TATHAM ENGINEERING

Enhancing our communities

Barrie YMCA, 535 Bayview Drive

HYDROGEOLOGICAL ASSESSMENT

YMCA Simcoe/Muskoka

File 423449 | January 19, 2024

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Issue	Date	Description
1	January 19, 2024	First Submission

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1 Introduction

Tatham Engineering Limited (Tatham) has been retained by YMCA of Simcoe/Muskoka (the client), to complete a Hydrogeological Assessment for the property located at 535 Bayview Drive, in Barrie, Ontario as shown on Figure 1.

The site is irregular in shape with a plan area of approximately 9.8 acres (4.0 ha). The area to be developed is situated in the northeast corner of the existing parking lot of Sadlon Arena. The Site is located in a primarily commercial area and is bounded by Bayview Drive to the west followed by Park Place (an open-air shopping center), Paul Sadlon Arena to the south, followed by Mapleview Drive, a dog park and stormwater management pond to the east, and industrial and commercial properties to the north.

It is understood the proposed development includes a multi-story community centre housing a fitness/rehabilitation centre, pool, community outreach services, youth transitional housing, licensed childcare facilities, and associated parking. The site will be accessed from Bayview Drive. The proposed development will be municipally serviced for water and sewage.

A geotechnical investigation was carried out by GEMTEC Consulting Engineers and Scientists (GEMTEC) and is reported under a separate cover.

1.1 PURPOSE AND SCOPE OF WORK

The main objectives of this Hydrogeological Assessment were to:

- Establish local and regional geology and hydrogeology.
- Determine potential construction dewatering requirements and provide an assessment of anticipated construction dewatering flow rates for a generic construction scenario.
- Assess groundwater quality and compare the results to the Provincial Water Quality Objectives (PWQO) and Ontario Regulation 153/04, as amended (O.Reg. 153/04).
- Qualitatively assess the potential impacts to the nearby structures, water bodies and water uses, if any, and comment on future regulatory agency involvement.

To achieve the above objectives, Tatham proposed the following scope of work:

- Complete a desktop review of pertinent geological and hydrogeological resources, Ministry of the Environment, Conservation and Parks (MECP) water well records, previous geotechnical reports completed by others, and proposed site plan drawings.
- Visit the site to note existing site conditions, topography, drainage, water features, neighboring land uses, and/or existing water supply or monitoring wells.

- Complete groundwater level monitoring of all accessible and functional wells installed on-site during the 2023 geotechnical investigation completed by GEMTEC.
- Perform borehole permeability testing at up to three monitoring wells to determine hydraulic conductivity of the screened soil deposits.
- Determine baseline groundwater quality by collecting and analyzing groundwater from select monitoring wells.
- Complete 4 months of continuous groundwater level monitoring between March to June to establish seasonal high groundwater levels (to be reported separately).
- Evaluate the background information, field, and laboratory data to evaluate the construction dewatering requirements and pre to post development water balance.
- Assess the feasibility of implementing Low Impact Development Features on-site.
- Prepare a Hydrogeological Assessment report.

1.2 WATER TAKING – TEMPORARY

Temporary construction dewatering is governed by the Environmental Protection Act, and the following water taking limits and requirements are outlined in O.Reg. 63/16:

- Construction dewatering less than 50,000 L/day: the taking of both groundwater and stormwater does not require a hydrogeological report nor a water taking permit.
- Construction dewatering greater than 50,000 L/day but less than 400,000 L/day: the taking of both groundwater and stormwater does require a hydrogeological report and registration on the Environmental Activity and Sector Registry (EASR).
- Construction dewatering greater than 400,000 L/day: the taking of groundwater and stormwater requires a hydrogeological report and an approved MECP Category 3 Permit-To-Take-Water (PTTW).

This hydrogeological assessment was carried out to assess the potential construction dewatering volumes in order to proceed in accordance with the applicable water taking regulatory requirements and to obtain the applicable water taking permit.

2 Site Setting

The site is irregular in shape with a plan area of approximately 9.8 acres (4.0 ha). The area to be developed is situated in the northeast corner of the existing parking lot of Sadlon Arena. The Site is located in a primarily commercial area and is bounded by Bayview Drive to the west followed by Park Place (an open-air shopping center), Paul Sadlon Arena to the south, followed by Mapleview Drive, a dog park and stormwater management pond to the east, and industrial and commercial properties to the north. A site location plan is enclosed as Figure 1.

We understand the proposed development includes a multi-story community centre housing a fitness/rehabilitation centre, pool, community outreach services, youth transitional housing, licensed childcare facilities, and associated parking. The site will be accessed from Bayview Drive. The proposed development will be municipally serviced for water and sewage.

2.1 PHYSIOGRAPHY, SURFICIAL AND BEDROCK GEOLOGY

The Site lies within the physiographic region known as the Peterborough Drumlin Field comprising of drumlinized till plains. Ontario Geological Survey (OGS) surficial and quaternary geology mapping indicates the Site consists of glaciofluvial deposits comprising sand and gravel with variable silt and clay contents. Based on the borehole drilling program carried out by GEMTEC concurrently, the on-site soils are consistent with the OGS geology mapping, indicating sand soils with variable contents of gravel, silt and clay. The details of the borehole drilling program are summarized in Section 4 and additional details are provided in the separate geotechnical report by GEMTEC, 2023.

Bedrock at the Site consists of limestone of the Lindsay Formation and Simcoe Group. Bedrock was not encountered during the 2023 geotechnical investigation at termination depths of 6.7 m below ground surface (bgs). Based on the Ontario Division of Mines Drift Thickness Series for the Barrie Area bedrock is anticipated at depths greater than 150 m.

2.2 TOPOGRAPHY AND DRAINAGE

The nearest water bodies are two tributaries of Lovers Creek, located approximately 525 m north and 80 m south of the Site. Further a stormwater management block comprising three stormwater management ponds is located to the east, immediately adjacent to the Site. Surface runoff is anticipated to flow to the east towards the existing stormwater management block, and the inferred groundwater flow is anticipated to be to the north/northeast towards Lake Simcoe/Kempenfelt Bay.

2.3 MECP WELL RECORDS

To assess the nature of the groundwater resources as well as the history of the well usage in the area, MECP water well records within a 500 m radius surrounding the Site were reviewed. The approximate MECP water well locations are shown on Figure 2, and a summary of the MECP water well records are provided in Appendix A.

A total of 20 MECP well records were identified within the reviewed area. Of the 20 MECP well records, four records were listed as monitoring wells, three were abandoned, one is listed for domestic and livestock use, and the remaining wells did not list usage.

Stratigraphy within the vicinity of the Site was generally described as sand with variable gravel and silt contents. Bedrock was not encountered in the reviewed MECP well records.

2.4 SOURCE WATER PROTECTION MAPPING

The Site is located in the Lakes Simcoe and Couchiching/Black River Source Protection Area. The site does not lie within a municipal Well Head Protection Area (WHPA), however, the southern portion of the site lies within an Intake Protection Zone as shown in Figures 3 and 4. The site does not lie within a Highly Vulnerable Aquiver (HVA), however, the northern portion of the site is considered to be a Significant Groundwater Recharge Area (SGRA) as shown in Figures 5 and 6.

2.5 SITE INSPECTION

A visual inspection of the site was conducted on July 14, 2023, to assess the site's drainage, topography, and surface water features.

The site is located north of the Sadlon Arena at 535 Bayview Drive in Barrie. It is currently comprised of a paved parking lot supplying overflow parking to the Sadlon Arena. Some grassy medians are noted throughout the site. The site is relatively flat. Stormwater management ponds are noted directly east of the site and it is anticipated the site's drainage follows local topography towards the existing stormwater facilities.

3 Procedures and Methodology

3.1 BOREHOLE DRILLING AND MONITORING WELL INSTALLATION

A total of five boreholes (BH23-01 to BH23-05) were advanced during the geotechnical investigation (GEMTEC, 2023) to depths of 6.7 m below existing grade. Monitoring wells were installed in three of the borehole locations (BH23-02, 23-03 and 23-05). The borehole/monitoring well locations are presented on Figure 7.

The geotechnical borehole logs are discussed further in Section 4 and are provided in Appendix B.

3.2 BOREHOLE PERMEABILITY TESTING

During the monitoring event, the shallow monitoring wells were found dry; as such, no borehole permeability testing was conducted.

3.3 GROUNDWATER SAMPLING

During the monitoring event, the shallow monitoring wells were found to be dry; as such, no background groundwater samples were collected.

However, as part of an on-going geoenvironmental investigation a deep monitoring well has been installed. It is Tatham's intention to retrieve a groundwater sample for chemical testing to assess background conditions and the results will be provided in a supplemental letter.

3.4 LONG-TERM GROUNDWATER LEVEL MONITORING

A long-term groundwater level monitoring program is to be carried out where groundwater levels will be monitored between March to June in the newly installed monitoring wells on-site to establish the seasonal high groundwater levels (or to confirm the wells are dry).

A supplemental groundwater level letter will be prepared at the end of the long-term groundwater monitoring program, highlighting the seasonal high groundwater levels measured.

4 Subsurface Conditions

The geotechnical investigation (GEMTEC, 2023) was reviewed for this hydrogeological investigation. The borehole and monitoring well locations are shown on Figure 7, and detailed subsurface borehole logs are presented in Appendix B.

4.1 STRATIGRAPHY

Based on the borehole drilling program carried out concurrently by GEMTEC, the on-site soils are consistent with the OGS geology mapping, indicating sand with variable contents of gravel, silt and clay. In general, the site consists of asphalt, underlain by sand/silty sand/gravelly sand fill over sand with trace of silt and gravel.

4.2 GROUNDWATER

Unstabilized groundwater level measurements and cave measurements were taken upon borehole drilling completion of each borehole by GEMTEC These measurements provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations that may arise. As noted on the borehole logs no water and/or cave were measured upon completion of the boreholes.

Monitoring wells were installed in three of the five boreholes during the geotechnical investigation and one of the three boreholes during the concurrent environmental investigation to facilitate measurement of stabilized groundwater level across the site. The monitoring wells were installed with 50-mm PVC riser pipe and a slotted 1.5 m or 3.0 m-long screen. The monitoring well installation details and stabilized groundwater level measurements are summarized in Table 1 below.

Table 1: Monitoring Well Installation Details and Stabilized Groundwater Levels

MONITORING WELL ID	GROUND SURFACE (m asl)	LOCATION OF SCREEN		STRATA SCREENED	GROUNDWATER DEPTH (m)/ELEVATION (m asl)	
		DEPTH (m)	ELEVATION (m asl)		AUGUST 10, 2023	JANUARY 12, 2024
BH/MW23-02	285.70	4.6 – 6.1	279.6 – 281.1	Sand	Dry	Dry
BH/MW23-03	285.40	4.6 – 6.1	279.3 – 280.8	Sand	Dry	Dry

MONITORING WELL ID	GROUND SURFACE (m asl)	LOCATION OF SCREEN		STRATA SCREENED	GROUNDWATER DEPTH (m)/ELEVATION (m asl)	
		DEPTH (m)	ELEVATION (m asl)		AUGUST 10, 2023	JANUARY 12, 2024
BH/MW23-05	284.30	4.6 – 6.1	278.2 – 279.7	Sand	Dry	Dry

5 Discussion and Analysis

Groundwater was not encountered in the three monitoring wells installed as part of the geotechnical investigation completed by others and in all boreholes advanced. This indicates that groundwater levels are below the borehole depth of exploration of 6.0 m below existing grade. As such, borehole permeability, baseline groundwater chemistry, and stabilized groundwater levels could not be measured. A deep groundwater well was installed by Tatham in January 2024 to a depth of 19.5 m. A background water quality sample will be collected from this location and the results will be provided in a supplemental letter.

It is understood preliminary site plans indicate excavation depths for the proposed YMCA building will be up to 3.6 m below existing grade.

Based on the measured groundwater levels and preliminary building design, it is not anticipated significant dewatering efforts would be required.

Localized sump pumping may be required during these works to ensure stable excavation slopes and dry working conditions. However, based on the above it is anticipated dewatering rates be negligible and will remain below the 50,000 L/day threshold and a PTTW and/ EASR with the MECP will likely not be required.

5.1 WATER BALANCE

An evaluation of the anticipated changes in the water balance between pre-development and post-development conditions has been included to quantify the expected changes to the water balance across the site.

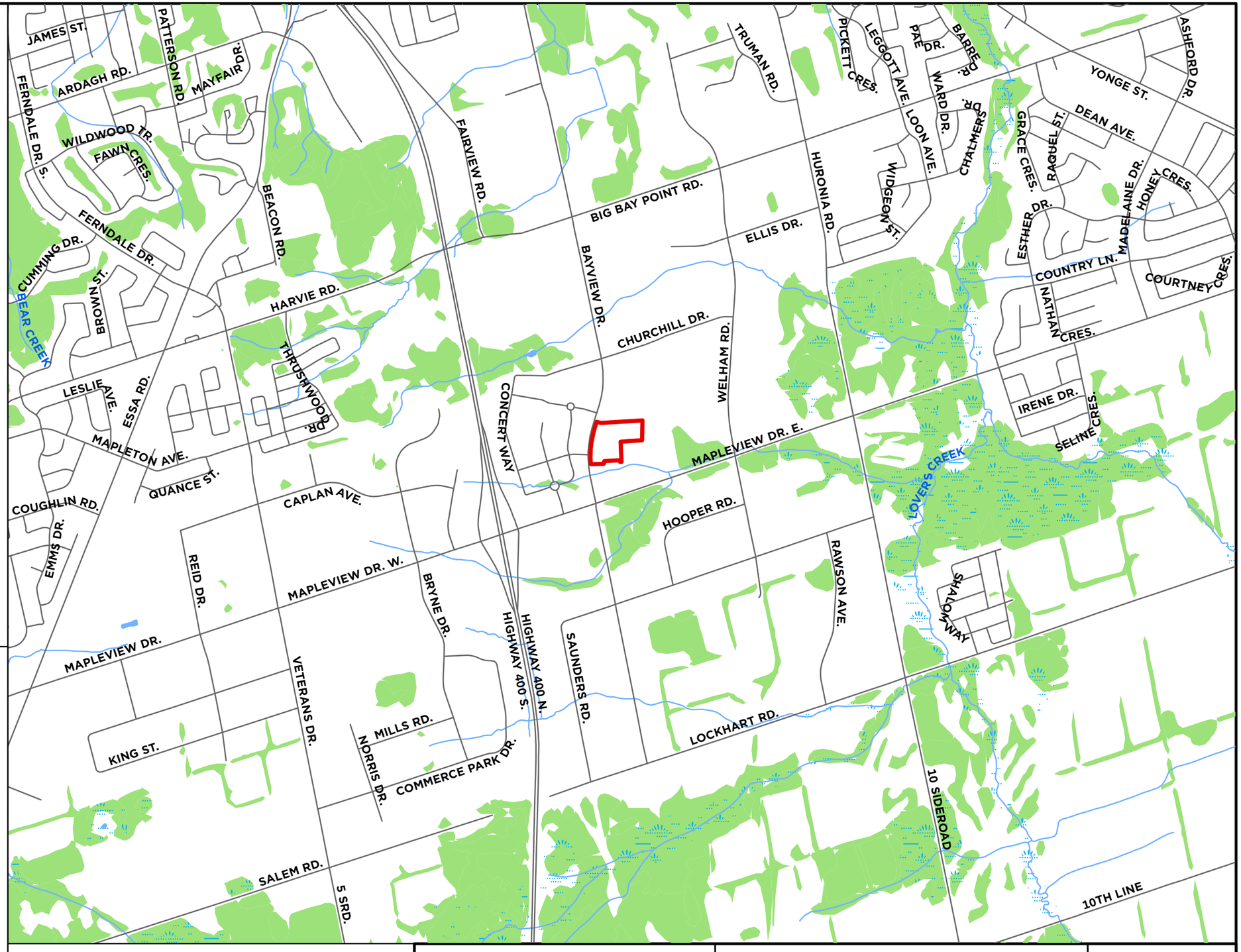
Using historical precipitation data from the Barrie WPCC weather station (1981 – 2010), the pre-development water balance model shows a total of 0 m^3 of annual infiltration volume provided over the site area (4.0 ha) since the site is already developed as a paved parking lot. The proposed land-use for the development will include a community building and associated parking resulting in an imperviousness of near 100%. The post-development water balance assessment shows the infiltration on the site will remain unchanged. However, the implementation of green space in the proposed concept plan will ultimately increase the pervious areas at the site and encourage infiltration.

Water balance calculations are included in Appendix C for reference.

6 References

Chapman, L.J. and Putnam, D.F. 2007. The Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 228.

GEMTEC, 2023. Preliminary Geotechnical Investigation Proposed YMCA 555 Bayview drive Barrie, Ontario, GEMTEC project: 100876.050



NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- ROAD
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA

0 0.25 0.5 1 1.5 KILOMETERS

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BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
SITE LOCATION PLAN

DWG. No. **FIG-1**

SCALE: 1:20,000	DRAWN: CW	DATE: JAN. 2024	JOB NO. 423449

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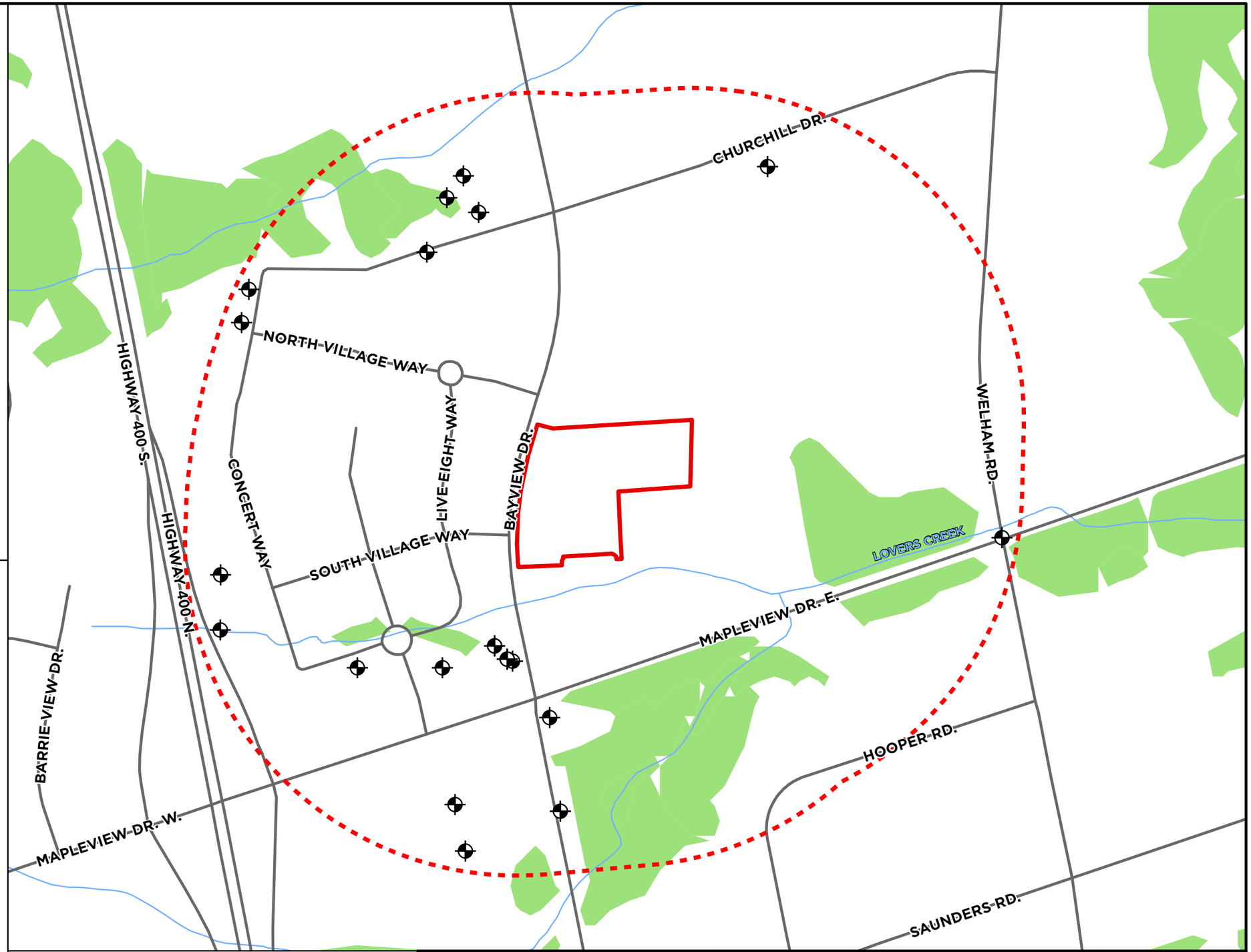
NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- STUDY AREA (500 M)
- MECP WATER WELLS
- WATERCOURSE
- WOODED AREA



0 125 250 500 METERS

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BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
MECP WELL LOCATIONS

DWG. No. **FIG-2**

SCALE: 1:6,000	DRAWN: CW	DATE: JAN. 2024	JOB NO. 423449

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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- WELLHEAD PROTECTION AREA (LSRCA 2022)
- ZONE
  - A
  - B
  - C
  - C1
  - D
- ROAD
- WATERCOURSE
- WOODED AREA

0 100 200 400 METERS

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BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
WELLHEAD PROTECTION AREA

DWG. No. **FIG-3**

SCALE: 1:5,000	DRAWN: AO	DATE: JAN. 2024	JOB NO. 423449

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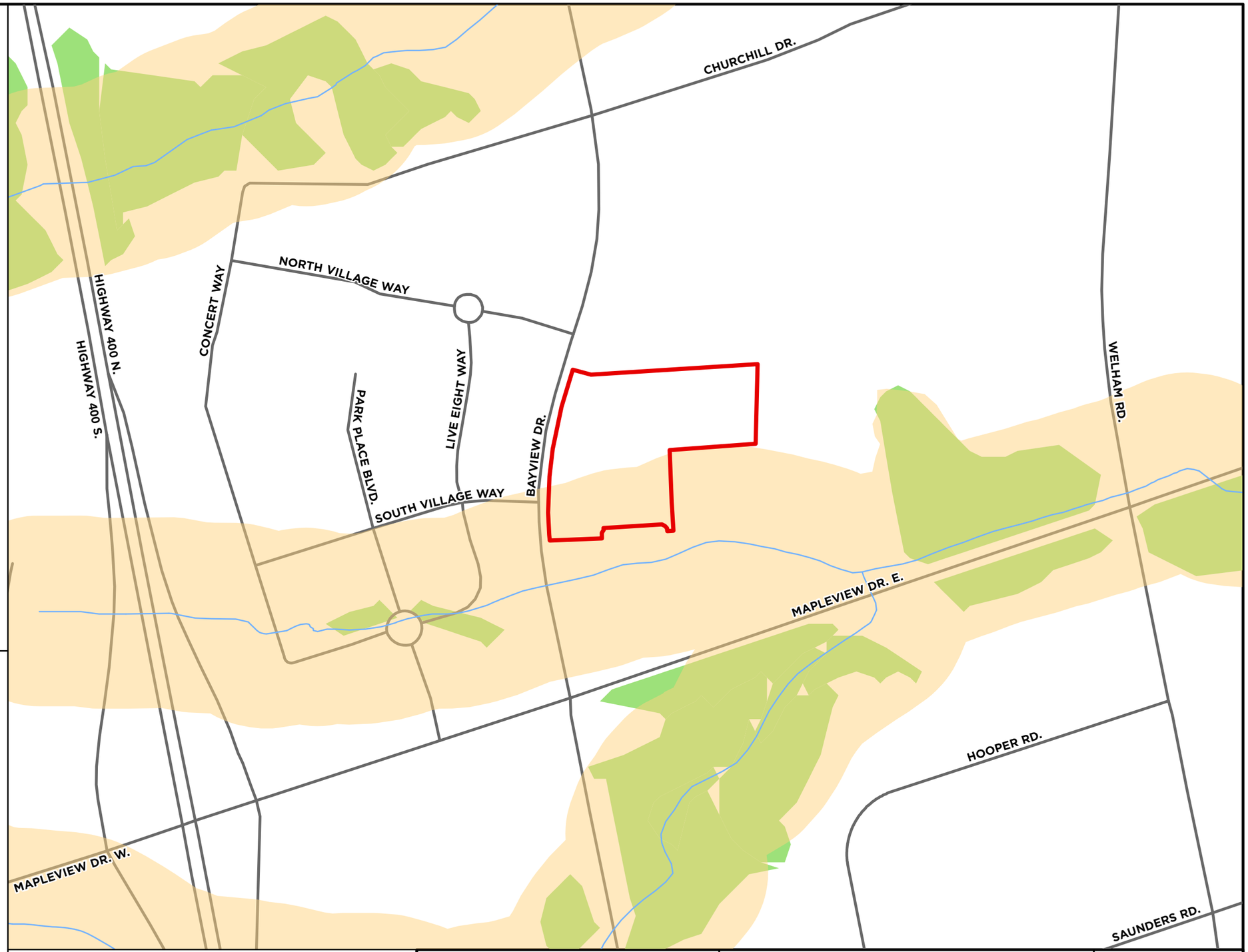
NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- INTAKE PROTECTION ZONES (LSRCA 2022)
  - 1
  - 2
  - 3
- ROAD
- WATERCOURSE
- WOODED AREA



0 100 200 400 METERS

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BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
INTAKE PROTECTION ZONE

DWG. No. **FIG-4**

SCALE: 1:5,000	DRAWN: AO	DATE: JAN. 2024	JOB NO. 423449

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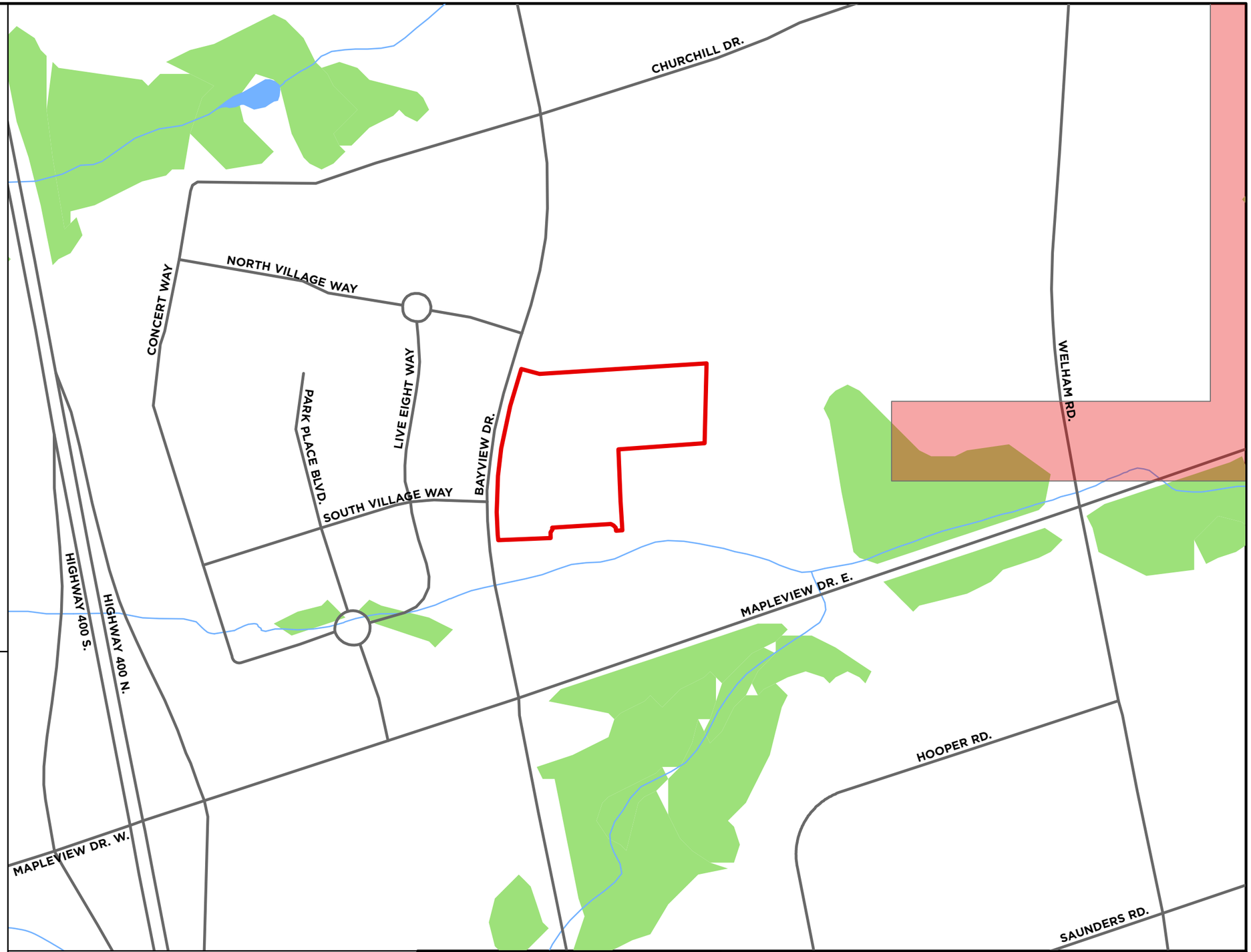
NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- HIGHLY VULNERABLE AQUIFER
- ROAD
- WATERCOURSE
- WOODED AREA



0 0.07 0.15 0.3 KILOMETERS

TATHAM ENGINEERING

BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
HIGHLY VULNERABLE AQUIFER

DWG. No. **FIG-5**

SCALE: 1:5,000	DRAWN: AO	DATE: JAN. 2024	JOB NO. 423449

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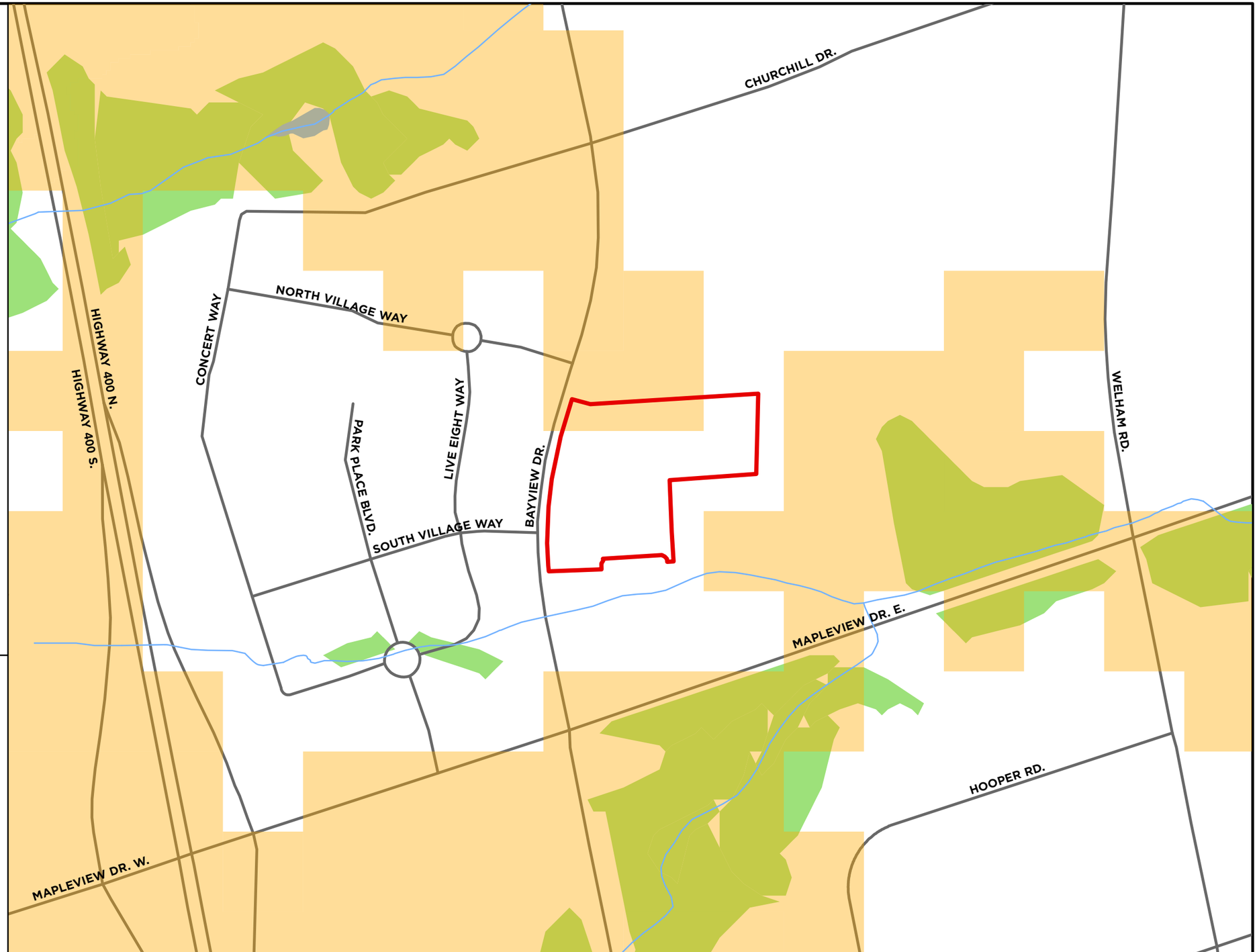
NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- SIGNIFICANT GROUNDWATER RECHARGE AREA
- ROAD
- WATERCOURSE
- WOODED AREA



0 0.07 0.15 0.3
KILOMETERS

TATHAM ENGINEERING

BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
SIGNIFICANT GROUNDWATER RECHARGE AREA

DWG. No. **FIG-6**

SCALE: 1:5,000	DRAWN: AO	DATE: JAN. 2024	JOB NO. 423449

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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- BOREHOLES (GEMTEC, 2023)
- MONITORING WELLS (GEMTEC, 2023)

0 25 50 75 METERS

TATHAM ENGINEERING

BARRIE YMCA, 535 BAYVIEW DRIVE
HYDROGEOLOGICAL ASSESSMENT
BOREHOLE LOCATION PLAN

DWG. No. **FIG-7**

SCALE: 1:1,000 | DRAWN: CW | DATE: JAN. 2024 | JOB NO. 423449

I:\2023 Projects\423449 - YMCA 555 Bayview Drive - Barrie\GIS\423449 - YMCA 555 Bayview Drive- jan2024\423449 - YMCA 555 Bayview Drive- jan2024.aprx

Appendix A:
MECP Water Well Records

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Ministry of the Environment, Conservation and Parks
Water Well Records

Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
BARRIE CITY (INNISFI	17 605290 4910186 W	2012/01 7201	2 2			MO	0058 10 0010 10	7176561 (Z141587) A125060	YLLW SAND GRVL PCKD 0068
BARRIE CITY (INNISFI	17 605271 4910206 W	1553						7201928 (Z162488) A125060	SILT SAND 0001 0068
BARRIE CITY (INNISFI	17 605290 4910186 W	1553						7220935 (Z162489) A	
BARRIE CITY (INNISFI	17 605199 4910881 W	2017/11 7383				NU		7301794 (Z275226) A	
BARRIE CITY (INNISFI	17 605247 4910859 W	2017/11 7383				NU		7301792 (Z275227) A	
BARRIE CITY (INNISFI	17 605682 4910928 W	2017/11 7626	2			MO	0043 10	7308533 (Z269538) A235184	BRWN FILL 0003 BRWN SAND WBRG 0053
BARRIE CITY (INNISFI	17 605169 4910799 W	2016/10 6032	1.79			MO	0040 10	7287448 (Z194338) A201440	BRWN SAND LOOS 0020 BRWN SAND DNSE 0050
BARRIE CITY (INNISFI	17 605186 4910283 W	2022/01 7644						7412172 (Z381028) A340430 P	
BARRIE CITY (INNISFI	17 605172 4910339 W	2022/01 7644						7412173 (Z381027) A340492 P	

Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
BARRIE CITY (INNISFI	17 605127 4910340 W	2022/01 7644						7412175 (Z381031) A340428 P	
BARRIE CITY (INNISFI	17 605129 4910324 W	2022/01 7644						7412176 (Z381029) A340491 P	
BARRIE CITY (INNISFI	17 605126 4910374 W	2022/01 7644						7412177 (Z371032) A340429 P	
BARRIE CITY (INNISFI	17 605095 4910419 W	2022/01 7644						7412178 (Z381033) A340497 P	
BARRIE CITY (INNISFI	17 605141 4910431 W	2022/01 7644						7412179 (Z381034) A340425 P	
BARRIE CITY (INNISFI	17 605163 4910391 W	2022/01 7644						7412180 (Z381035) A322057 P	
BARRIE CITY (INNISFI	17 605129 4910324 W	2022/01 7644						7412174 (Z381030) A340496 P	
BARRIE CITY (INNISFI CON 12 008	17 605271 4910206 W	2012/01 7201	2			MO	0010 10	7176562 (Z141586) A125060	YLLW SAND GRVL PCKD 0020

Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
BARRIE CITY (INNISFI CON 12 008	17 605192 4910173 W	1962/02 1614	4	FR 0125	68/100/12/1:30	ST DO	0120 5	5701449 ()	LOAM 0006 MSND GRVL 0076 MSND MUCK CLAY 0105 YLLW CLAY 0107 FSND 0120 MSND 0125
INNISFIL TOWNSHIP CON 11 008	17 605354 4910098 W	2004/07 6607	1.97	57		NU	0055 10	5739061 (Z17047) A015768	BRWN SAND DNSE 0065
INNISFIL TOWNSHIP CON 12 008	17 605298 4910183 W	2000/12 2801						5735779 (225709) A	

UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completed and Well Contractor Licence Number
CASING DIA: Casing diameter in inches
WATER: Unit of Depth in Feet. See Table 4 for meanign of code.
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hr : Min
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag. A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

Table 1: Core Material and Descriptive Terms

BLDR BOULDERS	FCRD FRACTURED	IRFM IRON FORMATION	PORS POROUS	SOFT SOFT
BSLT BASALT	FGRD FINE-GRAINED	LIMY LIMY	PRDG PREVIOUSLY DUG	SPST SOAPSTONE
CGRD COARSE-GRAINED	FGVL FINE GRAVEL	LMSN LIMESTONE	PRDR PREV. DRILLED	STKY STICKY
CGVL COARSE GRAVEL	FILL FILL	LOAM TOPSOIL	QRTZ QUARTZITE	STNS STONES
CHRT CHERT	FLDS FELDSPAR	LOOS LOOSE	QSND QUICKSAND	STNY STONEY
CLAY CLAY	FLNT FLINT	LTCL LIGHT-COLOURED	QTZ QUARTZ	THIK THICK
CLN CLEAN	FOSS FOSILIFEROUS	LYRD LAYERED	ROCK ROCK	THIN THIN
CLYY CLAYEY	FSND FINE SAND	MARL MARL	SAND SAND	TILL TILL
CMTD CEMENTED	GNIS GNEISS	MGRD MEDIUM-GRAINED	SHLE SHALE	UNKN UNKNOWN TYPE
CONG CONGLOMERATE	GRNT GRANITE	MGVL MEDIUM GRAVEL	SHLY SHALY	VERY VERY
CRYS CRYSTALLINE	GRSN GREENSTONE	MRBL MARBLE	SHRP SHARP	WBRG WATER-BEARING
CSND COARSE SAND	GRVL GRAVEL	MSND MEDIUM SAND	SHST SCHIST	WDFR WOOD FRAGMENTS
DKCL DARK-COLOURED	GRWK GREYWACKE	MUCK MUCK	SILT SILT	WTHD WEATHERED
DLMT DOLOMITE	GVLY GRAVELLY	OBDN OVERBURDEN	SLTE SLATE	
DNSE DENSE	GYPS GYPSUM	PCKD PACKED	SLTY SILTY	
DRTY DIRTY	HARD HARD	PEAT PEAT	SNDS SANDSTONE	
DRY DRY	HPAN HARDPAN	PGVL PEA GRAVEL	SNDY SANDYOAPSTONE	

Table 2: Core Color

WHIT WHITE
GREY GREY
BLUE BLUE
GREN GREEN
YLLW YELLOW
BRWN BROWN
RED RED
BLCK BLACK
BLGY BLUE-GREY

Table 3: Well Use

DO Domestic	OT Other
ST Livestock	TH Test Hole
IR Irrigation	DE Dewatering
IN Industrial	MO Monitoring
CO Commercial	MT Monitoring TestHole
MN Municipal	
PS Public	
AC Cooling And A/C	
NU Not Used	

Table 4:Water Detail

FR Fresh	GS Gas
SA Salty	IR Iron
SU Sulphur	
MN Mineral	
UK Unknown	

Appendix B:
Borehole Logs

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	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
UC	Unconfined compression test
γ	Unit weight

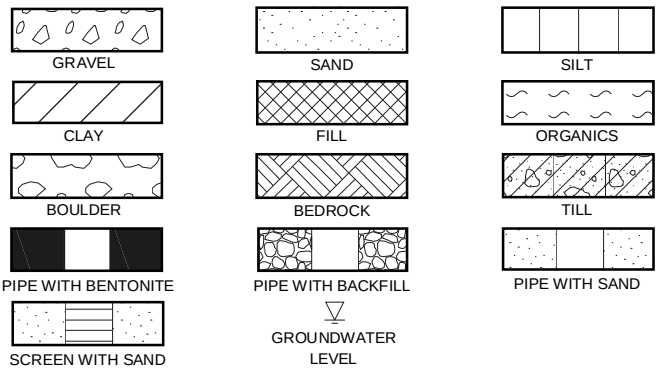
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

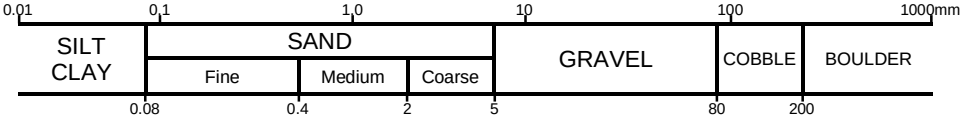
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	Description	Cu, kPa	Description
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE



DESCRIPTIVE TERMINOLOGY

(Based on the CANFEM 4th Edition)

GEMTEC

descriptive terms.pub
Modified May 2018

RECORD OF BOREHOLE BH23-1

CLIENT: Tatham Engineering Limited
PROJECT: Proposed YMCA, 555 Bayview Drive, Barrie, Ontario
JOB#: 100876.050
LOCATION: See Borehole Location plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Aug 2 2023

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger / Hollow Stem Auger (OD)	Ground Surface		284.00						
		ASPHALT		0.06						
		FILL - (SP) SAND, some gavel, trace fines; brown; non-cohesive, moist			1	AS	0	-		
				283.31						
1		FILL - (SM) SILTY SAND, trace gravel, trace plastic fines; brown; non-cohesive, moist, compact		0.69	2	SS	533	14		
				282.55						
		(SP) SAND, trace gravel, trace non-plastic fines; brown to light brown; non-cohesive, moist, loose to very dense		1.45	3	SS	356	6		
2					4	SS	483	9		
3					5	SS	559	30	M	
4					6	SS	610	61		
5					7	SS	610	63		
6					8	SS	559	52		
				277.29						
7		End of Borehole		6.71						
8		Notes: 1. Borehole dry upon completion of drilling. 2. No cave upon the completion of drillng. 3. Borehole backfilled with mixture of bentonite and cuttings.								

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA — NATURAL — REMOULDED
WATER CONTENT, % — W_P — W — W_L
10 20 30 40 50 60 70 80 90

GEMTEC
Consulting Engineers and Scientists

LOGGED: AW
CHECKED: RN

GEO - BOREHOLE LOG 100876.050_GEOTECH_GINT_R0_2023_08_11.GPJ GEMTEC 2018.GDT 9/1/23

RECORD OF BOREHOLE BH23-2

CLIENT: Tatham Engineering Limited
PROJECT: Proposed YMCA, 555 Bayview Drive, Barrie, Ontario
JOB#: 100876.050
LOCATION: See Borehole Location plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Aug 1 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (OD)	Ground Surface		285.70						Flush Mount
		ASPHALT		0.06						
		FILL - (SP) SAND, some gravel to gravelly, trace non-plastic fines; brown; non-cohesive, dry, compact			1	AS	0	-	M	
1		- becoming sand and gravel			2	SS	406	26		
				284.25						
		FILL - (SM-SP) SILTY SAND to SAND, some gravel; brown; non-cohesive, dry, dense		1.45	3	SS	559	35		
2				283.49						Bentonite
		(SP) SAND, trace non-plastic fines; light brown; non-cohesive, very dense, dry		2.21	4	SS	508	60		
3					5	SS	533	50		
4					6	SS	559	61		Filter Sand
5					7	SS	584	55		50 mm dia. well screen
6					8	SS	0	84		
				278.99						
7		End of Borehole		6.71						
8		Notes: 1. Borehole dry upon completion of drilling. 2. Piezometer installed as shown upon the completion of drilling.								

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: NATURAL, REMOULDED
WATER CONTENT, %: W_P, W, W_L
10 20 30 40 50 60 70 80 90

GEO - BOREHOLE LOG 100876.050_GEOTECH_GINT_R0_2023_08_11.GPJ GEMTEC 2018.GDT 9/1/23

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Consulting Engineers and Scientists

LOGGED: AW
CHECKED: RN

RECORD OF BOREHOLE BH23-3

CLIENT: Tatham Engineering Limited
PROJECT: Proposed YMCA, 555 Bayview Drive, Barrie, Ontario
JOB#: 100876.050
LOCATION: See Borehole Location plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Aug 2 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (OD)	Ground Surface		285.40						Flush Mount
		ASPHALT		0.06						
		FILL - (SP) GRAVELLY SAND, trace to some non-plastic fines; brown; non-cohesive, moist, compact			1	AS	0	-		
1					2	SS	610	26		
				283.95						
		(SM) SILTY SAND, some gravel, some plastic fines; brown; non-cohesive, moist, compact		1.45	3	SS	483	20	MH	
2				283.19						Bentonite
		(SP) SAND, trace gravel, trace non-plastic fines; brown; non-cohesive, moist, dense to very dense		2.21	4	SS	508	58		
3					5	SS	559	63		
4					6	SS	559	48		
					7	SS	584	44	M	Filter Sand
5										50 mm dia. well screen
6					8	SS	584	54		
				278.69						
		End of Borehole		6.71						
7		Notes:								
		1. Borehole dry upon completion of drilling.								
		2. Piezometer installed as shown upon the completion of drilling.								
8										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA — NATURAL — REMOULDED
WATER CONTENT, % — W_P — W — W_L
10 20 30 40 50 60 70 80 90

GEO - BOREHOLE LOG 100876.050_GEOTECH_GINT_R0_2023_08_11.GPJ GEMTEC 2018.GDT 9/1/23

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Consulting Engineers and Scientists

LOGGED: AW
CHECKED: RN

RECORD OF BOREHOLE BH23-4

CLIENT: Tatham Engineering Limited
PROJECT: Proposed YMCA, 555 Bayview Drive, Barrie, Ontario
JOB#: 100876.050
LOCATION: See Borehole Location plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Aug 1 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (OD)	Ground Surface		285.10						
		ASPHALT		0.06						
		FILL - (SW) GRAVELLY SAND, trace non-plastic fines; brown; non-cohesive, dry			1	AS	0	-		
				284.41						
1		FILL - (SM) SILTY SAND, trace to some gravel, trace plastic fines; brown; non-coheisve, moist, compact to very dense		0.69	2	SS	584	15		
					3	SS	483	58		
2										
				282.74						
		(SP) SAND, trace to some silt, trace gravel; light brown, non-cohesive, moist, very dense		2.36	4	SS	559	70		
3					5	SS	584	57		
4					6	SS	610	65	M	
5					7	SS	610	52		
6					8	SS	610	64		
				278.39						
7		End of Borehole		6.71						
		Notes: 1. Borehole dry upon completion of drilling. 2. Borehole backfilled with mixture of bentonite and cuttings. 3. No cave upon the completion of drillng.								
8										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: NATURAL, REMOULDED
WATER CONTENT, %: W_P, W, W_L
10 20 30 40 50 60 70 80 90

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LOGGED: AW
CHECKED: RN

GEO - BOREHOLE LOG 100876.050_GEOTECH_GINT_R0_2023_08_11.GPJ GEMTEC 2018.GDT 9/1/23

RECORD OF BOREHOLE BH23-5

CLIENT: Tatham Engineering Limited
PROJECT: Proposed YMCA, 555 Bayview Drive, Barrie, Ontario
JOB#: 100876.050
LOCATION: See Borehole Location plan

SHEET: 1 OF 1
DATUM: Unknown
BORING DATE: Aug 1 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger, Hollow Stem Auger (OD)	Ground Surface		284.30						Flush Mount
		ASPHALT		0.06						
		FILL - (SP) SAND, some gravel to gravelly, trace non-plastic fines; brown; non-coheisve, compact			1	AS	0	-		
1					2	SS	483	27		
				282.93						
		(SP) SAND, no to trace gravel, trace non-plastic fines; light brown; non-coheisve, very dense		1.37						
2					3	SS	533	50 / 0		Bentonite
					4	SS	610	50 / 0		
3					5	SS	610	80		
4					6	SS	559	56		Filter Sand
5					7	SS	584	51		50 mm dia. well screen
6					8	SS	584	65	M	
				277.59						
		End of Borehole		6.71						
7		Notes:								
		1. Borehole dry upon completion of drilling.								
		2. Piezometer installed as shown upon the completion of drilling.								
8										

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA — NATURAL — REMOULDED
WATER CONTENT, % — W_P — W — W_L
10 20 30 40 50 60 70 80 90

GEO - BOREHOLE LOG 100876.050_GEOTECH_GINT_R0_2023_08_11.GPJ GEMTEC 2018.GDT 9/1/23

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LOGGED: AW
CHECKED: RN

Appendix C:
Water Balance Calculations

TATHAM ENGINEERING

Water Budget

Project Details

YMCA Barrie, 535 Bayview Driv	423449

Prepared By

KG	January 11, 2024

Water Balance Detials

Methodology	Thornthwaite Method
Climate Data & Source	Barrie WPCC Climate Normal Data for 1981 to 2010 (Environment Canada)
Thornthwaite Coefficient	1.081

Month	Temp (°C)	Precip (mm)	Heat Index	PET (mm)	Daylight Factor	Days	AET (mm)	Surplus (mm)	Deficit (mm)
Jan.	-7.7	82.5	0.0	0.0	0.77	31	0.0	82.5	0.0
Feb.	-6.6	61.8	0.0	0.0	0.87	28	0.0	61.8	0.0
Mar.	-2.1	58.1	0.0	0.0	1.00	31	0.0	58.1	0.0
Apr.	5.6	62.2	1.2	28.3	1.12	30	31.8	30.4	0.0
May	12.3	82.4	3.9	75.2	1.23	31	92.7	0.0	10.3
Jun.	17.9	84.8	6.9	114.1	1.29	30	147.2	0.0	62.4
Jul.	20.8	77.2	8.7	135.7	1.26	31	171.3	0.0	94.1
Aug.	19.7	89.9	8.0	118.2	1.17	31	137.8	0.0	47.9
Sep.	15.3	94.0	5.4	77.9	1.04	30	81.2	12.8	0.0
Oct.	8.7	77.5	2.3	38.4	0.92	31	35.1	42.4	0.0
Nov.	2.7	88.9	0.4	9.2	0.80	30	7.4	81.5	0.0
Dec.	-3.5	73.6	0.0	0.0	0.74	31	0.0	73.6	0.0
Total	**-**	**933**	**36.8**	**597.1**	**-**	**365**	**704.6**	**443.1**	**214.8**

Additional Notes

PET = Potential Evapotranspiration

AET = Actual Evapotranspiration

Equations

$PET = 16\left(\frac{L}{12}\right)\left(\frac{N}{30}\right)\left(\frac{10T_d}{I}\right)^{\alpha}$ Where

PET is the estimated potential evapotranspiration (mm/month)

T_d is the average daily temperature (degrees Celsius; if this is negative, use 0) of the month being calculated

N is the number of days in the month being calculated

L is the average day length (hours) of the month being calculated

$\alpha = (6.75 \times 10^{-7})I^3 - (7.71 \times 10^{-5})I^2 + (1.792 \times 10^{-2})I + 0.49239$

$I = \sum_{i=1}^{12}\left(\frac{T_{m_i}}{5}\right)^{1.514}$ is a heat index which depends on the 12 monthly mean temperatures T_{m_i}.[1]

TATHAM ENGINEERING

Water Budget

Project Details

YMCA Barrie, 535 Bayview Drive	423449

Prepared By

KG	1/11/2024

Pre-Development Catchment Details

Area (ha)	4.02
Pervious Area (ha)	0.00
Impervious Area (ha)	4.02

Post Development Catchment Details

Area (ha)	4.02
Pervious Area (ha)	0.00
Impervious Area (ha)	4.02

Infiltration Factor	Pre-Development			Post Development		
	Pervious	Impervious	Total	Pervious	Impervious	Total
Topography	0.300	0.0		0.300	0.0	
Soil	0.400	0.0		0.400	0.0	
Land Cover	0.100	0.0		0.100	0.0	
Infiltration Factor	0.800	0.0		0.800	0.0	

Water Budget	Pervious	Impervious	Total	Pervious	Impervious	Total
Water Surplus (m^3)	0	17,811	17,811	0	17,811	17,811
Infiltration (m^3)	0	0	0	0	0	0
Runoff (m^3)	0	17,811	17,811	0	17,811	17,811
Reduction in Infiltration Volume (m^3)						**0**
Reduction in Infiltration Volume (%)						**0.0**

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2