P.Eng.
Geotechnical Engineer

Bill Cavers, P.Eng.
Associate, Senior Geotechnical Engineer

CK/WC/mvrd
n:\active\2013\1121 - geotechnical\13-1121-0123 claridge concession 10 cdp ottawa\03-geotechnical\4-memo\13-1121-0123 techmemo-007 2018-07-16.docx

Attachments: Figure 1 – Site Plan
Figures 2A to 2D – Test Fill Monitoring Results



LEGEND

- APPROXIMATE BOREHOLE LOCATION IN PLAN CURRENT INVESTIGATION
- APPROXIMATE BOREHOLE LOCATION IN PLAN PREVIOUS INVESTIGATIONS BY GOLDER ASSOCIATES LTD
- APPROXIMATE BOREHOLE LOCATION IN PLAN PREVIOUS INVESTIGATION BY PATERSON GROUP
- PROPOSED LOCATION FOR SETTLEMENT PLATE
- STUDY AREA LIMITS
- TEST FILL LIMIT
- 0.5 m GRADE RAISE FOR TEST FILL

NOTES

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. TECHNICAL MEMORANDUM No. 13-1121-0123
2. ALL CURRENT BOREHOLE LOCATIONS SHOWN ON THIS PLAN WERE DERIVED FROM GPS OBSERVATIONS USING THE CAN-NET VIRTUAL NETWORK REFERENCING THE **OTTAWA** BASE STATION AND WERE COLLECTED USING THE **MTM** PROJECTION AND NAD 83 DATUM IN ZONE 9 UNLESS OTHERWISE STATED
3. BOREHOLES "GREYED OUT" FOR CLARITY
4. FINAL ELEVATION OF TEST FILL PILE TO BE DETERMINED BASED ON UNIT WEIGHT OF MATERIAL USED AND ORIGINAL GROUND IN SETTLEMENT PLATE HOLE

REFERENCES / SPECIFICATIONS

BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP

DETAILS A, B, C, & D (TYP.)
SCALE 1:1 500

0 200 400 600
SCALE 1:10 000 METRES

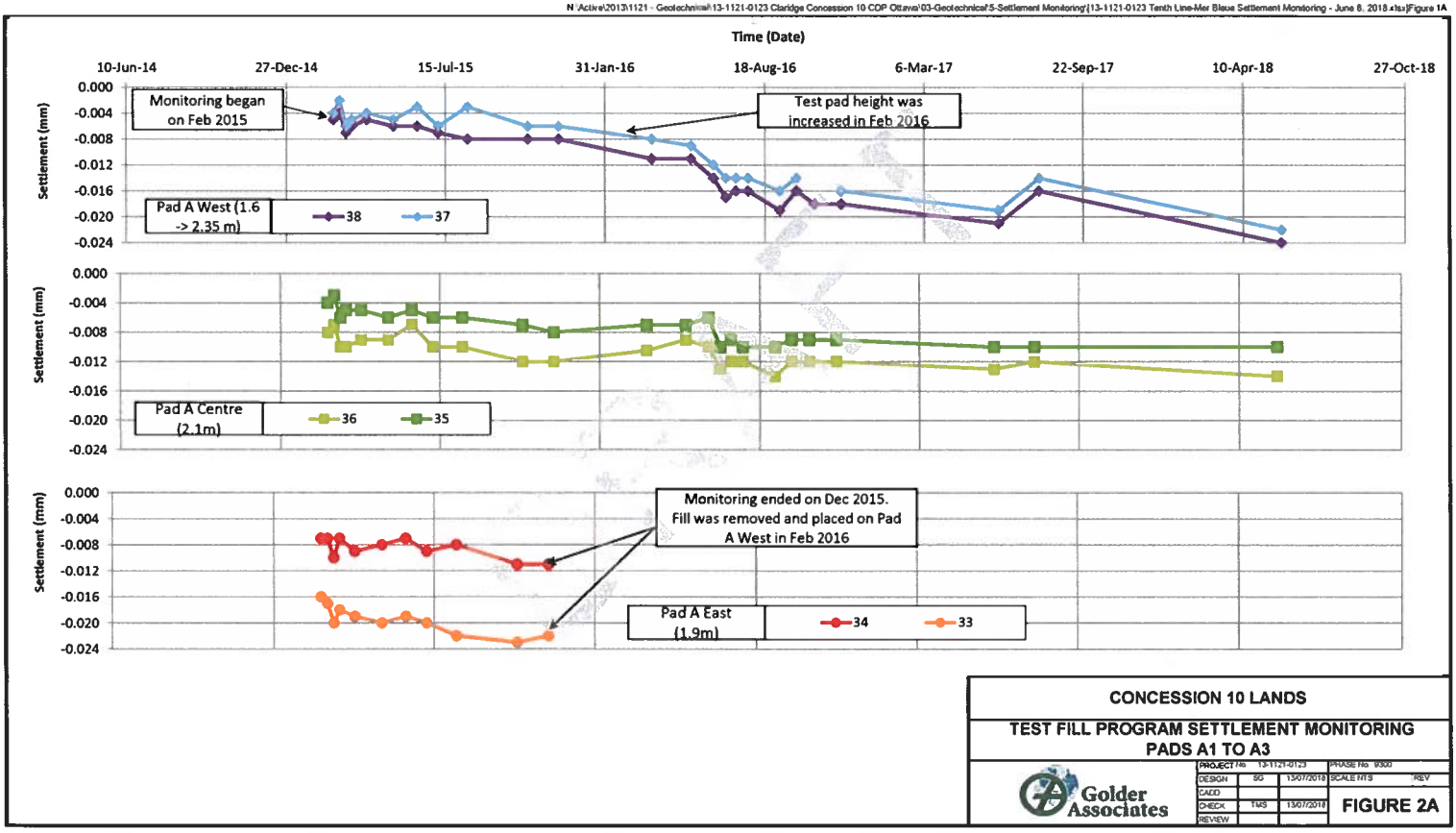
PROJECT
GEOTECHNICAL INPUT
COMMUNITY DESIGN PLAN
CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE
SITE PLAN

Golder Associates

PROJECT No.	13-1121-0123	FILE No.	1311210123-1002-0
DESIGN		SCALE	AS SHOWN
CADD	AM 2014-03-06	FIGURE	1
CHECK			
REVIEW			

N:\Active\2013\1121 - Geotechnical\13-1121-0123 Claridge Concession 10 CDP Ottawa\03-Geotechnical\5-Settlement Monitoring\[13-1121-0123 Tenth Line-Mer Bleue Settlement Monitoring - June 8, 2018.xls]Figure 1A



CONCESSION 10 LANDS

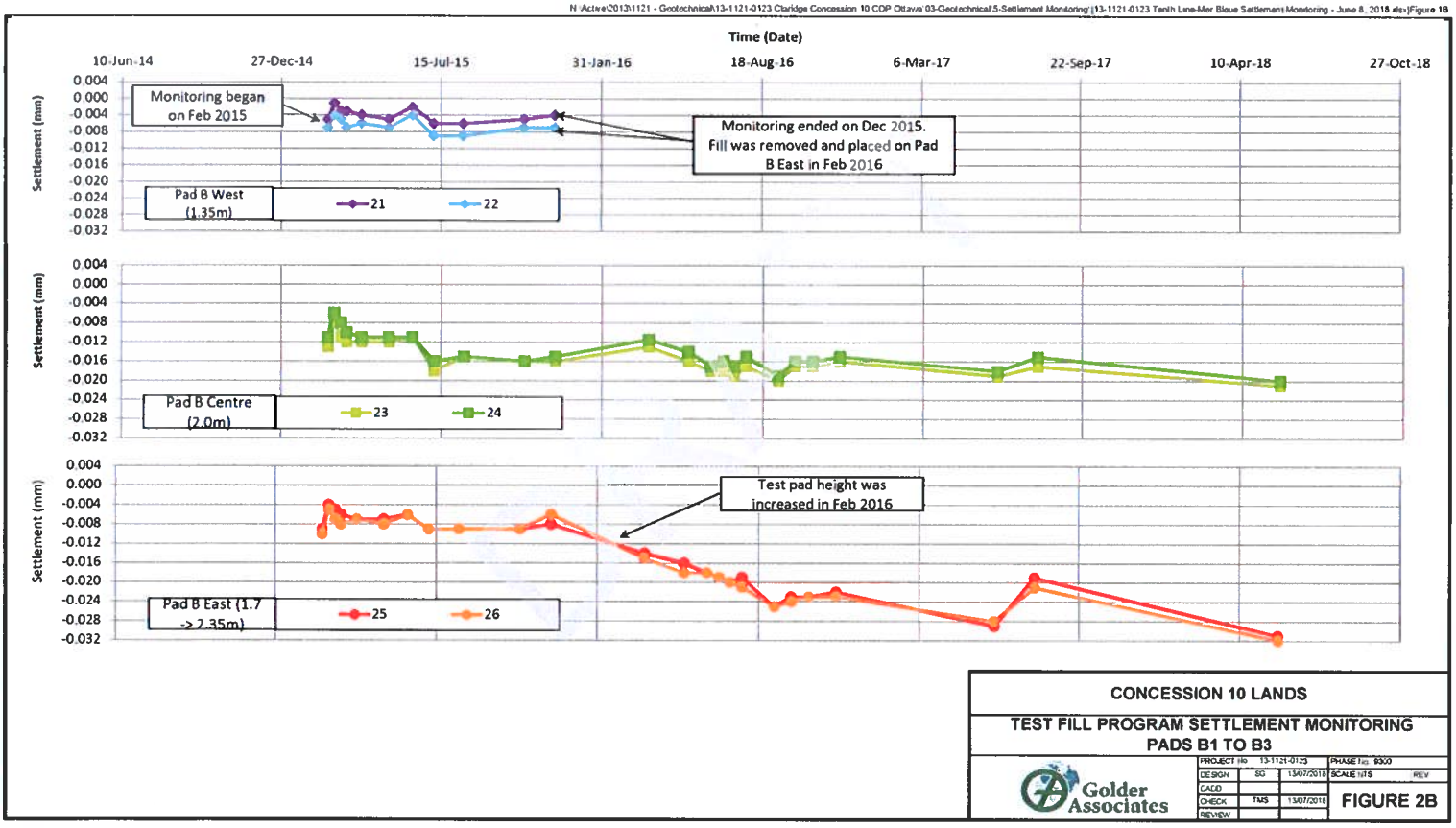
TEST FILL PROGRAM SETTLEMENT MONITORING PADS A1 TO A3

Golder Associates

PROJECT No. 13-1121-0123			PHASE No. 9300	
DESIGN	SG	13/07/2018	SCALE NTS	REV
CADD				
CHECK	TMS	13/07/2018		
REVIEW				

FIGURE 2A

N:\Active\2013\1121 - Geotechnical\13-1121-0123 Claridge Concession 10 CDP Ottawa\03-Geotechnical\5-Settlement Monitoring\[13-1121-0123 Tenth Line-Mer Bleue Settlement Monitoring - June 8_2018.xls]Figure 1B



CONCESSION 10 LANDS

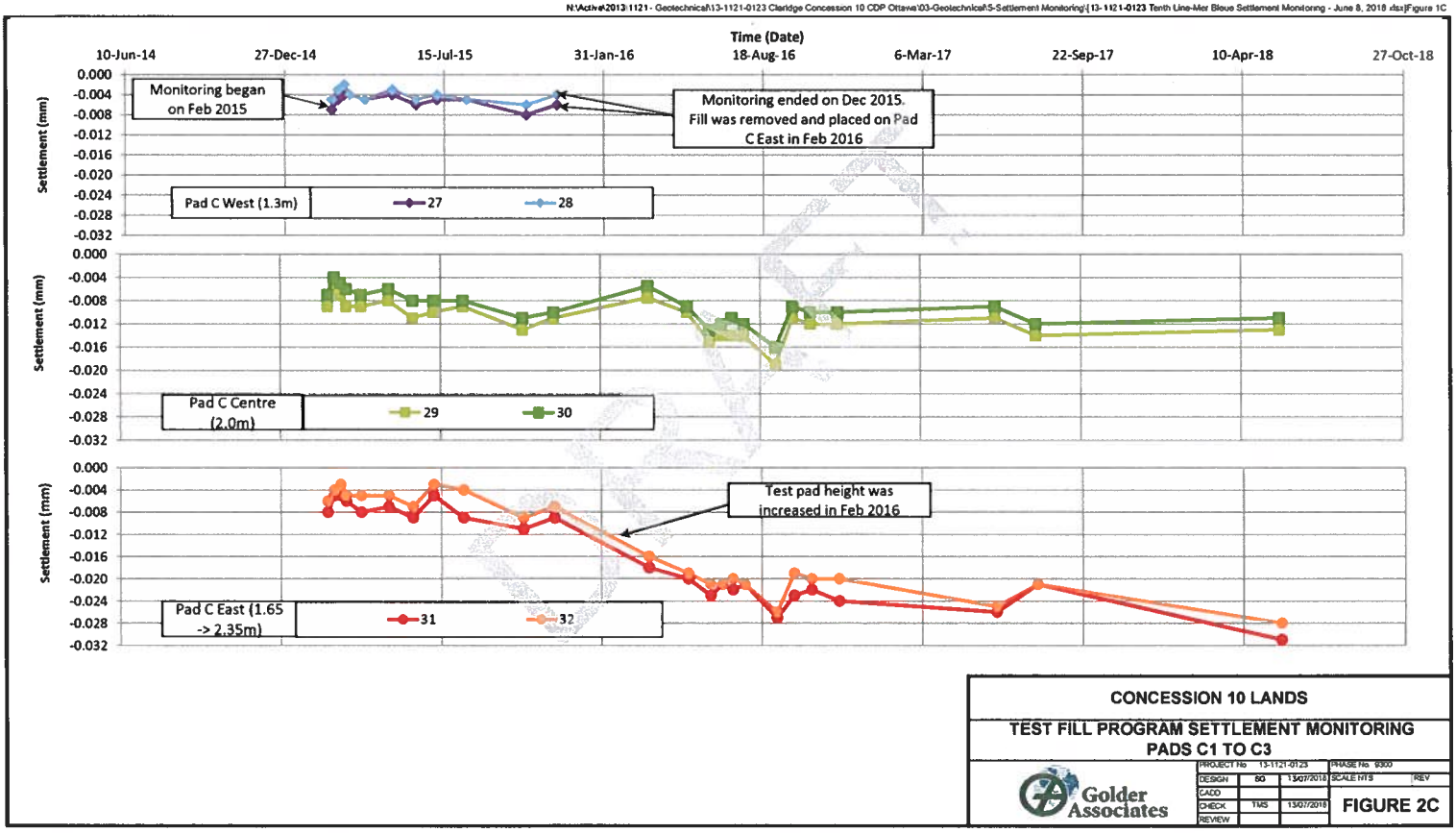
TEST FILL PROGRAM SETTLEMENT MONITORING PADS B1 TO B3

Golder Associates

PROJECT No.	13-1121-0123		PHASE No.	6300
DESIGN	SG	13/07/2018	SCALE	NTS
CADD				REV
CHECK	TMS	13/07/2018		
REVIEW				

FIGURE 2B

N:\Active\2013\1121 - Geotechnical\13-1121-0123 Claridge Concession 10 CDP Ottawa\03-Geotechnical\5-Settlement Monitoring\[13-1121-0123 Tenth Line-Mer Bleue Settlement Monitoring - June 8, 2018.xlsx]Figure 1C



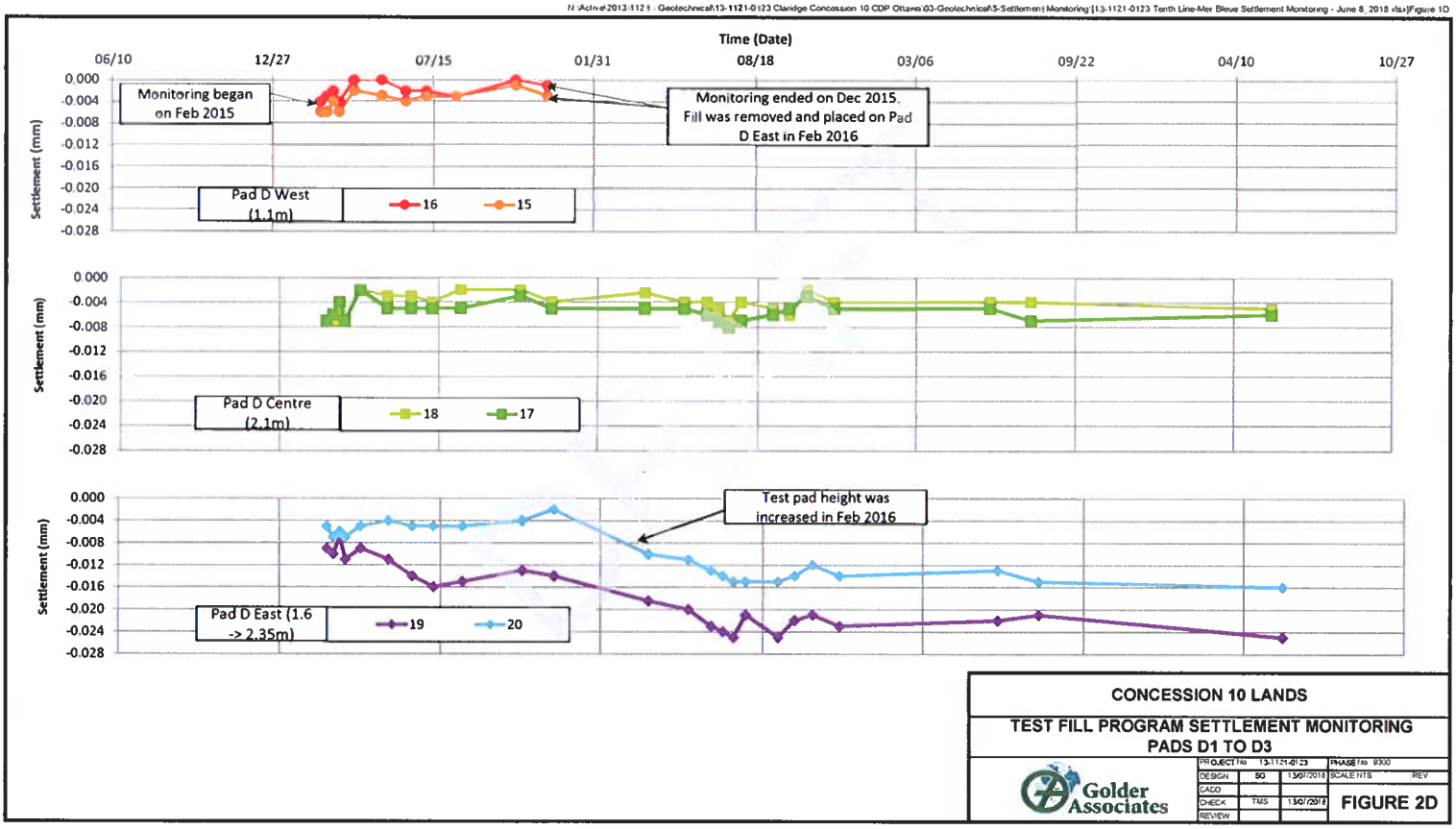
CONCESSION 10 LANDS

TEST FILL PROGRAM SETTLEMENT MONITORING PADS C1 TO C3

Golder Associates

PROJECT No 13-1121-0123			PHASE No 9300
DESIGN	SG	13/07/2018	SCALE NTS REV
CADD			
CHECK	TMS	13/07/2018	
REVIEW			

FIGURE 2C



CONCESSION 10 LANDS

TEST FILL PROGRAM SETTLEMENT MONITORING PADS D1 TO D3

Golder Associates

PROJECT No	13-1121-0123	PHASE No 9300		
DESIGN	SG	13/07/2018	SCALE NTS	REV
CADD				
CHECK	TMS	13/07/2018		
REVIEW				

FIGURE 2D

June 2017

REPORT ON

Geotechnical Input Community Design Plan Concession 10 Lands Ottawa, Ontario

Submitted to:

Claridge Homes
2001-210 Gladstone Avenue
Ottawa, Ontario
K2P 0Y6

REPORT

Report Number: 13-1121-0123 Rev-01

Distribution:

2 copies - Claridge Homes

1 copy - Golder Associates Ltd.

Golder Associates

Table of Contents

FIGURES

APPENDICES

1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical investigation carried out in relation to the preparation of a Community Design Plan for the proposed "Concession 10 Lands" development area.

The purpose of this preliminary geotechnical investigation was to determine the general soil and groundwater conditions across the site by means of eight broadly spaced boreholes. Based on an interpretation of the factual information obtained, along with the existing data available for this site, a preliminary assessment is provided on the geotechnical aspects of developing this area with residential developments. The guidelines and recommendations will need to be revisited if the results of the detailed investigations differ from that of the preliminary investigation.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

2.0 DESCRIPTION OF PROJECT AND SITE

The study area occupies a parcel of land which extends from Tenth Line Road to Mer Blue Road, in the east-west direction, and from about 1,200 metres north of Wall Road to about 600 metres south of Wall Road, in the north-south direction. The approximate limits of the study area are indicated on the Key Plan, Figure 1.

Most of the lands within the study area are currently being used for agriculture purposes. However, a central portion of the area (Capello Lands) is forested.

McKinnon Creek extends diagonally across the northeast portion of the study area.

North of Wall Road, the topography of the site is fairly flat and level. South of Wall Road, the topography of the site slopes down gently to the south.

It is understood that this community is generally being planned for development with conventional residential subdivisions.

Golder Associates previously carried out the following preliminary geotechnical studies within the study area, just north and south of Wall Road:

- A preliminary geotechnical investigation for Claridge Homes on a parcel of land located immediately north of Wall Road in 2011.
- A preliminary geotechnical investigation for Claridge Homes on a parcel of land located within the southernmost portion of the study area in 2012.

A preliminary geotechnical investigation was also previously carried out on the northern portion of site by Paterson Group (Paterson) and the results of that investigation are summarized in the following report to Mattamy Homes.

- "Preliminary Geotechnical Investigation, Bisson Property – Residential Development, Tenth Line Road, Ottawa (Cumberland), Ontario" dated March 9, 2006 (Report number PG0703-1).

Based on a review of the previous geotechnical studies, the subsurface conditions within the study area are indicated to generally consist of a thick deposit of sensitive marine clay.

The surficial geologic mapping produced by the Geologic Survey of Canada (GSC) for the study area is summarized on Figure 2. That mapping indicates that the entire study area is underlain by a thick deposit of sensitive marine clay, with the "south-western" portion of the site overlain by a sand cap.

Figure 3 summarizes the mapped trend in the depth to bedrock (i.e., thickness of soil cover) while Figure 4 summarizes the mapped bedrock formations that underlie the site. In general, the bedrock surface is expected to lie at depths in the range of 15 to 50 metres.

The bedrock geology mapping (Figure 4) indicates that the study area north of Wall Road is underlain by shale of the Billings Formation and that the study area south of Wall Road is underlain by interbedded shale and limestone of Lindsay Formation.

3.0 FIELD INVESTIGATION PROCEDURE

The fieldwork for this preliminary investigation was carried out between August 29 and September 4, 2013. At that time, eight boreholes (numbered 13-04 to 13-11, inclusive) were put down at the locations shown on the Site Plan, Figure 5.

All of the boreholes were advanced using track-mounted continuous flight hollow-stem auger drill rig supplied and operated by Marathon Drilling Company Ltd. of Ottawa, Ontario. The boreholes were advanced to depths ranging from about 7.8 to 9.1 metres below the existing ground surface. One additional borehole (numbered 13-07A) was put down adjacent to borehole 13-07 to obtain Shelby tube samples of the 'softer' silty clay.

Standard penetration tests were carried out in the boreholes at regular intervals of depth and samples of the soils encountered were recovered using split spoon sampling equipment. In addition, 13 relatively undisturbed 73 millimetre diameter thin walled Shelby tube samples of the silty clay were obtained from selected boreholes using a fixed piston sampler.

Standpipe piezometers were sealed into boreholes 13-04, 13-06, 13-07, 13-09, and 13-10 to allow subsequent measurement of the groundwater levels across the site. The groundwater levels in these standpipe piezometers were measured on September 2, 2013.

The fieldwork was supervised by a technician from our engineering staff who located the boreholes, directed the drilling operations and in situ testing, logged the boreholes and samples, and took custody of the soil samples retrieved.

Upon completion of the drilling operations, samples of the soils encountered in the boreholes were transported to our laboratory for further examination by the project engineer and for laboratory testing. The laboratory testing included natural water content determinations, Atterberg limit tests, and oedometer consolidation testing.

The borehole locations were selected, picketed, and surveyed in the field by Golder Associates Ltd. The borehole locations and elevations were surveyed using a Trimble R8 Global Positioning System (GPS) unit. The elevations are referenced to Geodetic datum.

4.0 SUBSURFACE CONDITIONS

4.1 General

Information on the subsurface conditions is provided as follows:

- The Record of Borehole Sheets for the current investigation are provided in Appendix A.
- The results of the laboratory water content and Atterberg limit testing carried out on selected samples of soils from the current investigation are provided on the Record of Borehole Sheets.
- The Record of Borehole Sheets and borehole logs for the previous investigations carried out by Golder Associates and Paterson Group are provided in Appendix B.
- The results of the oedometer consolidation tests carried out by Golder Associates for the current and previous investigations are provided on Figures C1 to C12 in Appendix C.
- The results of the oedometer consolidation tests carried out by Paterson Group for the previous investigation are provided in Appendix C.
- A summary of the engineering properties obtained from both the current and previous investigations is provided on Figure 6.

In general, the subsurface conditions within the study area consist of discontinuous layers of fill and sandy soils overlying a thick deposit of sensitive silty clay.

The following sections present a brief summary of the subsurface conditions encountered within the boreholes for both the current and previous investigations. For detailed descriptions of the subsurface conditions within the boreholes, the reader is referred to the borehole logs in Appendices A and B.

4.2 Fill and Topsoil

Surficial fill was encountered at the ground surface at boreholes 13-06 and 12-4. The fill at those borehole locations is about 1.8 and 0.5 metres thick, respectively, and generally consists of a mixture of clay and sand, with variable amounts of gravel, brick fragments, and organic matter.

Topsoil was encountered at the ground surface at most of the borehole locations. The topsoil varies from about 100 to 510 millimetres in thickness, but is generally less than 300 millimetres thick. A buried layer of topsoil, about 150 millimetres in thickness, was encountered beneath the fill in borehole 12-4.

4.3 Sandy Soils

Deposits of sand to silty sand exist beneath the fill, topsoil, or within the clayey soil at several of the borehole locations (boreholes 11-01, 11-02, 11-03, 11-06, 11-07, 12-1, 12-2, 12-5, 13-04, 13-05, and 13-07). Where encountered, this material is grey to brown in colour and ranges from about 70 to 910 millimetres in thickness.

Two standard penetration test "N" values of 4 and 5 obtained within the sandy deposits indicate a very loose to loose state of compactness.

4.4 Sensitive Silty Clay

The fill, topsoil, and sandy soils are underlain by a thick deposit of sensitive silty clay.

The upper 1 to 2.5 metres of the silty clay have generally been weathered to a grey brown crust. Standard penetration tests carried out within the weathered crust measured "N" values ranging from "weight of hammer" to 13 blows per 0.3 metres of penetration. The results of the in situ vane testing carried out within the weathered portion of the silty clay gave undrained shear strengths ranging from about 40 to 105 kilopascals. The results of the in situ testing indicate a firm to very stiff consistency.

The measured water contents of samples of the weathered crust were approximately 32 to 60 percent.

The silty clay below the depth of weathering is grey in colour. The unweathered grey silty clay deposit was fully penetrated in borehole 13-09 (advanced just south of Wall Road) and proven to extend to a depth of about 4.6 metres below the existing ground surface. The grey silty grey was inferred (using dynamic cone penetration tests) in BH 2, BH 4, and BH 6 (advanced at the northern portion of the site) to extend to a depth of about 21 metres below the ground surface. In the remaining boreholes, the grey silty clay was proven to depths of at least 6 to 14 metres below the ground surface prior to the boreholes being terminated.

The results of the in situ vane testing in the grey silty clay measured undrained shear strength values generally ranging from about 20 to 70 kilopascals, indicating a soft to stiff consistency.

The results of Atterberg limit testing carried out on samples of the unweathered silty clay gave plasticity index values of about 37 to 59 percent and liquid limit values of about 64 to 90 percent, indicating a high plasticity soil. The measured water contents of samples from the unweathered deposit were about 51 to 94 percent, which are generally in excess of the liquid limit values.

Oedometer consolidation testing was carried out on Shelby tube samples of the grey silty clay. The results of the testing are summarized in the table below.

Borehole/Sample Number	Sample Depth/Elevation (m)	Unit Weight (kN/m^3)	σ_P' (kPa)	σ_{VO}' (kPa)	C_c	C_r	e_o	OCR
11-4A / 1	4.8 / NA	14.6	75	35	3.27	0.027	2.58	2.1
11-6 / 3	3.5 / NA	15.3	65	40	1.94	0.030	2.15	1.6
12-3 / 3	3.5 / NA	15.1	85	50	1.52	0.013	2.24	1.7
12-5 / 4	5.0 / NA	15.0	75	50	3.57	0.020	2.30	1.5
13-04 / 6	5.0 / 82.3	15.7	60	50	1.19	0.015	1.93	1.2
13-05 / 3	3.4 / 82.7	15.0	75	40	2.63	0.013	2.33	1.9
13-06 / 6	5.7 / 81.4	15.2	75	55	1.53	0.012	2.17	1.4
13-06 / 7	7.2 / 79.9	16.6	120	65	0.66	0.005	1.54	1.8
13-07A / 1	4.1 / 81.2	15.2	80	40	1.50	0.012	2.14	2.0
13-08 / 4	4.8 / 80.7	14.8	110	50	3.53	0.002	2.38	2.2
13-10 / 4	4.2 / 80.8	14.6	100	45	3.21	0.005	2.54	2.2
13-11 / 5	5.7 / 79.1	15.1	105	55	2.33	0.010	2.21	1.9
BH 1 / TW 4	3.9 / 82.8	14.6	65	46	3.23	0.042	2.55	1.4
BH 1 / TW 5	6.4 / 80.3	15.4	105	60	3.91	0.025	2.09	1.8
BH 4 / TW 4	4.0 / 82.3	15.1	77	46	2.21	0.026	2.24	1.7
BH 5 / TW 3	4.0 / 82.8	15.1	81	46	2.27	0.035	3.37	1.8
BH 6 / TW 3	3.4 / 83.3	15.9	77	43	2.64	0.027	1.80	1.8
BH 6 / TW 6	9.5 / 77.2	15.6	115	78	2.28	0.025	1.98	1.5

Notes:

σ_P' - Apparent preconsolidation pressure
σ_{VO}' - Computed existing vertical effective stress
C_c - Compression index
C_r - Recompression index
e_o - Initial void ratio
OCR - Overconsolidation ratio

4.5 Glacial Till

Glacial till was encountered beneath the silty clay deposit at borehole 13-09 at a depth of about 4.6 metres below the existing ground surface. The glacial till was proven to extend to at least 7.8 metres below the existing ground surface. The glacial till consists of a heterogeneous mixture of gravel, cobbles, and boulders in a matrix of silty sand, with a trace of clay.

Standard penetration test "N" values obtained within the glacial till vary widely from 9 to greater than 50 blows per 0.3 metres of penetration, indicating a loose to very dense state of compactness. However, the higher "N" values likely reflect the presence of cobbles and boulders within the glacial till, rather than the state of packing of the soil matrix.

Glacial till was also inferred, using dynamic cone penetration tests, to exist beneath the silty clay deposit at BH 2, BH 4, and BH 6 at a depth of about 21 metres below the ground surface.

4.6 Refusal

Practical refusal to auger advancement was encountered in borehole 13-09 at a depth of about 7.8 metres below the existing ground surface.

Practical refusal to dynamic cone penetration was encountered in BH 2 and BH 6 at depths of about 33.0 and 30.5 metres, respectively, below the ground surface.

Refusal may indicate the bedrock surface, however, it likely reflects the presence of cobbles and boulders within the glacial till deposit.

Based on the published geological mapping, the bedrock surface in this area is indicated to be at about 15 to 50 metres depth below the ground surface.

4.7 Groundwater

The results of the groundwater level measurements are provided in the following table.

Borehole Number	Ground Surface Elevation	Geological Unit	Date of Measurement	Water Level Elevation	Water Level Depth (metres)
1	86.7	Silty Clay	October 28, 2005	85.9	0.8
2	86.3	Silty Clay	October 28, 2005	85.5	0.8
3	86.5	Silty Clay	October 28, 2005	85.2	1.3
4	86.3	Silty Clay	October 28, 2005	85.4	0.9
5	86.8	Silty Clay	October 28, 2005	85.9	0.9
6	86.7	Silty Clay	October 28, 2005	85.8	0.9
13-04	87.3	Silty Clay	September 2, 2013	85.7	1.6
13-06	87.1	Silty Clay	September 2, 2013	85.7	1.4
13-07	85.3	Silty Clay	September 2, 2013	84.6	0.7
13-09	85.1	Silty Clay	September 2, 2013	82.5	2.6
13-10	85.0	Silty Clay	September 2, 2013	83.2	1.8

Groundwater levels are expected to fluctuate seasonally. Higher groundwater levels are expected during wet periods of the year, such as spring.

5.0 DISCUSSION

This section of the report provides preliminary engineering guidelines pertaining to the geotechnical design aspects of the project based on our interpretation of the borehole information and the project requirements.

It should be emphasized that the scope of this investigation is appropriate for planning purposes only and is only for the residential portion of this development. Additional investigations will be required for preliminary and detailed design of the residential development, as well as design of any institutional, high density, or commercial developments.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

5.1 Site Grading and Foundation Design

As discussed previously, the subsurface conditions within the study area typically consist of a discontinuous deposit of surficial sand and silty sand, generally less than about 1 metre thick, overlying firm to very stiff weathered silty clay crust, generally about 1 to 2.5 metres thick, and then by a softer and compressible deposit of unweathered silty clay.

The 'softer' unweathered silty clay within the study area has very limited capacity to support additional stress, such as could be imposed by:

- The foundation loads of buildings/houses;
- The weight of grade raise fill placed on the site; and,
- The effects of groundwater level lowering (which reduces the buoyant forces that act between the soil particles), which could result from servicing and development of the site.

An increase in stress, if excessive (i.e., if raising the stress above, or even close to, the clay's preconsolidation pressure), could lead to significant consolidation settlements. Due to the low hydraulic conductivity of the clay, and the need to expel water for those settlements to occur, the settlements would be long-term in nature, possibly taking many months or years to complete. The grade raises within the study area will therefore need to be restricted, based on leaving sufficient remaining capacity for the clay to also support the foundation loads, without being overstressed. If the grade is raised excessively, then settlements could occur.

It is conventional practice to allow the stress *increase* on the silty clay to be about 80 percent of the difference between the existing natural stress level and the preconsolidation pressure (i.e., of the overconsolidation). This margin (of 20 percent) is left between the final stress level and the preconsolidation pressure because the effects of 'secondary compression' can cause large settlements even at stress levels just slightly below the preconsolidation pressure. The margin also allows for some uncertainty in the actual value of the preconsolidation pressure, the groundwater levels, the unit weight of the fill, etc.

Based on the results of this preliminary field investigation and existing available data, the maximum permissible grade raise should be restricted to no more than about 0.3 metres for this study area. This grade raise limitation has been assessed based on leaving some capacity for the silty clay deposit to support foundation loads for structures designed in accordance with Part 4 or Part 9 of the Ontario Building Code.

Structures which are built in accordance with Part 9 of the Ontario Building Code (i.e., typical house construction) consist of:

- Footings no greater than 0.6 metres in width.
- Footings designed for an allowable bearing pressure (or SLS net bearing resistance for Part 4) of 75 kilopascals.
- Footings which are placed at about 2.2 to 2.4 metres depth.

Given the very limited permissible grade raise value, a test fill program was carried out. A summary of the test fill program and results are provided in the following section.

5.2 Test Fill and Revised Grade Raise Limitations

5.2.1 Test Fill Background

Based on the preliminary design grading prepared by IBI Group, it is understood that this site will have finished grades which exceed the permissible value described above, and grade raises in the order of 1.0 to 1.6 metres are required. To limit/avoid the use of light weight fill materials, a 'test fill' program was undertaken to confirm the geotechnical assessment of the maximum permissible grade raises. The calculated permissible finished grade values were based on interpretation of laboratory test results as well as theoretical calculations of stresses and settlements. As such, there is an inherent potential for the actual permissible finished grade to be more than the calculated value. The test fill program allows for a direct measurement of the maximum permissible grade raises, without the uncertainty involved in a theoretical prediction.

5.2.2 Test Fill Program

A test fill program was carried out at four areas across the site (as shown on Figure 14).

The objective of the test fill program was to test/confirm the magnitude of stress increase that can be applied to the subgrade soils (i.e., to the soft/compressible clay at depth) without inducing excessive settlements.

Based on the measured unit weight for the fill used to construct the test pads, once spread and compacted by the bull-dozer tracks, and taking into account the 'efficiency' of the proposed test fill pad dimensions, future groundwater level lowering (discussed below), and foundation loads, the following test fill heights above original ground level were constructed:

Design Grade Raise To Be Tested (metres)	Corresponding Surcharge (kilopascals)	Equivalent Test Fill Height (metres)
0.5	17	1.3
0.8	22	1.6
1.2	30	2.1

The average groundwater level across the site was measured to be at about 1.2 metres below the ground surface. The test fill program assumed that the long term groundwater across the site would be 2.4 metres below the existing ground surface. This accounts for potential lowering due to house foundation drains as well as seasonal

fluctuation. Future groundwater level monitoring is not required across the general site. It is however recommended that groundwater level monitoring be carried out in the area of the ponds (which is discussed further in 5.2.5).

It is understood that the bottom of McKinnon's Creek will be lowered as part of the stormwater management plan. However, is it also understood (from IBI) that the permanent water level within the creek will not be lowered. This being the case, lowering the bottom of creek will not negatively impact the design of the development from a geotechnical point of view.

5.2.3 Test Fill Settlement Monitoring

The following provides comments on the settlement monitoring program:

- The subgrade settlements were monitored to evaluate the magnitude of settlement that occurred once the fill was placed and the rate of any on-going settlements. Since the magnitude of the settlement was expected to be relatively small, at least over short time periods, the survey methods/equipment was selected so as to have an accuracy of +/- 2 millimetres. Annis O'Sullivan Vollebekk Ltd. Ontario Land Surveyors carried out the settlement monitoring.
- Two settlement plates were placed at each of the test fill piles. The installation of the settlement plates occurred prior to the placement of the fill so that all of the settlements were captured by the settlement monitoring.
- A set of baseline/reference readings was taken for each settlement plate prior to any fill placement.
- A survey benchmark was established for each test pile location.
- The settlement plate (rod) elevations were collected every week during the first month after completion of filling and the frequency was then reduced to bi-weekly, and then a monthly basis thereafter.

5.2.4 Test Fill Results

- The settlements were measured from February 2015 to December 2015. During that period, a maximum settlement of about 22 millimetres was measured, with many of the settlement monitoring points moving less than 15 millimetres. The majority of the settlement occurred before October 2015. This magnitude of settlement is considered acceptable for standard house design and construction.
- Based on the results of the test fill program, it is our opinion that the maximum permissible grade raise for this site can be increased at most 1.0 metres (i.e., 0.7 metres higher than reported above). This maximum permissible grade raise is relative to the native topsoil.
- It should be noted that the test pads have been increased in height (in February 2016) to assess if the maximum permissible grade raise could be increased beyond the currently approved 1 metre. It is expected that up to about 12 to 18 months of monitoring will be required before a decision can be made.
- It is also suggested that "long-term" monitoring of the test fill be carried out, at least until construction of the development commences.

- The test fill program encompassed the softer parts of the site (the test pad locations were selected to be located on the "softest" parts of the site, based on existing information). However, in the event that the softer clays are encountered during the detailed investigations, a further test fill program or special foundation design considerations will be required.

If the grading restrictions determined during the test fill program cannot be accommodated, the following additional options could be considered:

1) Expanded Polystyrene (EPS) light weight fill could be used to backfill beneath/within the garages and porches. By using EPS beneath/within the garages and porches, the net effect of the basement unloading can be utilized. Typically, this will increase the maximum permissible grade raise at the house by about 0.2 to 0.3 metres, which will yield a potential maximum grade raise of about 1.2 to 1.3 metres for this site. But, this will have to be confirmed on a case by case basis.

2) EPS light weight fill could be used to backfill around the foundations (and not just beneath/within the garages and porches). As a preliminary guideline, any additional required grade raises, in excess of the specified values, could be accomplished using EPS. For this site, a grade raise of up to 1.5 metres at the houses could be accommodated.

3) For areas requiring significantly more grade raise, the area could be pre-loaded. This would involve placing fill material on the site to above what would be required for site grading, and allowing the settlements to take place. Once a sufficient amount of settlement had occurred, the excess fill material would be removed and the house construction could proceed. Instrumentation would need to be installed (i.e., settlement plates) to monitor the settlement and to establish when sufficient settlements had occurred such that house construction could proceed. To reduce the time required for the pre-loading, and limit the post-preload creep settlements, it is likely that a temporary surcharge above the existing grade would be needed. Wick drains could also potentially be used to accelerate the settlements. However, the pre-load time could be months or years.

Additional geotechnical guidelines would need to be provided if any of the above options are selected.

5.2.5 Houses near Stormwater Management Ponds

Two new stormwater management ponds are proposed for this development. The normal water levels in the ponds will range from about 3 to 5 metres below ground surface, which are lower than the measured groundwater levels. Groundwater drawdown should be expected near the ponds. This being the case an additional assessment was carried out for permissible grade raises in the areas of the ponds.

For our assessment, two scenarios were considered:

1) North Pond - bottom of pond in clay, as designed by IBI. The results indicate that the steady state drawdown in the clay is 1 metre at about 20 metres from the edges of the pond. Therefore, special design considerations ***may*** have to be given to houses which are located within about 20 metres of the edge of the north pond.

2) South Pond - Bottom of pond in glacial till, as designed by IBI. The results indicate that the steady state drawdown in the clay overlying the glacial till is about 30 metres from the edge of the pond. Therefore, special design considerations ***may*** have to be given to houses which are located within about 30 metres of the edge of the south pond.

It should be noted that the hydraulic conductivity of the clay was assumed to be $1x10^{-6}$ cm/s and the hydraulic conductivity of the glacial till was assumed to be $1x10^{-5}$ cm/s, both of which are considered to be conservatively high. Additional site specific hydraulic response testing should be carried out to determine if the predicted radius of influence of the groundwater drawdown in the area of the ponds can be reduced based on measured values. The testing should include a minimum of two groundwater monitoring devices installed in the silty clay at the north pond and a minimum of two groundwater monitoring devices installed in the glacial till at the south pond. Hydraulic conductivity testing, consisting of either rising or falling head testing, should be carried out in each groundwater monitoring device. Once the additional hydraulic conductivity testing has been completed, further guidelines can be provided.

5.2.6 Sediment Disposal Storage – East of Avalon West SWM Pond

The following is understood (from IBI) about the proposed sediment disposal storage area:

- The sediment will be placed along the east side of the Avalon West stormwater management pond.
- The total area being considered for the sediment storage is about 892 square metres.
- The stored sediment will not exceed more than 600 millimetres in thickness.
- The grades have not been raised (i.e., no grade raise fill is/was required) in the proposed sediment storage area.

Based on the above, there for no geotechnical concerns from a grade raise restriction perspective (i.e., the placement of the sediment will not result in significant settlement).

5.3 Seismic Design Considerations

The seismic design provisions of the 2012 Ontario Building Code depend, in part, on the shear wave velocity of the upper 30 metres of soil and/or bedrock below founding level. Based on the 2012 Ontario Building Code methodology, this site could be assigned a Site Class of E (for any structures requiring design under Part 4 of the Ontario Building Code). Consideration could be given to carrying out site specific shear wave velocity testing to determine if a more favourable Site Class can be attained.

There may be portions of the site where the shallow sandy deposits will be exposed at footing/subgrade level. Prior to construction of footings or the placement of engineered fill within these areas, the surface of the native sandy material should be proof rolled to provide surficial densification of any loose or disturbed material.

Since these shallow sandy deposits, wherever present, are typically loose, they could be potentially liquefiable in an earthquake (i.e., potentially subject to temporary strength loss and post-earthquake settlements). That potential issue is not however considered relevant to the house design because:

- The potential post-earthquake differential settlements would be relatively small in relation to the expected collapse potential of a house (and the objective of earthquake-resistant design is only to avoid collapse and to provide for safe exit).
- The proof rolling of the sandy subgrade soils, as specified above, would densify any such soils in the immediate area of the footings and therefore the directly supporting soils would be non-liquefiable.

5.4 Frost Protection

The native subgrade soils on this site are considered to be frost susceptible. Therefore, all exterior perimeter foundation elements or foundation elements in unheated areas should be provided with a minimum of 1.5 metres of earth cover for frost protection purposes. Isolated, unheated exterior footings adjacent to surfaces which are cleared of snow cover during winter months should be provided with a minimum of 1.8 metres of earth cover. Houses with conventional depth basements would satisfy these requirements.

5.5 Basement Floor Slabs

In preparation for the construction of the basement floor slabs, all loose, wet, and disturbed material should be removed from beneath the floor slab. Provision should be made for at least 200 millimetres of 19 millimetre crushed clear stone to form the base of the basement floor slabs.

The type of drainage system required (perimeter drains and/or underfloor drains; damp-proofing or water-proofing) depends upon the proposed basement founding elevations, soil types in the area of the house and stabilized groundwater levels. The groundwater level was noted at about 0.7 to 2.6 metres depth within the boreholes.

If/where the groundwater level is encountered above the sandy subgrade level, a geotextile could be required between the clear stone underslab fill and the sandy subgrade soils, to avoid loss of fine soil particles from the subgrade soil into the voids in the clear stone and ultimately into the drainage system. In the extreme case, loss of fines into the clear stone could cause ground loss beneath the slab and plugging of the drainage system. Where a geotextile is required, it should consist of a Class II non-woven geotextile with a Filtration Opening Size (FOS) not exceeding about 100 microns, in accordance with Ontario Provincial Standard Specification (OPSS) 1860.

To prevent hydrostatic pressure build up beneath the basement floor slabs, it is suggested that the granular base for the floor slabs be positively drained.

5.6 Excavation and Site Servicing

Excavation for basements and site services will be through the fill, topsoil, sand, silty sand, and silty clay. Excavations for site services will likely extend into the soft silty clay.

No unusual problems are anticipated in trenching in the overburden using conventional hydraulic excavating equipment. The sandy soils above the groundwater table and the firm to very stiff silty clay would generally be classified as a Type 3 soil in accordance with the Occupational Health and Safety Act of Ontario. As such, these excavations may be made with side slopes at 1 horizontal to 1 vertical. However, excavations within the sandy soils below the water table as well as into the underlying soft silty clay would be classified as a Type 4 soil; side slopes as flat as 3 horizontal to 1 vertical would therefore be required. Alternatively, the excavations could be carried out using steeper side slopes with all manual labour carried out within a fully braced, steel trench box for worker safety. The stability of braced excavations which could extend into the soft grey silty clay should be assessed individually based on the length, width, and depth of the trench box.

Some groundwater inflow into the trenches should be expected. However, it should be possible to handle the groundwater inflow by pumping from well filtered sumps established in the floor of the excavations, provided suitably sized pumps are used.

The high moisture content of the grey silty clay makes this soil difficult to handle and compact. If grey silty clay is excavated during installation of the site services, this material should be wasted or should only be used as backfill in the lower portion of the trenches to limit the amount of long term settlement of the roadway surface. If the grey silty clay is used in trenches under roadways, long term settlement of the pavement surface should be expected.

Impervious dykes or cut-offs should be constructed at 100 metre intervals in the service trenches to reduce groundwater lowering at the site due to the "french drain" effect of the granular bedding and surround for the service pipes. It is important that these barriers extend from trench wall to trench wall and that they fully penetrate the granular materials to the trench bottom. The dykes should be at least 1.5 metres wide and could be constructed using relatively dry (i.e., compactable) grey brown silty clay from the weathered zone.

It is envisioned that conventional service installation (bedding, cover, backfill, etc.) will be appropriate for this project.

5.7 Pavement Design

The required pavement structure for the roadways will depend upon the quality of the backfill in the service trenches. Previous experience with the construction of roadways on sites within similar subsurface conditions indicates the shallow subgrade soils will likely be generally wet of the optimum for compaction and will be very sensitive to disturbance, weather, and precipitation. It is therefore proposed that the following pavement structures be planned for these roadways, subject to review at the time of construction. It should also be expected that the subgrade will need to be covered with a suitable woven geotextile.

The pavement structure for local roads should consist of:

Pavement Component	Thickness (millimetres)
Asphaltic Concrete	90
OPSS Granular A Base	150
OPSS Granular B Type II Subbase	450

The pavement structure for collector roadways should consist of:

Pavement Component	Thickness (millimetres)
Asphaltic Concrete	90
OPSS Granular A Base	150
OPSS Granular B Type II Subbase	600

Please note that the pavement structure will need to be increased for bus routes (if there are any).

The granular base and subbase materials should be uniformly compacted to at least 100 percent of the materials' standard Proctor maximum dry density using suitable vibratory compaction equipment. The asphaltic concrete should be compacted in accordance with Table 10 of OPSS 310.

The composition of the asphaltic concrete pavement should be as follows:

- Superpave 12.5 mm Surface Course – 40 mm ; and,
- Superpave 19 mm Base Course – 50 mm.

The asphaltic cement should consist of PG 58-34 and the design of the mixes should be based on a Traffic Category B for local roads and Category C for collector roads.

5.8 Trees

The silty clay at the site is highly sensitive to water depletion by trees of high water demand during periods of dry weather. When trees draw water from the silty clay, the silty clay undergoes shrinkage which can result in settlement of adjacent structures. The zone of influence of a tree is considered to be approximately equal to the height of the tree. Therefore, trees which have a high water demand should not be planted closer to structures than the ultimate height of the trees.

5.9 McKinnon Creek – Slope Stability Assessment

McKinnon Creek extends diagonally across the northeast portion of the study area.

5.9.1 Site Reconnaissance

A reconnaissance at McKinnon Creek was carried out on May 8 and 9, 2014. The purpose of the site reconnaissance was to view the site conditions, to measure the slope geometry, and to observe the state of erosion at the toes of the slopes. A total of seven slope cross sections (labelled A-A' to G-G', inclusive) were surveyed at various locations along the creek. The survey was carried out using a Trimble R8 GPS survey unit. The approximate locations of the surveyed slope cross sections are shown on the Site Plan, Figure 5. The seven surveyed cross sections are provided on Figures 7 through 13.

In general, the slopes of the creek are about 2 to 4 metres in height and have a maximum inclination of about 10 to 25 degrees from horizontal. At the time of the site visit on May 8 and 9, 2014, both sides of slopes were mostly grass covered and no active erosion was observed at the toes of the slopes.

5.9.2 Slope Stability Analysis

Limit equilibrium slope stability analyses were carried out to assess the stability of the existing slopes. For this assessment, one cross section was selected for detailed analysis, based on the highest slope and steepest inclination, with each slope considered to be the most critical of the conditions along each bank of the creek.

In general, slope failures occur when the forces (or rotational moments) generated by the weight of the soil in a slope and external loads exceed the shear strength of the soil. The six main parameters involved in the engineering analysis of the stability of a slope are:

1) The geometry of the slope;
2) The subsurface stratigraphy within the slope (i.e., the composition of the various soil layers within the slope and their depth, thickness, and orientation);
3) The groundwater conditions (i.e., the groundwater levels and the hydraulic gradient/flow conditions);

4) The strength parameters for the soils;

5) The unit weights (i.e., densities) of the soils within the slope; and,

6) External loads on the slope, such as from foundations of structures, filling above the slope, or earthquakes.

For this site, the geometries of the slopes were based on the slope mapping, as described previously.

The subsurface stratigraphy used in the analyses was based on boreholes 11-04, 13-06, and BH4 which were put down near the creek. The subsurface conditions generally consist of up to about 2 metres of fill or topsoil, overlying a thick deposit of sensitive clay. The upper 1 to 2 metres of the silty clay have generally been weathered to a grey brown to red brown crust and has a stiff to very stiff consistency. The unweathered silty clay has soft to stiff consistency and was inferred (using dynamic cone penetration tests) to extend to a depth of about 21 metres below the ground surface. Glacial till was inferred to exist beneath the silty clay.

The selected soil stratigraphy and strength parameters used in the analyses are given in the table below.

Soil Type	Bulk Unit Weight, γ (kN/m^3)	Shear Strength Parameters[1]		
		Undrained Shear Strength, c_u (kPa)	Effective Angle of Internal Friction, φ' (degrees)	Effective Cohesion, c' (kPa)
Existing Fill	18.5	NA	28.0	0
Weathered Crust	17.8	80	35.0	5
Grey Silty Clay	15.5	20	28.7	7.4

Note: [1]The parameters were increased by 10 percent (for the seismic assessment) to account for strain hardening under seismic loading conditions.

The groundwater conditions within the slopes for static conditions were conservatively assumed to be at the ground surface. The groundwater conditions within the slopes for seismic conditions were conservatively assumed to be at the top of the weathered crust.

The stability of the slopes was evaluated for:

- Drained (i.e., long-term, static) conditions, for which effective stress soil parameters were used.
- Seismic conditions (i.e., the dynamic loading conditions during an earthquake), for which undrained shear strength parameters (with 10 percent increase to account for strain hardening under seismic conditions) were used. A horizontal seismic coefficient of 0.18 was used for the analyses. This value is based on the peak horizontal ground acceleration (which was amplified to account for a Site Class E) for Ottawa specified in the 2012 Ontario Building Code (with half that value being used, per standard practice).

The stability of the "worst-case" slope was evaluated using a 2 dimensional limit equilibrium methods and the commercially available SLOPE/W software. The Morgenstern-Price method was used to compute the factor of safety. The factor of safety is defined as the ratio of the magnitude of the forces/moments tending to resist failure to the magnitude of the forces/moments tending to cause failure. Theoretically, a slope with a factor of safety of

less than 1.0 will fail and one with a factor of safety of 1.0 or greater will stand. However, because the modeling is not exact and natural variations exist for all of the parameters affecting slope stability, a factor of safety of 1.5 is used to define a stable slope (for static loading conditions), and/or to define the 'safe' set-back distance from an unstable slope.

For seismic loading conditions, a factor of safety of 1.1 is typically used.

5.9.3 Slope Stability Results

The results of the stability analyses carried out for drained (i.e., static) conditions indicate that the factors of safety against global instability of the existing slopes are greater than 1.5, and these slopes are therefore considered stable from a geotechnical perspective. The factor of safety against instability under *seismic* loading was determined to be greater than 1.1 and therefore these slopes are also considered stable during a design earthquake event.

5.9.4 Limits of Hazard Lands

Hazard Lands associated with unstable slopes, as defined by the Ministry of Natural Resources (MNR) guidelines and provincial planning policies, are unsuitable for development with either publicly owned infrastructure or private development. In accordance with the MNR guidelines, the set-back distance from the crest of an unstable slope to the Limit of Hazard Lands should include three components, as appropriate, namely:

1) A "Stable Slope Allowance", which is determined as the limit beyond which there is an acceptable factor of safety (i.e., greater than about 1.5 static or 1.1 seismic) against the table land being impacted by a slope failure.

2) An "Erosion Allowance", to account for future movement of the slope toe, in the table land direction, as a result of erosion along the slope toe/creek bank. The magnitude of the Erosion Allowance depends upon the type of soil being eroded at the slope toe, the severity of the erosion, and the water course characteristics.

3) An "Erosion Access Allowance" of 6 metres, to allow a corridor by which equipment could travel to access and repair a future slope failure. This Erosion Access Allowance is included in the determination of the Limit of Hazard Lands wherever the development could restrict future slope access.

5.9.4.1 Stable Slope Allowance

For this site, the results of the stability analyses indicate that the factors of safety against global instability of the existing slopes for both static and seismic conditions are greater than the minimum required 1.5 and 1.1, respectively, and these slopes are considered stable. This being the case, a Stable Slope Allowance is not required.

Filling of the table land area could negatively impact on the stability of the adjacent creek slope and increase the required set-back. If additional significant filling is considered for this site, the stability of the slopes should be reassessed.

5.9.4.2 Erosion Allowance

An Erosion Allowance needs to be applied wherever there is active erosion, or the potential for active erosion based on the flow velocities. Based on the observations made during the site reconnaissance, there appears to be no active erosion. This being the case, an Erosion Allowance is not required.

5.9.4.3 *Erosion Access Allowance*

The Erosion Access Allowance included in the MNR procedures for determining the Limit of Hazard Lands is intended to provide a corridor of sufficient width across the table land that equipment could access the site of a future slope failure to undertake a repair. The width of the Erosion Access Allowance is typically 6 metres. The MNR documents do not provide guidance on those situations where the Erosion Access Allowance need, or not need, be applied. However, as a general guideline, the Erosion Access Allowance should be included wherever the development plans would preclude equipment access to the slope. For example, it should be included where buildings or fences will be constructed right up to the Limit of Hazard Lands or crest of slope. But it probably need not be included in the Limit of Hazard Lands associated with the construction of a parking lot on the table land area, since equipment could cross the parking lot. Judgement needs to be used in its application.

Limit of Hazard Land Summary

The following table provides a summary of the various "set-back" components which are applicable for determining the total set-back for this site.

Stable Slope Allowance (metres)	Erosion Allowance (metres)	Access Allowance (metres)	Total Set-Back (metres)
0	2	6(1)	8

Note: (1) Assumes that access to the slope is restricted. This allowance can be reduced to 0 metres if unrestricted access to the slope is available.

6.0 ADDITIONAL CONSIDERATIONS

The geotechnical input provided in this report is preliminary in nature, is based on a limited number of widely spaced boreholes, and is intended solely to provide a preliminary assessment of the geotechnical issues relating to the development of this site. Once the planning process has been completed, additional investigation will be required prior to the future design stage.

7.0 CLOSURE

We trust this preliminary report contains sufficient information for your present requirements. If you have any questions concerning this report, or if we can be of further service to you on this project, please call us.

GOLDER ASSOCIATES LTD.

for Christine Ko, P.Eng.
Geotechnical Engineer

Troy Skinner, P.Eng.
Associate, Geotechnical Engineer

CK/TMS/mvrd
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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 Groundwater 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.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

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.

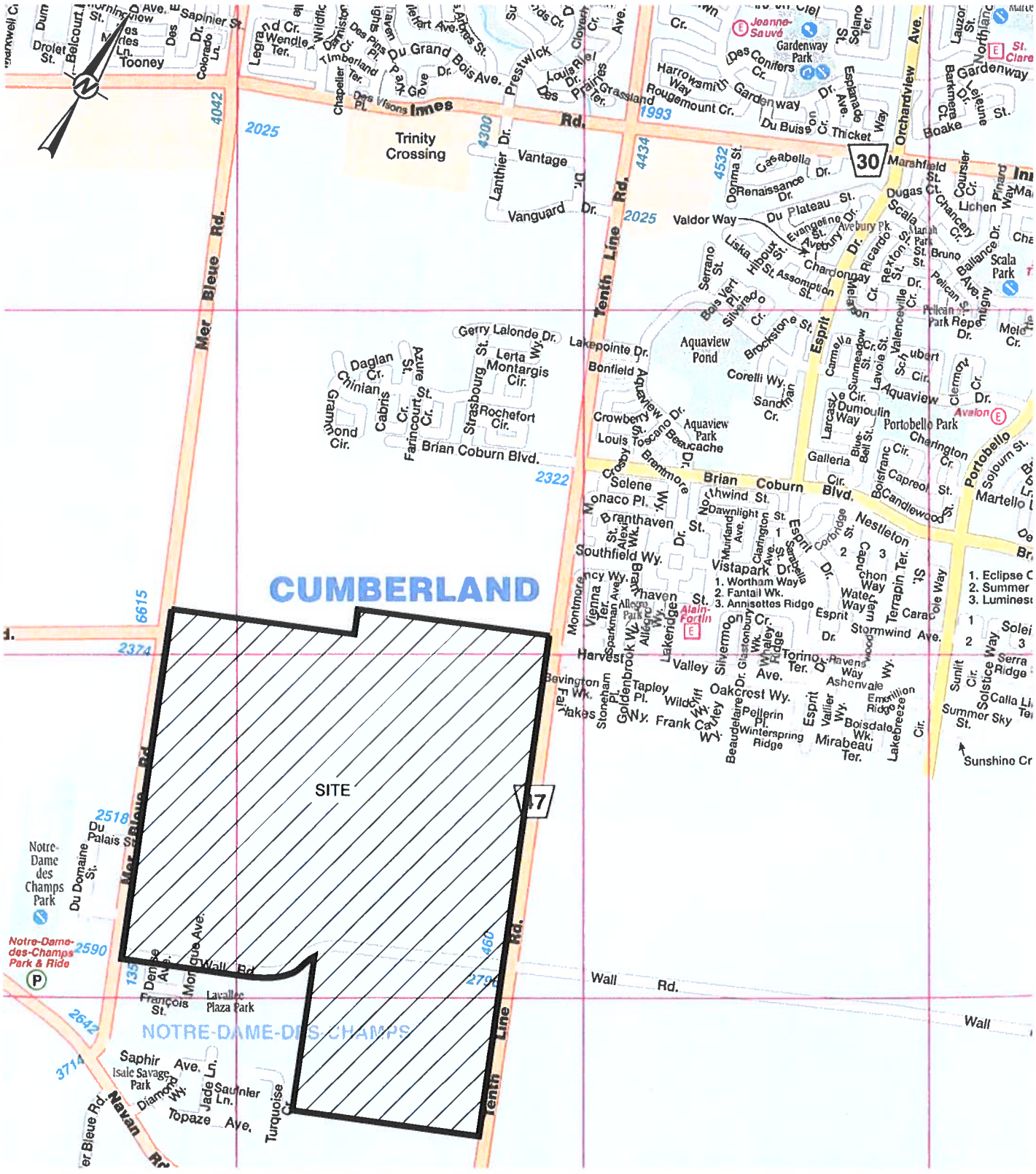
Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater 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.



LEGEND

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 13-1121-0123

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SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW

PROJECT

GEOTECHNICAL INPUT COMMUNITY DESIGN PLAN CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE

KEY PLAN

Golder Associates

PROJECT No.	13-1121-0123		FILE No.	1311210123-1000-01
DESIGN			SCALE	AS SHOWN
CADD	JM	2014-04-01	FIGURE	1
CHECK	CK	2016-02-23		
REVIEW	TMS	2016-02-23		

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LEGEND

- ROAD
- STUDY AREA

SURFICIAL GEOLOGY

7	ORGANIC DEPOSITS: MUCK & PEAT
6a	ALLUVIAL DEPOSITS: SILTY SAND, SILT, SAND & CLAY
6b	ALLUVIAL DEPOSITS: MEDIUM GRAINED STRATIFIED SAND WITH SOME SILT
4	DELTAIC AND ESTUARY DEPOSITS: MEDIUM TO FINE GRAINED SAND
3	OFFSHORE MARINE DEPOSITS: CLAY, SILTY CLAY & SILT
3a	OFFSHORE MARINE DEPOSITS: CLAY, SILT UNDERLYING EROSIONAL TERRACES
1a	TILL, PLAIN WITH LOCAL RELIEF <5M
1b	TILL, DRUMLINIZED
I	LANDSLIDE AREA
r2	BEDROCK: LIMESTONE, DOLOMITE, SANDSTONE & LOCAL SHALE
zz	WATERBODY

NOTES

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 13-1121-0123

REFERENCE

BÉLANGER, J. R. 2008 URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE 5311, 1 DVD.
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CLIENT
CLARIDGE HOMES

PROJECT
GEOTECHNICAL INPUT
COMMUNITY DESIGN PLAN
CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE
SURFICIAL GEOLOGY

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-05-14
PREPARED	BR
DESIGN	---
REVIEW	KSL
APPROVED	TMS

PROJECT No.	PHASE	Rev.	FIGURE
13-1121-0123	1000	C	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI D 25mm

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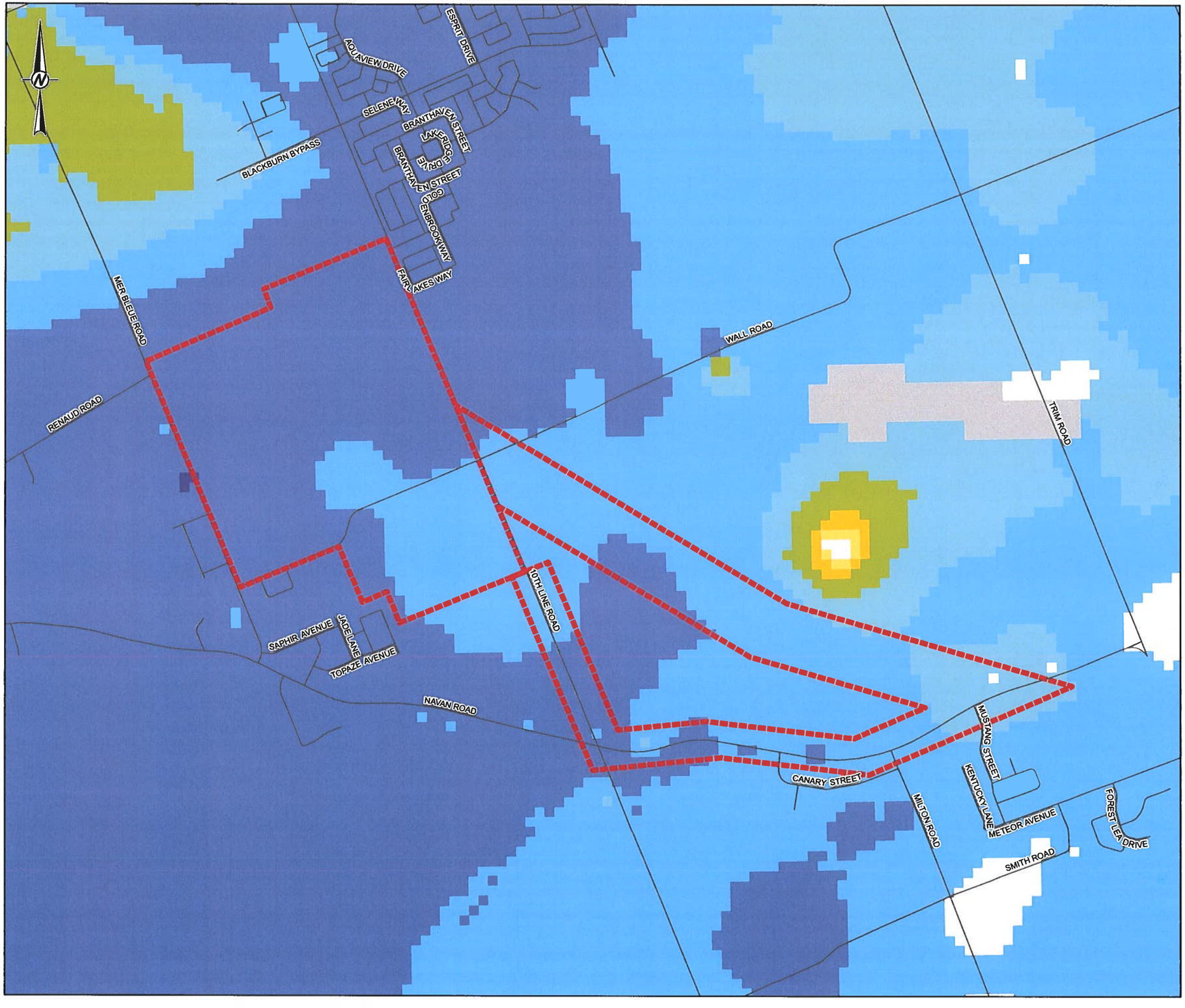

LEGEND

- ROAD
- STUDY AREA

TREND IN DEPTH TO BEDROCK (m)

- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 5
- 5 to 10
- 10 to 15
- 15 to 25
- 25 to 50
- 50 to 100
- 100 to 200

NOTES

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 13-1121-0123

REFERENCE

2010 BÉLANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001

LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2011
DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9

0 200 400 800
SCALE 1:20,000 METERS

CLIENT
CLARIDGE HOMES

PROJECT
GEOTECHNICAL INPUT
COMMUNITY DESIGN PLAN
CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE
TREND IN BEDROCK DEPTH

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-05-14
PREPARED	ABD
DESIGN	--
REVIEW	KSL
APPROVED	TMS

PROJECT No. 13-1121-0123 | PHASE 1000 | Rev. C | FIGURE 3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI D

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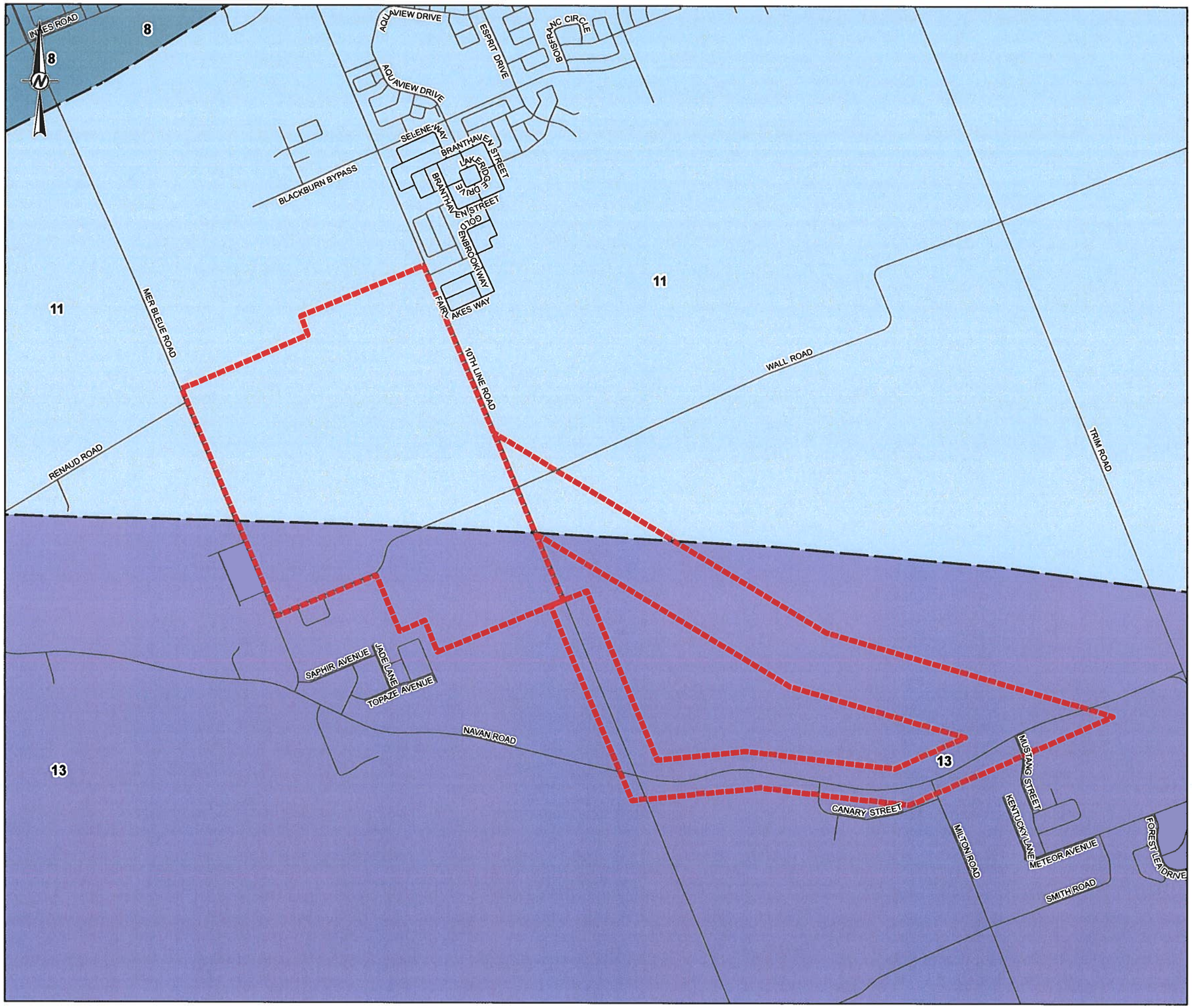


LEGEND

- ROAD
- STUDY AREA
- FAULT LINE

BEDROCK GEOLOGY

- 13: BILLINGS FORMATION - SHALE, MINOR LIMESTONE
- 11: LINDSAY FORMATION - LIMESTONE, NODULAR TO BLACK LAMINATED
- 8: GULL RIVER FORMATION - LIMESTONE, WITH DOLOSTONE BEDS TOWARDS BASE

NOTES

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 13-1121-0123

REFERENCE

ARMSTRONG, D.K. AND DODGE, J.E.P. PALEOZOIC GEOLOGY MAP OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE--DATA 219
LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2011
DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9

0 200 400 800
SCALE 1:20,000 METERS

CLIENT
CLARIDGE HOMES

PROJECT
GEOTECHNICAL INPUT
COMMUNITY DESIGN PLAN
CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE
BEDROCK GEOLOGY

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-05-14
PREPARED	BR
DESIGN	CK
REVIEW	KSL
APPROVED	TMS

PROJECT No. 13-1121-0123 | PHASE 1000 | Rev. C | FIGURE 4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI D

25mm

Path: N:\Active\2013\1121 - Geotechnical\13-1121-0123 Claridge Concession 10 CDP Ottawa\07-Spatial\MXD\GIS\MXD\GEOTECHNICAL_INPUT\13112101 23-04.mxd

LEGEND

- APPROXIMATE BOREHOLE LOCATION IN PLAN, CURRENT INVESTIGATION
- APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATIONS BY GOLDER ASSOCIATES LTD.
- APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY PATERSON GROUP
- STUDY AREA LIMITS
- A A' APPROXIMATE CROSS-SECTION LOCATION IN PLAN

NOTES

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 13-1121-0123
2. ALL CURRENT BOREHOLE LOCATIONS SHOWN ON THIS PLAN WERE DERIVED FROM GPS OBSERVATIONS USING THE CAN-NET VIRTUAL NETWORK REFERENCING THE OTTAWA BASE STATION AND WERE COLLECTED USING THE MTM PROJECTION AND NAD 83 DATUM IN ZONE 9, UNLESS OTHERWISE STATED

REFERENCES / SPECIFICATIONS

BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP

0 200 400 600
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW

PROJECT
GEOTECHNICAL INPUT
COMMUNITY DESIGN PLAN
CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE
SITE PLAN

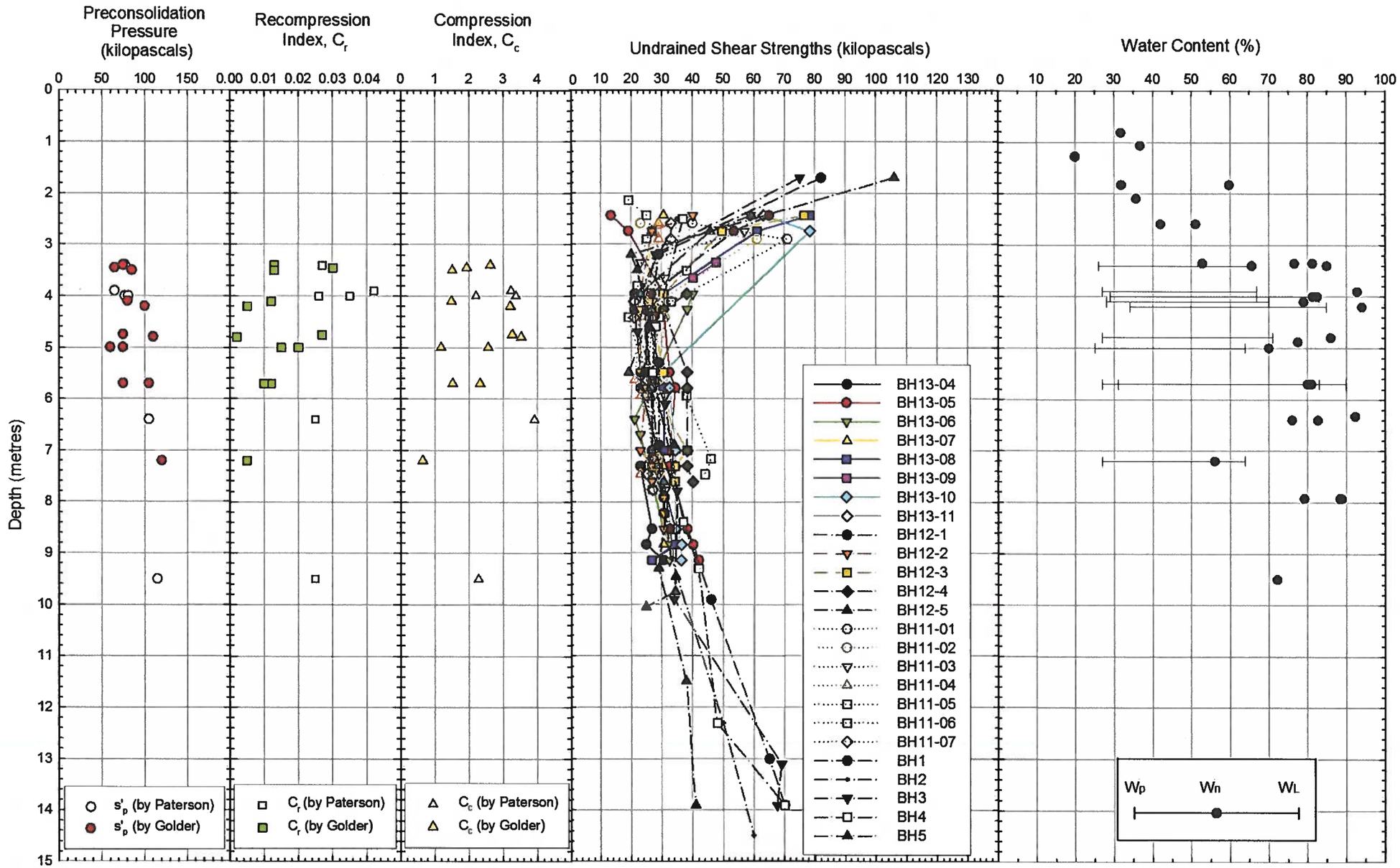
Golder Associates

PROJECT No.		13-1121-0123	FILE No.		1311210123-1000-05
DESIGN			SCALE		AS SHOWN
CADD	JM	2014-06-11	FIGURE		
CHECK	CK	2016-02-23			5
REVIEW	TMS	2016-02-23			

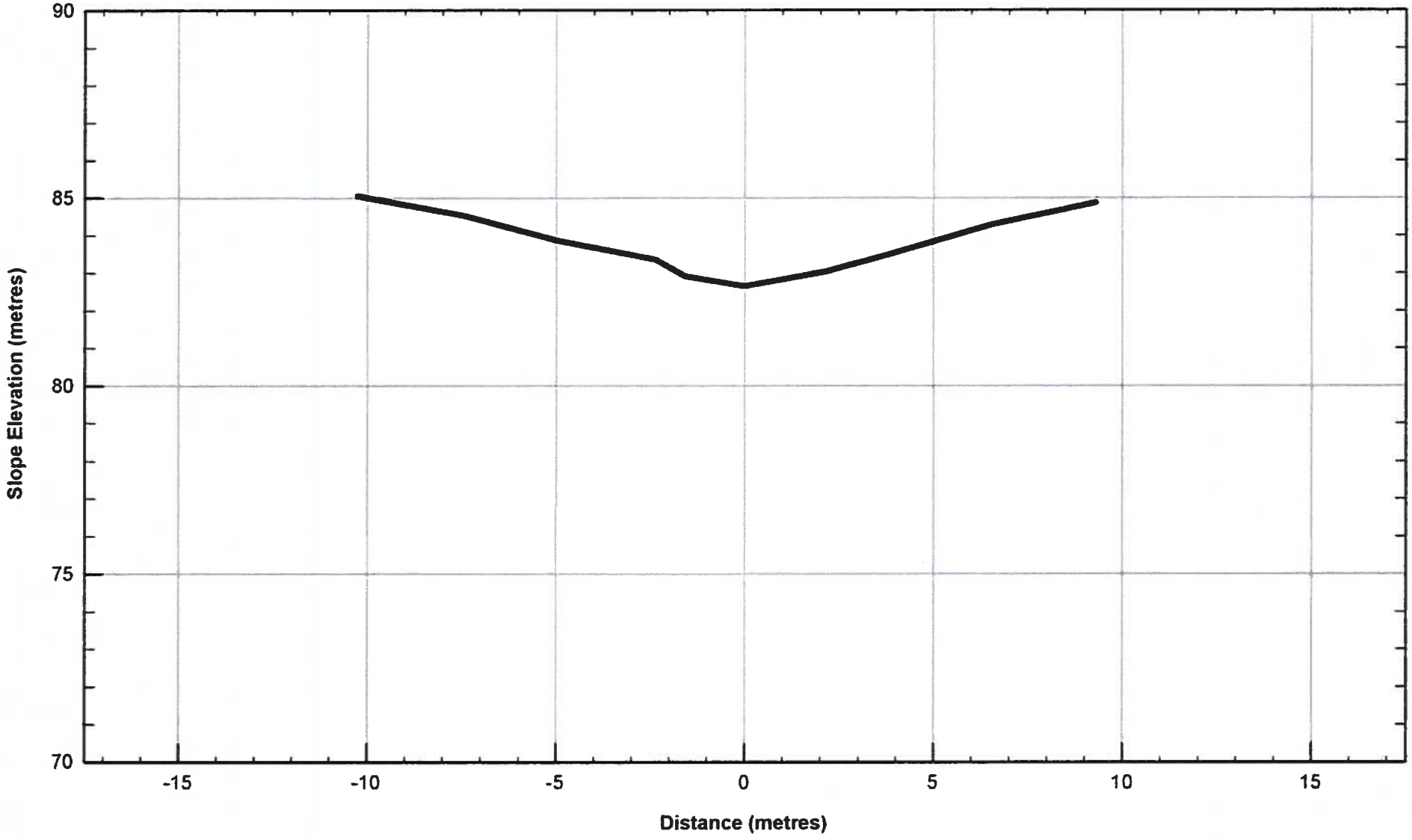
N:\Active\2013\121 - Geotechnical\13-1121-0123 Claridge Concession 10 CDP Ottawa\07-Spatial\MXD\PRODUCTION\Phase 1000\1311210123-1000-05 - ANSI_B_FIGURE_LANDSCAPE | Modified: jmcconnell 02/23/2016 11:39 AM | Plotted: jmcconnell 02/23/2016

Summary of Engineering Properties
Community Design Plan
Concession 10 Lands, Ottawa, Ontario

FIGURE 6

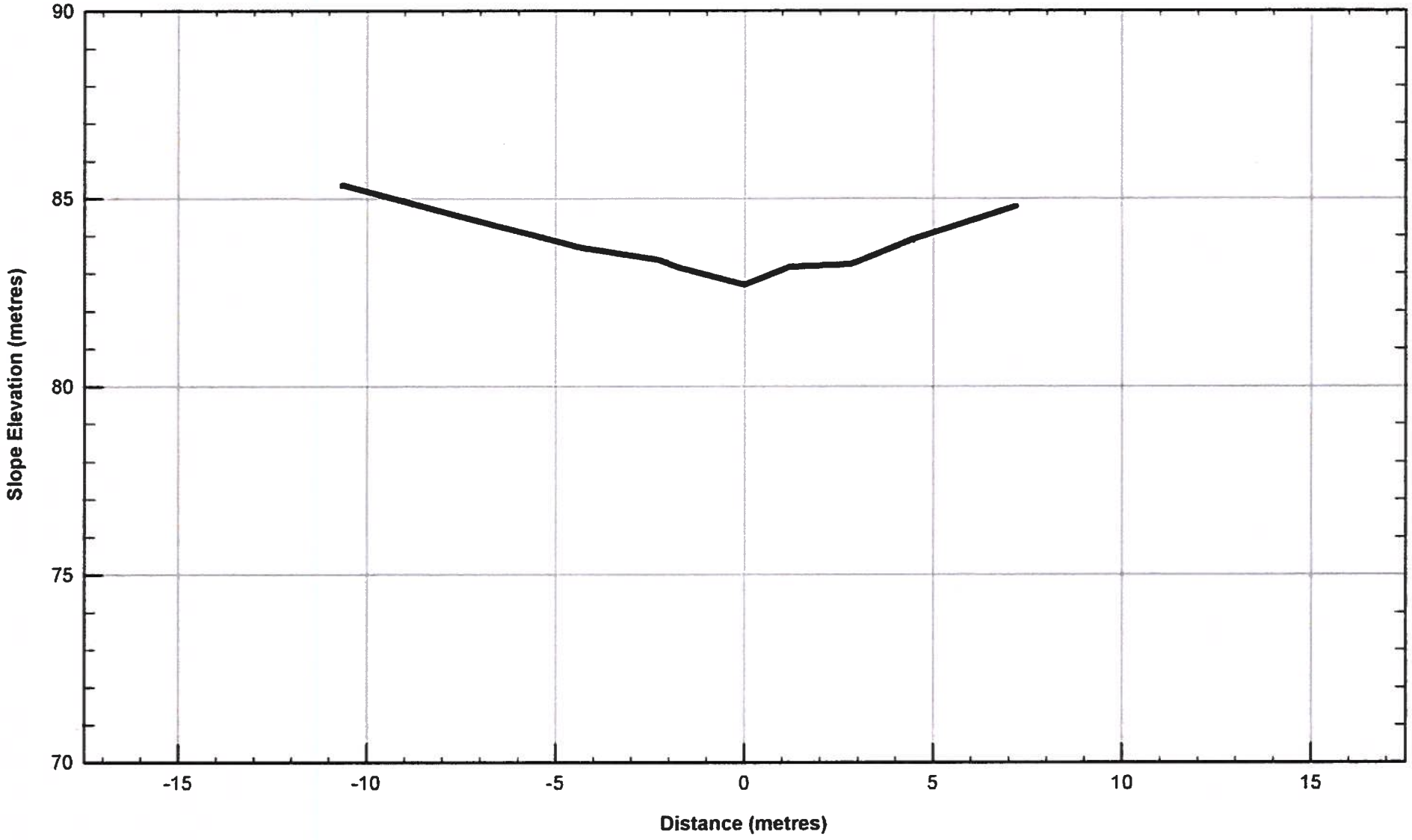


Cross Section A-A'



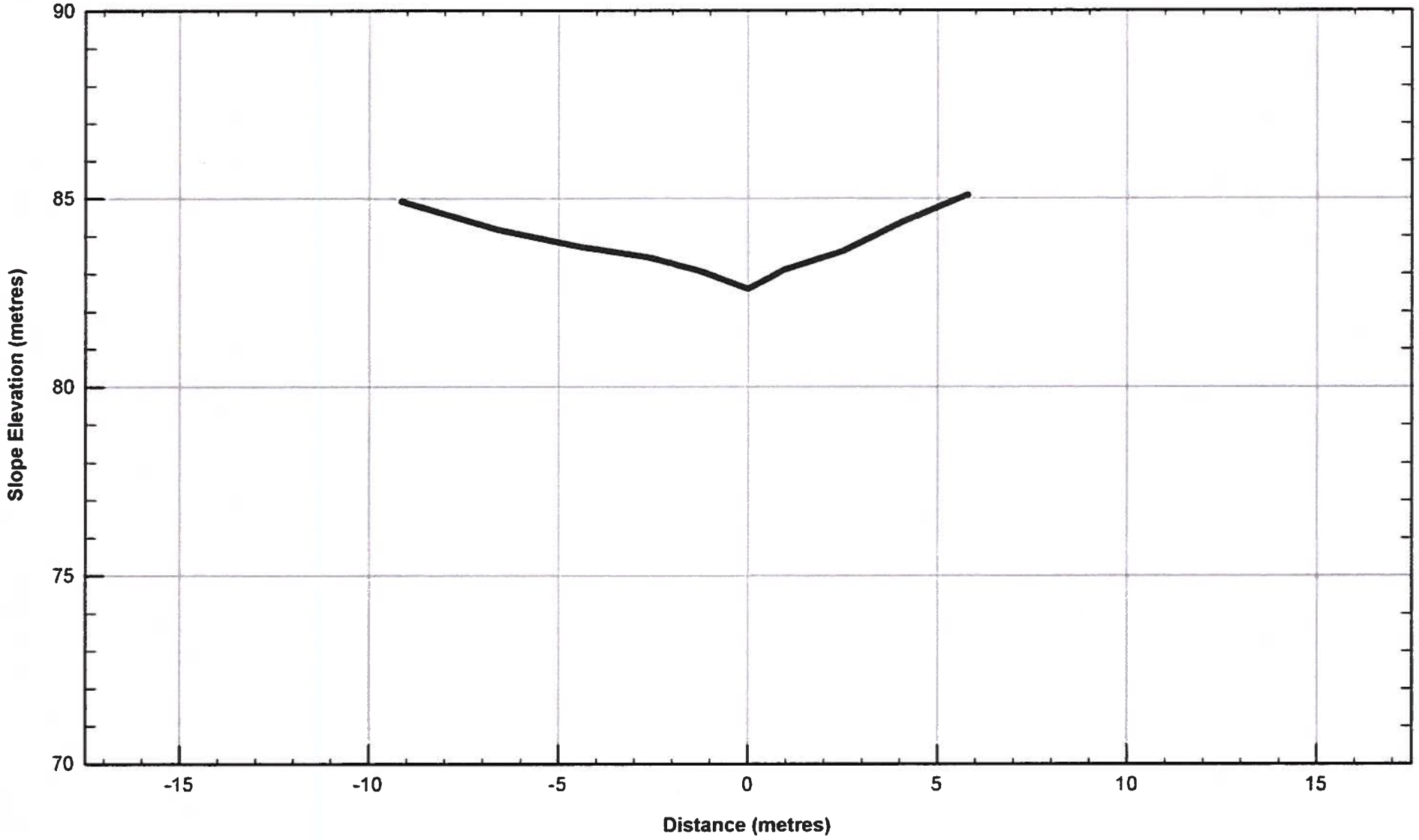
Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 7

Cross Section B-B'



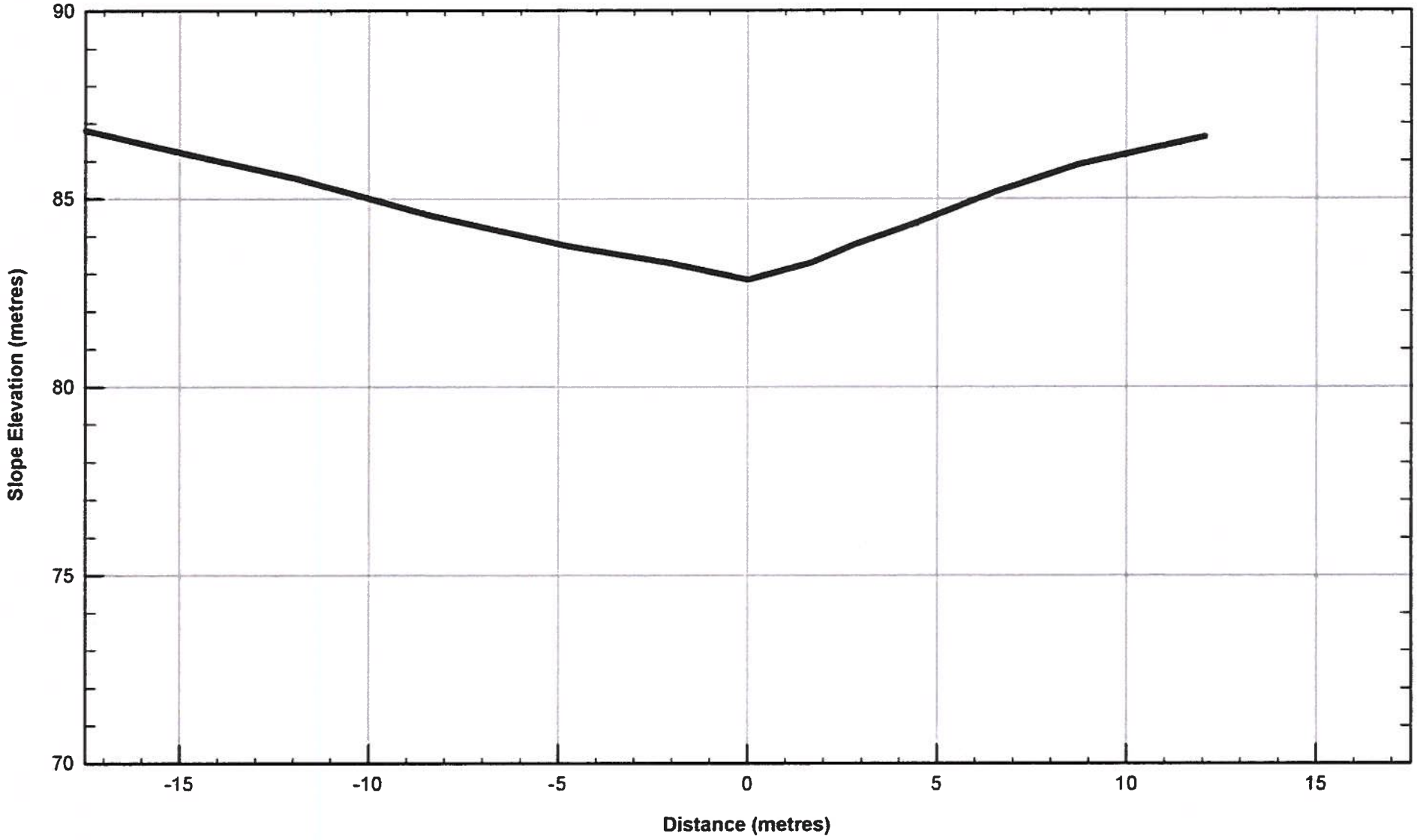
Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 8

Cross Section C-C'



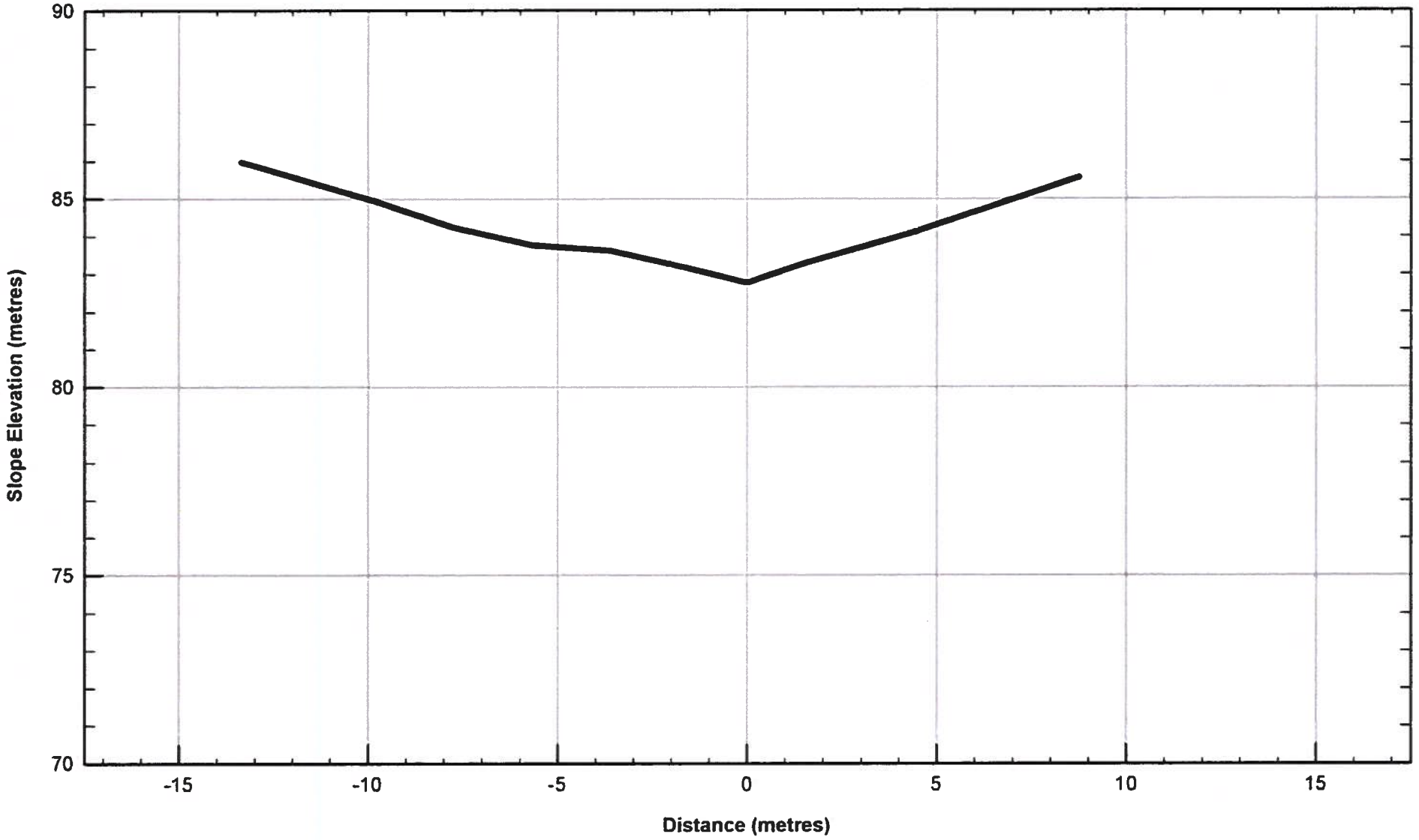
Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 9

Cross Section D-D'



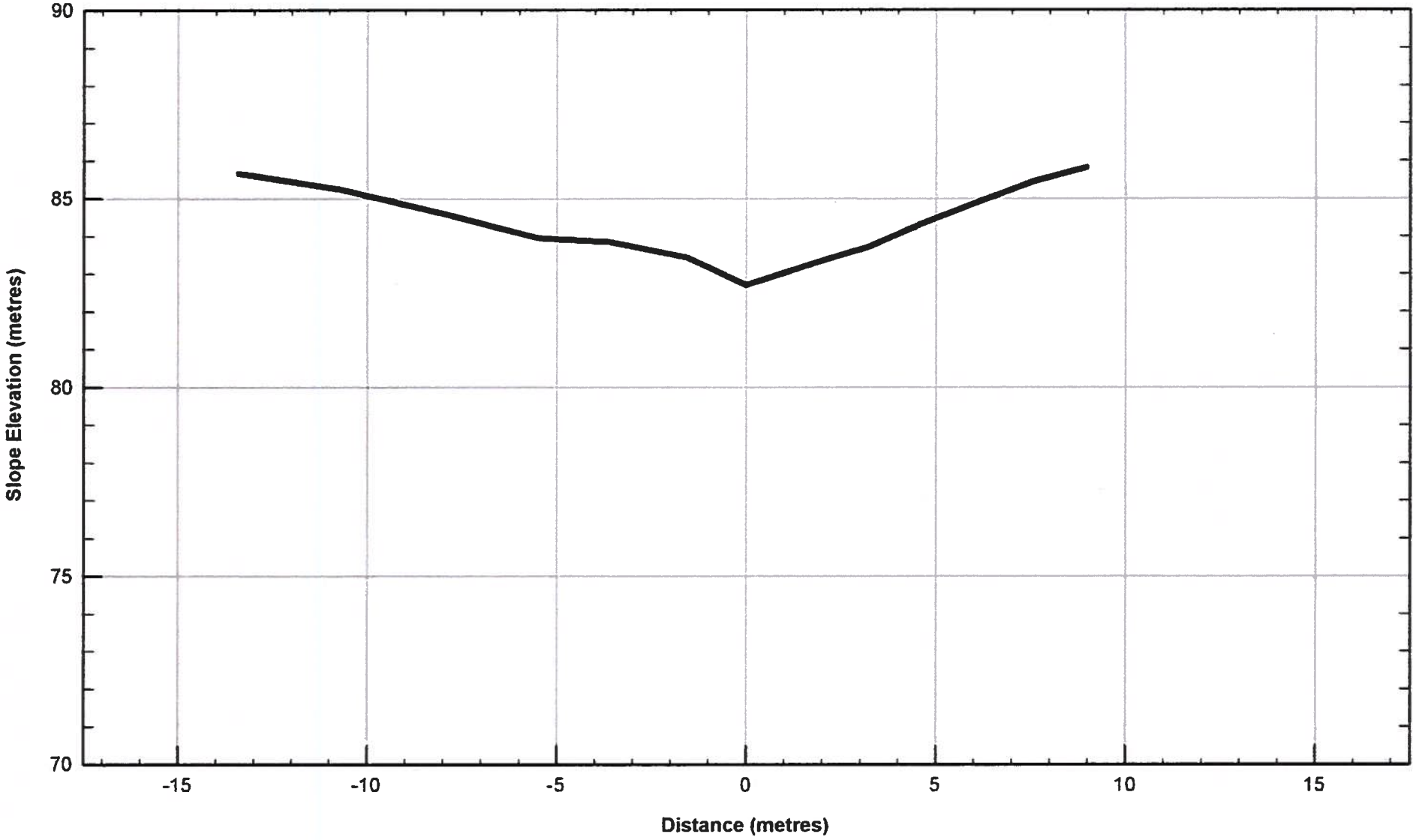
Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 10

Cross Section E-E'



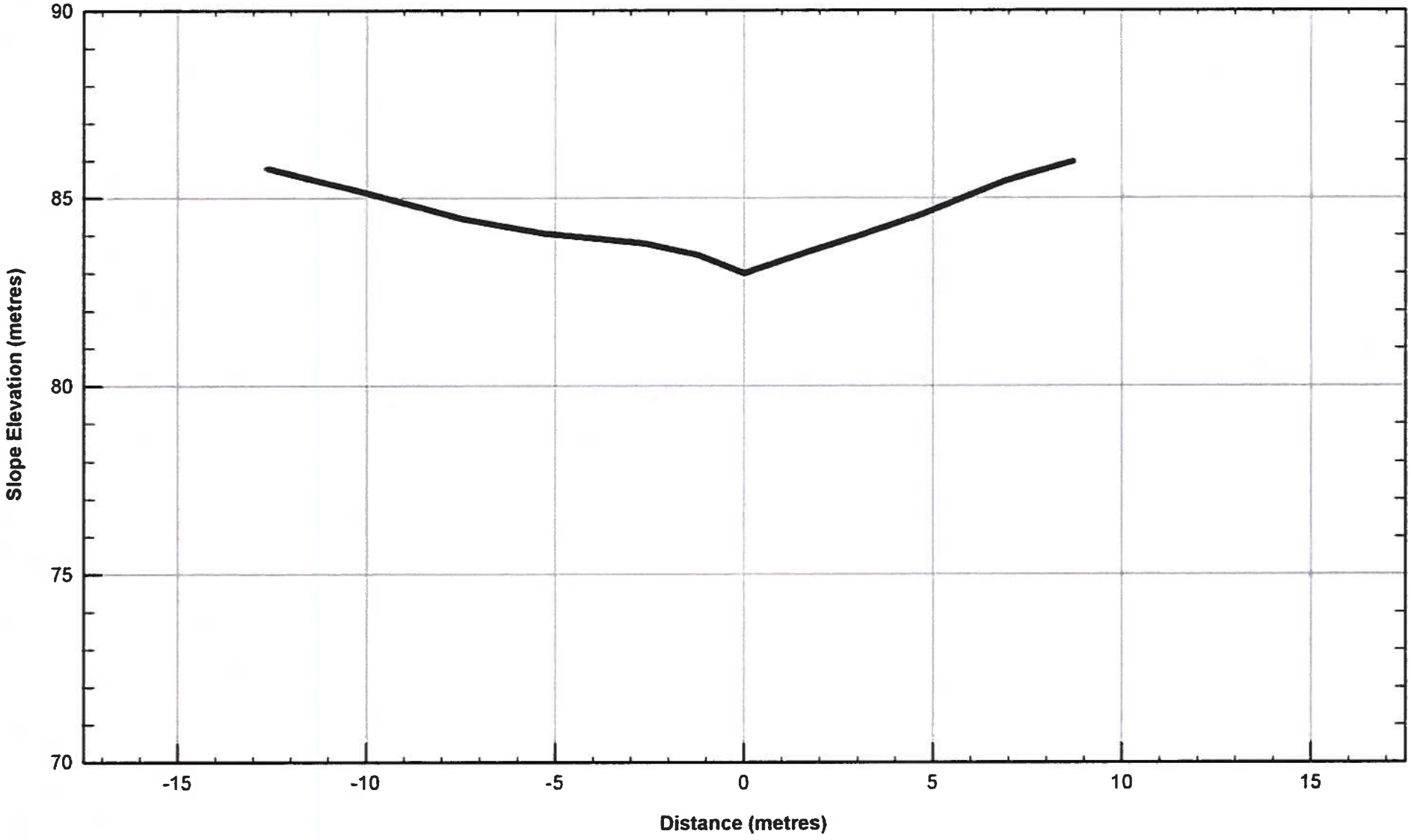
Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 11

Cross Section F-F'



Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 12

Cross Section G-G'



Golder Associates	Date: May 22, 2014 Drawn: WAM Project: 13-1121-0123 Chkd: CK	SLOPE CROSS SECTION	FIGURE 13

LEGEND

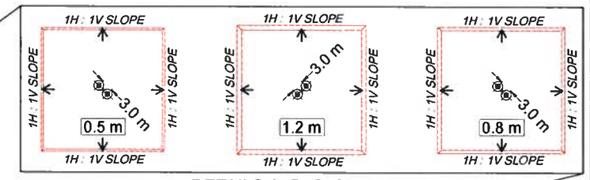
- APPROXIMATE BOREHOLE LOCATION IN PLAN, CURRENT INVESTIGATION
- APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATIONS BY GOLDER ASSOCIATES LTD.
- APPROXIMATE BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION BY PATERSON GROUP
- PROPOSED LOCATION FOR SETTLEMENT PLATE
- STUDY AREA LIMITS
- TEST FILL LIMIT
- 0.5 m — GRADE RAISE FOR TEST FILL

NOTES

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 13-1121-0123
2. ALL CURRENT BOREHOLE LOCATIONS SHOWN ON THIS PLAN WERE DERIVED FROM GPS OBSERVATIONS USING THE CAN-NET VIRTUAL NETWORK REFERENCING THE OTTAWA BASE STATION AND WERE COLLECTED USING THE MTM PROJECTION AND NAD 83 DATUM IN ZONE 9, UNLESS OTHERWISE STATED
3. BOREHOLES "GREYED OUT" FOR CLARITY
4. FINAL ELEVATION OF TEST FILL PILE TO BE DETERMINED BASED ON UNIT WEIGHT OF MATERIAL USED AND ORIGINAL GROUND IN SETTLEMENT PLATE HOLE

REFERENCES / SPECIFICATIONS

BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP



DETAILS A, B, C, & D (TYP.)
SCALE 1:1,500

SCALE 1:10,000
0 200 400 600
METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW

PROJECT
GEOTECHNICAL INPUT
COMMUNITY DESIGN PLAN
CONCESSION 10 LANDS, OTTAWA, ONTARIO

TITLE
TEST FILL SITE PLAN

Golder Associates

PROJECT No.		13-1121-0123	FILE No.		1311210123-1002-01
DESIGN			SCALE		AS SHOWN
CADD	JM	2014-30-07	FIGURE		14
CHECK					
REVIEW					

N:\Active\2013\121 - Geotechnical\13-1121-0123 Claridge Concession 10 CDP Ottawa\07-Spatial\MXD\PRODUCTION\Phase 1000\1311210123-1002-01.dwg | Layout: 14 1311210123-1002-01 - ANSI_B_FIGURE_LANDSCAPE | Modified: jmclarnon 05/20/2017 2:02 PM | Plotted: jmclarnon 05/20/2017

APPENDIX A

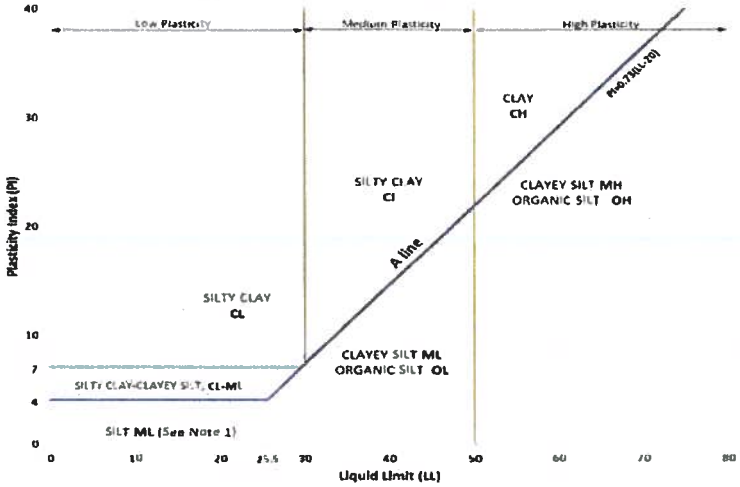
List of Abbreviations and Symbols
Record of Borehole Sheets
Current Investigation by Golder Associates

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators: Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)	Organic Content	USCS Group Symbol	Primary Name
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% (see Note 2)	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.*, SAND and GRAVEL, SAND and CLAY)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects, approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-04

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: September 3, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		87.25							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (MH) CLAYEY SILT, some sand, trace gravel; brown; moist.		0.00 / 87.02	1	GRAB	-				
		(CI/CH) SILTY CLAY, trace sand; grey brown to red brown (WEATHERED CRUST); cohesive, moist, very stiff.		0.23							
1				86.08	2	SS	15				
		(SM) SILTY SAND, fine, trace clay; grey brown to brown; non-cohesive, moist, loose.		1.17							
					3	SS	5				
2				85.19							Native Backfill
		(CI/CH) SILTY CLAY; grey brown to red brown (WEATHERED CRUST); cohesive, moist, stiff.		2.06 / 84.81							
		(CI/CH) SILTY CLAY; grey to red brown, with black mottling; cohesive, moist, soft to firm.		2.44	4	SS	2				
3					5	SS	WH				
4											Bentonite Seal
					6	TP	PM			C	Standpipe
5											
6					7	TP	PM				
7											Cave
8					8	SS	PM				
9				78.11							
		End of Borehole		9.14							WL in Standpipe at Elev. 85.68 m on Sept. 2, 2013
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KE
CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-05

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: September 3, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		86.12							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; brown; moist.		0.00 / 85.71							
		(CI/CH) SILTY CLAY; grey brown to red brown (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.41 / 84.90	1	SS	6				
		(SM) SILTY SAND, fine to medium, trace clay; grey brown to red brown; non-cohesive, moist to wet		1.22 / 84.60							
		(SP) SAND, fine; grey brown; non-cohesive, wet, very loose to loose.		1.52 / 83.99	2	SS	4				
		(CI/CH) SILTY CLAY; grey, with black mottling; cohesive, soft to firm, moist		2.13							
					3	TP	PM			C	
					4	SS	PM				
					5	SS	PM				
					6	TP	PM				
		End of Borehole		76.98 / 9.14							Open borehole dry upon completion of drilling

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KE

CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-06

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: September 4, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		87.08							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SM) SILTY SAND, with organic matter; brown; non-cohesive, dry to moist.		0.00							
		FILL - (CH-SM) SILTY CLAY and SILTY SAND, trace to some gravel, with organic matter and brick fragments; brown to grey; non-cohesive, dry to moist, compact.		0.15							
1					1	SS	15				Native Backfill
				85.25							
2		(CI/CH) SILTY CLAY, trace sand and organic matter; grey brown (WEATHERED CRUST); cohesive, moist, very stiff.		1.83	2	SS	8				
					3	SS	8				
3				84.03							
		(CI/CH) SILTY CLAY; grey to red brown; cohesive, moist, stiff to firm.		3.05	4	SS	4				Bentonite Seal
4											Standpipe
				82.51							
		(CI/CH) SILTY CLAY; grey; cohesive, moist, soft to firm.		4.57	5	SS	1				
5					6	TP	PM			C	
6											
											Cave
7					7	TP	PM			C	
8					8	SS	PM				
9				77.94							
		End of Borehole		9.14							WL in Standpipe at Elev. 85.66 m on Sept. 2, 2013
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KE
CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-07

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: August 29, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.33							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; brown; moist.		0.00 / 85.10							
		(SM) SILTY SAND; grey; non-cohesive, dry to moist.		0.23 / 84.72							
		(CI/CH) SILTY CLAY; grey brown (WEATHERED CRUST); cohesive, moist, stiff.		0.61	1	SS	3				
1											
					2	SS	2				
2				83.20							
		(CI/CH) SILTY CLAY; grey; cohesive, moist, soft to firm.		2.13				⊕ +			
								⊕ +			
3					3	SS	PM				Native Backfill
								⊕ +			
4								⊕ +			
					4	SS	PM				
5								⊕ +			
								⊕ +			
6					5	SS	PM				
								⊕ +			Bentonite Seal
7								⊕ +			
					6	SS	PM				Standpipe
8								⊕ +			
								⊕ +			Cave
				76.49							
9		End of Borehole		8.84							WL in Standpipe at Elev. 84.60 m on Sept. 2, 2013
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KE

CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-07A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: September 3, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	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) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.33							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; brown; moist.		0.00							
				85.10							
		(SM) SILTY SAND; grey; non-cohesive, dry to moist.		0.23							
				84.72							
1		(CI/CH) SILTY CLAY; grey brown (WEATHERED CRUST); cohesive, moist, stiff.		0.61							
2				83.20							
		(CI/CH) SILTY CLAY; grey; cohesive, moist, soft to firm.		2.13							
3											
4					1	TP	PM				
					2	TP	PM			C	
5				80.30							
		End of Borehole		5.03							
		Note: Soil stratigraphy from 0.00 m to 3.81 m inferred from Record of Borehole 13-07.									Open borehole dry upon completion of drilling
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KE

CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-08

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: August 29, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.52							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SAND; brown; dry to moist.		0.00 / 85.19							
		(CI/CH) SILTY CLAY, with grey fine sand seams; red brown to grey brown (WEATHERED CRUST); cohesive, moist, very stiff.		0.33	1	SS	8				
1				84.15							
		(CI/CH) SILTY CLAY; grey brown (WEATHERED CRUST); cohesive, moist, stiff.		1.37	2	SS	5				
2		- Silt seam from 1.83 m to 1.88 m									
				82.47							
3		(CI/CH) SILTY CLAY; grey; cohesive, moist, firm.		3.05	3	SS	1				
4											
					4	TP	PM			C	
5											
6					5	SS	PM				
7											
					6	SS	PM				
8											
9				76.38							
		End of Borehole		9.14							Open borehole dry upon completion of drilling
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KE

CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-09

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: August 29, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	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) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.12							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; brown; dry to moist.		0.00							
				84.82							
		(CI/CH) SILTY CLAY, red brown to grey brown, trace silt seams (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.30							
1					1	SS	13				
		- Silt seam from 1.22 m to 1.43 m									
					2	SS	7				Native Backfill
2											
					3	SS	3				
3				82.07							
		(CI/CH) SILTY CLAY; grey; cohesive, moist, firm.		3.05				⊕ +			Bentonite Seal
								⊕			
4					4	SS	WH				Standpipe
				80.55							
		(SM) SILTY SAND, some gravel, trace clay; grey (GLACIAL TILL), presence of cobbles and/or boulders inferred from auger resistance; non-cohesive, moist, loose to very dense.		4.57							
5					5	SS	17				
					6	SS	9				
6											Cave
					7	SS	55				
7											
				77.37	8	SS	>50				
		End of Borehole Auger Refusal		7.75							WL in Standpipe at Elev. 82.50 m on Sept. 2, 2013
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KE

CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-10

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: August 30, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		84.95							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; brown; dry to moist.		0.00 / 84.65							
		(CL/CH) SILTY CLAY; red brown to grey brown (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.30							
1					1	SS	8				
					2	SS	4				
2								⊕ +			Native Backfill
								⊕ +			
3				81.90							
		(CI/CH) SILTY CLAY; grey; cohesive, moist, firm.		3.05	3	SS	WH				
4					4	TP	PM		○	C	
					5	SS	PM				Bentonite Seal
5								⊕ +			Silica Sand
								⊕ +			
6					6	TP	PM				
								⊕ +			
7								⊕ +			Cave
					7	SS	PM				
8								⊕ +			
								⊕ +			
9				75.81							
		End of Borehole		9.14							WL in Standpipe at Elev. 83.24 m on Sept. 2, 2013
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KE

CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 13-11

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: August 30, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		84.81							
		TOPSOIL - (SM) SILTY SAND; brown; dry to moist.		0.00 84.61							
		(CL/CH) SILTY CLAY; red brown to grey brown (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.20							
1					1	SS	10				
2					2	SS	6	>96 +			
3				81.76							
		(CI/CH) SILTY CLAY; grey, with red mottling; cohesive, moist, firm.		3.05	3	SS	3				
4											
5					4	SS	PM				
					5	TP	PM			C	
6											
7					6	TP	PM				
8					7	SS	PM				
9				75.67							
		End of Borehole		9.14							Open borehole dry upon completion of drilling
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KE
CHECKED: KSL

MIS-BHS 001 1311210123.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 15-1

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: April 29, 2015

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		86.61							
0	Power Auger 200 mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE		0.00							
		FILL - (SW) gravelly SAND, angular; grey (PAVEMENT STRUCTURE)		0.15 / 85.85							
1		FILL - (SW) gravelly SAND, some gravel; brown (PAVEMENT STRUCTURE); non-cohesive, moist, compact		0.76 / 85.34	1	SS	19				
		(SM) SILTY SAND, trace gravel and organic matter; grey; non-cohesive, wet, loose		1.27	2	SS	7				
2				84.17							
		(SM) SILTY SAND, fine; brown to grey; non-cohesive, wet, compact		2.44	3	SS	18				
3				83.56							
		(CL/CI) SILTY CLAY; grey; cohesive, w>PL, firm to soft		3.05	4	SS	WH				
				82.65							
4		(CL/CI) SILTY CLAY; grey; cohesive, w~PL, soft		3.96				⊕ + ⊕ +			
5					5	SS	WH	⊕ + ⊕ +			
6					6	SS	PM				
7								⊕ + ⊕ +			
8					7	SS	PM				
9								⊕ + ⊕ +			
					8	SS	WH				
10				76.55							
		(CL/CI) SILTY CLAY; grey; cohesive, w~PL, firm		10.06				⊕ + ⊕ +			
11					9	SS	PM				
				74.72				⊕ + ⊕ +			
12		End of Borehole		11.89							
13											
14											
15											

DEPTH SCALE

1 : 75

Golder Associates

LOGGED: HEC

CHECKED: KSL

MIS-BHS 001 1527071.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 15-2

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: April 27, 2015

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.41							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SW) gravelly SAND, angular; grey (PAVEMENT STRUCTURE)		0.00							Flush Mount Casing
1				84.27	1	SS	16				
		FILL - (SW) gravelly SAND, angular; grey and brown (PAVEMENT STRUCTURE)		1.14							
				83.89							
2		(SM) SILTY SAND, fine; mottled grey brown; non-cohesive, moist to wet, compact to dense		1.52	2	SS	32				
				82.82	3	SS	3				
3		(CL/CI) SILTY CLAY; grey; cohesive, w~PL, soft to firm		2.59	4	SS	1				Native Backfill and Bentonite
4								⊕ +			
								⊕ +			
5					5	SS	WH				
								⊕ +			
6								⊕ +			
					6	SS	WH				
7								⊕ +			Bentonite Seal
								⊕ +			Silica Sand
8					7	SS	PM				
								⊕ +			50 mm Diam. PVC #10 Slot Screen
9								⊕ +			
					8	SS	PM				
10								⊕ +			
								⊕ +			Cave
11					9	SS	PM				
								+			
				73.52				⊕ +			
12		End of Borehole		11.89							WL in Screen at Elev. 82.92 m on May 12, 2015
13											
14											
15											

DEPTH SCALE

1 : 75

Golder Associates

LOGGED: HEC

CHECKED: KSL

MIS-BHS 001 1527071.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 15-3

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: April 27, 2015

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	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) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		85.62							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SW) gravelly SAND, angular; grey (PAVEMENT STRUCTURE)		0.00 / 85.16							
		FILL - (GW) sandy GRAVEL, angular; grey (PAVEMENT STRUCTURE); compact		0.46 / 84.10	1	SS	21				
1		(SM) SILTY SAND; brown; non-cohesive, moist to wet, compact		1.52	2	SS	17				
2					3	SS	22				
3					4	SS	WH				
		(CL/CI) SILTY CLAY; grey; cohesive, w>PL, soft		81.96 / 3.66	5	SS	WH				
4					6	SS	PM				
5								⊕ +			
6					7	SS	PM	⊕ +			
7								⊕ +			
8					8	SS	WH				
9								⊕ +			
					9	SS	PM	⊕ +			
10								⊕ +			
11					10	SS	WH				
				73.73				⊕ +			
12		End of Borehole		11.89							
13											
14											
15											

DEPTH SCALE
1 : 75

Golder Associates

LOGGED: HEC
CHECKED: KSL

MIS-BHS 001 1527071.GPJ GAL-MIS.GDT 05/14/15 JM

PROJECT: 13-1121-0123

RECORD OF BOREHOLE: 15-4

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: April 28, 2015

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		82.13							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SW) gravelly SAND, angular; grey (PAVEMENT STRUCTURE)		0.00 / 81.83	1	GRAB	-				Flush Mount Casing
		FILL - (GW) sandy GRAVEL, angular; grey (PAVEMENT STRUCTURE)		0.30 / 81.37	2	GRAB	-				
1		(CH/CI) SILTY CLAY; grey brown, fissured (WEATHERED CRUST); cohesive, w>PL, very stiff		0.76	3	SS	4				
2					4	SS	13				
					5	SS	6				
3				79.08							
		(CH/CI) SILTY CLAY; grey and red brown, slightly fissured; cohesive, w>PL, stiff		3.05	6	SS	1	⊕ +			
4											Native Backfill and Bentonite
5				76.95	7	SS	WH	⊕ +			
		(CH/CI) SILTY CLAY; grey, with black organic mottling; cohesive, w>PL, firm		5.18							
6					8	SS	WH	+			
7								⊕ +			
8					9	SS	WH				
								⊕ +			Bentonite Seal
9				72.99							Silica Sand
		(SM) gravelly SILTY SAND, some fine sand layers, trace clay; dark grey (GLACIAL TILL); non-cohesive, wet, compact		9.14	10	SS	11				
10					11	SS	26				50 mm Diam. PVC #10 Slot Screen
11					12	SS	18				Cave
				70.85							
		End of Borehole		11.28							WL in Screen at Elev. 76.60 m on May 12, 2015
12											
13											
14											
15											

DEPTH SCALE

1 : 75

Golder Associates

LOGGED: PAH

CHECKED: KSL

MIS-BHS 001 1527071.GPJ GAL-MIS.GDT 05/14/15 JM

APPENDIX B

Borehole Records
Previous Geotechnical Investigations by Golder Associates and Paterson Group

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-01

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 22, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Dark brown to brown SAND, trace silt, with rootlets		0.10							
1		Very stiff to firm red brown SILTY CLAY (Weathered Crust)		0.91	1	50 DO	5	⊕ +			
2					2	50 DO	2	⊕ +			
3		Soft to firm grey SILTY CLAY, with silt seams		2.90	3	50 DO	1	⊕ +			
4								⊕ +			
5					4	50 DO	WH	⊕ +			
6					5	50 DO	WH	⊕ +			
7								⊕ +			
		End of Borehole		7.47				⊕ +			
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC

CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-01A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 22, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							Native Backfill
		Dark brown to brown SAND, trace silt, some rootlets		0.10							Bentonite Seal
1		Very stiff to firm red brown SILTY CLAY (Weathered Crust)		0.91							
2											Native Backfill
3		Soft to firm grey SILTY CLAY, with silt seams		2.90							
4											Bentonite Seal
											Silica Sand
5											Standpipe
					1	73 TP	PH				Native Backfill
6		End of Borehole		6.00							
		Note: Soil stratigraphy from 0.00 m to 6.00 m inferred from BH 11-01									
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC
CHECKED: TMS

MIS-BHS 001 1111210120 GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-02

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 22, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Dark brown to red brown SAND, trace silt, with rootlets		0.10	1	GRAB	-				
		Very stiff to stiff red brown SILTY CLAY (Weathered Crust)		0.48	2	50 DO	6				
1					3	50 DO	5				
2		Soft to stiff red grey to grey SILTY CLAY, with silt seams		1.80							
3					4	50 DO	WH				
4											
5					5	50 DO	WH				
6											
					6	50 DO	WH				
7											
		End of Borehole		7.42							
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC
CHECKED: TMS

MIS-BHS 001 1111210120 GPJ GAL-MIS GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-03

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 21, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Brown SILTY SAND		0.10	1	GRAB	-				
		Very stiff grey brown SILTY CLAY (Weathered Crust)		0.38							
1					2	50 DO	9				
		Very stiff red grey SILTY CLAY		1.37							
					3	50 DO	4				
2		Firm grey SILTY CLAY		2.13							
					4	50 DO	1				
3					5	50 DO	WH				
4								⊕ +			
								⊕ +			
					6	50 DO	WH				
5											
								⊕ +			
6								⊕ +			
					7	50 DO	WH				
7								⊕ +			
								⊕ +			
		End of Borehole		7.78				⊕ +			
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC

CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-03A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 21, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Brown SILTY SAND		0.10							
		Very stiff grey brown SILTY CLAY (Weathered Crust)		0.38							
1											
		Very stiff red grey SILTY CLAY		1.37							
2		Soft to stiff grey SILTY CLAY		2.13				⊕ +			
								⊕ +			
3								⊕ +			
		End of Borehole		3.66				⊕ +			
		Note: Soil stratigraphy from 0.00 m to 3.66 m inferred from BH 11-03									
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JC

CHECKED: TMS

MIS-BHS 001 1111210120 GPJ GAL-MIS GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-04

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 21, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	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	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE									
		TOPSOIL		0.00							
		Very stiff red brown SILTY CLAY, with sandy silt seams (Weathered Crust)		0.10							Native Backfill
											Bentonite Seal
1		Stiff to firm red grey SILTY CLAY, with some silt seams		1.07	1	50 DO	4				
					2	50 DO	2				
2								⊕ +			
								⊕ +			
3		Soft to firm grey SILTY CLAY, with silt seams		3.05	3	50 DO	WH				Native Backfill
	Power Auger 200 mm Diam. (Hollow Stem)							⊕ +			
4								⊕ +			
					4	50 DO	WH				
5								⊕ +			
								⊕ +			
6		- Black organic mottling at 6.25 m			5	50 DO	WH				Bentonite Seal
											Silica Sand
7								⊕ +			Standpipe
								⊕ +			
8					6	73 TP	PH				Native Backfill
		End of Borehole		8.26							
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JC

CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-04A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 21, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, 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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Very stiff red brown SILTY CLAY, with sandy silt seams (Weathered Crust)		0.10							
1		Stiff to firm red grey SILTY CLAY, with some silt seams		1.07							
2											
3		Soft to firm grey SILTY CLAY, with silt seams		3.05							
4					1	73 TP	PH			C	
5											
6					2	73 TP	PH				
		End of Borehole		6.27							
7		Note: Soil stratigraphy from 0.00 m to 6.27 m inferred from BH 11-04									
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JC

CHECKED: TMS

MIS-BHS 001 1111210120 GPJ GAL-MIS GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-05

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 20, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0		TOPSOIL		0.00							
		Very stiff grey brown SILTY CLAY (Weathered Crust)		0.10							Native Backfill
1					1	50 DO	10				Bentonite Seal
					2	50 DO	7				
2		Very stiff to stiff red grey to grey SILTY CLAY		2.13							
					3	50 DO	3				
3					4	50 DO	1				Native Backfill
	Power Auger 200 mm Diam. (Hollow Stem)	Firm grey SILTY CLAY, with silt seams		3.66				⊕ +			
4								⊕ +			
					5	50 DO	WH				
5								⊕ +			Bentonite Seal
								⊕ +			Silica Sand
6					6	50 DO	WH				
											Standpipe
7								⊕ +			
		End of Borehole		7.47				⊕ +			Native Backfill
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC
CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-05A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 20, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Very stiff grey brown SILTY CLAY (Weathered Crust)		0.10							
1											
2											
		Very stiff to stiff red grey to grey SILTY CLAY		2.13							
3											
		Firm grey SILTY CLAY, with silt seams		3.66							
4					1	73 TP	PH				
		End of Borehole		4.47							
5		Note: Soil stratigraphy from 0.00 m to 4.47 m inferred from BH 11-05									
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JC

CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-05B

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Very stiff grey brown SILTY CLAY (Weathered Crust)		0.10							
1											
2		Very stiff to stiff red grey to grey SILTY CLAY		2.13							
3								⊕ +			
		Soft to firm grey SILTY CLAY, with silt seams		3.66				⊕ +			
4								⊕ +			
		End of Borehole		4.11							
		Note: Soil stratigraphy from 0.00 m to 4.11 m inferred from BH 11-05									
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JC
CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-06

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Brown SILTY SAND, with rootlets		0.15							
		Stiff red grey SILTY CLAY, some silty fine sand seams (Weathered Crust)			1	50 DO	2				
1											
					2	50 DO	2				
2		Very soft to firm grey SILTY CLAY		2.13				⊕ +			
								⊕ +			
3					3	73 TP	PH			C	
								⊕ +			
4								⊕ +			
					4	73 TP	PH				
5								⊕ +			
								⊕ +			
6					5	73 TP	PH				
								⊕ +			
7								⊕ +			
								⊕ +			
8		End of Borehole		7.77							
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PH
CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-06A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, 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	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Brown SILTY SAND, with rootlets		0.15							
		Stiff red grey SILTY CLAY, some silty fine sand seams (Weathered Crust)									
1											
2								⊕ +			
		Soft to firm grey SILTY CLAY		2.13				⊕ +			
		End of Borehole		2.74				⊕ +			
3		Note: Soil stratigraphy from 0.00 m to 2.74 m inferred from BH 11-06									
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PH

CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 11-1121-0120

RECORD OF BOREHOLE: 11-07

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 22, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	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	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE									
		TOPSOIL		0.00							
		Brown SILTY SAND, with rootlets		0.10							
		Stiff red grey SILTY CLAY, some silty fine sand seams (Weathered Crust)		0.24							Native Backfill
1					1	50 DO	5				Bentonite Seal
		Stiff to firm red grey SILTY CLAY		1.52							
2					2	50 DO	2				
								⊕ +			Native Backfill
3		Soft to firm grey SILTY CLAY		2.90				⊕ +			
					3	73 TP	PH				
4								⊕ +			
								⊕ +			
					4	73 TP	PH				Bentonite Seal
5											Silica Sand
								⊕ +			Standpipe
6								⊕ +			
		- Black organic mottling at 6.10 m			5	50 DO	WH				
7								⊕ +			Native Backfill
								⊕ +			
		End of Borehole		7.77				⊕ +			
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PH

CHECKED: TMS

MIS-BHS 001 1111210120.GPJ GAL-MIS.GDT 05/15/15 JEM

PROJECT: 12-1121-0095

RECORD OF BOREHOLE: 12-1

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 18, 2012

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + rem V. ⊕ Q - ● U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE									
	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown to black; moist.		0.00							
		(SM) SILTY SAND, fine to medium; brown to grey brown, with silty clay layers; non-cohesive, wet.		0.23							
1		(CI/CH) SILTY CLAY; grey brown, with grey silty sand layers, highly fissured (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.81	1	SS	5				
					2	SS	4				Native Backfill
2								⊕ +			
								⊕ +			
3		(CI/CH) SILTY CLAY; grey, with grey silty sand layers; cohesive, moist, soft to firm.		3.05	3	SS	PM				
								⊕ +			Bentonite Seal
4								⊕ +			
											Standpipe
					4	TP	PH				
5								⊕ +			
								⊕ +			
6											
					5	SS	PM				
											Cave
7								⊕ +			
								⊕ +			
								⊕ +			
8								⊕ +			
								⊕ +			
		End of Borehole		8.54							
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RI
CHECKED: TMS

MIS-BHS 001 1211210095.GPJ GAL-MIS.GDT 05/15/15 JM

PROJECT: 12-1121-0095

RECORD OF BOREHOLE: 12-2

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 18, 2012

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT (Wp, W, Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown to black; moist.		0.00							
		(SM) SILTY SAND, fine to medium; brown to grey brown, with brown silty clay layers; non-cohesive, wet.		0.23							▽
1		(CI/CH) SILTY CLAY; grey brown, with silty sand layers, moderately fissured (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.97	1	SS	4				
					2	SS	WH				
2		(CI/CH) SILTY CLAY; grey; cohesive, moist, soft to firm.		2.13				⊕ +			
3					3	SS	PM	⊕ +			
4								⊕ +			
5					4	SS	PM	⊕ +			
6					5	TP	PH	⊕ +			
7								+ ⊕ +			
8								⊕ +			
								⊕ +			
		End of Borehole		8.54				⊕ +			WL in open borehole at 0.69 m depth below ground surface upon completion of drilling
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: RI

CHECKED: TMS

MIS-BHS 001 1211210095.GPJ GAL-MIS.GDT 05/15/15 JM

PROJECT: 12-1121-0095

RECORD OF BOREHOLE: 12-3

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 17, 2012

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT (Wp W Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) CLAYEY SILTY SAND; dark brown to black; moist.		0.00							
		(CI/CH) SILTY CLAY; grey brown, with grey silty sand layers, moderately fissured (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.30							
1					1	SS	4				
2					2	SS	2	⊕ ⊕ +			
3		(CI/CH) SILTY CLAY; grey; cohesive, moist, firm.		3.05	3	TP	PH			C	
4								⊕ ⊕ + +			
5					4	SS	PM				
6								⊕ ⊕ + +			
7					5	SS	PM				
								⊕ ⊕ ⊕ + + +			
		End of Borehole		7.62							Open borehole dry upon completion of drilling
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: RI

CHECKED: TMS

MIS-BHS 001 1211210095.GPJ GAL-MIS.GDT 05/15/15 JM

PROJECT: 12-1121-0095

RECORD OF BOREHOLE: 12-4

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: May 16, 2012

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT (Wp W Wl, 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SM) gravelly SILTY SAND; dark brown; moist.		0.00							
		FILL - (CL/CI) SILTY CLAY, some sand; dark brown to brown, with organic matter; cohesive, moist.		0.25							
		TOPSOIL - (CL/CI) SILTY CLAY, trace sand; dark brown to black; moist.		0.46							
1		(CI/CH) SILTY CLAY; grey brown, with grey brown silty sand layers and grey silt layers, moderately fissured (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.61	1	SS	7				
					2	SS	6				Native Backfill
2											
					3	SS	2				
3		(CI/CH) SILTY CLAY; grey; cohesive, moist, firm.		3.05	4	SS	WH				
4								⊕ +			Bentonite Seal
					5	TP	PH				Standpipe
5								⊕ +			
								⊕ +			
6					6	SS	PM				Cave
7								⊕ +			
								⊕ +			
		End of Borehole		7.62				⊕ +			
8											Open borehole dry upon completion of drilling
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RI
CHECKED: TMS

MIS-BHS 001 1211210095.GPJ GAL-MIS.GDT 05/15/15 JM

PROJECT: 12-1121-0095

RECORD OF BOREHOLE: 12-5

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: May 17, 2012

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND, some clay; dark brown to black; moist.		0.00							
		(SM) SILTY SAND, fine to medium; brown to grey brown, with grey brown silty clay layers; non-cohesive, moist, very loose.		0.51							
1		(CI/CH) SILTY CLAY; grey brown, with silty sand layers, highly fissured (WEATHERED CRUST); cohesive, moist, very stiff to stiff.		0.94	1	SS	4				
					2	SS	3				Native Backfill
2		(CI/CH) SILTY CLAY; grey, with shells and grey fine sand layers; cohesive, moist, soft to firm.		2.44							
3					3	SS	PM				
4											Bentonite Seal
					4	TP	PH			C	Silica Sand
5											
6					5	SS	PM				
7											Cave
8					6	SS	PM				
		- Gravel layer at 8.44 m									
9					7	SS	WR				
10		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: RI

CHECKED: TMS

MIS-BHS 001 1211210095.GPJ GAL-MIS.GDT 05/15/15 JM

PROJECT: 12-1121-0095

RECORD OF BOREHOLE: 12-5

SHEET 2 OF 2

LOCATION: See Site Plan

BORING DATE: May 17, 2012

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	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) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		End of Borehole		10.06				⊕ +			Open borehole dry upon completion of drilling
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RI

CHECKED: TMS

MIS-BHS 001 1211210095.GPJ GAL-MIS.GDT 05/15/15 JM

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

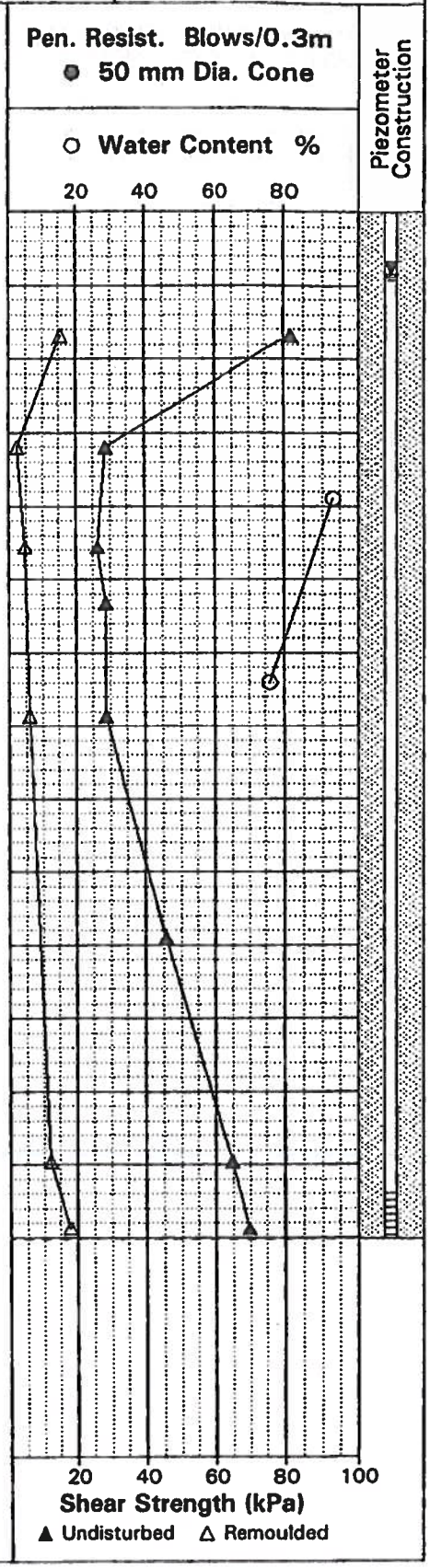
REMARKS

BORINGS BY CME 55 Power Auger DATE 9 OCT 05

FILE NO. PG0703

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.70
TOPSOIL 0.18							
Stiff to firm, brown SILTY CLAY		SS	1	83	9	1	85.70
		SS	2	100	2	2	84.70
- firm and grey by 2.1m depth		SS	3	100	1	3	83.70
		TW	4	98		4	82.70
		TW	5	97		5	81.70
		SS	6	100	1	6	80.70
		TW	7	100		7	79.70
						8	78.70
- stiff by 10.5m depth		SS	8	100	1	9	77.70
		TW	9	95		10	76.70
						11	75.70
						12	74.70
						13	73.70
14.02						14	72.70
End of Borehole							
(GWL @ 0.84m-Oct. 28/05)							



Piezometer Construction

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

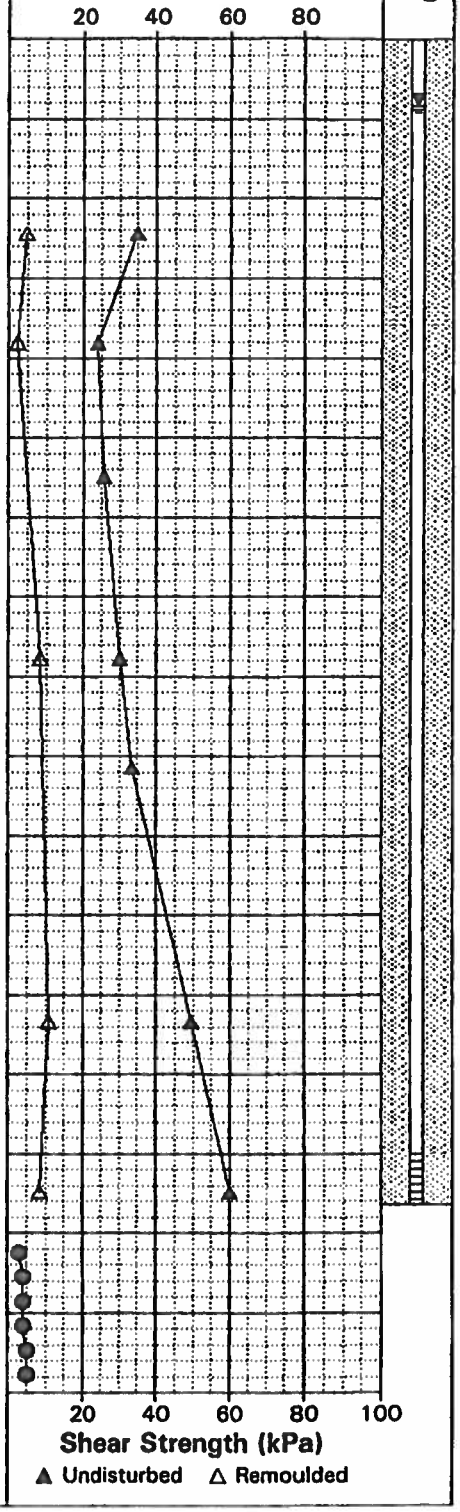
FILE NO. PG0703

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger DATE 6 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.29
TOPSOIL 0.29							
Stiff to firm, brown SILTY CLAY		SS	1	83	11	1	85.29
		SS	2	100	4	2	84.29
- brown-red by 1.3m depth							
- firm and brown-grey by 2.1m depth		TW	3	95		3	83.29
- grey by 2.6m depth						4	82.29
		SS	4	100	1	5	81.29
		SS	5	100	1	6	80.29
						7	79.29
		TW	6	93		8	78.29
						9	77.29
						10	76.29
		SS	7	100	1	11	75.29
						12	74.29
- stiff by 13.0m depth						13	73.29
		SS	8	100	1	14	72.29
14.63							
Dynamic Cone Penetration Test commenced @ 14.63m depth						15	71.29
						16	70.29
Inferred SILTY CLAY						17	69.29



Piezometer Construction

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PG0703

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger

DATE 6 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
Inferred SILTY CLAY						17	69.29
						18	68.29
						19	67.29
						20	66.29
21.00						21	65.29
						22	64.29
						23	63.29
						24	62.29
						25	61.29
Inferred GLACIAL TILL						26	60.29
						27	59.29
						28	58.29
						29	57.29
						30	56.29
						31	55.29
(GWL @ 0.83m-Oct. 28/05)						32	54.29
32.99							
End of Borehole							
DCPT refusal @ 32.99m depth							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PG0703

REMARKS

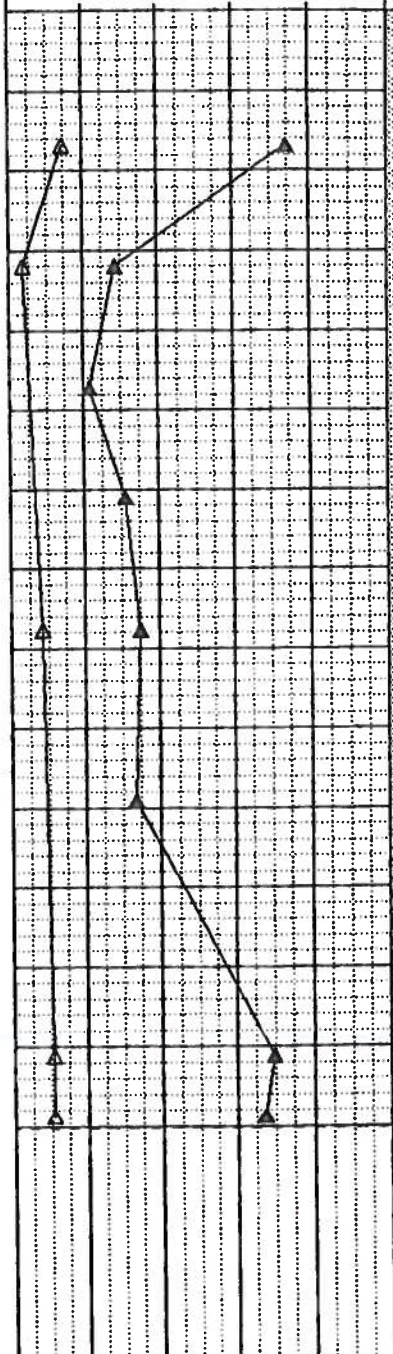
HOLE NO. BH 3

BORINGS BY CME 55 Power Auger

DATE 7 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.54
TOPSOIL 0.20							
Stiff, red-brown SILTY CLAY		SS	1	83	11	1	85.54
- stiff to firm and brown by 1.8m depth		SS	2	100	1	2	84.54
- firm to soft and grey by 2.4m depth		SS	3	100	1	3	83.54
		TW	4	88		4	82.54
						5	81.54
- firm by 6.0m depth						6	80.54
						7	79.54
						8	78.54
						9	77.54
		TW	5	100		10	76.54
						11	75.54
- stiff by 11.5m depth		SS	6	100	1	12	74.54
						13	73.54
14.02 End of Borehole						14	72.54
(GWL @ 1.27m-Oct. 28/05)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PG0703

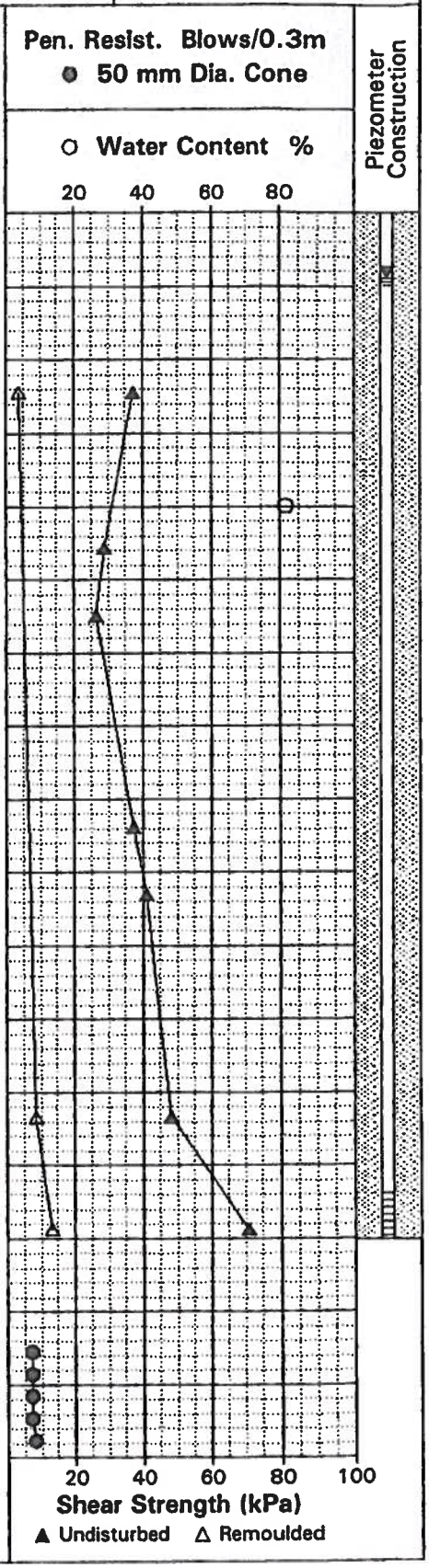
REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger

DATE 7 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.32
TOPSOIL 0.25							
Stiff, red-brown SILTY CLAY		SS	1	88	9	1	85.32
		SS	2	100	3	2	84.32
- firm and brown by 2.1m depth						3	83.32
- grey by 2.6m depth		SS	3	100	1		
		TW	4	92		4	82.32
						5	81.32
						6	80.32
		SS	5	100	1	7	79.32
		TW	6	100		8	78.32
						9	77.32
						10	76.32
						11	75.32
		SS	7	100	1	12	74.32
- stiff by 13.0m depth						13	73.32
14.02						14	72.32
Dynamic Cone Penetration Test commenced @ 14.02m depth						15	71.32
						16	70.32
Inferred SILTY CLAY						17	69.32



Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

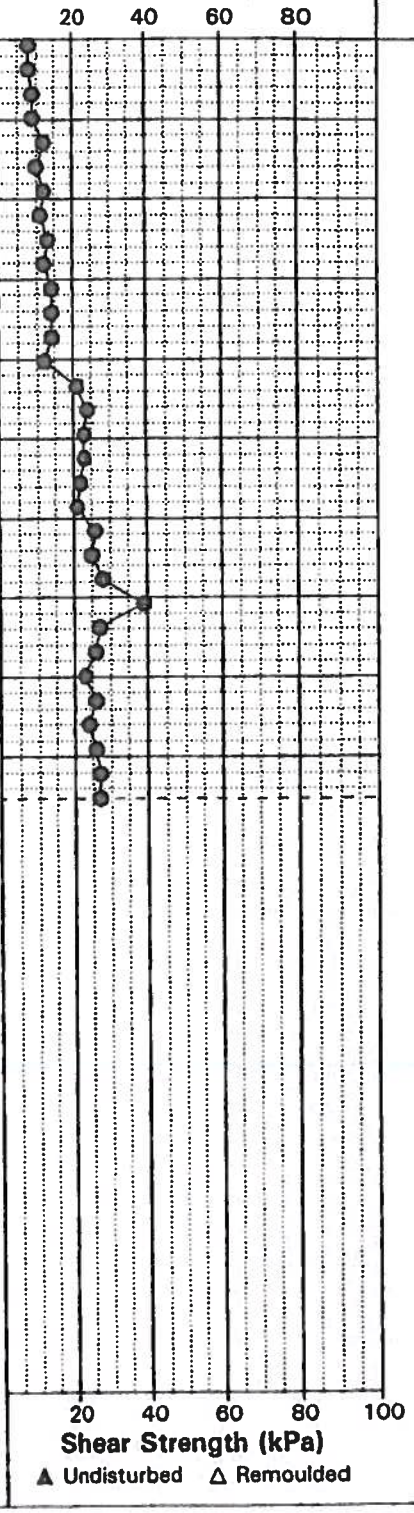
FILE NO. PG0703

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger DATE 7 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
Inferred SILTY CLAY						17	69.32		
						18	68.32		
						19	67.32		
						20	66.32		
21.00						21	65.32		
Inferred GLACIAL TILL						22	64.32		
						23	63.32		
						24	62.32		
						25	61.32		
26.52						26	60.32		
End of Borehole									
(GWL @ 0.90m-Oct. 28/05)									



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

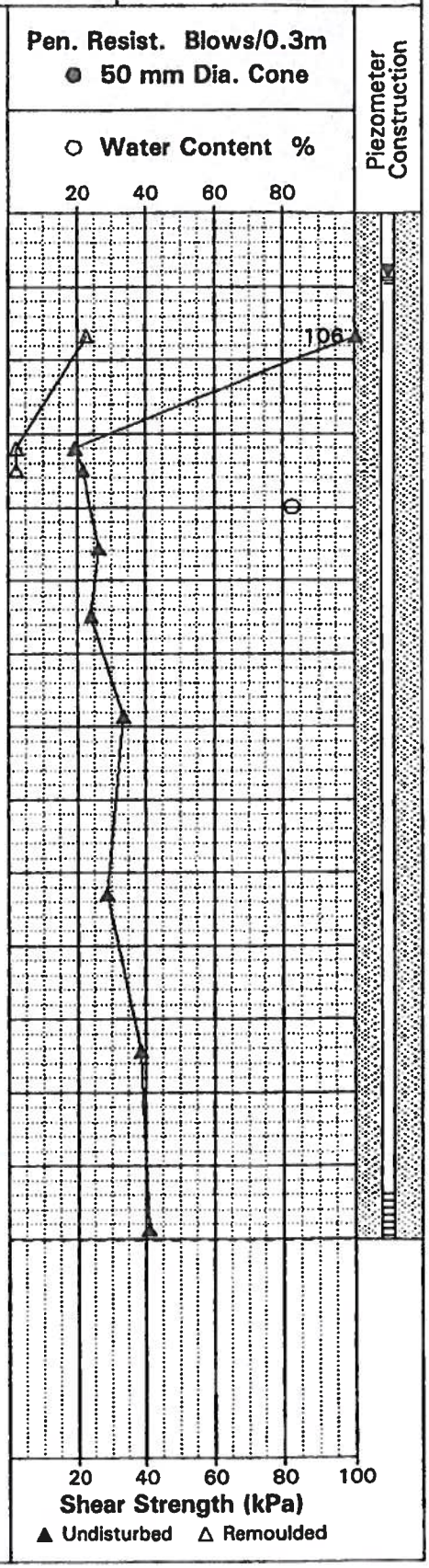
FILE NO. PG0703

REMARKS

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger DATE 11 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.78
TOPSOIL 0.25							
Very stiff, red-brown SILTY CLAY		SS	1	92	9	1	85.78
- firm to soft by 1.8m depth		SS	2	0	2	2	84.78
- soft and grey by 2.6m depth		TW	3	90		3	83.78
- firm by 4.4m depth		TW	4	92		4	82.78
		SS	5	100	1	5	81.78
		TW	6	100		6	80.78
		SS	7	100	1	7	79.78
						8	78.78
						9	77.78
						10	76.78
						11	75.78
						12	74.78
						13	73.78
14.02						14	72.78
End of Borehole							
(GWL @ 0.87m-Oct. 28/05)							



patersongroup

Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PG0703

REMARKS

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger

DATE 11 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.65
TOPSOIL 0.23							
Stiff to firm, red-brown SILTY CLAY		SS	1	75	10	1	85.65
		SS	2	100	2	2	84.65
- soft and brown by 2.1m depth							
- grey by 2.6m depth		TW	3	96		3	83.65
		TW	4	96		4	82.65
- firm by 5.0m depth						5	81.65
		SS	5	100	1	6	80.65
						7	79.65
						8	78.65
		TW	6	96		9	77.65
						10	76.65
		SS	7	100	1	11	75.65
						12	74.65
						13	73.65
- stiff by 13.5m depth		TW	8	96		14	72.65
14.94						15	71.65
Dynamic Cone Penetration Test commenced @ 14.94m depth						16	70.65
Inferred SILTY CLAY						17	69.65

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Bisson Properties, Tenth Line Road
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PG0703

REMARKS

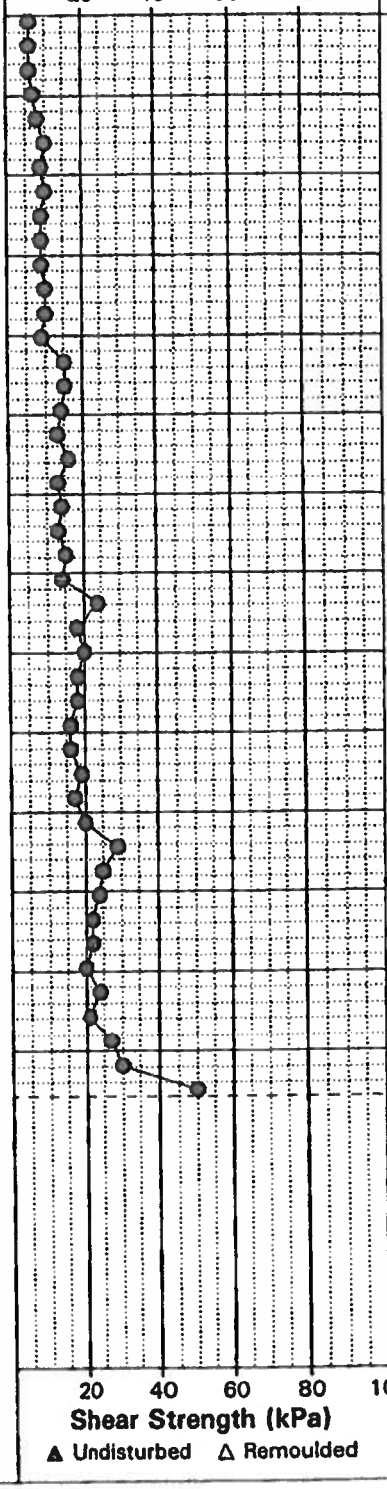
HOLE NO. BH 6

BORINGS BY CME 55 Power Auger

DATE 11 OCT 05

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
Inferred SILTY CLAY						17	69.65
						18	68.65
						19	67.65
						20	66.65
21.00						21	65.65
Inferred GLACIAL TILL						22	64.65
						23	63.65
						24	62.65
						25	61.65
						26	60.65
						27	59.65
						28	58.65
						29	57.65
						30	56.65
30.56							
End of Borehole							
DCPT refusal @ 30.56m depth							
(GWL @ 0.94m-Oct. 28/05)							

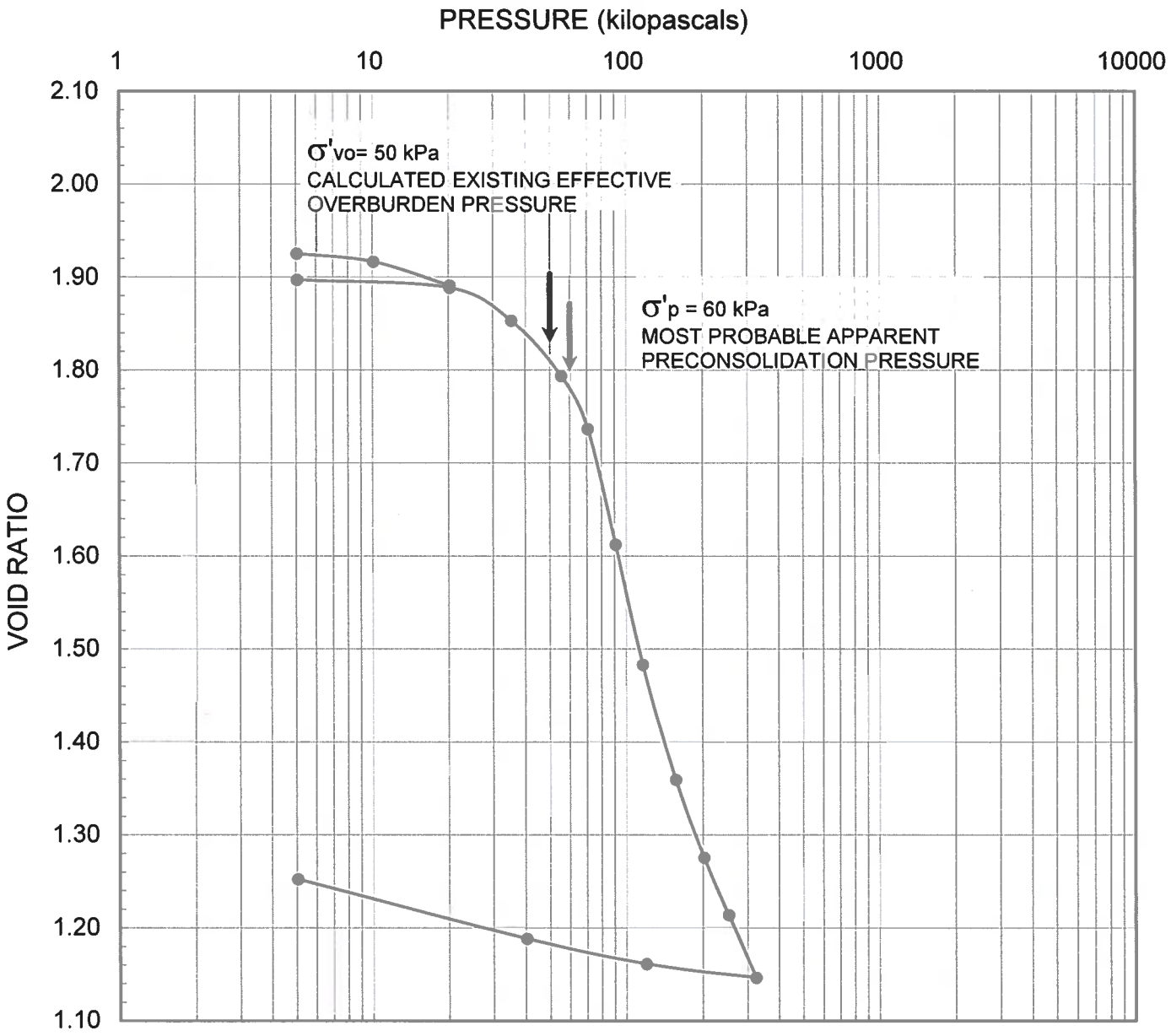
Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

APPENDIX C

Oedometer Consolidation Test Results



LEGEND

Borehole:	13-4	w_i = 70%	S_o = 100%	γ = 15.7 kN/m³
Sample:	6	w_f = 46%	e_o = 1.93	G_s = 2.77
Depth (m):	5.0	w_l = 64%	C_c = 1.19	
Elevation (m):	82.3	w_p = 25%	C_r = 0.015	

Golder Associates

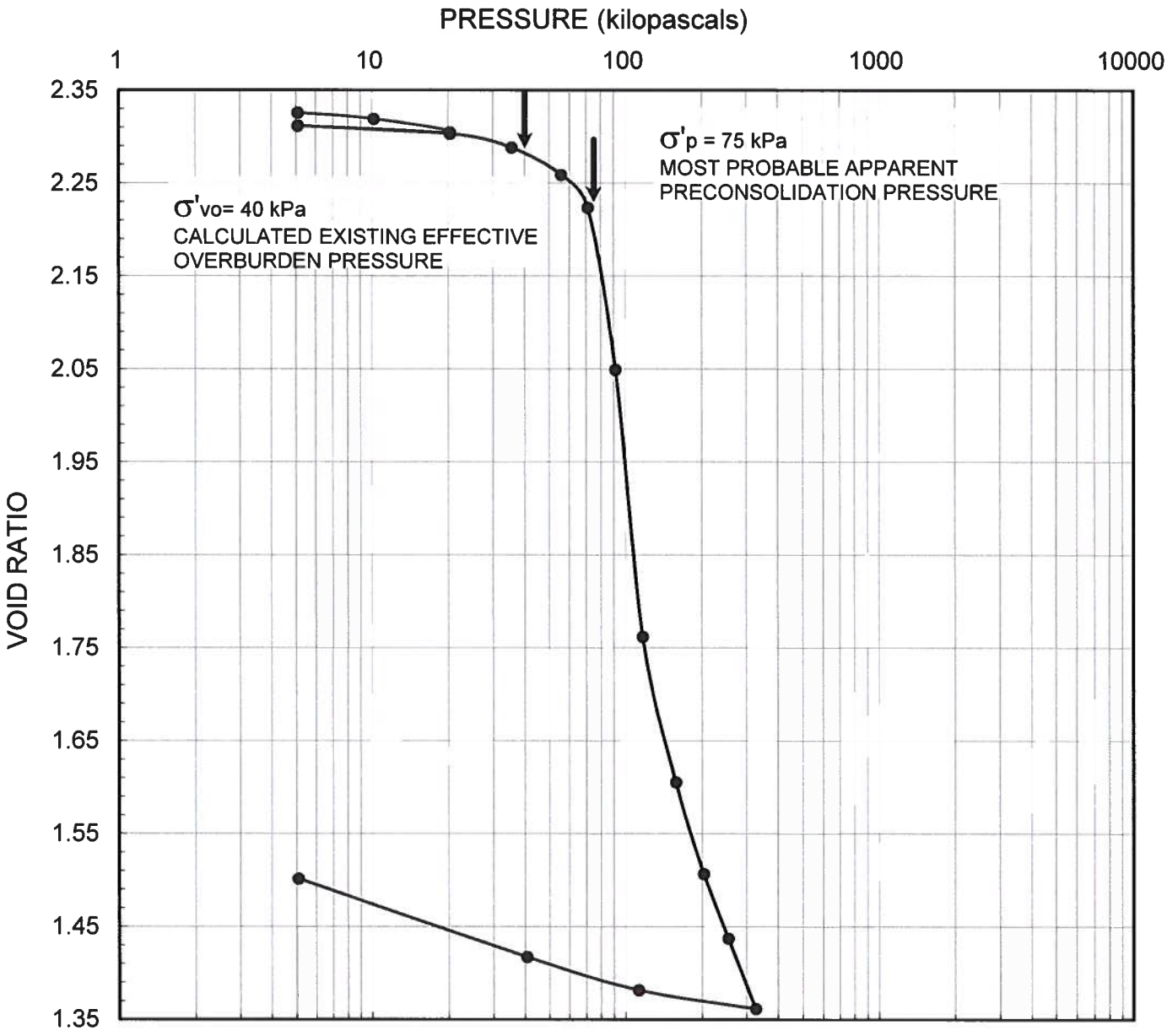
SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
ENTERED	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	13-1121-0123	REV.	2

FIGURE C1



LEGEND

Borehole:	13-5	w_i = 85%	S_o = 100%	γ = 15 kN/m³
Sample:	3	w_f = 55%	e_o = 2.33	G_s = 2.76
Depth (m):	3.4	w_l = 66%	C_c = 2.63	
Elevation (m):	82.7	w_p = 26%	C_r = 0.013	

Golder Associates

SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
ENTERED	CW
CHECK	CNM
REVIEW	CK

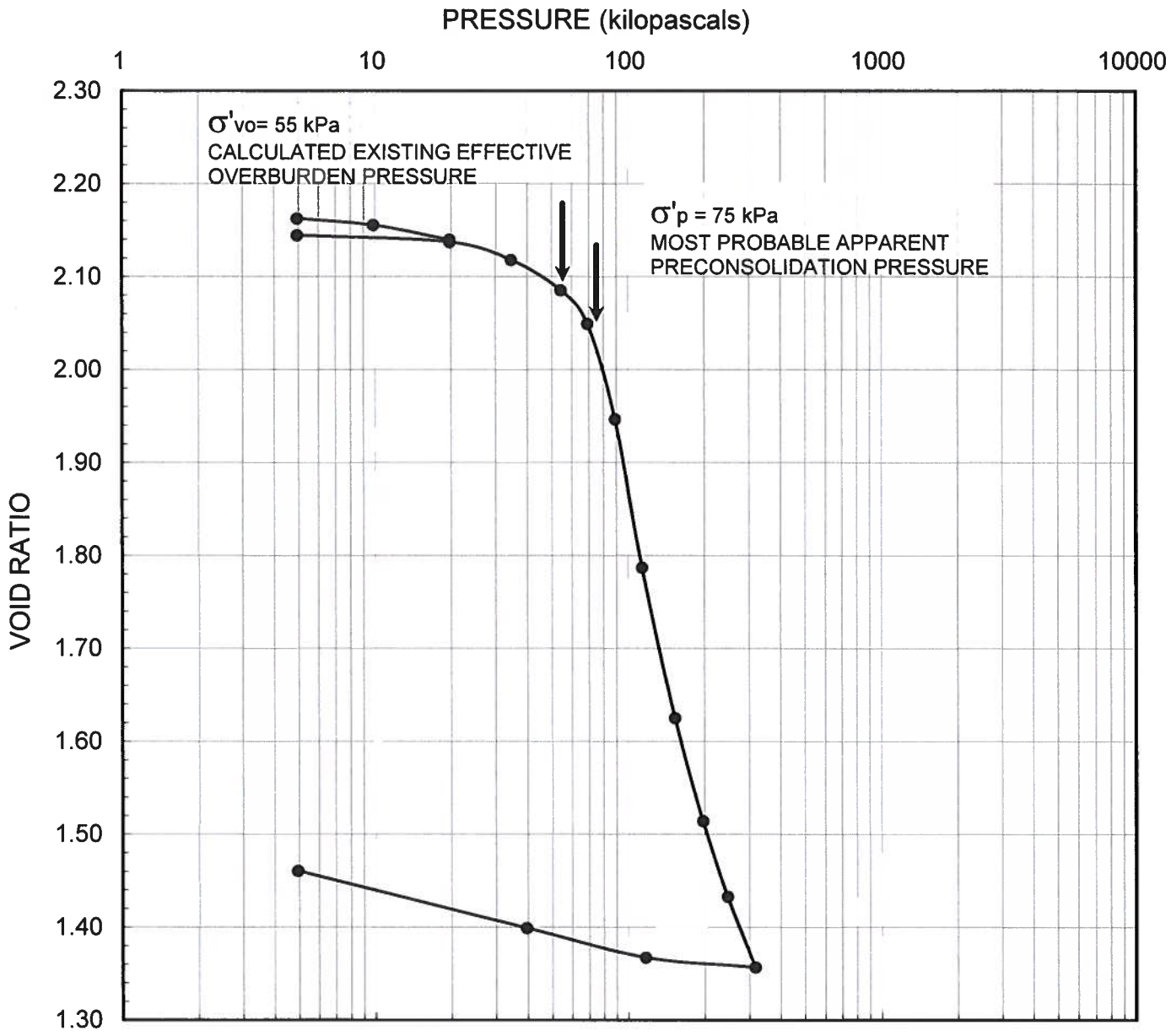
FILE No. Consolidation summary

PROJECT No. 13-1121-0123 REV. 2

TITLE

CONSOLIDATION TEST RESULTS

FIGURE C2



LEGEND

Borehole:	13-6	w_i = 80%	S_o = 101%	γ = 15.2 kN/m³
Sample:	6	w_f = 55%	e_o = 2.17	G_s = 2.74
Depth (m):	5.7	w_l = 90%	C_c = 1.53	
Elevation (m):	81.4	w_p = 31%	C_r = 0.012	

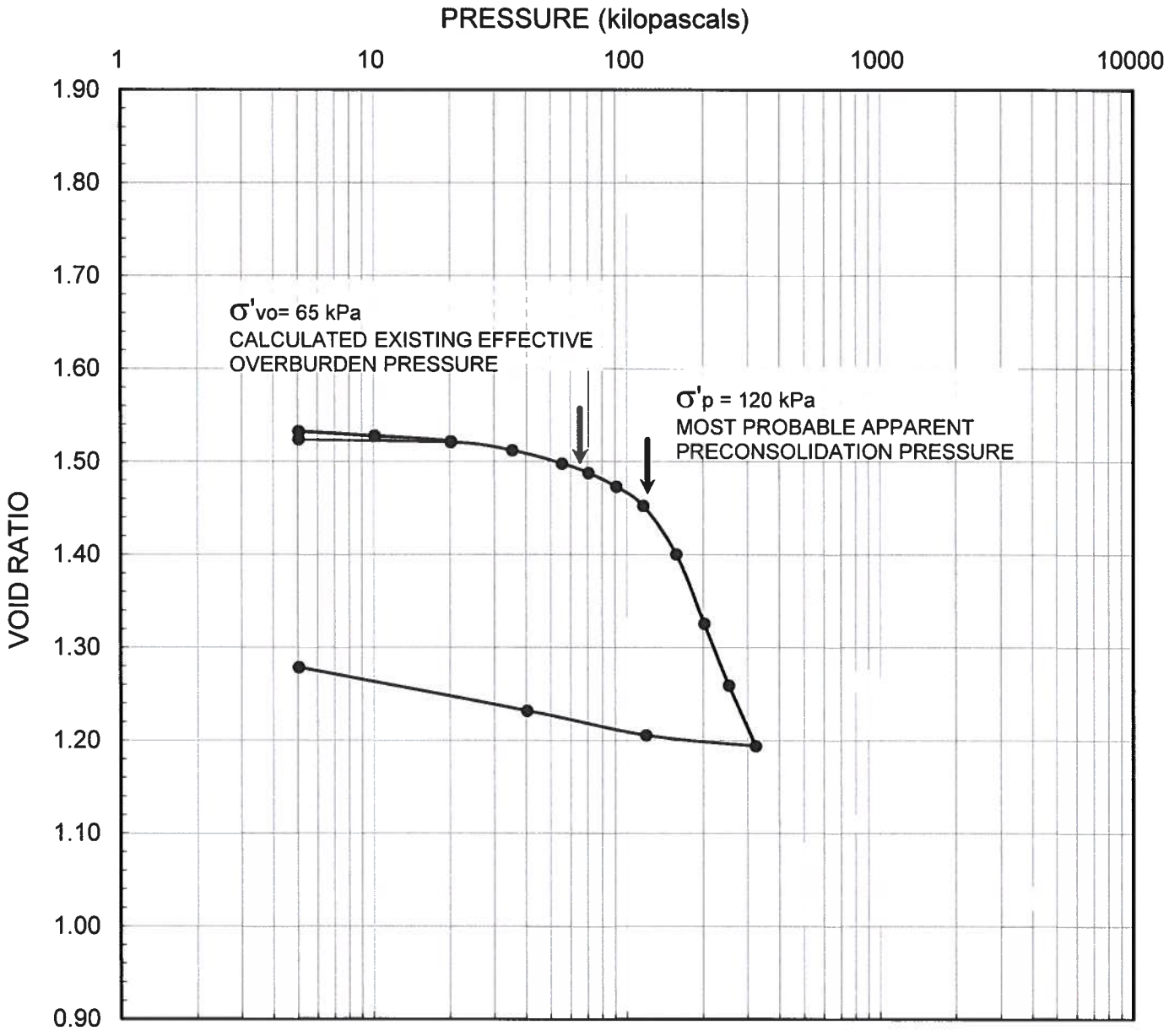
Golder Associates

SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
ENTERED	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	13-1121-0123	REV. 2	FIGURE C3

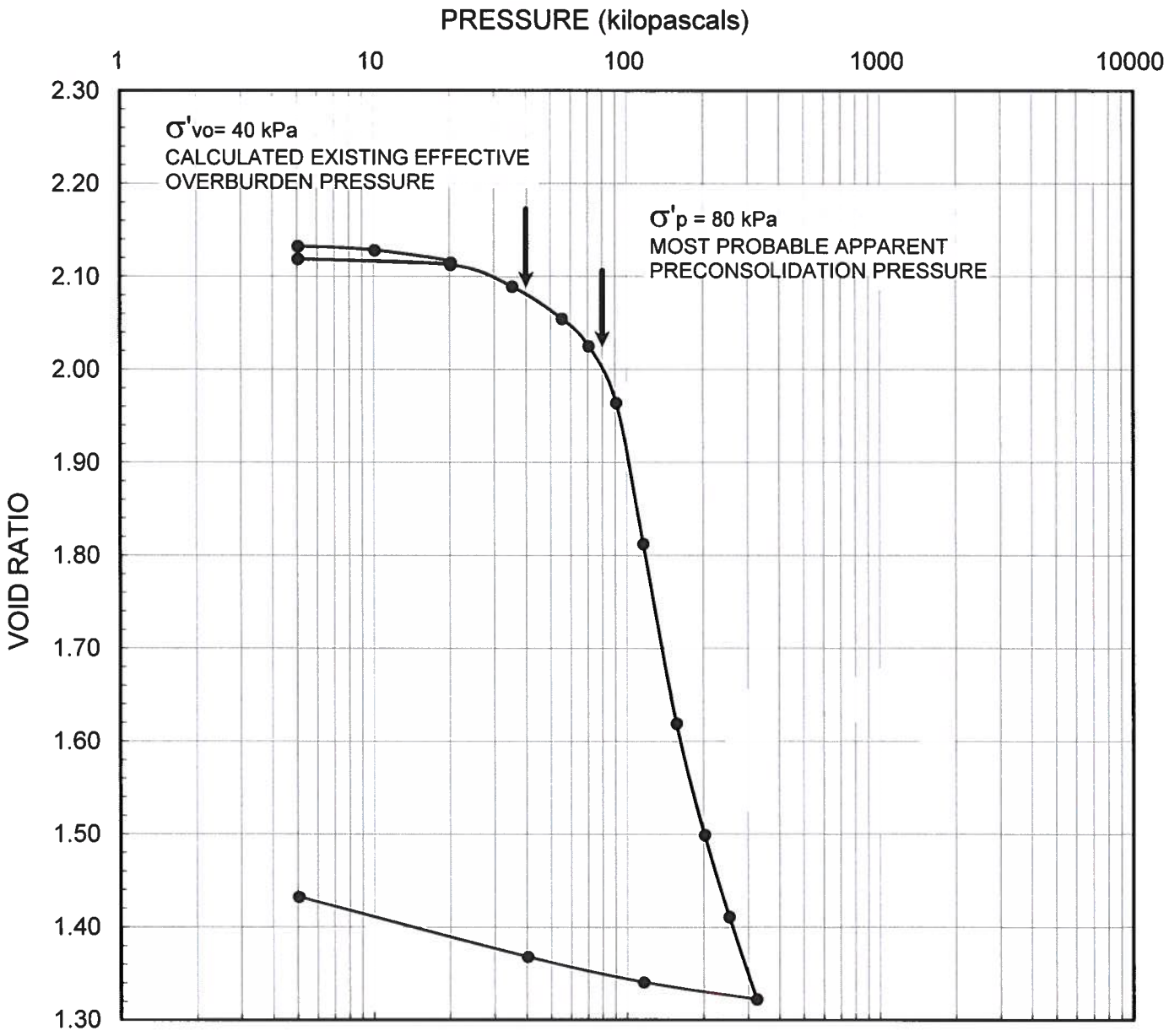


LEGEND

Borehole:	13-6	w_i = 56%	S_o = 101%	γ = 16.6 kN/m³
Sample:	7	w_f = 47%	e_o = 1.54	G_s = 2.75
Depth (m):	7.2	w_l = 64%	C_c = 0.66	
Elevation (m):	79.9	w_p = 27%	C_r = 0.005	

Golder Associates

SCALE	AS SHOWN	TITLE	CONSOLIDATION TEST RESULTS
DATE	04/02/14		
CADD	N/A		
ENTERED	CW		
FILE No.	Consolidation summary		
CHECK	CNM		
PROJECT No.	13-1121-0123 REV. 2		
REVIEW	CK	FIGURE	C4



LEGEND

Borehole:	13-7A	w_i = 79%	S_o = 100%	γ = 15.2 kN/m³
Sample:	1	w_f = 54%	e_o = 2.14	G_s = 2.72
Depth (m):	4.1	w_l = 70%	C_c = 1.50	
Elevation (m):	81.2	w_p = 28%	C_r = 0.012	

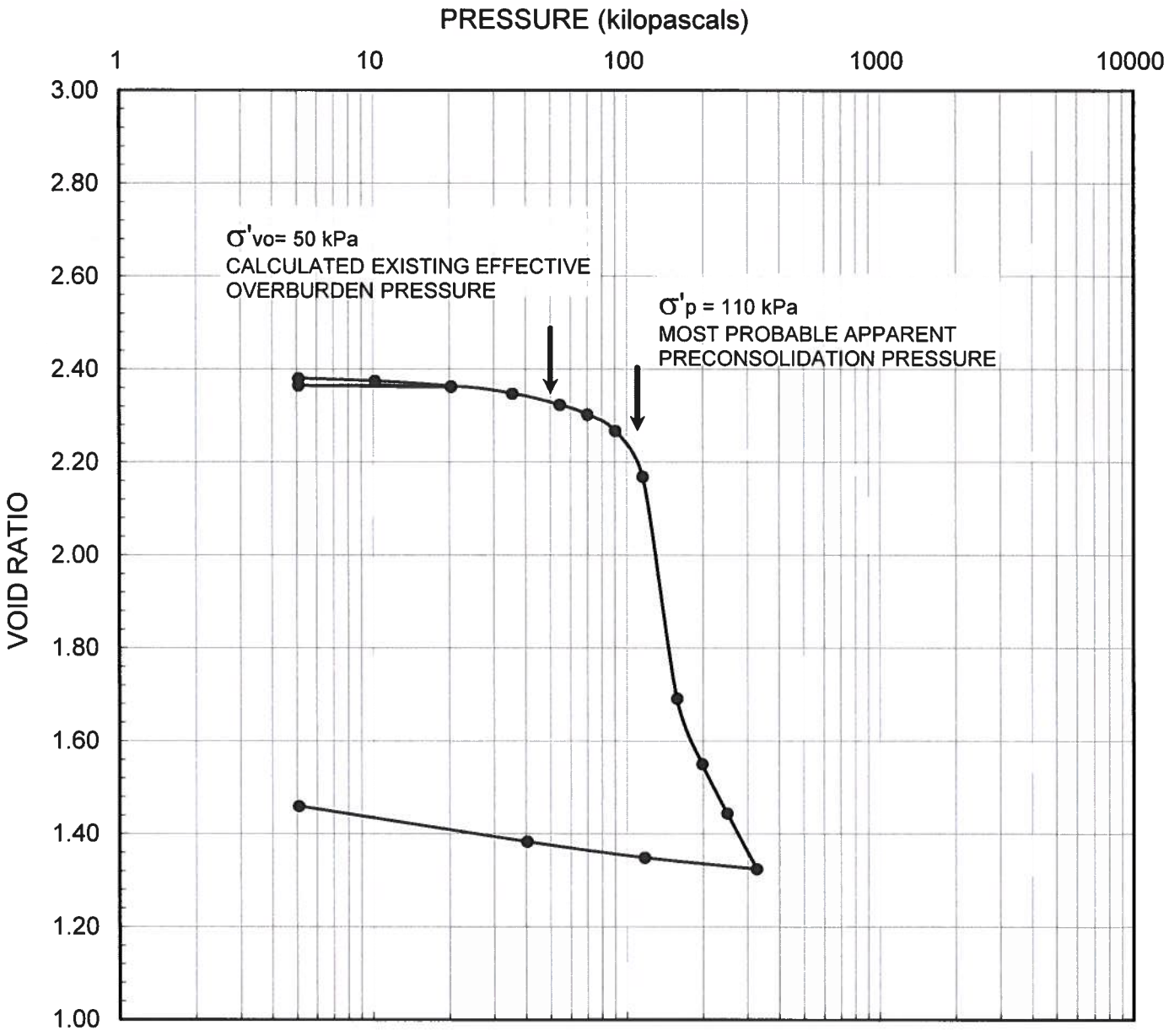
Golder Associates

SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
ENTERED	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	13-1121-0123	REV. 2	FIGURE C5



LEGEND

Borehole:	13-8	w_i = 86%	S_o = 99%	γ = 14.8 kN/m³
Sample:	4	w_f = 55%	e_o = 2.38	G_s = 2.74
Depth (m):	4.8	w_l = 71%	C_c = 3.53	
Elevation (m):	80.7	w_p = 27%	C_r = 0.002	

Golder Associates

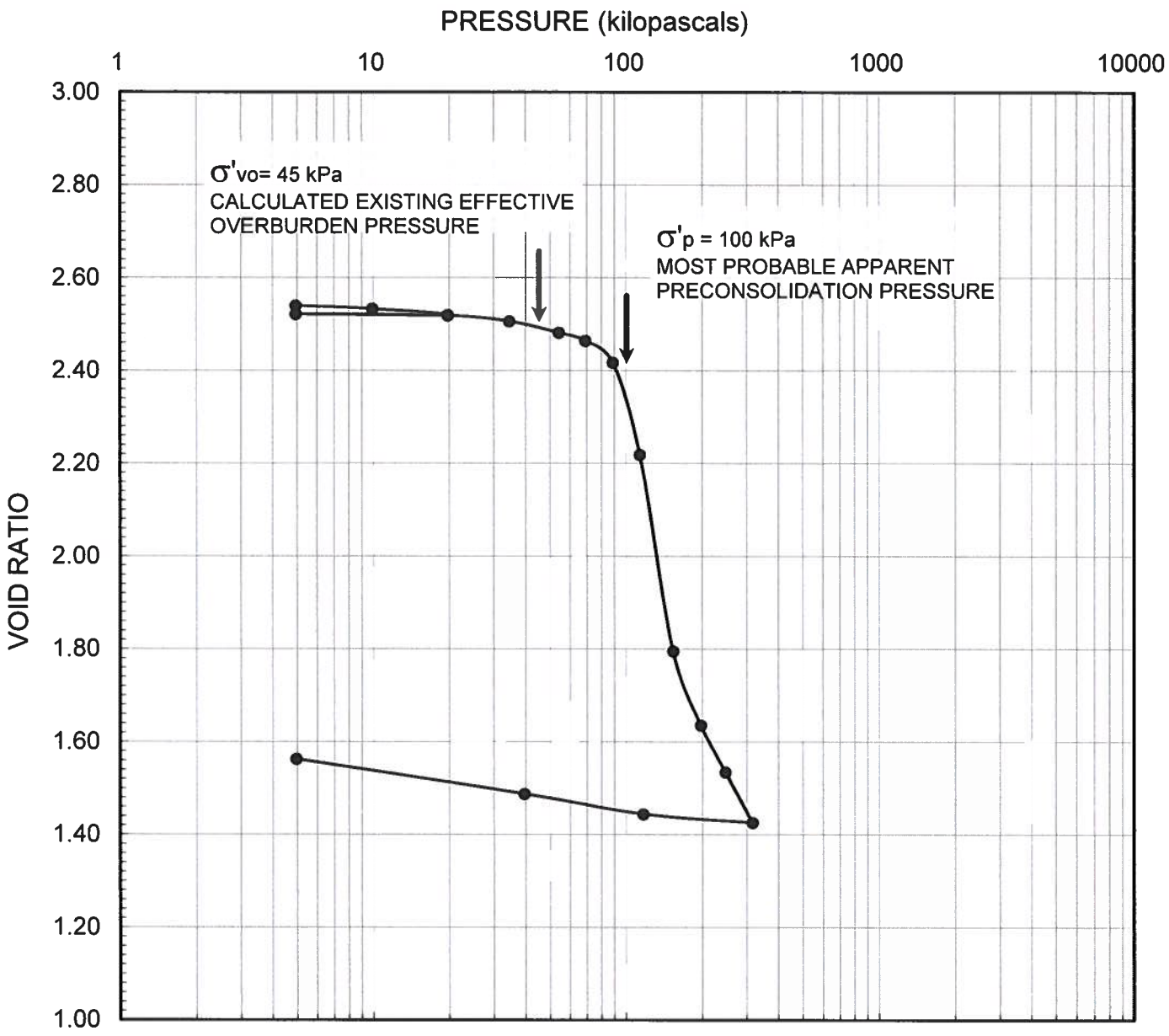
SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
ENTERED	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	13-1121-0123	REV.	2

FIGURE **C6**



LEGEND

Borehole:	13-10	w_i = 94%	S_o = 100%	γ = 14.6 kN/m³
Sample:	4	w_f = 58%	e_o = 2.54	G_s = 2.72
Depth (m):	4.2	w_l = 85%	C_c = 3.21	
Elevation (m):	80.8	w_p = 34%	C_r = 0.005	

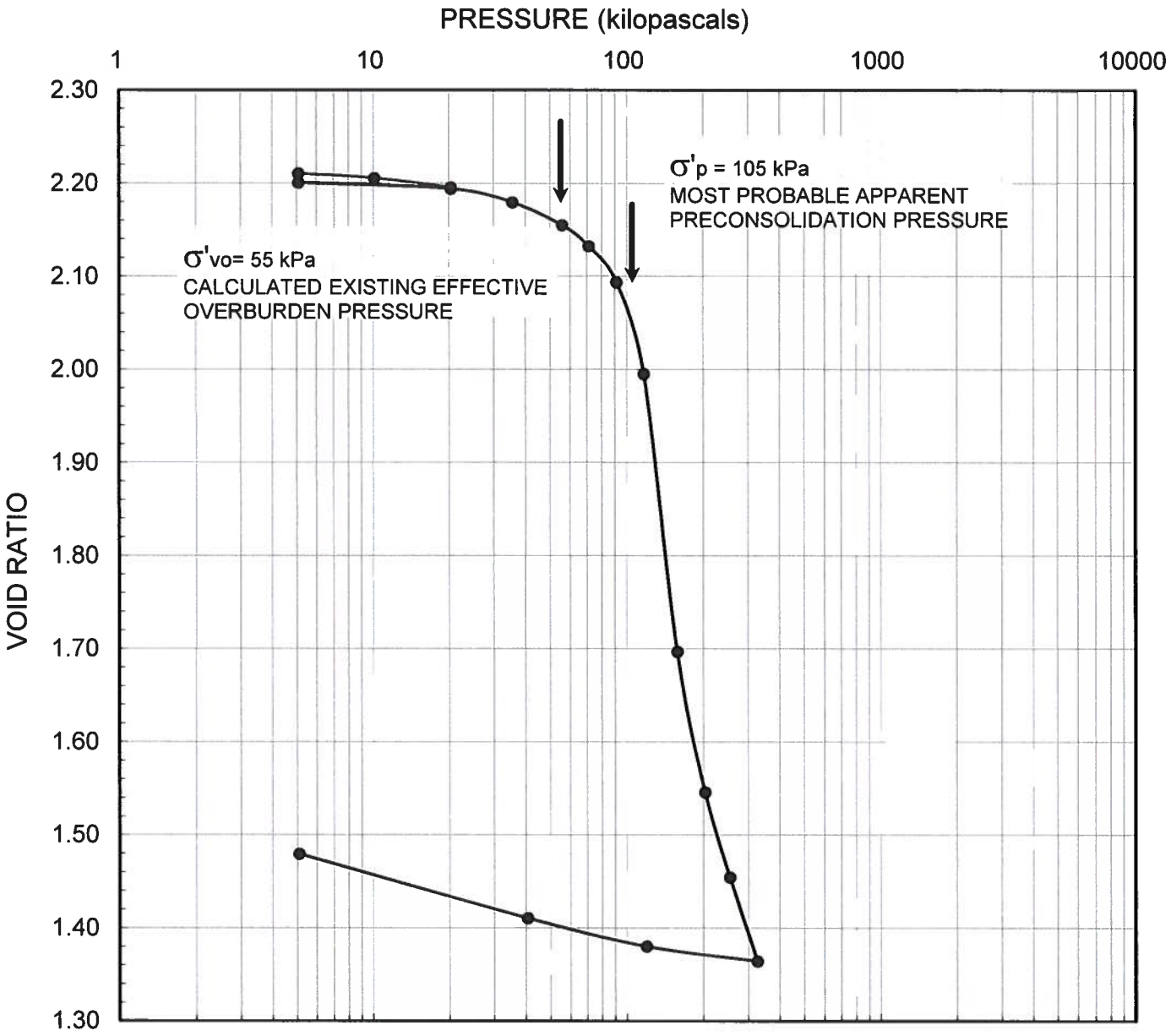
Golder Associates

FILE No.	Consolidation summary	SCALE	AS SHOWN
PROJECT No.	13-1121-0123	REV. 2	DATE 04/03/14
		CADD	N/A
		ENTERED	CW
		CHECK	CNM
		REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FIGURE C7



LEGEND

Borehole:	13-11	w_i = 81%	S_o = 100%	γ = 15.1 kN/m³
Sample:	5	w_f = 55%	e_o = 2.21	G_s = 2.74
Depth (m):	5.7	w_l = 83%	C_c = 2.33	
Elevation (m):	79.1	w_p = 27%	C_r = 0.010	

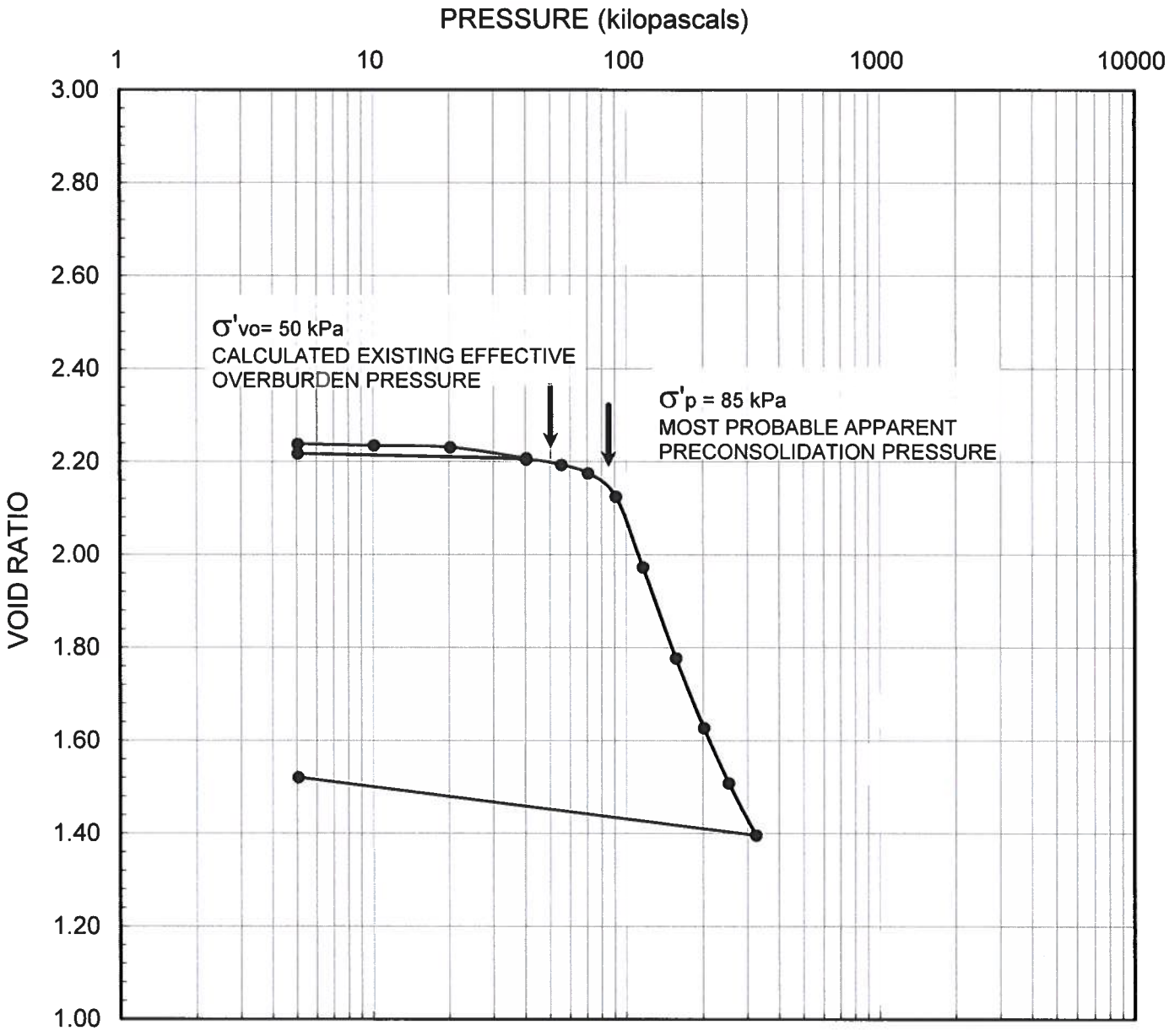
Golder Associates

SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
ENTERED	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	13-1121-0123	REV. 2	FIGURE C8



LEGEND

Borehole:	12-3	w_i = 81%	S_o = 100%	γ = 15.1 kN/m³
Sample:	3	w_f = 56%	e_o = 2.24	G_s = 2.76
Depth (m):	3.5	w_l = 89%	C_c = 1.52	
		w_p = 30%	C_r = 0.013	

Golder Associates

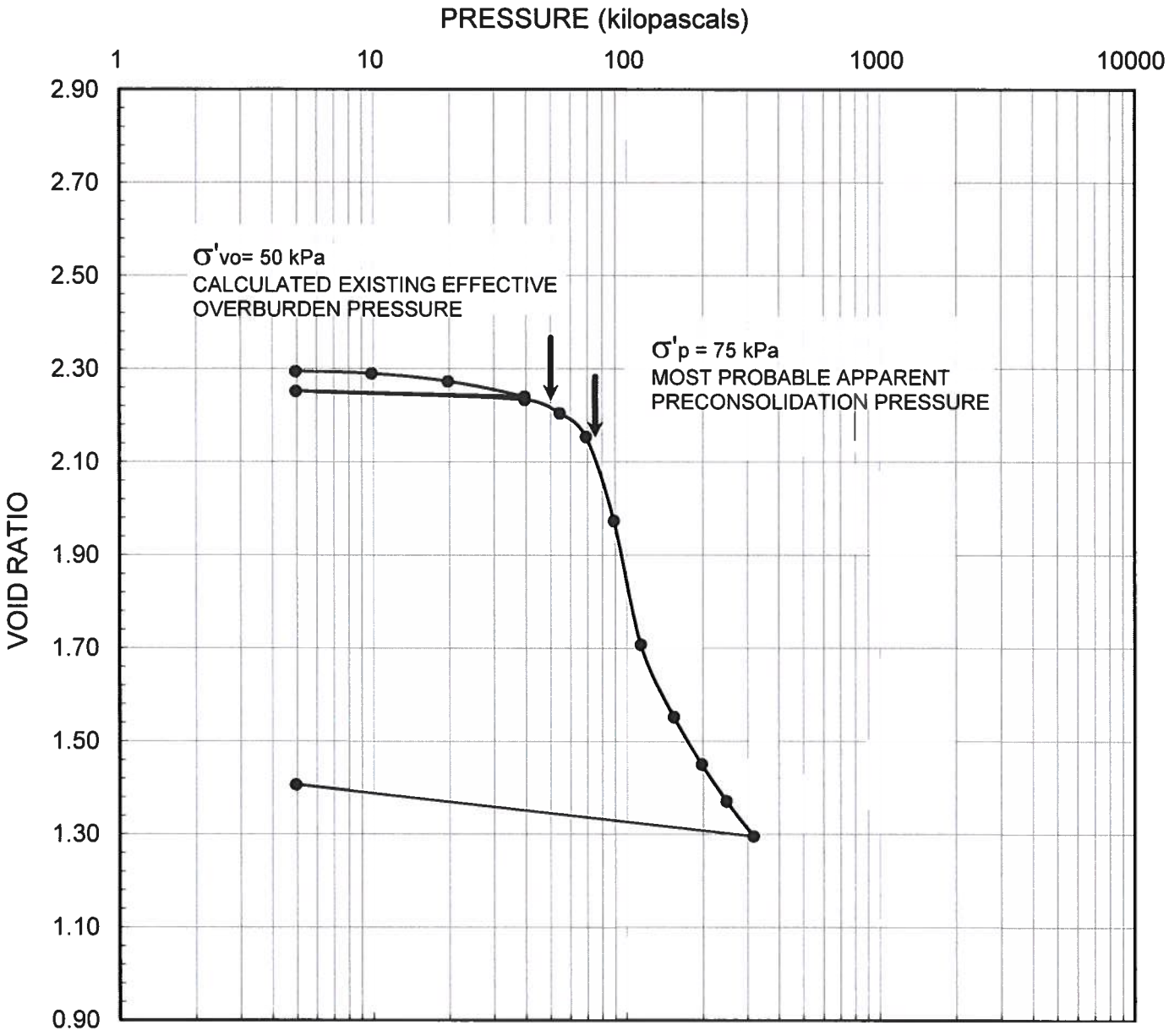
SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
DESIGN	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	12-1121-0095	REV. 1	

FIGURE **C9**



LEGEND

Borehole:	12-5	w_i = 81%	S_o = 98%	γ = 15 kN/m³
Sample:	4	w_f = 50%	e_o = 2.30	G_s = 2.79
Depth (m):	5.0	w_l = 78%	C_c = 2.57	
		w_p = 28%	C_r = 0.020	

Golder Associates

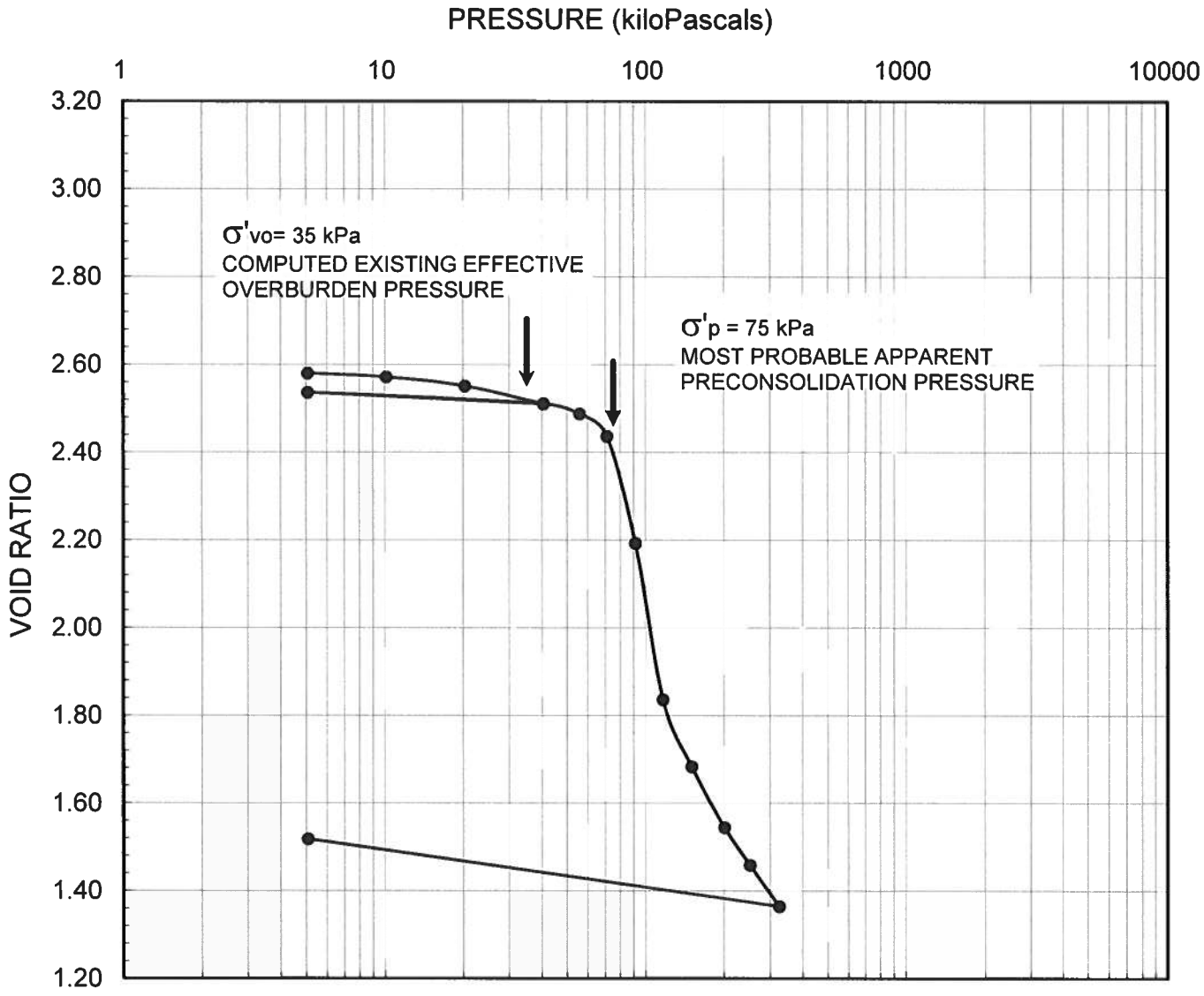
SCALE	AS SHOWN
DATE	04/02/14
CADD	N/A
DESIGN	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No.	Consolidation summary		
PROJECT No.	12-1121-0095	REV.	1

FIGURE **C10**



LEGEND

Borehole:	11-4A	w_i = 96.2%	S_o = 101%
Sample:	1	w_f = 57.5%	C_c = 3.27
Depth (m):	4.75	w_l = 75.8%	C_r = 0.027
		w_p = 27.3%	γ = 14.6 kN/m³

Golder Associates

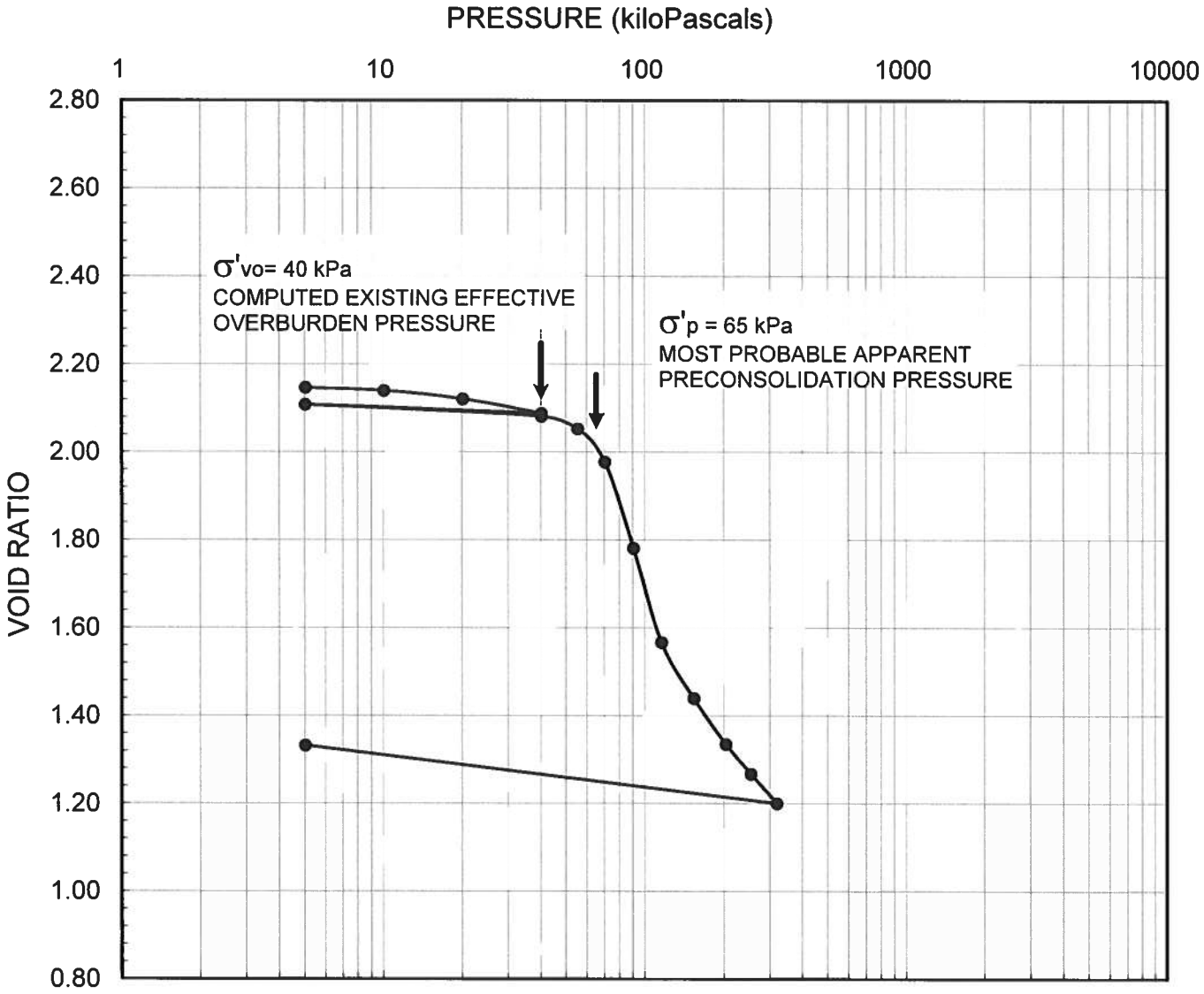
SCALE	AS SHOWN
DATE	04/02/14
DESIGN	NA
CADD	CW
CHECK	CNM
REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FILE No	Consolidation summary		
PROJECT No	11-1121-0120	REV.	1

FIGURE **C11**



LEGEND

Borehole:	11-6	w_i = 79.2%	S_o = 101%
Sample:	3	w_f = 50.0%	C_c = 1.94
Depth (m):	3.45	w_l = 67.5%	C_r = 0.030
		w_p = 28.9%	γ = 15.3 kN/m³

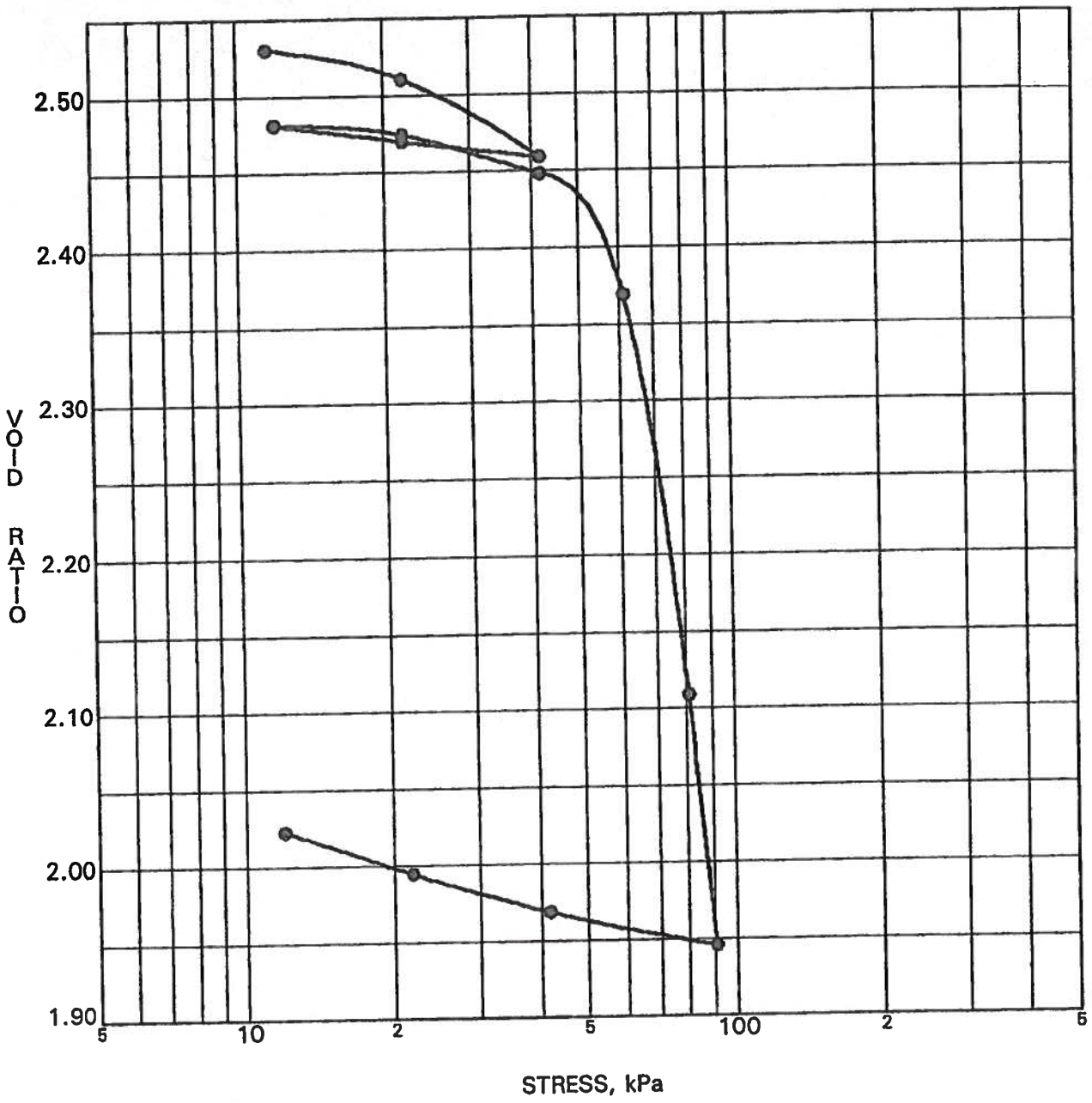
Golder Associates

FILE No.	Consolidation summary	SCALE	AS SHOWN
PROJECT No.	11-1121-0120 REV. 1	DATE	04/02/14
		DESIGN	NA
		CADD	NA
		CHECK	CNM
		REVIEW	CK

TITLE

CONSOLIDATION TEST RESULTS

FIGURE C12



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1	p'_o	46 kPa	Ccr	0.042
Sample No.	TW 4	p'_c	65 kPa	Cc	3.230
Sample Depth	3.90 m	OC Ratio	1.4	Wo	92.8 %
Sample Elev.	82.80 m	Void Ratio	2.550	Unit Wt.	14.6 kN/m^3

CLIENT Mattamy Homes
PROJECT Geotechnical Investigation - Bisson Properties, Tenth Line Road

FILE NO. PG0703
DATE 15/10/05

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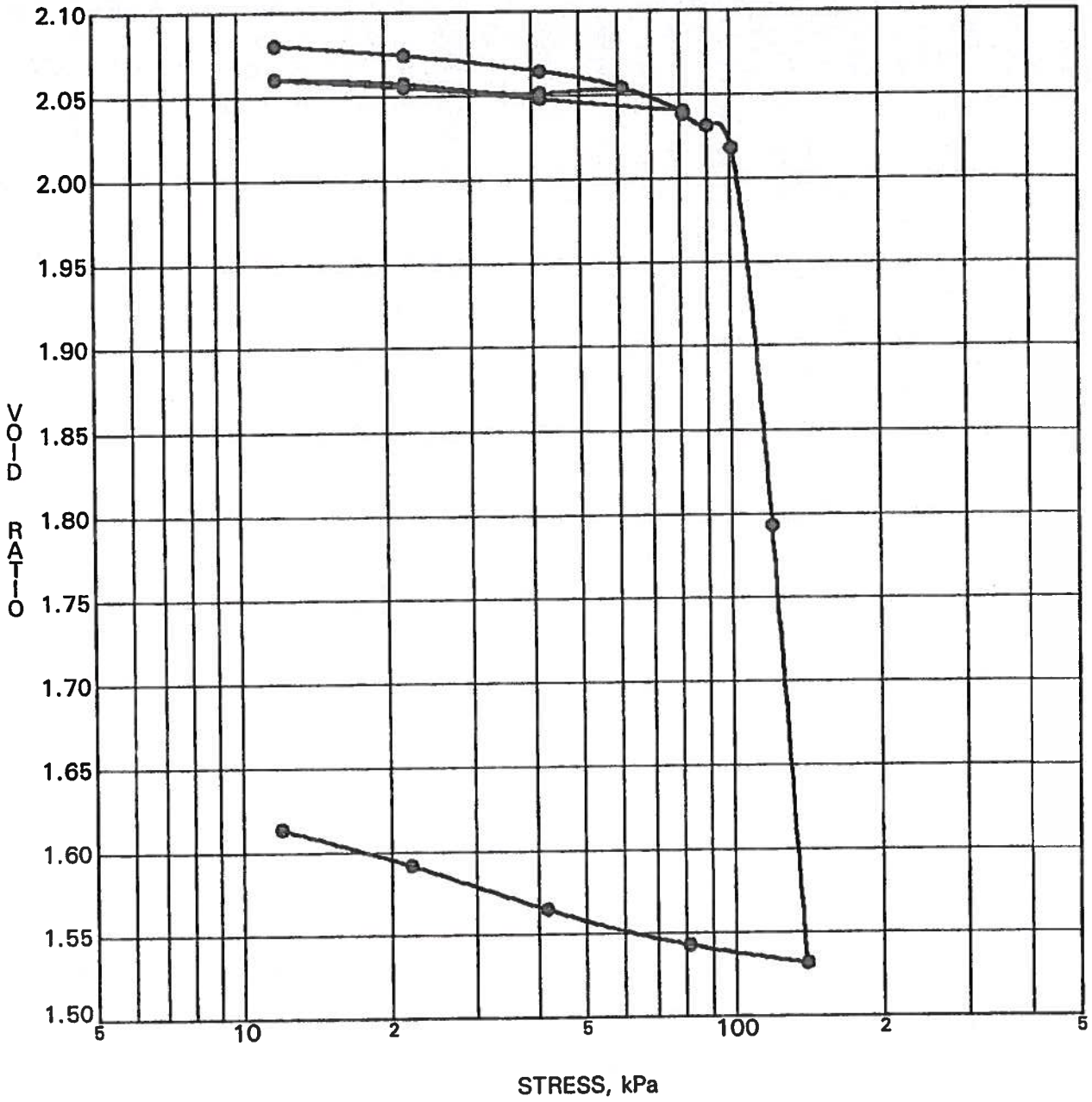
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



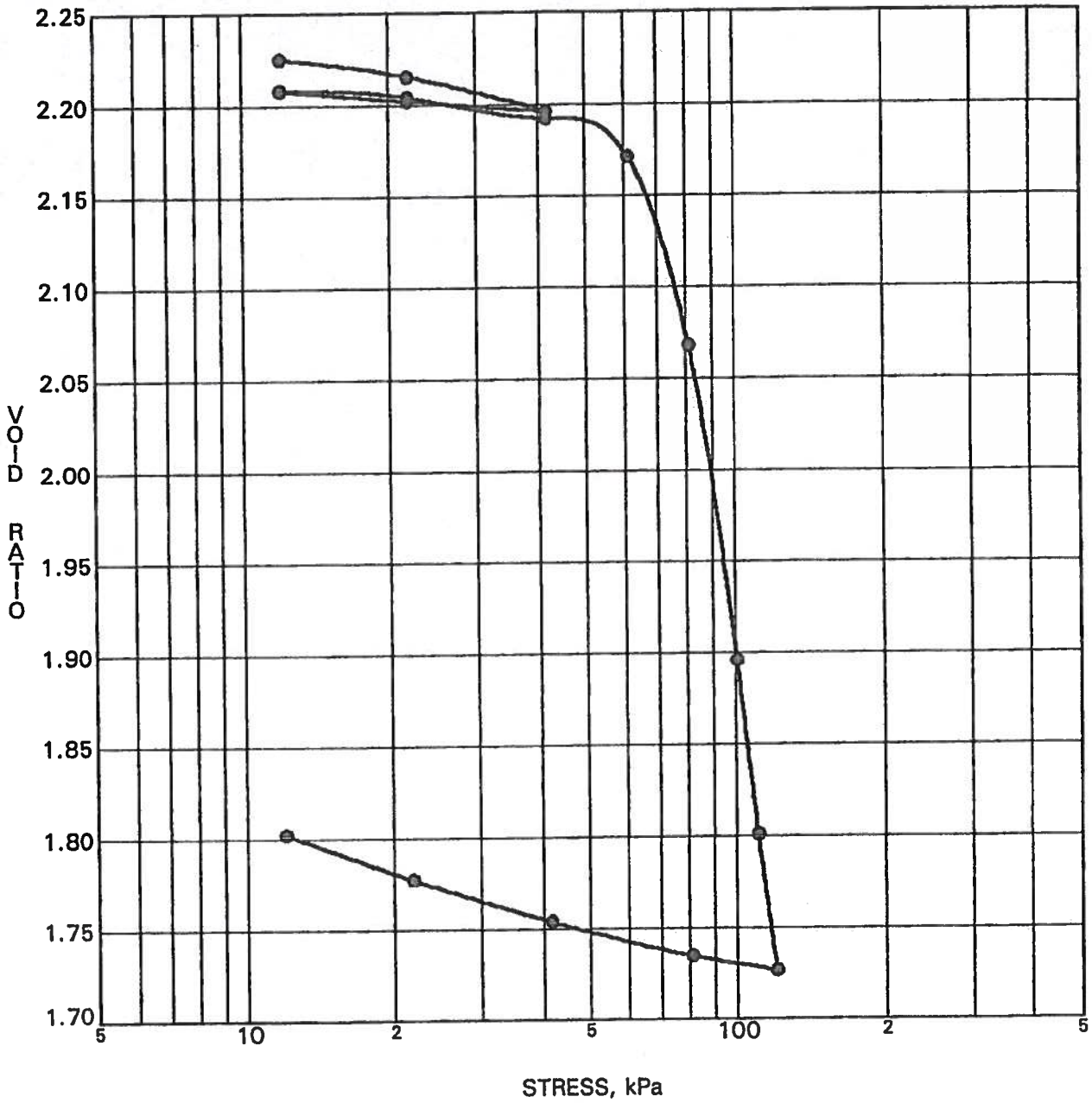
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 1	p'_o	60 kPa	Ccr	0.025
Sample No.	TW 5	p'_c	105 kPa	Cc	3.910
Sample Depth	6.40 m	OC Ratio	1.8	Wo	76.0 %
Sample Elev.	80.30 m	Void Ratio	2.090	Unit Wt.	15.4 kN/m^3

CLIENT Mattamy Homes
PROJECT Geotechnical Investigation - Bisson Properties, Tenth Line Road

FILE NO. PG0703
DATE 17/11/05

patersongroup Consulting Engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 4	p'_o	46 kPa	Ccr	0.026
Sample No.	TW 4	p'_c	77 kPa	Cc	2.210
Sample Depth	4.00 m	OC Ratio	1.7	Wo	81.3 %
Sample Elev.	82.32 m	Void Ratio	2.240	Unit Wt.	15.1 kN/m^3

CLIENT Mattamy Homes
PROJECT Geotechnical Investigation - Bisson Properties, Tenth Line Road

FILE NO. PG0703
DATE 16/10/05

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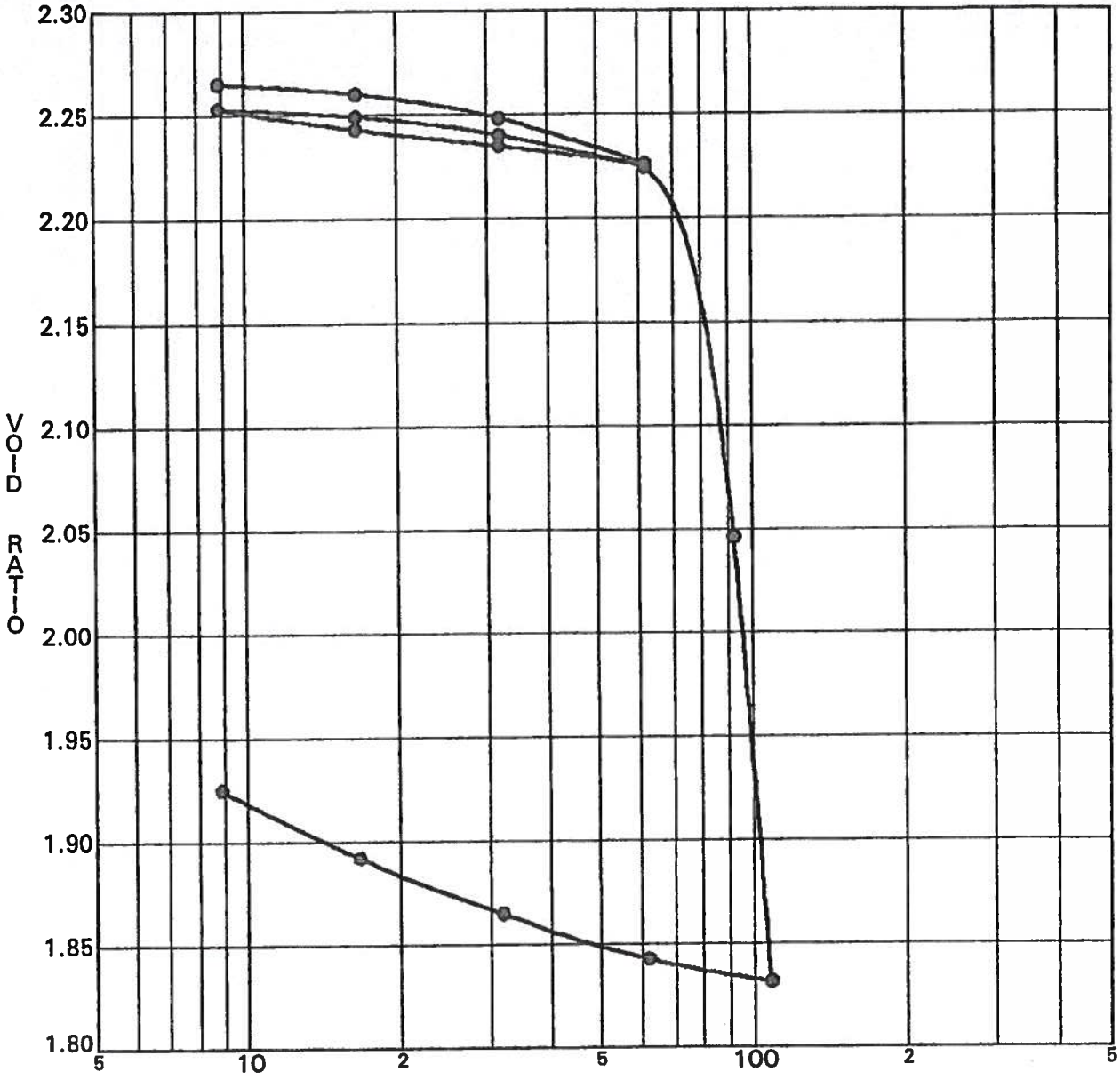
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



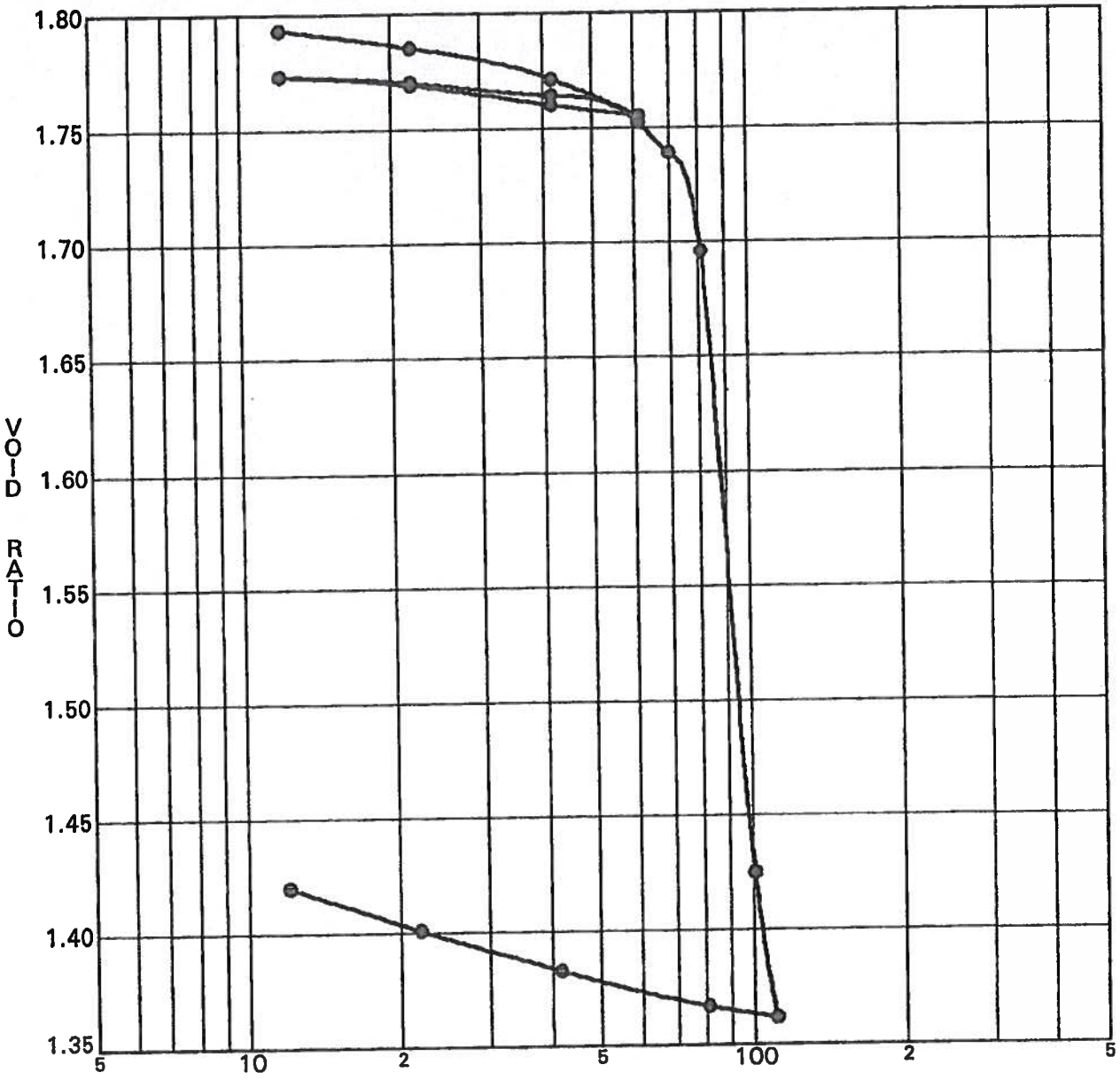
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 5	p'_o	46 kPa	Ccr	0.035
Sample No.	TW 3	p'_c	81 kPa	Cc	3.370
Sample Depth	4.00 m	OC Ratio	1.8	Wo	82.5 %
Sample Elev.	82.78 m	Void Ratio	2.270	Unit Wt.	15.1 kN/m^3

CLIENT Mattamy Homes
PROJECT Geotechnical Investigation - Bisson Properties, Tenth Line Road

FILE NO. PG0703
DATE 15/10/05

patersongroup Consulting Engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 6	p'_o	43 kPa	Ccr	0.027
Sample No.	TW 3	p'_c	77 kPa	Cc	2.640
Sample Depth	3.40 m	OC Ratio	1.8	Wo	65.6 %
Sample Elev.	83.25 m	Void Ratio	1.800	Unit Wt.	15.9 kN/m^3

CLIENT Mattamy Homes
PROJECT Geotechnical Investigation - Bisson Properties, Tenth Line Road

FILE NO. PG0703
DATE 10/11/05

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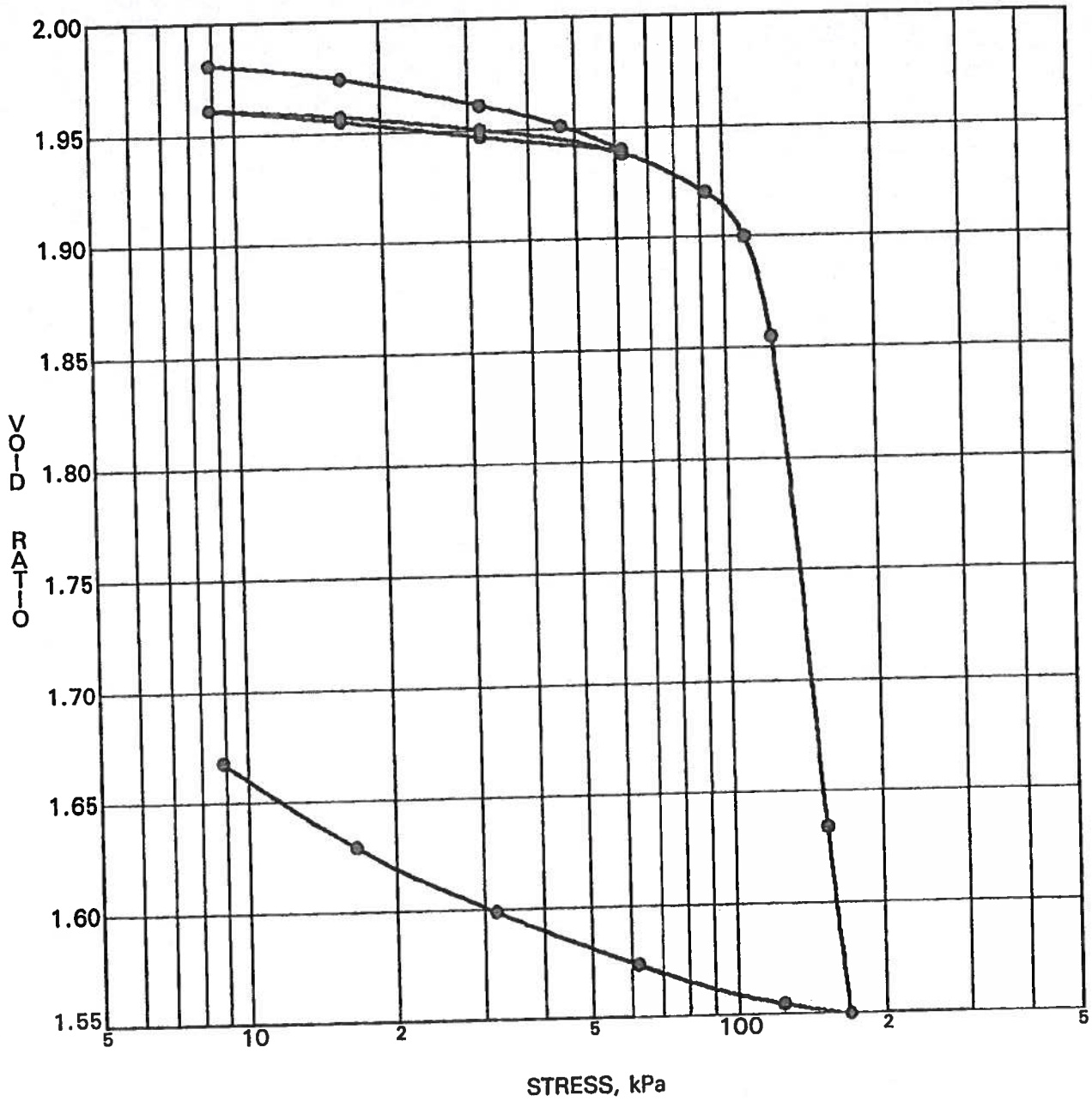
CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 6	p'_o	78 kPa	Ccr	0.025
Sample No.	TW 6	p'_c	115 kPa	Cc	2.280
Sample Depth	9.50 m	OC Ratio	1.5	Wo	72.2 %
Sample Elev.	77.15 m	Void Ratio	1.980	Unit Wt.	15.6 kN/m^3

CLIENT Mattamy Homes

PROJECT Geotechnical Investigation - Bisson Properties, Tenth Line Road

FILE NO. PG0703

DATE 04/11/05

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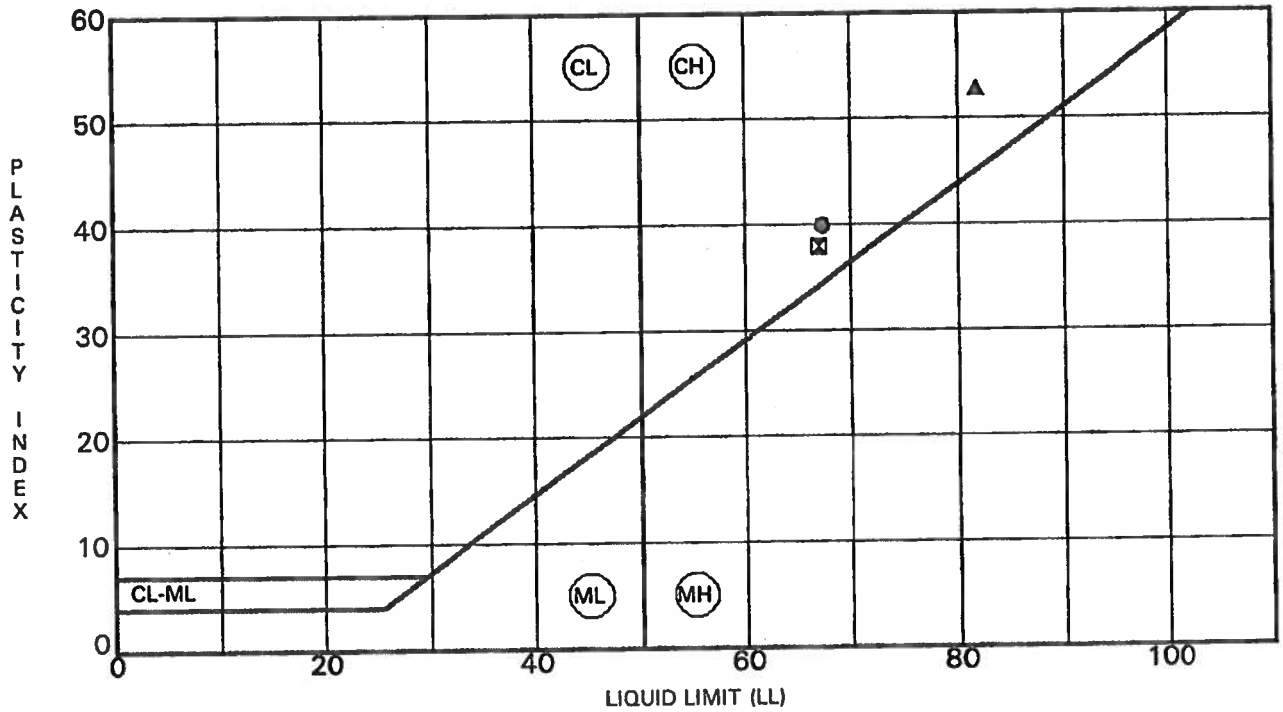
CONSOLIDATION TEST



Specimen Identification		LL	PL	PI	Fines	Classification
● BH 1	TW4	67	27	40		
⊠ BH 4	TW4	67	29	38		
▲ BH 5	TW3	82	29	53		

CLIENT Mattamy Homes

PROJECT Geotechnical Investigation - Brisson Properties, Tenth Line Road

FILE NO. PG0703

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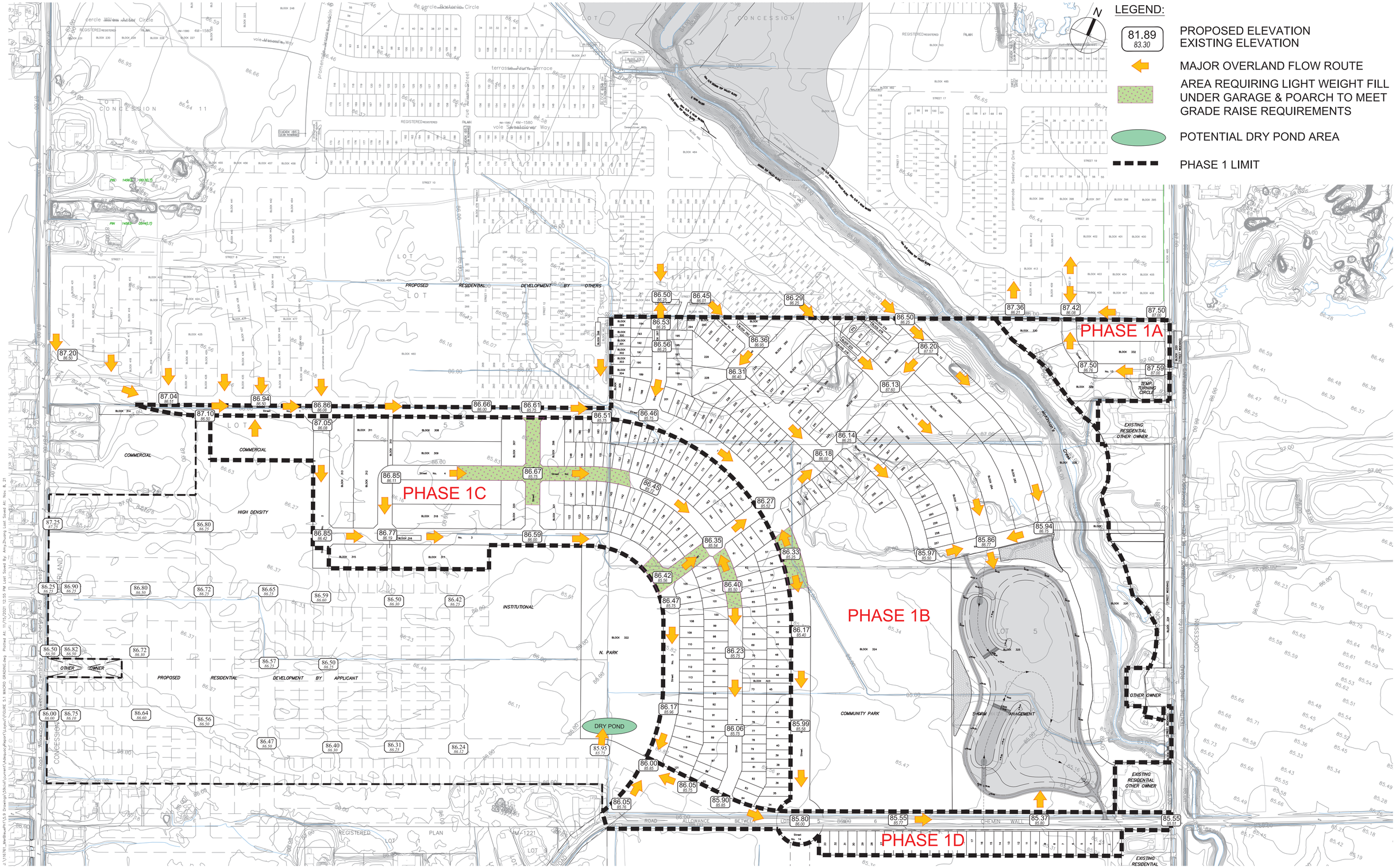

Scale
1 : 2000

Project Title
MER BLEUE
PHASE 1

Drawing Title
MACRO GRADING

Sheet No.
FIGURE 5.1

EROSION AND SEDIMENT CONTROL MEASURES ALONG COMMON LOT LINE TO BE COORDINATED WITH ADJACENT DEVELOPER BASED ON TIMING OF WORKS.

PHASE 1A

PHASE 1B

PHASE 1C

PHASE 1D

PROPOSED RESIDENTIAL DEVELOPMENT BY OTHERS

PROPOSED RESIDENTIAL DEVELOPMENT BY APPLICANT

EXISTING RESIDENTIAL OTHER OWNER

TEMP. TURNING CIRCLE

MUD MAT

MUD MAT

COMMERCIAL

HIGH DENSITY

INSTITUTIONAL

COMMUNITY PARK

N. PARK

ADDITIONAL LAND OWNED BY APPLICANT

LEGEND:

- SILT FENCE
- STRAW BALE CHECK DAM
- SEDIMENT INTERCEPTOR SWALE
- SEDIMENT TRAP
- PHASE 1 LIMIT

N

Scale	Project Title	Drawing Title	Sheet No.
1 : 4000	MER BLEUE PHASE 1	EROSION & SEDIMENTATION CONTROL PLAN	FIGURE 6.0

IBI

J:\116761_MerBleuPh1\5.9 Drawings\50civil\current\AdequacyReport\Layout\FIGURE 6.0 EROSION & SEDIMENTATION CONTROL PLAN.dwg Plotted At: 11/15/2021 Last Saved By: AmyZhuang Last Saved At: Nov. 8, 21