



December 22, 2022

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Via Email:
VLeon@riocan.com

Re: OTT-22015769-A0 Desk Top Geotechnical Study. Proposed Residential Development
1640 – 1660 Carling Avenue, Ottawa, Ontario

Introduction

EXP Services Inc. (EXP) is pleased to present RioCan Real Estate Investment Trust (RioCan) with this geotechnical desktop study for the proposed residential development to be situated at the site registered by the street address of 1640 – 1660 Carling Avenue, Ottawa, Ontario, hereafter referred to as the “Site” (Figure 1).

The subject site located at the northeast corner of Carling Avenue and Clyde Avenue North, Ottawa, Ontario. 1660 Carling Avenue is currently occupied by an existing Canadian Tire two-storey building, which includes both retail space, an automotive garage, and surface parking. 1640 Carling Avenue comprises of a single-storey restaurant currently operating as Boston Pizza and surface parking. The Site has a total area of approximately 2.3 hectares.

It is understood that plans call for demolishing of the existing CTC store and restaurant and redevelop the site with six (6) forty (40) storey residential towers each with three levels of underground parking (Figure 4).

It is also understood that at this stage access for completion of any fieldwork to support a detailed geotechnical investigation and other studies is not possible and therefore a desktop study has been requested based on the available data. A detailed geotechnical investigation with borehole drilling will be completed at a later date once access to the site is granted. This letter report should be used for general information purposes.

Scope of Work

Scope of work for this desktop study is to as follow:

- Review of all available reports;
- Summarize possible subsurface and groundwater condition;
- Present possible foundation alternatives for the proposed development;
- Present preliminary seismic site classification;
- Comment on floor slab and drainage requirements; and,
- Comment on excavation and effect of groundwater during the excavation process.

Background Information Data

The following reports were reviewed to prepare this desktop geotechnical study:

- Geotechnical Investigation, Proposed Canadian Tire Store #290, 1650 and 1666 Carling Avenue, Ottawa, Ontario prepared for Turpin Group Inc., by Trow Associates Inc., dated September 2, 2006 – revised October 31, 2006.

It should be noted that following the above investigations, the site had undergone major construction comprising of demolishing previous buildings, installation of services and construction of the existing CTC store. Therefore the above data especially related to bedrock elevation are not representative of the current site conditions and therefore shouldn't be relied on for any costing, design, etc..

Geology of the Site

Regional Physiography

The Site is located within the physiographic region known as the Ottawa Valley Clay Plains. On a regional mapping scale, the site borders two (2) physiographic landforms. The southern half falls within the Limestone Plains and the northern half within Sand Plains. Drumlinized Till Plains manifesting low standing drumlins comprising of till type soils (Chapman & Putnam, 2007) lies to the west of the site (Figure 2).

Regional Geology and Hydrogeology

The surficial geology can be described as fine-textured glaciomarine deposits, consisting of stone-poor, sandy to silty sand textured till. The surficial geology of the Site and surrounding areas is shown on Figure 2. The bedrock primarily consists of Upper Ordovician dolostone, shale and limestone units of Shadow Lake Formation of Ottawa Group (Ontario Geological Survey, 2011) (Figure 3).

Regional groundwater across the site flows north towards the Ottawa River. Local deviations from regional groundwater flow pattern may occur in response to changes in topography and/or soils, as well as the presence of surface water features and/or existing subsurface infrastructure.

Inferred Subsurface Soil and Groundwater Condition

A total of thirty-six (36) boreholes (BH G1 to G12 and E1 to E24) were drilled to depths ranging between to 1.9 m to 6.8 m depths during the 2005/2006 geotechnical investigation completed by Trow (now EXP). All of the boreholes were advanced until refusal on inferred bedrock surface. The bedrock was core drilled in some of the boreholes.

Review of available boreholes data revealed the site is likely underlain by variable depths of overburden comprising of reworked fill, granular material (used in the previous construction) and by sandy silt to silty sand till in selected areas that were not disturbed by previous construction. The overburden is underlain by bedrock likely present at depths of less than 4 m except in areas which were blasted or excavated for the installation of services, structures, etc., as part of construction of the existing CTC store and restaurant. The elevations of the bedrock as established in 2005/2006 varied from Elevation 74.5 m to 76.9 m. The bedrock underlying the site was identified as limestone of the Ottawa Formation and was of good to excellent quality within the depths cored/investigated. The unconfined compression strength of three bedrock cores tested in 2005/2006 from 3 to 4 m depth ranged between 104 to 129 MPa.

The inferred bedrock elevations as recorded in 2005/2005 are presented on Figure No. 4.

The groundwater table was recorded in the shallow fractured bedrock at elevations of 74.5 m to 75.8 m (EXP geotechnical investigations in 2006) and 75.56 m to 75.50 m in 2022 (Englobe investigation in 2022).

Foundation Alternatives

It is understood that plans call for the redevelopment of the site with up to six (6) forty-storey residential towers, each with up to three levels of underground parking. Based on this information, the lowest floor slab in the parking garages of the proposed structures will likely be set at a depth of 9 to 10 m below the existing grades and will be likely founded in the limestone bedrock.

Based on the above information, it is considered that the most appropriate foundation for the proposed residential towers with three levels of underground parking is spread and strip footings designed to bear on the sound bedrock free of soil filled seams and below any fractured and weathered zones.

Spread and strip footings founded on the competent sound limestone bedrock, free of soil filled seams and below the weathered and fractured zones may be designed for a factored geotechnical resistance at Ultimate Limit State (ULS) of 2000 to 4000 kPa, depending on the amount of inspection and testing completed during construction and pending results of the detailed geotechnical investigation. The factored ULS value includes a resistance factor of 0.5. The Serviceability Limit State (SLS) bearing pressure of the bedrock required to produce 25 mm settlement of the structure will be much larger than the recommended value for factored geotechnical resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design.

Seismic Class

A seismic site response **Class A or B** may be available for structures founded 9 to 10 m in the limestone bedrock in accordance with Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC), as amended May 2, 2019. However, this would require confirmation by the completion of a Multi-Level Analysis of Surface Waves (MASW) at the site.

Grade Raise Restriction

Based on topography of the site and the fact that it is located in a well develop area, it is anticipated that minimal grade raise will be required as part of the proposed re-development. However, as the site is underlain by shallow granular material overburden over bedrock, there is no grade restriction for the site.

Lateral Earth Pressure

If the space between the subsurface walls and the rock face is to be backfilled, the subsurface walls will be subjected to lateral static earth pressure as well as lateral dynamic earth pressure during a seismic event. The lateral static earth pressure that the subsurface walls would be subjected will have to be provided as part of the detailed geotechnical investigation.

Floor Slabs

The lowest level floor slabs in the underground parking garage may be designed as a slab-on-grade with perimeter and underfloor drainage systems. The floor slab should be set on a bed of well packed 19 mm clear stone at least 200 mm thick placed on an engineered fill pad at least 300 mm thick placed on the sound limestone bedrock.

Excavation

Excavation of the overburden soils may be undertaken using large heavy mechanical equipment capable of removing debris within the fill as well as cobbles and boulders within the fill and glacial till. They must be undertaken in accordance with the Occupational Health and Safety Act (OHSA), Ontario Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils on site are considered to be Type 3 and as such must be cut back at 1H:1V from the bottom of the excavation.

Excavations within the bedrock may be undertaken with near vertical sides subject to review by a geotechnical engineer. The rock face may require support in the form of rock bolts to maintain the integrity of the rock face. In the upper weathered/fractured zones of the bedrock, rock bolts in combination with wire mesh system and/or shotcrete may be required. This will be best established on-site during excavation. Excavation of bedrock will require line drilling and blasting techniques and should be undertaken by a specialized contractor. Pre-condition survey of surrounding buildings and infrastructure (such as roadways, sidewalks and underground services) should be undertaken at the site prior to start of construction as well as conducting vibration monitoring during blasting and rock excavation and construction operations.

Seepage of the surface and subsurface water into the excavations is anticipated. It should be possible to collect water entering the excavations at low points and to remove it by conventional pumping techniques. In areas of high infiltration and below the groundwater level, a higher seepage rate should be anticipated and may require high-capacity pumps to keep the excavation dry. Refer to the desktop hydrogeological study for additional information regarding dewatering and effect of construction on neighboring properties

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Backfill and Use of Re-use of Existing Material

It is anticipated that all the fill required for construction will have to be imported to the site and conform to the Ontario Provincial Standard Specification (OPSS) requirements for Granular A, B Type II and Select Subgrade Material (SSM). Some granular fill currently on site will be able to be used as backfill. Crushing of the excavated bedrock can be implemented for use as granular fill.

General Comments and Closure

This report is based on available and outdated data and is designed to provide very general information of the geotechnical condition and consideration for the proposed developments and shouldn't be used for design or bidding purposes. A more detailed investigation by drilling of exploratory boreholes will have to be completed once access to the site is granted to EXP.

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Should you have any questions about this proposal, please do not hesitate to contact this office.

Sincerely,

EXP Services Inc.



Ismail Taki, M. Eng., P.Eng.
 Senior Manager – Geotechnical Services
 Earth & Environment

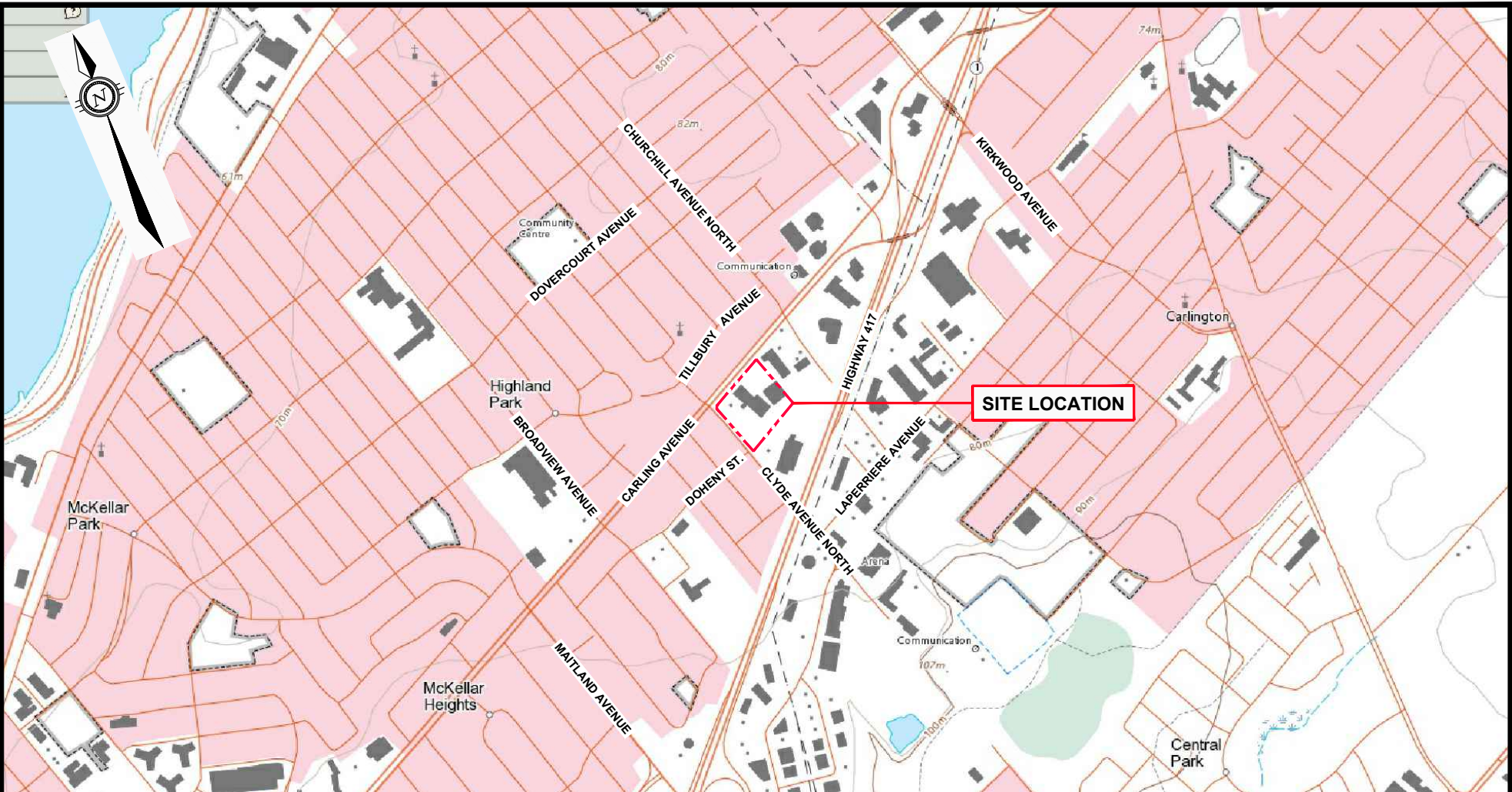



Chris T. Kimmerly, M.Sc., P.Geo.
 Manager – Environmental Services
 Earth & Environment

*Desktop Geotechnical Study. Proposed Residential Development
1640-1660 Carling Avenue, Ottawa, Ontario
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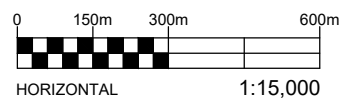
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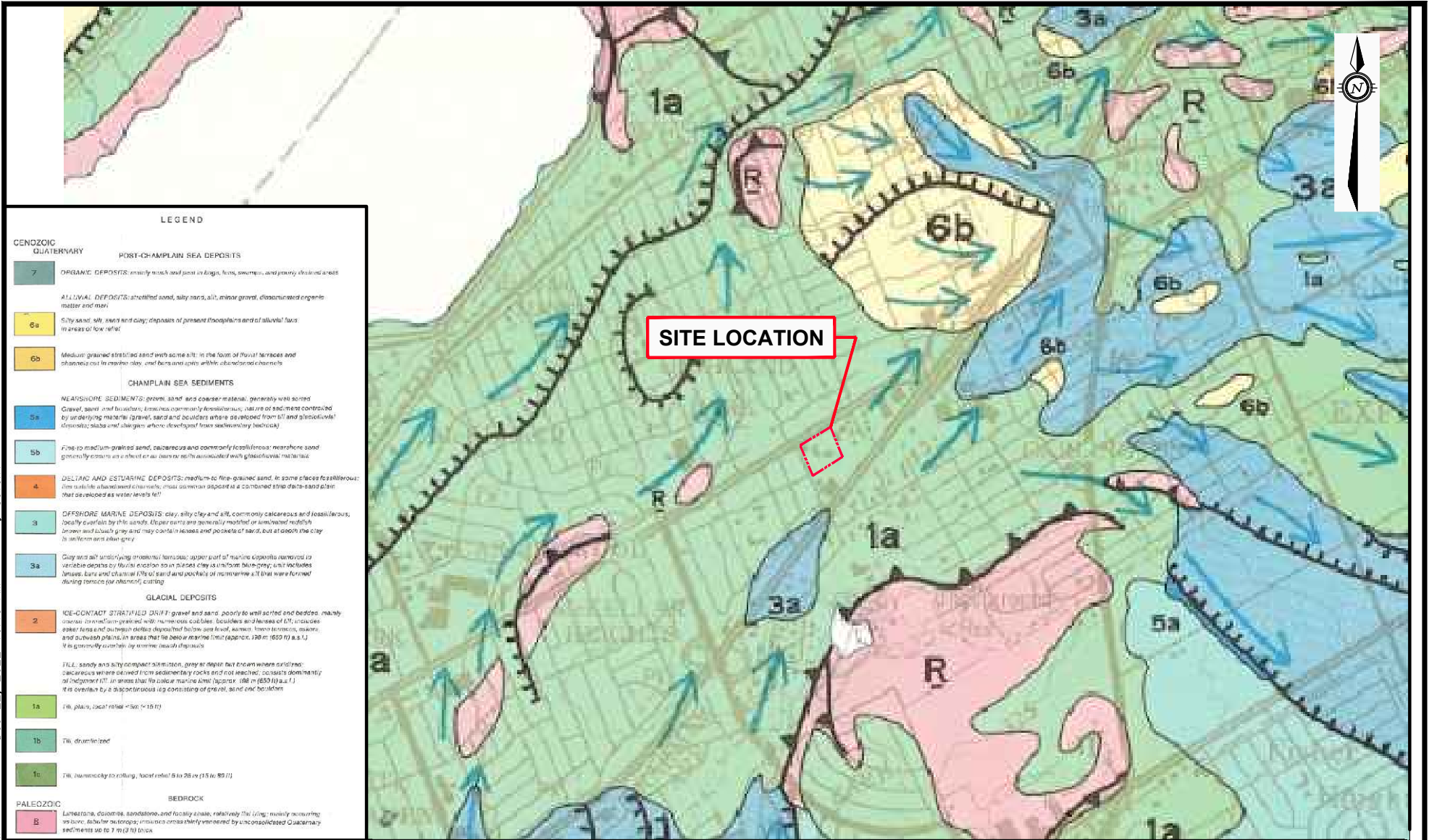
LEGEND

 PROPERTY BOUNDARY



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DATE DECEMBER 2022		PROJECT: GEOTECHNICAL DESKTOP STUDY PROPOSED HIGHRISE DEVELOPMENT, 1660-1640 CARLING AVENUE, OTTAWA, ON		project no. OTT-22015769-A0
DESIGN DA / LW	CHECKED CK / IT	TITLE: SITE LOCATION PLAN		scale 1:15,000
DRAWN BY AS				FIG 1



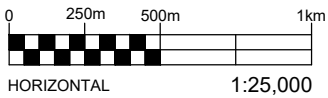
LEGEND

- CENOZOIC**
- QUATERNARY**
- POST-CHAMPLAIN SEA DEPOSITS**
- 7** ORGANIC DEPOSITS: mainly peat and peat in logs, bogs, swamps, and peaty stream beds
 - ALLUVIAL DEPOSITS:** stratified sand, silty sands, silt, minor gravel, disarticulated organic matter and man
 - 6a** Silty sand, silt, sand and clay; deposits of present floodplains and of alluvial fans in areas of low relief
 - 6b** Medium-grained stratified sand with some silt. In the form of fluvial terraces and channels cut in eroded clay, and fans and spurs with block and channels
- CHAMPLAIN SEA SEDIMENTS**
- 5a** NEARSHORE SEDIMENTS: green, sand and coarse material, generally well sorted. Gravel, silt, and fossils; facies commonly fossiliferous; nature of sediments controlled by underlying materials (gravel, sand and boulders where developed from till and glacioluvial deposits; silts and shales where developed from sedimentary basins)
 - 5b** Fine to medium-grained sand, calcareous and commonly fossiliferous; nearshore sand generally occurs as a sheet or as coarse silt accumulated with glacioluvial materials
 - 4** DELTAIC AND ESTUARINE DEPOSITS: medium to fine-grained sand. In some places fossiliferous; fine silt, silty sand and clay; may contain pebbles or a combined strip sand and silt that developed as water levels fell
 - 3** OFFSHORE MARINE DEPOSITS: clay, silty clay and silt, commonly calcareous and fossiliferous, locally overlain by thin sands. Upper parts are generally mottled or laminated reddish brown and bluish gray and may contain lenses and pockets of sand, but at depth the clay is uniform and bluish gray
 - 3a** Clay and silt underlying drowned terraces; upper part of marine deposits removed to variable depths by fluvial erosion so in places clay is uniform blue-gray; unit includes lenses, bars and channels filled with sand and pockets of nonmarine silt that were formed during terraces (see also unit 2)
- GLACIAL DEPOSITS**
- 2** ICE-CONTACT STRATIFIED DRIFT: gravel and sand, poorly to well sorted and bedded, mainly coarse to medium-grained with numerous cobbles, boulders and lenses of till; includes gravel bars and outwash belts deposited below sea level, success from erosion, waves, and outwash plains. In areas that lie below marine limit (approx. 100 m (650 ft) a.s.l.) it is generally overlain by some local deposits
 - TILL:** sandy and silty compact siltstone, grey to deep red brown where oxidized; calcareous where derived from sedimentary rocks and not leached; consists dominantly of independent till. In areas that lie below marine limit (approx. 100 m (650 ft) a.s.l.) it is overlain by a discontinuous cap consisting of gravel, sand and silt
 - 1a** Till, plain, local relief < 5m (15 ft)
 - 1b** Till, drumlinized
 - 1c** Till, hummocky to rolling, local relief 5 to 25 m (15 to 80 ft)
- PALEOZOIC**
- BEDROCK**
- B** Limestone, dolomite, sandstone, and fossiliferous, relatively thin; mainly occurring in bore, regular outcrops; usually crosshatched; covered by uncompacted Quaternary sediments up to 1 m (3 ft) thick



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DATE DECEMBER 2022		PROJECT: GEOTECHNICAL DESKTOP STUDY PROPOSED HIGHRISE DEVELOPMENT, 1660-1640 CARLING AVENUE, OTTAWA, ON		project no. OTT-22015769-A0
DESIGN DA / LW	CHECKED CK / IT	DRAWN BY AS		scale 1:25,000
TITLE: SURFICIAL GEOLOGY				FIG 2



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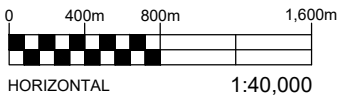
- Q No information is available on the rock formations underlying these Quaternary deposits
- ORDOVICIAN**
- 19 QUEENSTON FORMATION: red shale
- 18 CARLSBAD FORMATION: grey shale, sandy shale, some dolomitic layers
- 17 BILLINGS FORMATION: black shale with some brown shale
- 16 EASTVIEW FORMATION: dark grey almost black limestone
- 15 OTTAWA FORMATION: limestone with some shaly partings; some sandstone in basal part
- 14 ST. MARTIN FORMATION: shale, sandstone, impure limestone, dolomite
- 13 ROCKCLIFFE FORMATION: shale with lenses of sandstone
- 12 OXFORD FORMATION: dolomite and limestone
- 11 MARCH FORMATION: interbedded sandstone and sandy dolomite
- ORDOVICIAN OR CAMBRIAN**
- 10 NEPEAN FORMATION: sandstone
- PRECAMBRIAN**
- 9 Granite, quartz, monzonite, granodiorite, tonalite, massive and foliated; also associated migmatite
- 8 Syenite, monzonite, massive and foliated
- 7 Pegmatite, white pegmatite associated with marble
- 6 Diorite, gabbro, anorthositic, melagabbro
- 5 Marble, lime silicate rocks, interbedded amphibolite, skarn
- 4 Amphibolite, greenstone, associated migmatite, in places garnetiferous (includes probable mafic metavolcanics)



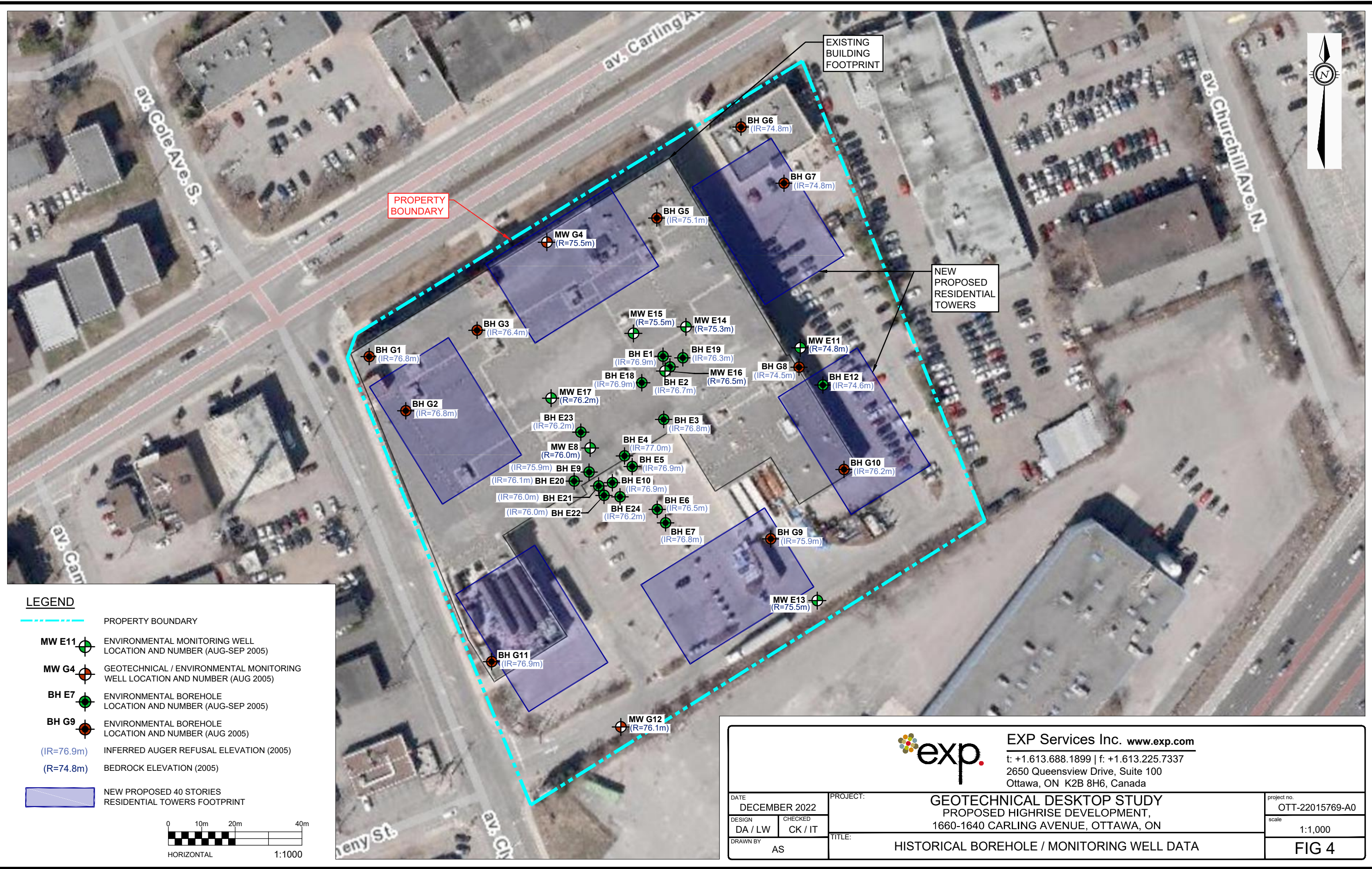
SITE LOCATION



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DATE DECEMBER 2022	PROJECT: GEOTECHNICAL DESKTOP STUDY PROPOSED HIGHRISE DEVELOPMENT, 1660-1640 CARLING AVENUE, OTTAWA, ON	project no. OTT-22015769-A0
DESIGN DA / LW	CHECKED CK / IT	scale 1:40,000
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		FIG 3



LEGEND

- PROPERTY BOUNDARY
- ENVIRONMENTAL MONITORING WELL LOCATION AND NUMBER (AUG-SEP 2005)
- GEOTECHNICAL / ENVIRONMENTAL MONITORING WELL LOCATION AND NUMBER (AUG 2005)
- ENVIRONMENTAL BOREHOLE LOCATION AND NUMBER (AUG-SEP 2005)
- ENVIRONMENTAL BOREHOLE LOCATION AND NUMBER (AUG 2005)
- (IR=76.9m) INFERRED AUGER REFUSAL ELEVATION (2005)
- (R=74.8m) BEDROCK ELEVATION (2005)
- NEW PROPOSED 40 STORIES RESIDENTIAL TOWERS FOOTPRINT

HORIZONTAL 1:1000

		EXP Services Inc. www.exp.com t: +1.613.688.1899 f: +1.613.225.7337 2650 Queensview Drive, Suite 100 Ottawa, ON K2B 8H6, Canada	
DATE	DECEMBER 2022	PROJECT:	GEOTECHNICAL DESKTOP STUDY PROPOSED HIGHRISE DEVELOPMENT, 1660-1640 CARLING AVENUE, OTTAWA, ON
DESIGN	CHECKED	TITLE: HISTORICAL BOREHOLE / MONITORING WELL DATA	
DA / LW	CK / IT		
DRAWN BY	AS	project no. OTT-22015769-A0 scale 1:1,000	

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