



PROPOSED SEWAGE WORKS DESIGN
BRIEF & IMPACT ASSESSMENT

LARRY ROBINSON ARENA

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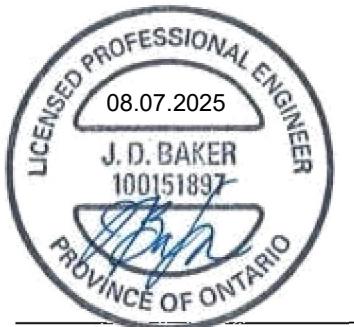
This report is respectfully submitted to the City of Ottawa in response to the request for engineering services scope of work for the Hydrogeological Study and Sewage Impact Assessment on the proposed septic system servicing the Larry Robinson Arena.

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APPENDIX B – EVB Technical Memorandum
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List of Revisions

Date	Revision #	Issued For	Revision Details
2025-04-30	0	MECP Pre-Consultation	Draft
2025-07-17	1	ECA Application	

1 INTRODUCTION

This Sewage Works Design Brief & Impact Assessment has been prepared by EVB Engineering on behalf of the City of Ottawa (the City) in support of constructing a new private on-site sewage system servicing the Larry Robinson Arena, located at 2785 8th Line Road, Metcalfe Ontario.

The follow report provides a summary of the objectives and background for the project, the development of the site characterization, including geology and hydrogeology of the site, followed by the site development concept, with respect to the design of a new private septic system, as well as a sewage system terrain evaluation and groundwater impact assessment.

1.1 OBJECTIVES

The objective of this document are to:

- ◆ Present the site development and sewage works design details for the proposed works.
- ◆ Provide an understanding of the existing subsurface geological and hydrogeologic conditions in order to support the design and evaluation of the impacts on the natural environment from the new sewage works proposed for the Larry Robinson Arena.
- ◆ Provide the framework for the determination of the contaminant attenuation limits and attenuation zones and provide application of Guideline B-7.
- ◆ Assess the impacts of the proposed sewage works.

1.2 BACKGROUND

The City of Ottawa is intending on constructing an approximately 7,600 square foot building addition on the north side of the Larry Robinson Arena. The proposed addition will consist of the modernization and expansion of the current change rooms, providing an enhanced barrier-free entrance, expansive lobby areas with accessible seating facilities, and retrofitting the existing bleachers to meet accessibility standards.

Following a review of the existing on-site sewage works, it was determined that the current septic system was not capable of servicing the Larry Robinson Arena and a new system would need to be constructed. EVB issued a Technical Memorandum titled “Inspection of Existing Sewage Works” on August 20th, 2024 (Appendix F), which outlines the details of the existing septic system approvals and summary of the findings from the investigation.

2 SITE CHARACTERIZATION

2.1 SURFICIAL AND BEDROCK GEOLOGY

2.1.1 REGIONAL SURFICIAL GEOLOGY

Figure 2.1 presents a snapshot from The Surficial Geology of Southern Ontario Mapping (Ontario Geological Survey, 2003) for the subject area. The mapping depicts that the representative soil deposits in the subject area is comprised of a mixture of coarse-textured glaciomarine deposits consisting of sand, gravel, minor silt and clay, and bedrock drift complex in Paleozoic terrain. Additionally, organic deposits, ice-contact stratified deposits, till, and fine-textured glaciomarine deposits are present in the area.

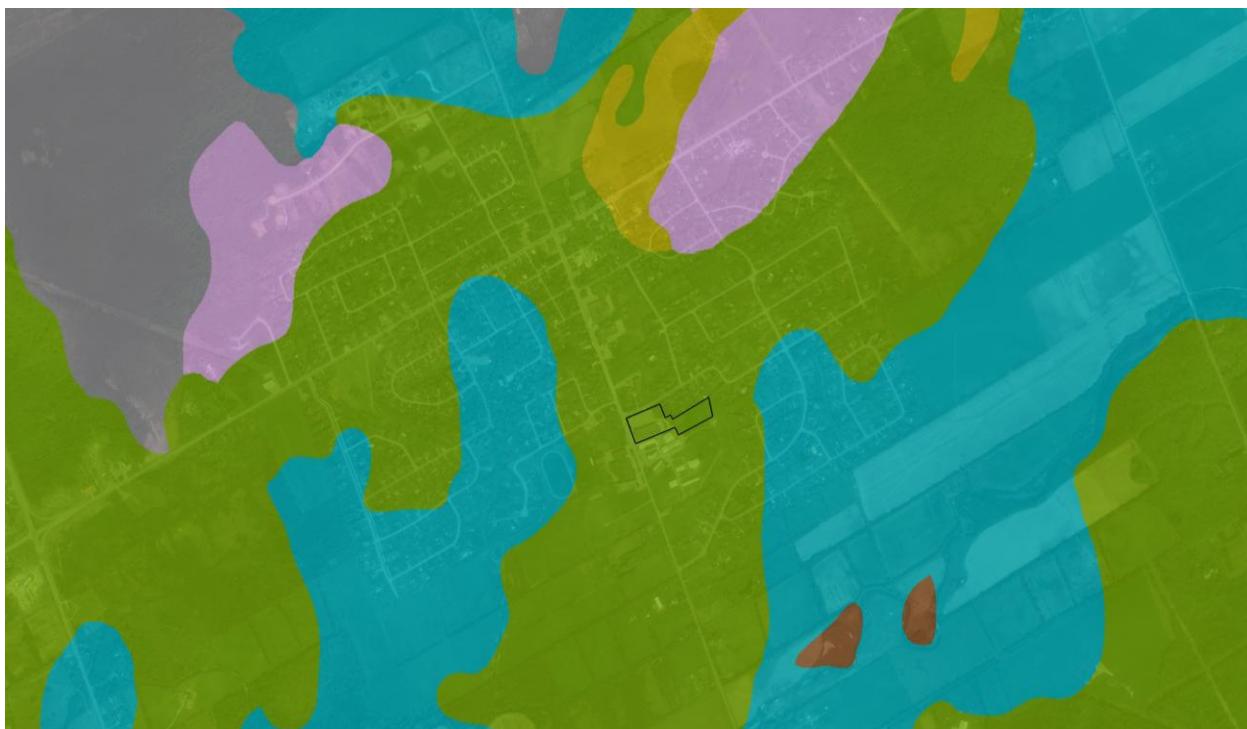


FIGURE 2.1: SURFICIAL GEOLOGY (MRD 128)

Map Colour	Soil Description
Green	Till – stone poor sandy silt to silty sand textured till on Paleozoic Terrain
Light Blue	Fine-textured glaciomarine deposits – silt & clay, minor sand & gravel. Massive to well laminated
Yellow	Coarse-textured glaciomarine deposits – sand, gravel, minor silt and clay. Deltaic deposits
Pink	Bedrock-drift complex in Paleozoic terrain
Brown	Modern alluvial deposits – clay, silt, gravel, may contain organic remains
Grey	Organic deposits – peat, muck, marl

2.1.2 REGIONAL BEDROCK GEOLOGY

Figure 2.2 presents a snapshot from the mapping from the Ministry of Energy, Northern Development and Mines (MRD 126), which indicates that the subject area is predominantly underlain by the bedrock in the Lower Ordovician age. The bedrock is classified in the Beekmantown group and consists of dolostone and sandstone.



FIGURE 2.2: BEDROCK GEOLOGY (MRD 128)

Map Colour	Bedrock Description
Lower Ordovician	
Light Blue	Dolostone, sandstone – Beekmantown Group

2.1.3 LOCAL GEOLOGY

The local surficial and bedrock geology of the site has been inferred from the local well records accessed through the Ministry of Environment, Conservation and Parks Water Well Information System (WWIS)¹ and the geotechnical borehole program. The MECP's WWIS identified 89 drilled wells located within 500 m of the subject property, the well records have been summarized and tabulated in Table A-1 (Appendix A).

LOCAL SURFICIAL/BEDROCK GEOLOGY

Based on the well record data, the local surficial and bedrock geology may be generally described by the following classifications:

Unit	Description	Depth (m b.g.s.)	Thickness (m)
Overburden	Sand / Clay / Hardpan	0 – 15.5 m b.g.s.	5.0 m +/- 3.4 m
Bedrock	Limestone	0 – 15.5 m b.g.s.	-

The well records indicate that the area is covered by a thin layer of overburden material consisting of a mixture of clay and hardpan with some gravel and sand. This overburden layer ranges in thickness from approximately 0 to 5.0 m, with some wells indicating 10 - 15 m in thickness.

The local bedrock is described as sandstone and limestone throughout the well records with an average depth to bedrock of 5.4 m, with some areas having bedrock outcrops at the ground surface. The wells indicated in the WWIS database were all terminated within the bedrock layer at an average depth of 25 m b.g.s.

¹ <https://www.ontario.ca/environment-and-energy/map-well-records>, accessed September 24, 2024

GEOTECHNICAL INVESTIGATION (EVB)

On March 24th and 25th, 2025, EVB was on-site to install a series of monitoring wells around the site using a track mounted drill rig supplied by Downing Well Drilling. Soil samples were inspected using a 50mmØ split spoon (SS) sampler. Split spoon samples indicated the underlying soil consisted of a silty clay material. Bedrock was encountered 1.63 to 1.81 m b.g.s.

Five overburden monitoring wells were installed at a depth of 1.6 to 1.8 m b.g.s. and 3 shallow bedrock monitoring wells were installed at a depth of 4.5 to 4.9 m b.g.s. The monitoring wells were equipped with 0.9 to 1.5 m long screens. Waterra tubing and foot valves were installed in the monitoring wells to collect groundwater samples around the site.

2.2 TOPOGRAPHY

A topographic survey was completed by EVB staff on March 25th, 2024 in the area of the septic bed. The site elevation varies between 88.50 and 87.00 m above sea level. The contours provided from the survey indicate that surface water would drain to the southwest.

2.3 GROUNDWATER

MECP WELL RECORDS

During installation, the depth to water and static water levels in the local wells were recorded in the MECP's well record forms. From the well records, the average depth to water was 24.7 m below ground surface (b.g.s.), with a maximum depth of 121 m b.g.s. and minimum depth of 5.2 m b.g.s. Based on the well records, water was found in the bedrock unit at an average of 8.4 m below the top of the bedrock layer. It can be assumed that the supply aquifer for this region is in the bedrock.

The hydrostatic surface reported in these wells had an average water level of 4.4 m b.g.s. with a maximum depth of 22.6 m and minimum depth of 0.61 m. The static water level was determined at the time of installation of the well through direct measurement.

OVERBURDEN MONITORING WELLS

Five overburden and three bedrock monitoring wells were installed by EVB, with Downing Well Drilling, varying in depth from approximately 1.6 m to 4.9 m below ground surface (b.g.s.) in order to monitor the shallow groundwater levels in the overburden across the site. The overburden was observed to be a stiff and compacted brown silty clay above the bedrock.

On April 29th, 2025, the static water levels in each monitoring well to determine the direction of groundwater flow in the overburden and shallow bedrock. During the site visit, the overburden wells were dry, indicating there is no shallow groundwater in overburden unit. The water level in the shallow bedrock wells ranged between 84.93m ASL and 85.47 mASL and appears to be flowing to the South. A potentiometric contour for the shallow bedrock has been provided on Figure 1 (attached). Based on the potentiometric contour, the groundwater in the shallow bedrock has a horizontal gradient of approximately 0.005 m/m.

2.4 CONCEPTUAL HYDROGEOLOGIC SITE MODEL

The site hydrogeologic model may be described as a thin clay deposit overlying a bedrock aquifer. The potentiometric surface of the bedrock aquifer is located within the upper sand units, approximately 4.4 m below ground surface. As indicated in the MECP well records, the main source of groundwater is in the bedrock. The area surrounding the site is characterized by the following hydrostratigraphy:

- ◆ Overburden:
 - **Clay, Hardpan**, 5.0 +/- 3.4 m thickness, this material is described as a brown or grey clay and hardpan material.
 - This surficial layer is aerially extensive to a 500 m radius from the development, as identified from various descriptions in the MECP well records and the geology mapping for the region.

The upper 2 m of this material will be subject to a freeze/thaw cycle and is underlain by a bedrock.

- ◆ Bedrock:

- ◆ **Limestone/Shale**, top of bedrock surface ranges from a minimum of 0 m to a maximum value of 15.5 m and an average bedrock surface located 5.4 m b.g.s. The supply aquifer for the area is found in the bedrock layer.

With regards to the site application, sewage effluent will be discharged on top of the silty clay layer and be forced to percolate through the soils by gravitational forces, mixing with the pore water prior to mounding upon the top of bedrock and subsequently moving horizontally. The average depth to the water bearing zone in the MECP wells is 24.7 m b.g.s. and was found within the bedrock unit. The boreholes completed by EVB described the overburden as a compact clay material before reaching bedrock.

The general hydrogeologic conditions of the site are described as an unconfined bedrock aquifer overlain by a thin surficial clay layer. The main water bearing features in the bedrock are located approximately 24.7 m b.g.s. within bedding planes and other vertically fractured features in the rock. The potentiometric surface in the bedrock aquifer is generally located at a depth of 4.4 m b.g.s.

3 SEWAGE WORKS DESIGN BRIEF

It is proposed to install a new Class 4 sewage system in the northern corner of the property, in order to avoid high foot traffic areas, isolating the disposal area, and maximizing the natural attenuation provided by the underlying soils.

The proposed sewage works for the site will comprise of a Shallow Buried Trench leaching bed, complete with an iQ.MBBR sewage treatment system, provided by Bergmann North America Inc. (BNA). The treatment system has been designed based on the objectives outlined in Table 3-1, per the Section 8.7.6.1.(1) of the OBC, outlining the treatment requirements for Level 4 treatment systems. Additionally, the iQ.MBBR treatment system will provide up to 95% total inorganic nitrogen (TIN) reduction prior to discharging to the shallow buried trench system.

TABLE 3-1: RAW SEWAGE DESIGN PARAMETERS

Parameter	Influent Criteria	Effluent Criteria
BOD ₅	300 mg/L	
cBOD ₅	-	10 mg/L
TSS	300 mg/L	10 mg/L
TKN	80 mg/L	
TP	15 mg/L	
TIN		3.2 mg/L

The following sections outline the design details for the shallow buried trench and iQ.MBBR treatment system for the proposed development.

3.1 DESIGN SEWAGE FLOW

Sewage systems are sized based on the requirements of Part 8 of the Ontario Building Code (OBC). Section 8.2.1.3.(3) of the Ontario Building Code states “Where a building contains more than one establishment, the total daily design sanitary sewage shall be the sum of the total design sanitary sewage flow for each establishment”.

The proposed facility contains a bleacher and lobby area for fans, a meeting room, and a community hall with a kitchen. Based on Table 8.2.1.3.B, the design sewage flow for the proposed facility is calculated to be:

Stadiums, Race Tracks, Ball Parks

Bleachers/Rink Slab	= 576 seats x 20 L/seat/d	= 11,520 L/d
Lobby	= 40 seats x 20 L/seat/d	= 800 L/d
Total Seating Capacity Design Flow		= 12,320 L/d

Assembly Hall (no food service)

Meeting Room	= 50 persons x 8 L/d per bay	= 400 L/d
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Assembly Hall (food service provided (kitchen))

Community Hall	= 200 persons x 36 L/seat/d	= 7,200 L/d <u>AND,</u>
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Total Estimated Design Sewage Flow

Design Flow	= 12,320 L/d + 400 L/d + 7,200 L/d	= 19,920 L/d
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3.2 SHALLOW BURIED TRENCH

The Shallow Buried Trench (SBT) System will be located at the northern corner of the property, shown on Drawing C1.2. Following the requirements of Section 22.4 of the MECP's 2008 *Design Guidelines for Sewage Works*, a soil evaluation was completed from the borehole logs and field interpretation.

Based on the MECP Well Records and results from the monitoring well installation, the soils can be characterized as having very low permeability, with a hydraulic conductivity of 10^{-5} cm/s or less and a percolation rate greater than 50 min/cm. Therefore, the new SBT leaching bed will be constructed as a fully raised system, installed by excavating the topsoil material and scarifying the native material before placement of the imported sand material.

The imported sand material will be septic sand, having a percolation value of 6 – 10 min/cm. The length of distribution piping for a SBT system is based on the equations from Table 8.7.3.1A of the OBC and is shown below.

Although the SBT will employ imported sand material, the total length of distribution piping has been calculated using the equation for an underlying soil type with a percolation rate of $20 < T \leq 50$ min/cm, in order to be conservative.

- ◆ The length of distribution piping is $= Q/50 = 19,920 \text{ L/d} \div 50 = 398.4 \text{ m}$;
- ◆ The recommended contact area is $= QT/850 = (19,920 \text{ L/d} \times 50 \text{ min/cm})/850 = 1,172 \text{ m}^2$;

The distribution piping will consist of 40 runs of 10 m, providing a total length of 400 m. In order to maximize effluent distribution, the piping will be evenly split between 10 equally sized cells, each containing 4 runs of distribution piping spaced at 2.0 m.

The SBT will consist of an 83 m x 15 m sand layer, providing a total contact area of 1,245 m².

EFFLUENT DOSING

The effluent dosing to the SBT bed is volumetrically based on the peak design flows and the methodology of distributing the sewage flow over a 24-hour period.

- ◆ Flow Rate: $= 19,920 \text{ L/d} / 24 \text{ hr/d} = 830 \text{ L/hr}$
- ◆ Number of Dosing Events: $= 24 \text{ events/d} / 24 \text{ hr/d} = 1 \text{ event/hr}$
- ◆ Volume per Dosing Event: $= 830 \text{ L/hr} / 1 \text{ event/hr} = 830 \text{ L/event}$
- ◆ Design Pumping Rate: $= 3.5 \text{ L/s} @ 9.5 \text{ m TDH}$
- ◆ Pump Event Duration: $= 4.0 \text{ min/event}$

ORIFICE SPACING

The distribution piping in the SBT bed will contain 10 top orifices and 4 bottom drain orifices. The orifice spacing can be found in the Multiple Orifice Flow Calculations design sheet in Appendix D.

- ◆ Top Orifices:
 - 10, 4.8mmØ orifices, spaced at 1.0 m
 - The first top orifice is located 0.5 m from the header pipe
- ◆ Bottom Orifices:
 - 4, 4.8mmØ orifices, spaced at 2 m
 - The first bottom drain orifice is located 2 m from the header pipe.

3.3 SEWAGE WORKS DESIGN CONSTRAINTS

The layout of the proposed sewage works must consider the locations of adjacent watercourses and surrounding wells on or adjacent to the property. Section 8.7.4.2.(11) of the OBC states that the separation distances for distribution piping shall be increased by twice the height that the leaching bed is raised above the original grade. As such, the following separation distances shall be used for the proposed shallow buried trench system.

TABLE 3-2: MINIMUM SEPARATION DISTANCES

Object	Separation Distance (m)
Structure	$5 + 1.8 = 6.8$
Drilled Well	$15 + 1.8 = 16.8$
Dug Well	$30 + 1.8 = 31.8$
Body of Water	$15 + 1.8 = 16.8$
Property Line	$3 + 1.8 = 4.8$

All separation distances identified in Table 3-2 are identified on Drawing C1.3. In order to be conservative with the design of the shallow buried trench septic bed, we have assumed the high groundwater table is at the ground surface and included 900mm separation accordingly.

3.4 IQ.MBBR SEWAGE TREATMENT SYSTEM

The sewage treatment system proposed for the development is the iQ.MBBR treatment system, provided by Bergmann North America (BNA) Inc. The proposed system will be installed in sub-grade precast concrete tanks and will consist of the following unit processes. Further details can be found in the proposal prepared by BNA in Appendix E.

1. Flow Balancing Tank

- ◆ One (1) single compartment equalization tank with a working capacity of approximately 18,000 L to receive sanitary wastewater from the facility by gravity. Wastewater will be pumped from the equalization tank at a time dose rate into the primary treatment tank.

2. Primary Treatment Tank

- ◆ One (1) double compartment primary treatment tank with a working capacity of approximately 30,000 L, comprised of a 20,000 L Sludge Storage chamber and a 9,600 L primary clarifier chamber, receiving discharge from the equalization tanks.

3. Secondary Treatment

- ◆ One (1) triple compartment secondary treatment tank with a nominal volume of approximately 22,750 L, comprised of one 7,500 L bioreactor chamber (Bioreactor #1), one 7,500 L bioreactor chamber (Bioreactor #2), and one 5,600 L secondary clarifier chamber, dosed from the primary clarifier in the primary treatment tank.

4. Tertiary Treatment

- ◆ Three (3) single compartment tertiary treatment tanks comprised of one (1) 3,600 L anoxic bioreactor tank, one (1) 3,600 L bioreactor tank (Bioreactor #3), and one (1) 3,600 L tertiary clarifier tank.

5. Effluent Pump Tank

- ◆ One (1) single compartment effluent pump tank with a working capacity of approximately 7,500 L, receiving wastewater from the secondary clarifier chamber by gravity in the secondary treatment tank. The effluent pump tank will be equipped with two (2) Liberty Model FL102M-2 series effluent pumps.

6. Flow Meter Basin

- ◆ One (1) flow meter basin to intercept the forcemain from the effluent pump tank to the leaching bed.

7. Control Panel

- ◆ Two (2) Click + Clean control panels' the first to control the pump tank pumps and the second to control the pumps installed in the secondary treatment tank.

3.5 PROCESS FLOW

Raw sewage from the school will flow by gravity into a 18,000 L equalization tank. The equalization tank is equipped with two submersible effluent pumps operating on an alternating timer, that discharge sewage to the 30,000 L Primary Treatment Tank.

The primary treatment tank is comprised of a 20,000 L sludge storage chamber and 9,600 L Primary Clarifier chamber. The sludge storage chamber provides settling and storage of primary and secondary solids, while the primary clarifier provides additional settling and conditioning of the wastewater, including a nominal level of pre-anoxic denitrification for process stabilization. The primary effluent discharges to an 22,750 L secondary treatment tank by gravity.

Secondary treatment is accomplished through the iQ.MBBR system which utilizes a moving bed bioreactor (MBBR) process. The biological stage consists of two (2) aerobic bioreactors in series containing specifically designed plastic carrier media, having a surface area of 500 m²/m³. Microorganisms attach to the carrier and consume the organic material in the wastewater. Oxygen needed for the aerobic treatment process is supplied by six linear air blowers and distributed in the biological reactors stage by fine bubble

diffusers. The blowers are controlled using dissolved oxygen sensors to run only when required. Media retaining screens are installed in each bioreactor to keep the carrier media in place, while allowing the process wastewater and excess biosolids to pass through.

Secondary sludge is settled out in the secondary clarifier, equipped with a sloped wall double hopper, two sludge return pumps and one floating sludge (skimmer) pump. Secondary sludge settles to the bottom of the hoppers and is returned to the sludge storage tank, along with any floating sludge removed by the skimmer pump.

Tertiary nitrification is provided using one (1) anoxic bioreactor to remove any residual nitrate nitrogen to the effluent objective indicated in Table 3-1. The anoxic bioreactor is an MBBR containing specially designed plastic carrier media having a specific surface area of $500 \text{ m}^2/\text{m}^3$. Denitrifying bacteria attach to the carrier media and consume the nitrate and nitrite in the secondary effluent using supplemental carbon as an energy source under low oxygen conditions. The anoxic bioreactor is sized to remove up to 21.9 mg/L of residual nitrate at design flow ($0.37 \text{ kgNO}_3/\text{d}$) based on a recommended loading rate of $0.5 \text{ gNO}_3/\text{m}^2\text{-d}$. Supplemental carbon dosing is flow paced based on the influent equalization pump operation and proportioned to limit residual nitrate. The carbon supplement is intermittently mixed with the influent to the reactor via mixing pump. The anoxic bioreactor is fully mixed periodically using coarse bubble diffusers and two (2) dedicated linear air blowers to remove any excess biomass while limiting the oxygen added.

Effluent from the anoxic bioreactor may contain residual cBOD_5 and TSS. To ensure the effluent meets the required criteria, further aerobic treatment and clarification is provided. Tertiary effluent polishing is provided using one (1) bioreactor (Bioreactor #3) and one (1) tertiary clarifier tank. Bioreactor #3 acts as an aerobic MBBR polisher to consume any excess carbon from the tertiary process, working on the same treatment principles as the two main bioreactors, and includes two (2) linear air blowers to supply air to the process. The tertiary clarifier contains one (1) sloped wall double hopper, one (1) surface skimmer, and two (2) sludge return pumps. Tertiary sludge settles to the bottom of the hoppers and is returned to the sludge storage tank along with any floating sludge removed by the skimmer pump.

From the secondary clarifier, the wastewater is discharged to the effluent pump tank, complete with duplex effluent pumps. The duplex pumps send effluent to the shallow buried trench leaching bed.

Three (3) control panels are provided to control the treatment plant, equalization tanks, and effluent pump tanks, which include GPRS remote monitoring with current sensing on each output. Flow data logging is available on the equalization and effluent pumps based on pump run time, and a flow meter installed in a subgrade chamber at the effluent tank discharge is included. The blowers, chemical dosing pumps, and control panels are intended to be housed in a pre-cast concrete control shed adjacent to the treatment tanks.

4 GROUNDWATER IMPACT ASSESSMENT

The following groundwater impact assessment has been completed based on Chapter 22 of the MECP's *2008 Design Guidelines for Sewage Works*.

4.1 SYSTEM ISOLATION

Section 22.5.14 from the MECP's *2008 Design Guidelines for Sewage Works* states that "where it can be shown that the uppermost subsurface unit(s) at an infiltration facility have a vertical hydraulic conductivity of 10^{-5} cm/sec or less, is at least 10 m (33 ft) thick and extends at least 100 m (330 ft) downgradient of the infiltration area, attenuation calculations may not be required".

Based on the conceptual hydrogeological model discussed in Section 2.4, the surficial soils that will be receiving the sewage effluent are not sufficiently isolated from the water supply aquifer based on the following lines of evidence:

- The underlying soil has a hydraulic conductivity greater than 10^{-7} cm/s and the thickness of the overburden layer defined in the MECP well records, and determined from the borehole/monitoring well installation, indicates the thickness of the overburden is less than 10 meters and is aerially extensive (greater than 500m).

Therefore, the subject area is hydrogeologically sensitive, and the ground surface conditions are not hydraulically isolated from the underlying aquifer.

4.2 CONTAMINANT ATTENUATION CALCULATIONS

Because the subject area is hydraulically isolated from the underlying aquifer, the following contaminant attenuation calculations have been completed based on the equations set in Section 22.5.8 of the MECP's *2008 Design Guidelines for Sewage Works* to determine the impact of the sewage effluent at the property boundaries and have been compared to the allowable concentrations based on the MECP's *Guideline B-7: Reasonable Use Policy*.

4.2.1 REASONABLE USE POLICY

Using the *Reasonable Use Policy*, the allowable concentration (C_m) of nitrogen at the property boundary can be calculated using equation below. Where (C_b) is the background concentration, (C_r) is the ODWS/OG, and (x) is a constant, which is 0.25 for health-related parameters and 0.5 for non-health related parameters. In order to be conservative, the background concentrations used for this calculation is 0 mg/L.

Allowable Concentration:
$$\begin{aligned} C_m &= C_b + x (C_r - C_b) \\ &= 0.00 + 0.25 (10 - 0) \\ &= 2.50 \text{ mg/L} \end{aligned}$$

4.2.2 PREDICTION OF CONTAMINANT ATTENUATION

The required treated sewage concentration for the septic system in order to meet the Reasonable Use Policy concentration of 2.50 mg/L can be calculated using the equations from Chapter 22. The dilution area (A_D) for the proposed septic system to the downgradient property boundary is shown in Figure 1, attached, and the concentration of nitrate-nitrogen in the sewage effluent (C_s) is based off an assumed sewage concentration of 60 mg/L.

Dilution Area (A_D)	= 2,990 m ²
Annual Sewage Volume (V_s)	= 19.92 m ³ /d x 365 d/year
Annual Infiltration Rate (K)	= 0.250 m/year
	= 7,271 m ³

Annual Dilution Volume: $V_A = A_D \times K$
 $= 2,990 \text{ m}^2 \times 0.250 \text{ m/year}$
 $= 750 \text{ m}^3$

Total Volume of Water: $V_T = V_A + V_s$
 $= 750 \text{ m}^3 + 7,271 \text{ m}^3$
 $= 8,021 \text{ m}^3$

Concentration at Property Line: $C_{PB} = (C_s \times V_s) / V_T$
 $= (40 \text{ mg/L} \times 7,271 \text{ m}^3) / 8,021 \text{ m}^3$
 $= 36.3 \text{ mg/L}$

Based on the attenuation calculations, the nitrate concentration at the downgradient property boundary would be 36.3 mg/L, assuming a design flow of 19,920 L/d for the septic system, which exceeds the allowable concentration of 2.5 mg/L.

In order to meet the allowable concentration of nitrogen at the downgradient property boundary, a robust treatment system would need to be installed. The minimum removal efficiency provided by this treatment system is calculated below.

Allowable Sewage Concentration: $C = (C_{PB} \times V_T) / V_s$
 $= (2.50 \text{ mg/L} \times 8,021 \text{ m}^3) / 7,271 \text{ m}^3$
 $= 2.78 \text{ mg/L}$

Removal Efficiency: $\% \text{ Removal} = [1 - (C / C_s)] \times 100\%$
 $= [1 - (2.78 \text{ mg/L} / 40 \text{ mg/L})] \times 100\%$
 $= 93\%$

At a minimum, the total removal efficiency needed to meet the ODWS/OG for nitrates at the property boundary (10 mg/L) is calculated below.

Allowable Sewage Concentration: $C = (C_{PB} \times V_T) / V_s$
 $= (10 \text{ mg/L} \times 8,021 \text{ m}^3) / 7,271 \text{ m}^3$
 $= 11.3 \text{ mg/L}$

Removal Efficiency: $\% \text{ Removal} = [1 - (C / C_s)] \times 100\%$
 $= [1 - (11.3 \text{ mg/L} / 40 \text{ mg/L})] \times 100\%$
 $= 72.4\%$

The proposed iQ.MMBR treatment system is capable of removing 95% of total inorganic nitrogen in the raw sewage, which meets the requirements of the MECP's Reasonable Use Policy at the downgradient property boundary.

5 PROPOSED MONITORING PROGRAM

Following the installation of the new on-site sewage works, a monitoring program should be implemented to verify the impacts to the environment caused by the sewage disposal system, if any.

Quarterly sampling should be completed at the equalization tank and effluent pump tank to confirm the raw sewage and effluent quality entering and exiting the iQ.MBBR system, prior to discharging to the leaching bed. Additional samples and groundwater level measurements should be collected at the eight monitoring wells installed on the subject property (see Table 5-1).

TABLE 5-1: MONITORING PROGRAM

Sample	Location	Frequency	Parameters
Influent	Equalization Tank		BOD ₅ , TSS, TKN
Effluent	Effluent Pump Tank		
Shallow Groundwater	25-1s, 25-2s, 25-3s, 25-4s, 25-5s	Quarterly	cBOD ₅ , TSS, NO ₂ , NO ₃ , TIN, TN
Bedrock Groundwater	25-2d, 25-3d, 25-5d		

Based on the layout of the existing monitoring network, monitoring wells 25-1s, 25-2s and 25-2d are upgradient of the proposed shallow buried trench and should be used as background monitoring wells. Monitoring wells 25-3s, 25-3d, 25-5s, and 25-5d are located along the downgradient property line and are immediately downgradient from the leaching bed. As such, these wells should be used as the compliance well for the site. Monitoring well 25-4s can be used to characterize the impacted groundwater quality.

6 CONCLUSIONS

- ◆ EVB was retained by the City of Ottawa to complete the detailed design for a new on-site sewage works servicing the Larry Robinson Arena located at 2785 8th Line Road, Metcalfe, ON.
- ◆ Following a review of the occupancy of the Larry Robinson Arena, the new sewage works will be designed to handle an average daily flow of 19,920 L/d.
- ◆ Based on MECP well records and the monitoring well installation, the site and local area is underlain by thin, compacted, sand/clay layer, followed by grey limestone and shale.
- ◆ The local water supply aquifer is found in the bedrock at an average depth of 24.7 m b.g.s. with the potentiometric surface located at an average of 4.4 m b.g.s.
- ◆ The direction of the groundwater flow was determined by measuring the static water level at eight monitoring wells located around the site. From the water level measurements, it was determined that the overburden wells were dry, indicating there is no shallow water table, while the direction of groundwater flow in the shallow bedrock is to the south.
- ◆ The site has been assessed according to Chapter 22 of the *2008 Design Guidelines for Sewage Works* to identify the impacts of the proposed sewage works on the local area groundwater supplies. Based on Section 22.5.14 of the Guideline, the proposed development is not hydraulically isolated from the water supply aquifer, due to the thin sand layer (less than 10 m thickness) overlying the bedrock aquifer:
- ◆ As the subject site is not sufficiently isolated from the water supply aquifer, impacts at the downgradient property boundary were calculated using the MECP's *Guideline B-7: Reasonable Use Policy* and contaminant attenuation calculations from Chapter 22 of the MECP's *2008 Design Guidelines for Sewage Works*.
- ◆ Using the MECP's *Guideline B-7: Reasonable Use Policy*, the allowable concentration of nitrogen at the property boundary was calculated to be 2.50 mg/L.
- ◆ Following the Prediction of Contaminant Attenuation steps outlined in Chapter 22, it was determined that the downgradient nitrate-nitrogen concentration at the property boundary was 36.3 mg/L, which exceeds the allowable concentration determined through the *Reasonable Use Policy*.
- ◆ In order to meet the allowable downgradient nitrate-nitrogen concentration at the property boundary, the allowable effluent nitrate-nitrogen concentration being discharge to the septic bed was determined to be 2.8 mg/L. To obtain this effluent criterion, an advanced tertiary treatment system, capable of removing a minimum of 93% nitrate removal, must be installed. At a minimum, in order to meet the ODWS/OG concentration of 10 mg/L for nitrate-nitrogen at the downgradient property boundary, the advanced tertiary treatment system will need to remove at least 72% of nitrates in the sewage prior to discharging to the septic bed.
- ◆ The iQ.MBBR treatment system, provided by Bergmann North America (BNA), is capable of providing 30% total nitrogen removal in raw sewage. By including a Tertiary Treatment “add-on”, the system is capable of providing 95% total nitrogen removal. This would reduce the total inorganic nitrogen concentration at the property boundary to 2.50 mg/L, meeting the required reasonable use concentration.

7 REFERENCES

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The Ministry of Northern Development and Mines. 2009. Bedrock Geology of Ontario, MRD 126 - Revision 1. scale 1:250,000.

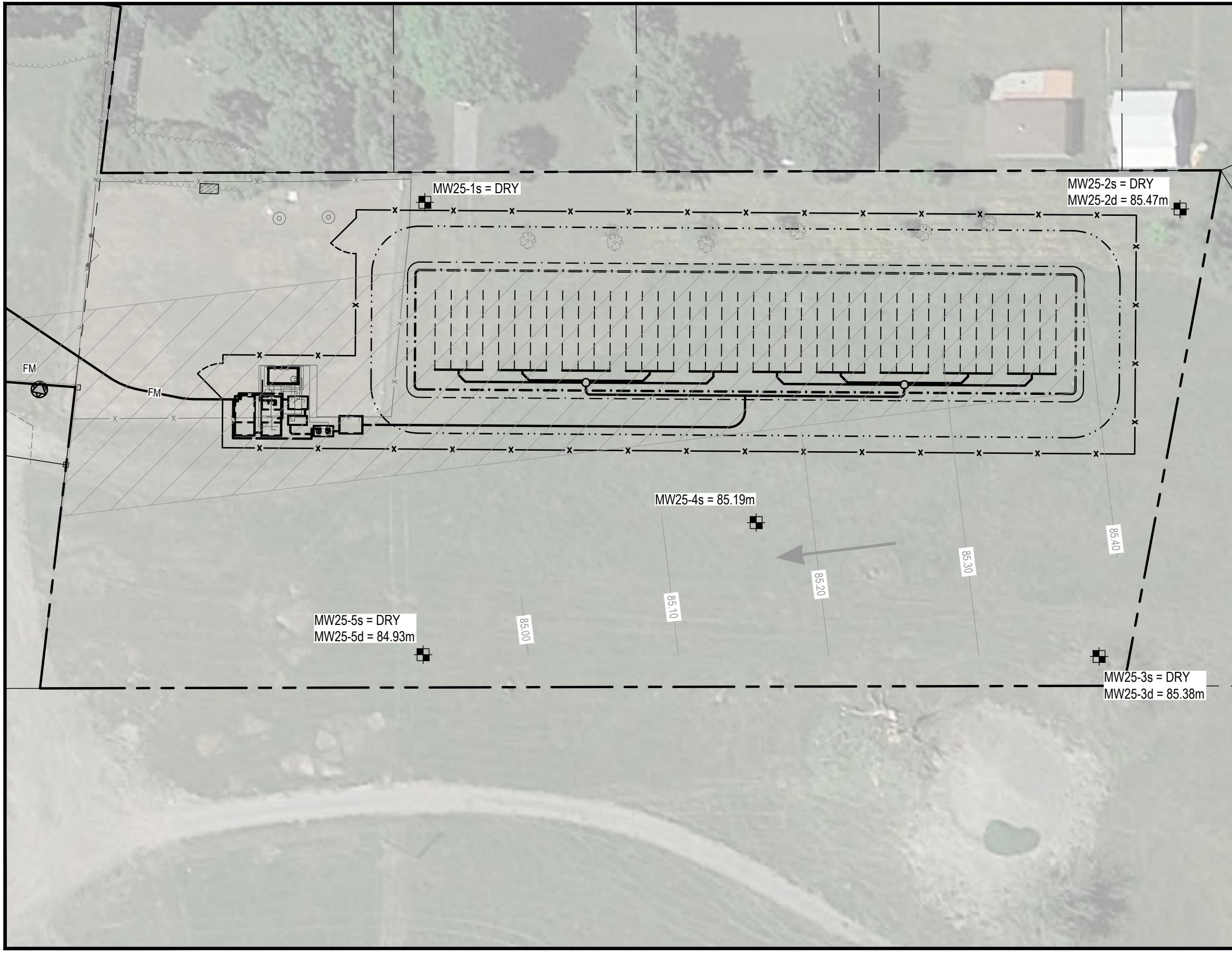
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Fetter, C.W. 1994. Applied Hydrogeology. Prentice-Hall, Inc. Upper Saddle River, New Jersey 07458.

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Figures



LEGEND:

PROPERTY LINE
EXISTING PROPERTY LINE
NEW DISTRIBUTION PIPE
NEW FORCEMAIN
NEW CONTACT AREA
NEW FENCE
NEW TOP OF SLOPE
NEW BOTTOM OF SLOPE
85.30
POTENTIOMETRIC CONTOUR
EXISTING MONITORING WELL
DILUTION AREA



800 SECOND STREET WEST
CORNWALL, ONTARIO CANADA, K6J 1H6
TEL: 613-935-3775 | FAX: 613-935-6450
WEBSITE: EVBengineering.com

CLIENT:

CITY OF OTTAWA

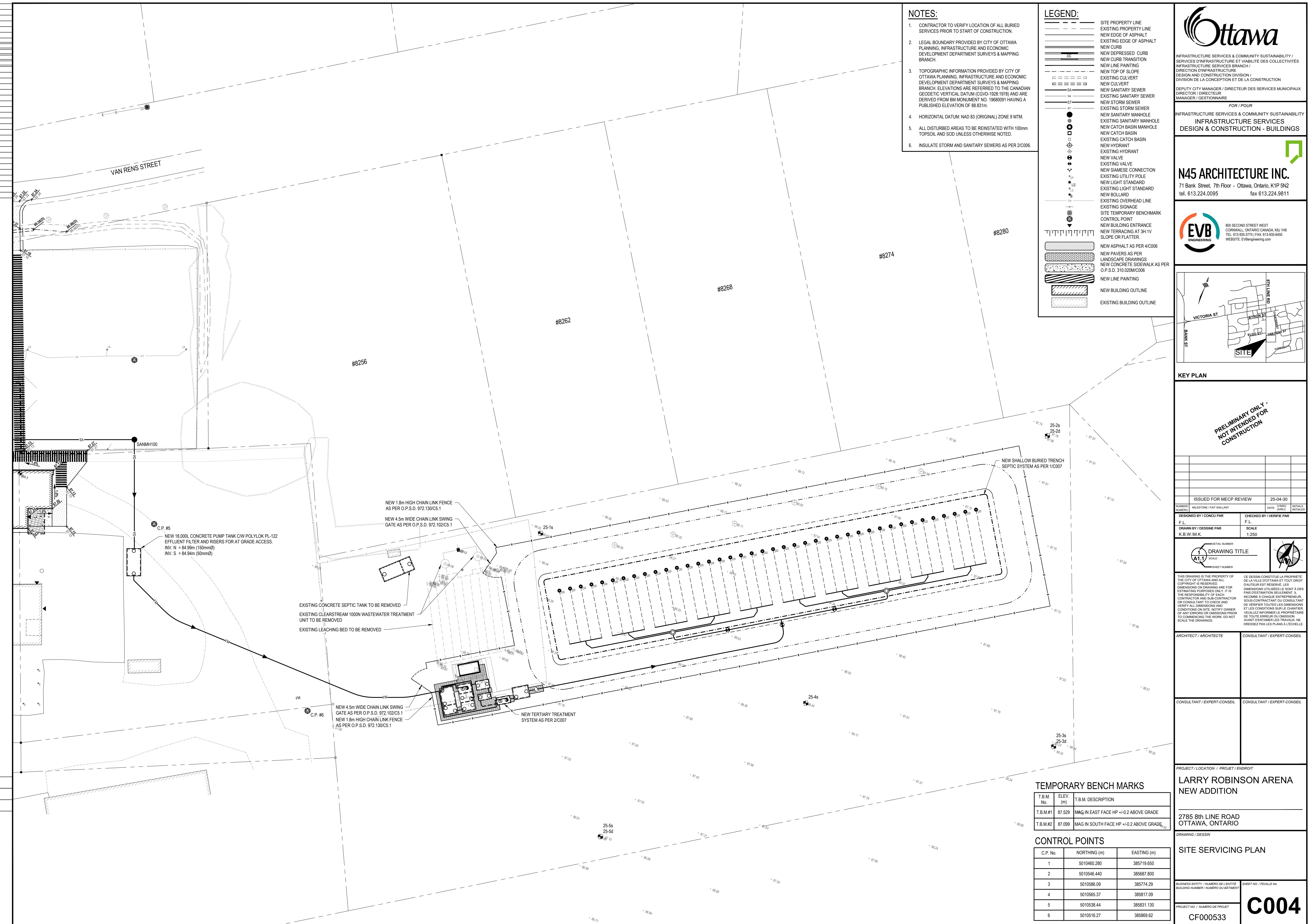
PROJECT:

LARRY ROBINSON ARENA
NEW ADDITION

TITLE:

SHALLOW BEDROCK
GROUNDWATER FLOW DIRECTION
2025-04-29

SCALE: 1:500	JOB NO: 23211
DESIGNED BY:	DATE: 25/04/29
DRAWN BY: AP	DRAWING NO.
CHECKED BY: JB	FIG. 1



APPENDIX A

MECP Well Records

Table A-1: MECP Well Record Database for the Area Identified in Drawing G1.0

Well Information		Location			Date Constructed	Borehole Log			Well Depth (m)	Depth to Water (m)	Static Water Level (m)	Stratigraphy				Accessed Aquifer			
ID	Type	Northing	Easting	Address		Start Depth (m)	End Depth (m)	Description				Overburden Thickness (m)	Description	Contact Zone (m)	Description	Depth to Bedrock (m)	Description	Depth to Water from Bedrock (m)	Unit
1507522	Drilled	5008715	462865		17-Jan-52	0.30	5.79	Boulder Clay	10.67	10.67	2.13	5.49	Boulder Clay	-	-	5.79	Limestone	4.88	Bedrock
1507525	Drilled	5008740	462945		15-Jan-55	5.79	10.67	Hard Limestone											
1507530	Drilled	5008705	462900		19-Jul-58	0.30	2.13	Black Loam	16.46	16.46	3.35	1.83	Black Loam	-	-	2.13	Limestone	14.33	Bedrock
1507542	Drilled	5008640	462765	106 Second Ave, Ottawa	10-Sep-63	2.13	16.46	Limestone											
1507544	Drilled	5008645	462725	824 Rainsford Street, Osgoode	23-Dec-63	0.00	5.49	Clay Loam	17.07	16.15	2.44	5.49	Clay Loam	-	-	5.49	Limestone	0.92	Bedrock
1507551	Drilled	5008550	462980		28-May-58	5.49	17.07	Grey Limestone											
1507552	Drilled	5008330	463080	1171 Kingston Ave, Ottawa	05-Jun-63	0.00	4.88	Clay Loam	18.59	18.29	3.66	3.05	Clay	-	-	3.05	Limestone	0.30	Bedrock
1507553	Drilled	5008010	462980		26-May-64	4.88	14.63	Blue Limestone											
1507554	Drilled	5008570	462980		0.00	7.32	7.32	Clay	15.24	14.63	3.05	7.32	Clay	-	-	7.32	Limestone	0.61	Bedrock
1507555	Drilled	5008550	462980		0.00	4.88	Clay Loam	14.63	13.41	1.83	4.88	Clay	-	-	4.88	Limestone	1.22	Bedrock	
1507556	Drilled	5008500	463000		0.00	1.22	1.22	Gravely Loam	15.54	12.19	6.71	1.22	Gravely Loam	-	-	1.22	Limestone	3.35	Bedrock
1507557	Drilled	5008730	463070		0.00	2.13	2.13	Loam, Boulders	21.34	13.72	3.05	2.13	Loam, Boulders	-	-	2.13	Limestone	7.62	Bedrock
1507558	Drilled	5008570	462980		0.00	6.10	6.10	Limestone	16.76	15.24	3.05	0.00	-	-	-	6.10	Limestone	1.52	Bedrock
1507559	Drilled	5008500	463000		0.00	4.57	4.57	Loam, Boulders	5.18	5.18	0.61	4.57	Loam, Boulders	0.61	Gravel	-	-	0.61	Gravel
1507562	Drilled	5008730	463070		0.00	36.58	36.58	Limestone	36.58	36.58	2.74	0.00	-	-	-	0.00	Limestone	36.58	Bedrock
1507631	Drilled	5008745	463010		30-May-61	0.00	2.13	Sandy Clay with Boulders											
1507646	Drilled	5008730	462995		0.00	1.83	1.83	Gravel, Boulders	39.01	10.67	1.52	2.13	Sandy Clay with Boulders	-	-	2.13	Limestone	28.34	Bedrock
1507647	Drilled	5008630	463180		15-Mar-49	1.83	48.77	Grey Limestone											
1507648	Drilled	5008240	463070		0.00	2.44	2.44	Till, Boulders	25.30	25.30	0.91	2.44	Till, Boulders	-	-	2.44	Limestone	22.86	Bedrock
1507649	Drilled	5008430	463140		0.00	1.52	1.52	Topsoil / Till	22.74	20.73	2.44	1.52	Topsoil / Till	-	-	1.52	Sandstone	2.01	Sandstone
1507650	Drilled	5008460	463240		0.00	1.22	1.22	Clay	73.15	-	-	1.22	Clay	-	-	1.22	Limestone	-	Bedrock
1507651	Drilled	5008240	463170		18-May-60	0.00	0.91	Grey Limestone	48.77	42.67	3.66	0.91	Clay	-	-	0.91	Limestone	6.10	Bedrock
1507652	Drilled	5008100	463400		15-Dec-60	0.00	10.67	10.67	10.67	9.14	0.91	3.96	Hardpan	-	-	3.96	Limestone	1.53	Bedrock
1507653	Drilled	5008100	463400		0.00	10.36	10.36	Brown Sand / Boulders	28.96	27.43	10.67	10.36	Brown Sand / Boulders	-	-	10.36	Limestone	1.53	Bedrock
1510173	Drilled	5008782	462720.9	Clyde Ave, Ottawa	30-Aug-69	6.10	6.10	Brown Gravel	12.19	9.14	2.13	6.10	Brown Clay	0.3	Brown Gravel	6.40	Limestone	3.05	Bedrock
1510439	Drilled	5008962	462890.9	4040 Staton E, Ottawa	20-Nov-69	6.40	12.19	Grey Limestone											
1511127	Drilled	5008590	462710	1356 Meadowlands Dr, Ottawa	29-Apr-71	6.00	6.10	Brown Clay	15.24	11.89	0.91	6.10	Brown Clay	1.22	Black Gravel	7.32	Limestone	3.35	Bedrock
1511173	Drilled	5008852	462810.9	Levis Street, Vanier	27-May-71	7.32	7.32	Black Gravel	15.24	11.89	0.91	7.32	Grey Limestone						
1511273	Drilled	5008892	462840.9		10-Jul-71	0.00	2.74	2.74	13.11	23.16	1.83	13.11	Clay/Hardpan	-	-	13.72	Limestone	0.6	Bedrock
1511672	Drilled	5008922	462830.9	Bruce Street, Metcalfe	27-Aug-71	2.95	2.95	Brown Sand Clay	29.87	14.94	1.83	12.34	Sandy Clay / Till	-	-	12.34	Limestone	13.93	Bedrock
1511823	Drilled	5008802	462810.9		19-May-72	2.95	8.84	Grey Till											
1511824	Drilled	5008792	462790.9		23-May-72	0.00	7.01	7.01	15.24	15.24	1.22	7.01	Grey Clay / Stones	-	-	7.01	Limestone	8.23	Bedrock
1512291	Drilled	5008802	462790.9		07-Sep-72	0.00	5.79	8.23	16.46	16.46	1.52	8.23	Clay / Hardpan	-	-	8.23	Limestone	8.2296	Bedrock
1512499	Drilled	5008843	462796.9		05-Apr-73	1.22	1.22	Brown Soft Clay	13.72	13.11	2.44	3.66	Clay	4.27	Gravel	7.92	Limestone	0.61	Bedrock
1513253	Drilled	5008681	462789	111 Stanwood Road, Ottawa	08-May-73	0.00	0.61	0.61	16.46	16.46	1.52	0.61	Brown Sand / Clay	-	-	15.54	Limestone	0.91	Bedrock
1513262	Drilled	5008696	462825		30-Apr-73	0.00	0.61	0.61	15.54	22.25	1.52	0.61	Brown Hardpan / Gravel / Boulders	-	-	15.54	Limestone	-	
1515182	Drilled	5008521	463129.8		05-Dec-75	0.00	4.57	4.57	13.72	12.19	1.52	4.57	Grey Clay / Boulders	-	-	13.72	Limestone	0.91	Bedrock
1515534	Drilled	5008672	462770.9		29-Jan-76	0.00	3.66	3.66	10.97	13.72	1.52	3.66	Hardpan	-	-	3.66	Sandstone	1.53	Bedrock
1515601	Drilled	5008762	462910.9		23-Aug-76	0.00	4.88	4.88	13.72	12.19	1.52	4.88	Clay	-	-	2.13	Sandstone	0.61	Bedrock
1515611	Drilled	5008702	462950.9		17-Aug-76	0.00	2.13	2.13	6.10	6.10	1.52	2.13	Black Shale Rock	-	-	1.83	Limestone	1.22	Bedrock
1515665	Drilled	5008260	463300	Box 450, RR #5, Ottawa	01-Jun-77	0.00	3.96	3.96	13.72	12.19	1.52	3.96	Clay	-	-	3.96	Sandstone	0.61	Bedrock
1515965	Drilled	5008260	463300		9.75	9.75	9.75	9.75	13.41	12.19	1.83	6.10	Grey Clay / Gravel	3.66	Clay / Gravel	9.75	Limestone	1.22	Bedrock

Table A-1: MECP Well Record Database for the Area Identified in Drawing G1.0

Well Information				Location		Date Constructed	Borehole Log			Well Depth (m)	Depth to Water (m)	Static Water Level (m)	Stratigraphy					Accessed Aquifer						
ID	Type	Northing	Easting	Address	Start Depth (m)	End Depth (m)	Description	Overburden Thickness (m)	Description	Contact Zone (m)	Description	Depth to Bedrock (m)	Description	Depth to Water from Bedrock (m)	Unit									
1516098	Drilled	5008602	463070.9		0.00	1.22	Brown Topsoil					12.19	11.58	3.05	3.96	Silt	-	-	5.18	Limestone	0.61	Bedrock		
1516204	Drilled	5008542	463030.8		1.22	5.18	Grey Silt												7.32	Limestone	1.83	Bedrock		
1516340	Drilled	5008340	463000	Box 450, RR #5, Ottawa	0.00	7.32	Grey Clay / Stones					13.41	11.58	2.44	7.32	Clay / Stones	-	-						
1516601	Drilled	5008362	463170.8		0.00	7.32	Grey Limestone					13.11	12.19	1.52	7.32	Clay	-	-						
1516853	Drilled	5008762	463010.9		0.00	5.18	Grey Gravel / Boulders / Pebbles					91.44	42.67	5.18	5.18	Gravel / Boulders / Pebbles	-	-			5.18	Limestone	48.77	Bedrock
1517002	Drilled	5008521	463229.8		0.00	2.13	Brown Topsoil												2.13	Sandstone	6.7	Bedrock		
1517633	Drilled	5008921	462929.9		0.00	5.49	Black Shale Rock					12.19	12.19	3.05	2.13	Hardpan	-	-						
1517977	Drilled	5008921	462929.9		0.00	5.49	Grey Sandstone												0.91	Limestone	0.91	Bedrock		
1518025	Drilled	5008921	462829.9	RR # 1, Winchester	0.00	0.91	Brown Clay / Sand					39.62	38.71	6.71	0.91	Clay / Sand	-	-						
1518388	Drilled	5008621	463029.9		0.00	28.96	Grey Limestone												28.96	Black Limestone				
1518676	Drilled	5008621	463029.9		0.00	3.35	Brown Clay												3.35	Grey Hardpan				
1519255	Drilled	5008621	463029.9		0.00	7.32	Grey Limestone												7.32	Limestone	0.92	Bedrock		
1528839	Drilled	5008279	463430.8		0.00	1.83	Red Clay												1.83	Grey Hardpan / Stones				
1529156	Drilled	5008320	463485.8	Rosemeadow, Metcalfe	0.00	5.49	Grey Clay / Hardpan												5.49	Limestone	0.61	Bedrock		
1529440	Drilled	5008279	463527.8	Rosemeadow, Metcalfe	0.00	12.19	Grey Limestone												12.19	Grey Hardpan / Gravel				
1532274	Drilled	5008811	463393		0.00	6.10	Grey Hardpan / Gravel												6.10	Limestone	0.61	Bedrock		
1533379	Drilled	5008835	463532.4	8323 Van Rens Street, Metcalfe	0.00	19.81	Grey Limestone												19.81	Grey Limestone				
1533384	Drilled	5008369	463577.4	434-300 Earl Grey Dr, Kanata	0.00	24.69	Grey Limestone / Boulders												24.69	Grey Limestone				
1533508	Drilled	5008782	463556	8372 Van Rens street, Metcalfe	0.00	37.49	Grey Limestone / Shale Layered												37.49	Grey Limestone / Shale Layered				
1534637	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	37.49	Grey Hardpan / Dense												37.49	Grey Hardpan / Dense				
1535033	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	25.91	Brown Hardpan / Dense												25.91	Grey Limestone / Red Shale Layered				
1535379	Drilled	5008835	463532.4	8323 Van Rens Street, Metcalfe	0.00	8.53	Sandy Clay												8.53	Limestone	4.57	Bedrock		
1535384	Drilled	5008369	463577.4	434-300 Earl Grey Dr, Kanata	0.00	89.61	Grey Limestone												89.61	Sandy Clay				
1535508	Drilled	5008782	463556	8372 Van Rens street, Metcalfe	0.00	89.61	Grey Limestone / Boulders												89.61	Grey Limestone / Boulders				
1535637	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	83.21	Brown Clay / Gravel / Boulder (Loose)												83.21	Grey Limestone (Hard)				
1535638	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	10.06	Grey Limestone (Hard)												10.06	Grey Limestone (Hard)				
1535639	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	12.19	Grey Shale (Hard)												12.19	Grey Shale (Hard)				
1535640	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	12.19	Grey Limestone (Hard)												12.19	Grey Limestone (Hard)				
1535641	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	34.75	Grey Limestone / Hard Rock												34.75	Grey Dolomite (Hard)				
1535642	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	34.75	Brown Clay / Stones												34.75	Grey Dolomite (Hard)				
1535643	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	73.46	Grey Limestone / Dolomite Layered (Hard)												73.46	Grey Limestone / Dolomite Layered (Hard)				
1535644	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	30.48	Brown Hardpan / Stone / Clay												30.48	Brown Hardpan / Stone / Clay				
1535645	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	118.20	Sand / Rock Fill												118.20	Grey Limestone				
1535646	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	118.20	Grey Sandstone / Limestone Mixed												118.20	Grey Sandstone / Limestone Mixed				
1535647	Drilled	5008929	463352	8282 Lourdes, Metcalfe	0.00	134.10	Brown Clay / Packed Stones												134.10	Brown Clay / Packed Stones				
1535648	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	83.21	Grey Limestone (Dark, Broken Layers)												83.21	Grey Limestone (Dark, Broken Layers)				
1535649	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	29.87	Brown Clay / Packed Stones												29.87	Brown Clay / Packed Stones				
1535650	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	8.30	Brown Clay / Packed Stones												8.30	Brown Clay / Packed Stones				
1535651	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	1.52	Brown Clay / Packed Stones												1.52	Brown Clay / Packed Stones				
1535652	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	83.21	Grey Limestone (Dark, Broken Layers)												83.21	Grey Limestone (Dark, Broken Layers)				
1535653	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535654	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535655	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535656	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535657	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535658	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535659	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535660	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535661	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535662	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535663	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535664	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535665	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535666	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535667	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535668	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535669	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535670	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535671	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535672	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535673	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535674	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535675	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535676	Drilled	5008489	463143	2800 Albert Street, Metcalfe	0.00	15.20	Brown Clay / Packed Stones												15.20	Brown Clay / Packed Stones				
1535																								

Table A-1: MECP Well Record Database for the Area Identified in Drawing G1.0

Well Information		Location			Date Constructed	Borehole Log			Well Depth (m)	Depth to Water (m)	Static Water Level (m)	Stratigraphy				Accessed Aquifer			
ID	Type	Northing	Easting	Address		Start Depth (m)	End Depth (m)	Description				Overburden Thickness (m)	Description	Contact Zone (m)	Description	Depth to Bedrock (m)	Description	Depth to Water from Bedrock (m)	Unit
1535213	Drilled	5009021	463334	8279 Nova Lux Way, Metcalfe	12-Oct-04	0.00	0.50	Brown Till	48.76	48.00	6.87	0.50	Brown Till	-	-	0.50	Limestone	0.76	Bedrock
1536635	Drilled	5008965	463409	8290 Nova Lux Way, Metcalfe	18-Aug-06	0.50	48.76	Grey Limestone	99.06	45.72	7.62			-	-	0.91	Limestone	44.81	Bedrock
1536636	Drilled	5008889	463007	2714 Albert ST, Metcalfe	28-Jul-06	0.00	0.91	Brown Flat Rock											
						0.91	99.06	Grey Limestone											
						0.00	4.27	Brown Hardpan / Stones / Gravel	22.86	21.95	3.94	4.27	Brown Hardpan / Stones / Gravel	-	-	4.27	Limestone	0.91	Bedrock
7054471	Drilled	5008921	463364	8292 Lourdes Way, Metcalfe	04-Dec-07	0.00	1.50	Brown Clay / Sand / Stones	73.76	70.00	10.00	1.50	Brown Clay / Sand / Stones	-	-	1.50	Limestone	3.76	Bedrock
						1.50	73.76	Grey Limestone											
7115939	Drilled	5008638	463084	2759 Heatherlyn Cres, Metcalfe	04-Nov-08	0.00	0.91	Brown Clay (Soft)	27.27	12.12	5.00	3.64	Clay	-	-	3.64	Limestone	15.15	Bedrock
						0.91	3.64	Red Clay (Soft)											
						3.64	27.27	Grey Limestone											
7166845	Drilled	5008714	463125	2761 8th Line Road, Metcalfe	04-May-11	0.00	3.65	Brown Soil / Stones	106.06	59.43	8.66	3.65	Brown Soil / Stones	-	-	3.65	Limestone	46.63	Bedrock
						3.65	106.06	Grey Limestone (Dark Layers)											
7171814	Drilled	5008875	463378	8312 Lourdes Way, Osgoode	12-Oct-11	0.00	3.66	Boulder / Sand Clay	73.15	69.49	12.85	3.66	Boulder / Sand Clay	-	-	3.66	Limestone	3.66	Bedrock
						3.66	69.49	Grey Limestone											
7197615	Drilled	5008901	463489	8332 Lourdes Way, Metcalfe	23-Nov-12	0.00	2.74	Brown Hardpan / Stones	40.54	39.62	9.30	2.74	Brown Hardpan / Stones	-	-	2.74	Limestone	0.92	Bedrock
						2.74	40.54	Grey Limestone											
7274826	Drilled	5008423	462870	2810 Eldo Street, Metcalfe	30-Sep-16	0.00	6.06	Grey Clay (Soft)	30.90	8.48	2.96	6.06	Clay	2.42	Grey Sand	8.48	Limestone	22.42	Bedrock
						6.06	8.48	Grey Sand (Soft)											
						8.48	30.90	Grey Limestone (Hard)											
7287869	Drilled	5008364	462781	2824 Eldo Street, Metcalfe	17-May-17	0.00	8.53	Sand / Clay / Boulders											
						8.53	23.16	Black Limestone											
						23.16	28.35	Black Limestone	30.78	23.16	22.56	8.53	Sand / Clay / Boulders	-	-	8.53	Limestone	7.62	Bedrock
						28.35	28.96	Black Limestone											
						28.96	30.78	Black Limestone											
7296310	Drilled	5008330	462758	2834 Eldo Street, Metcalfe	09-Aug-17	0.00	1.52	Clay											
						1.52	7.32	Fine Silt / Gravel	25.60	20.42	2.64	7.32	Clay / Silt / Gravel	-	-	7.32	Limestone	5.18	Bedrock
						7.32	20.42	Grey Limestone											
						20.42	21.64	Grey Limestone											
						21.64	25.60	Grey Limestone											
7383631	Drilled	5008428	462793	2811 Eldo Street, Metcalfe	14-Sep-20	0.00	3.66	Sand											
						3.66	10.67	Clay with Stones	24.38	20.42	3.66	7.01	Clay	-	-	10.67	Limestone	3.96	Bedrock
						10.67	11.58	Fractured Bedrock											
						11.58	24.38	Med Limestone											
Average									31.98	24.73	4.42	5.01		2.08		5.35		8.36	
Maximum									134.10	121.30	22.56	15.54		4.27		15.54		53.34	
Minimum									5.18	5.18	0.61	0.00		0.30		0.00		0.30	

APPENDIX B

EVB Technical Memorandum



TECHNICAL MEMORANDUM

PROJECT: Larry Robinson Arena Expansion
DATE: August 20th, 2024
TO: Kevin Voelker, C.E.T.
FROM: Adam Poapst, P. Eng
RE: Inspection of Existing Sewage Works

1 INTRODUCTION

1.1 BACKGROUND

EVB Engineering was retained by the City of Ottawa to complete an assessment of the existing sewage works servicing the Larry Robinson Arena, located at 2785 8th Line Road, Metcalfe, Ontario.

It is our understanding that the City is intending on constructing an approximately 7,600 square foot building addition on the north side of the existing building. The addition will consist of the modernization and expansion of the current change rooms, providing an enhanced barrier-free entrance, expansive lobby areas with accessible seating facilities, and retrofitting the existing bleachers to meet accessibility standards.

1.2 OBJECTIVES

The following Technical Memorandum has been prepared to address the following requirements:

- ◆ Completion of an intrusive condition assessment of the existing sewage works, including probing and excavations of the tile bed system to confirm the construction and arrangement of the system.
- ◆ A review of the capacity of the existing septic system based on the original design documents and the "as-constructed" condition of the leaching bed components, in an effort to determine the maximum sewage flow that can be supported by the system.
- ◆ Develop recommendations for the existing system upgrades which would provide longevity of the system and potential future expansion.

1.3 METHODOLOGY

On August 8th, 2024, EVB staff were on site to complete a field investigation for the existing on-site sewage system.

This investigation included a visual assessment of the area where the bed is located, probing the area of the septic bed to determine the extents of the distribution pipes, and exposing sections of the distribution piping via test pits to determine the construction details for the septic system.

1.4 EXISTING DOCUMENTATION

1.4.1 ORIGINAL SEPTIC BED (1987)

The original septic system servicing the Larry Robinson Arena was constructed in 1987 and was approved by the Ministry of Environment, Conservation, and Parks under Certificate of Approval (CofA) Number 82 (22-8) 980.

The calculated design flow for the original septic system was determined based on water meter readings for the Lietrim Arena, as the two rinks had similar operating hours and a comparably sized banquet hall on the second floor. The average daily flow for the Lietrim Arena was 13,000 L/d between January and February 1986. To provide a safety factor for peak flows, the design flow included an additional 20 L/seat/day for the 300-person capacity banquet hall. As such, the total daily design sewage flow was 19,000 L/d.

The septic system was constructed as a conventional Class 4 leaching bed, comprised of two beds, each containing 16 runs of 75mm diameter, 30m long, tile piping. The existing septic system included one (1) 45,500 L concrete septic tank and one (1) 4,500L concrete pumping chamber.

1.4.2 UPDATED SEPTIC BED (2001)

The City has provided a drawing titled "Sewage System Layout Plan" prepared by John D. Patterson and Associates Ltd. in August 2000, that indicates the original septic bed has been replaced with a much smaller Class 4 septic system, constructed with a tertiary treatment system. However no other records of this system could be located in the City files.

Based on the notes provided in the drawing, the design sewage flow appears to have been calculated based on a review of pump out records for the existing septic tank between 1997 and 1999. From the pump out records, it was determined that the system produced an average daily flow of 3,800 L/d.

The updated septic system appears to be a Class 4 conventional leaching bed comprised of 10 runs of 75mm diameter, 15m long, perforated PVC pipe. A safety factor of 1.5 was used in sizing the bed to account for peak sewage flows.

The updated septic system includes the existing 45,500 L concrete septic tank, as well as two (2) 22,700 L concrete septic tanks. It appears that the first 22,700 L tank includes duplex sewage pumps in the primary compartment that send effluent to the secondary compartment. Effluent would then flow by gravity into the primary compartment of the second 22,700 L tank, which includes a Clearstream 1000N treatment system. The secondary compartment of the final tank contains a duplex pump system that sends effluent through the forcemain to the septic bed.

2 ASSESSMENT OF EXISTING SYSTEM

2.1 EXISTING SEPTIC TANKS

The existing septic tanks were not assessed during the field investigation, aside from confirming the inlet invert elevation of the primary septic tank.

The location of the existing tanks are directly within the extents of the proposed building addition and given the age of the existing tanks (41 years), it is likely that any attempt to relocate them would result in adverse affects to the structural integrity of the tanks. As such, it is recommended that the existing septic tanks be replaced with new tanks.

2.2 EXISTING LEACHING BED

2.2.1 VISUAL INSPECTION

At the time of the site visit, EVB located the existing septic bed within a fenced area in the field on the east side of the arena. Upon initial inspection, the construction of the leaching bed appeared to be consistent with the design drawings prepared by Paterson in 2001.

The leaching bed did not display any visual signs of failure, such as blowouts or seeps, and/or spongy wet spots throughout the area of the bed.



Figure 2-1: Existing Leaching Bed

2.2.2 INTRUSIVE INSPECTION

In order to confirm the length and configuration of the existing distribution piping, EVB staff located the header and footer at the four corners of the distribution piping. Once one corner was confirmed, EVB located each run of distribution piping by probing the soil along the header and footer and marking each pipe location with spray paint. Additional locations along the header and/or footer were exposed to confirm the location the distribution pipe run.

The inspection confirmed that the leaching bed was comprised of 10 runs of 15m long, 75mm diameter, perforated distribution piping, spaced at 1.6m. The header and footer pipe were comprised of solid 75mm diameter white PVC pipe. The configuration of the leaching bed is consistent with the Patterson drawing from 2000.

One test pit was dug down to determine the total depth of sand in below the distribution piping and confirm whether any signs of failure could be observed. The test pit indicated the leaching bed consisted of 0.30m of septic sand below a layer of topsoil, followed by a 75mm diameter distribution pipe installed with a geosynthetic liner within a 0.30m thick layer of clean septic stone. Below the septic stone was approximately 0.90m of septic sand. The gravel and septic sand below the distribution piping was dry and did not show any evidence of failure (i.e., saturate soils, ponding effluent, biofilm, etc.).



Figure 2-2: Septic Sand in TP1



Figure 2-3: Septic Stone in TP1

3 CAPACITY ASSESSMENT

The design capacity for the existing sewage works has been determined following a review of the original design details and the observations made on-site, in comparison to the Ontario Building Code.

3.1 REVIEW OF DESIGN SEWAGE FLOWS

Table 8.2.1.3.B of the Ontario Building Code (OBC) does not include Hockey Arenas in its list of establishments, however "Stadiums, Racetracks, Ball Parks" would be the closest establishment to an arena. As such, the design sewage flow would be based on a volume of 20 L/seat/day. Additionally, there is a community center and kitchen located on the second floor of the arena. Table 8.2.1.3.B of the OBC states that assembly halls with food services provided have a design flow of 36 L/seat/day.

In order to calculate the design sewage flows based off Part 8 of the OBC, the following assumptions were made regarding the arenas capacity:

1. Arena stands: 824 seats – based on As-Built Drawing "Second Floor Plan" by Graham Berman & Associates (date unknown)
2. Community Center: 300 seats – based on Metcalfe Arena Sewage System prepared by Oliver, Mangione, McCalla & Associates, dated October 29, 1987.

Based on the assumptions above, the design flow for the Larry Robinson Arena would be as follows:

Stadiums, Racetracks, Ball Parks

$$1 - \text{Per Seat} = 824 \text{ seats} \times 20 \text{ L/seat/d} = 16,480 \text{ L/d} +$$

Assembly Halls with Food Service Provided

$$2 - \text{Per Seat} = 300 \times 36 \text{ L/seat/d} = 10,800 \text{ L/d}$$

Total Estimated Design Sewage Flow

$$\text{Total Design Flow} = 16,480 \text{ L/d} + 10,800 \text{ L/d} = 27,280 \text{ L/d}$$

3.2 CAPACITY ASSESSMENT

The following equations from Part 8 of the Ontario Building Code are used to determine the minimum size requirements of a new septic system based on the design sewage flow.

Minimum Length of Distribution Piping: $L = Qt/300$ (with Level IV Tertiary Treatment)

Minimum Volume of Septic Tank: $V = 3Q$ (for commercial systems)

Where L is the length of distribution piping required, Q is the design sewage flow for the system, and t is the design percolation rate of the imported sand material. Septic sand typically has a percolation rate of 6 to 10 min/cm, as such, an assumed value of 8 min/cm has been used.

Based on the Length of Distribution Piping:

$$\begin{aligned} L &= Qt/300 \\ Q &= L \times 300 / t \\ &= 150\text{m} \times 300 / 8 \\ &= 5,625 \text{ L/d} \end{aligned}$$

Based on the Size of Septic Tanks:

$$\begin{aligned}V &= 3Q \\Q &= V/3 \\&= (45,500 + 22,700) / 3 \\&= 68,200 / 3 \\&= 22,733 \text{ L/d}\end{aligned}$$

From the calculations above, the size of the leaching bed is the limiting factor on the capacity of the existing septic system servicing the Larry Robinson Arena. As such, the system should be capable of handling a maximum sewage flow of 5,625 L/d.

Based on Table 8.2.1.3.B. of the OBC, the average daily design flow for the arena would be approximately 27,280 L/d, which is 4.8x higher than the capacity of the leaching bed. Although the daily water use may be less than the calculated design flow, there are no historical water use records for the Larry Robinson Arena. As such, the OBC design flow should be used as the basis for the design of a new leaching bed.

Aside from a drawing titled "Sewage System Layout Plan" prepared by John D. Paterson and Associates Ltd in August 2000, there does not appear to be any record/approval of this septic bed on file at the City. Given the large reduction in design flows, further attempt to locate this approval should be made in order to determine whether the bed can remain in place.

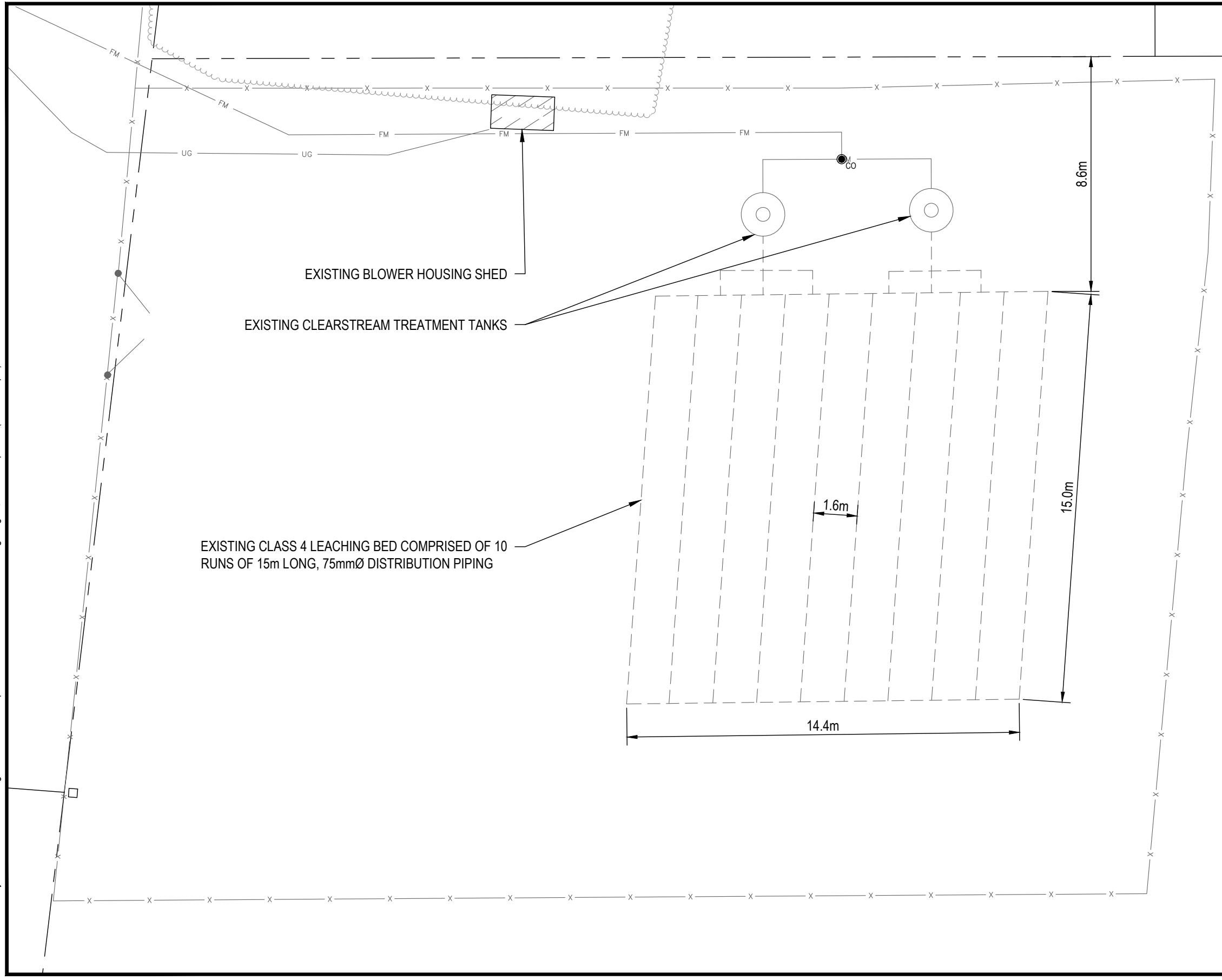
Because the calculated design flow exceeds 10,000 L/d, a new septic system would be regulated under Section 53 of the Ontario Water Resources Act (OWRA) and administered by the Ministry of Environment, Conservation, and Parks (MECP) and an Environmental Compliance Approval would need to be issued by for the system.

Respectfully Submitted,

EVB Engineering



Adam Poapst, P. Eng
Environmental Engineer
cc. Jamie Baker, EVB Engineering



LEGEND

- EXISTING FENCE
- EXISTING PROPERTY LINE
- EXISTING POWER SUPPLY
- EXISTING TREELINE
- EXISTING BUILDING
- EXISTING DISTRIBUTION PIPE
- EXISTING SEPTIC TANK
- EXISTING FORCEMAIN
- EXISTING CLEAN OUT



800 SECOND STREET WEST
CORNWALL, ONTARIO CANADA, K6J 1H6
TEL: 613-935-3775 | FAX: 613-935-6450
WEBSITE: EVBengineering.com

CLIENT:

CITY OF OTTAWA

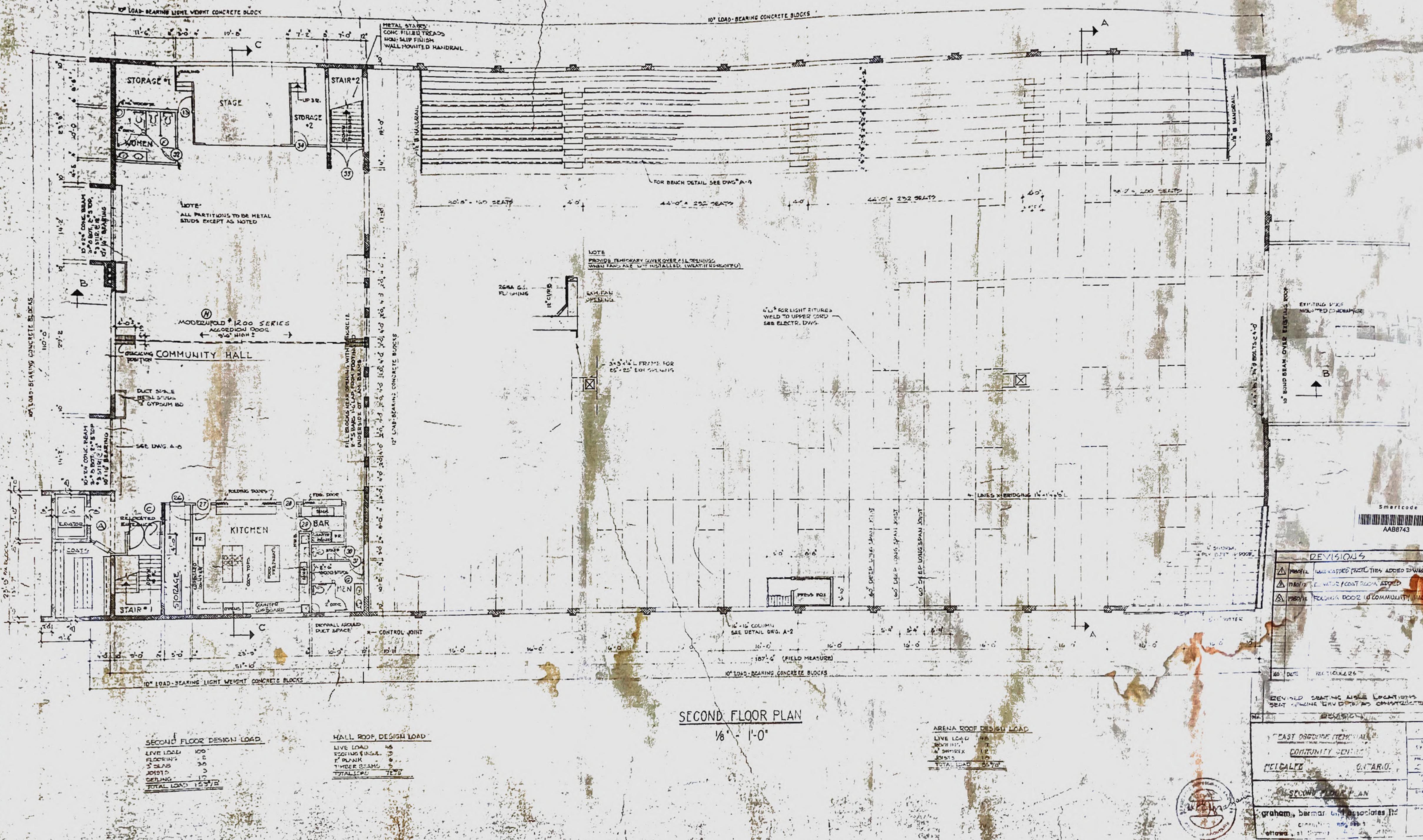
PROJECT:

LARRY ROBINSON ARENA
NEW ADDITION

TITLE:

EXISTING SEPTIC BED

SCALE: 1:150	JOB NO: 23211
DESIGNED BY:	DATE: 24/08/20
DRAWN BY: AP	DRAWING NO.
CHECKED BY: JB	FIG. 1



File Search Reply – Match Found

To: Kevin Voelker **Date:** July 3, 2024
Email: Kevin.voelker@ottawa.ca **Phone:** 613-580-2424 x23728

Follow up Inquiries Please Reference: 24OT077F Archive file: 1987-890 Civic Address: 2785 8 th Line Rd Former Township: Osgoode		
	Septic system designed per the attached records for:	Real estate feature listing obtained via the internet:
Bedrooms	n/a	
Bathrooms		
Square M		

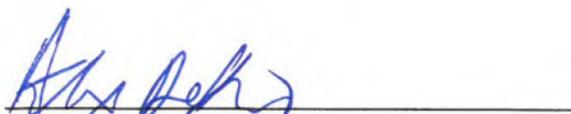
Attachment(s):

- Permit / Application
- Drawings

The foregoing information is given for your convenience only. Supplementary requests are necessary for conformity with other legislation such as flood plain or shoreline works. It should be clearly understood that you must satisfy yourself as to whether the premises and the existing or proposed use thereof is or would be in conformity with all applicable regulations. For further information please contact the Septic Office staff at the number listed above.

Thank you for contacting the Septic Approval Office.

Part 8 Inspector: Alex Dekleine





Ministry
of the
Environment

**APPLICATION FORM AND CERTIFICATE OF
APPROVAL FOR A CLASS 2-6 SEWAGE SYSTEM**
(Please Print Clearly)

(Please Print Clearly)

Application No. 82 (22-8) 980
Fee Receipt No. 4771
Date Received 10.04.87

1. Name of Owner Township of Osgoode		Tel. No. 821-1107		2. Installer's Name		Tel. No.	
Address P.O. Box 130 (No., Street, City, Town, etc.) Metcalfe, Ontario K0A 2P0				Address (No., Street, City, Town, etc.)			
<p>3. Propose to <u>construct</u> a Class <u>4A</u> sewage system to serve the arena (<u>METCALFE</u>) (Construct/Install/Alter/Extend/ Enlarge)</p> <p>4. Location — Region, County, District R.M.O.C.</p> <p>5. State No. of</p> <p>6. Water Supply</p> <p>SEE ATTACHED DESIGN</p>							

7. Attach completed sketch on Page 2 – List other attachments:

<p>8. Relationship to Severance if applicable</p> <p><input type="checkbox"/> Lot Approval Pending</p> <p><input type="checkbox"/> Lot Approved</p> <p>Under Severance Application No.</p>	<p>9. Directions to Lot:— Highway No., Secondary Roads, Signs to Follow, etc.</p> <p>ALBERT STREET - ULG OF METCALFE</p>
--	--

10. I certify that the above information is complete and correct and that, if approved, the work will conform with Provincial requirements for sewage systems and local Municipal By-Laws.

Name of Agent Oliver, Mangione, McCalla & Assoc. Ltd.	Tel. No. 225-9940	Signature of Owner or Agent S. G. Simmerling
Address (No., Street, . . .) 154 Colonnade Road South		Date S.G. Simmerling, P.Eng.
City, Town, etc. Nepean, Ontario K2E 7J5		Date September 24, 1987

11. INSPECTOR'S REPORT		Inspection Time and Date <u>9:50 AM</u> <u>NOV 3 1987</u>	Sub-Surface Conditions Encountered			
Weather <u>Cloudy</u> <u>Rain</u>	Representing Owner	Leaching Bed Design Criteria		Rock & G.W.T.	Depth (m)	Soil Type
		Depth to Rock m.	Design H.W.T. m.			
REQUIREMENTS		Length of Distribution Pipe (metres)	Working Capacity of Septic/Holding Tank (Litres)		-0	
				-0.25		
				-0.50		
				-0.75		
				-1.00		
				-1.25		
				-1.50		

Conditions of Approval and Reasons (e.g. fill, grading, drainage improvements, design sewage flows)

OR

Reasons where Proposal not Acceptable (add additional pages if required)



12. LOT DIAGRAM AND SEWAGE SYSTEM PLAN: — Draw to scale indicating north point and showing:

- Location of sewage system components (e.g. tanks, leaching bed). Locate and show horizontal distances from system to adjacent existing or proposed buildings, water supplies (including neighbours), existing on-site sewage systems, driveways, property lines, lakes, rivers, water courses, swimming pools.
- Lot dimensions, topographic features (e.g. swamps, steep slopes) near system.
- If any part of proposal conforms to a specific standard drawing, give reference number(s).

SEE DRAWING #87-5707-SSL #87-5707-SD1 BY OLIVER, MANGIONE, McCALLA & ASSOCIATES LIMITED

13. A Certificate of Approval for this application is refused for the reasons given in Section 11 Page 1

INSPECTED AND RECOMMENDED BY	REFUSED	DATE
DIRECTOR		

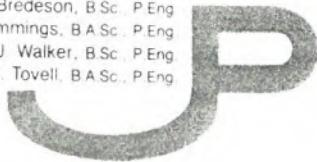
CERTIFICATE OF APPROVAL

Application approved and this Certificate of Approval under Section 65 of the Environmental Protection Act is hereby issued for the proposal outlined on Pages 1 and 2 of the application and its attachments as amended by the requirements and conditions of Section 11 provided that the sewage system shall be completed and a Use Permit issued within 12 months of the issue hereof or such extended period as the Director on application allows. DO NOT OPERATE THE SYSTEM UNTIL A USE PERMIT IS ISSUED.

INSPECTED AND RECOMMENDED BY	ISSUED	DATE
DIRECTOR		

Under Section 121 of the Environmental Protection Act, an applicant may appeal a decision by writing to the Director and to the Environmental Appeal Board, 1 St. Clair Avenue West, Toronto, Ont., M4V 1K7 within 15 days of receipt of the decision.

L. Bredeson, B.Sc., P.Eng.
B. F. Cummings, B.A.Sc., P.Eng.
S. J. Walker, B.Sc., P.Eng.
A. J. Tovell, B.A.Sc., P.Eng.



JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Engineers & Geologists
Soil Investigations
Inspection & Testing Services
Damage Claims

Offices & Laboratory
28 Concourse Gate
Nepean, Canada K2E 7T7
Telephone (613) 226-7381

July 17, 1987

Oliver, Mangione, McCalla and
Associates Limited
154 Colonnade Road South
Nepean, Ontario
K2E 7J5

Attention: Mrs. Sheila Clark, P. Eng.

Subject: New Septic Sewage System
Metcalfe Arena
Project No. 5707

Dear Mrs. Clark;

The soil sample that was submitted to this firm from the above noted project has been analyzed and the results interpreted in terms of the soil's applicability to the proposed leaching bed for the septic system.

The sample is comprised of 26% gravel-sized particles, 36% sand-sized particles, and 38% finer than the #200 mesh sieve. From a visual examination of the fine particles, it was determined that they were predominantly silt-sized with less than 15% being clay-sized particles. The coarse fraction is generally angular to sub-angular. The sample can be texturally classified as a silty sand-gravel (SM-SC).

The percolation time (T-time) has been estimated to be 15 min/cm on the basis of the grain size distribution results. Also, the hydraulic conductivity (K) has been estimated to be on the order of 10^{-4} cm/s.

We trust that this letter will provide you with sufficient information for your present needs. If we can be of further assistance, please call.

Yours truly,

JOHN D. PATERSON & ASSOCIATES LTD.

DH/hj

David R. Harding, M.Sc.

REPORT NO. CL 6259-87

Job: 87-5707

October 29, 1987

METCALFE ARENA SEWAGE SYSTEM

1. Calculation of Sewage Quantities

The sewage quantity for the arena system is based on the water metre reading for the Lietrim Arena for January and February 1986. The Lietrim Arena like the Metcalfe Arena has ice only in the winter and has banquet facilities upstairs of comparable size. The metre reading for the two winter months averaged 13,000 L/day.

*- SEATING CAPACITY?
- NO. OF FIXTURES?
- WHAT ABOUT PEAK PER DAY?*
In order to add a factor of safety for a peak day we have added an extra 20 L/day/seat for the assembly hall licensed for 300 people, for a total of 6000 L/day.

Total peak flow for a day is therefore estimated to be 19,000 L.

Sewage characteristics are anticipated to be of domestic strength given waste is primarily from washroom use.

2. Septic Tank

?
3 X
Double flow per day since facility is not in 24 hour use and peak flow should only be on weekends on a 12 hour flow basis.

*19,000 x 2 = 38,000 litre tank or 8,400 gallons
propose 45,500 L or 10,000 gallon
(existing tank 3200 gallons)*

3. Tile Bed

Two - 6 hour percolation tests were performed and the average rate was 6.6 min/cm and 7.7 min/cm for percolation hole #1 and #2 respectively.

Grain size distribution analysis performed by J.D. Paterson on soil samples taken by the soils consultant indicated a hydraulic conductivity estimated to be in the order of 10^{-4} cm/sec. with an estimated "T"-time of 15 min/cm.

$$L = (19,000) (10) / 200 = 950 \text{ m of tile}$$

Job: 87-5707

October 29, 1987

- 2 -

Using the above information plus the fact that imported Granular 'C' material will have an approximate "T" of 5 min/cm and less than 5% passing the No. 200 sieve, the "T" used for design was 10 min/cm.

As a result, two (2) beds are proposed, each consisting of 16 runs at 30 m for a total of 960 lineal metres of 75 mm diameter tile.

4. Pumping Chambers

*CH 6 C's
posicg
CALCS?*

A duplex pumping system is proposed, each 1 Hp. pump serving one-half of the tile field. At a rate of 200 L/min, the 1930 litre dosage volume will have a duration of 9.7 min and a maximum frequency of 9.8/day.

5. Test Holes

A series of 8 test holes were dug by a backhoe in the proposed tile field area. They ranged in depth from 0.6 m to 2.25 m to hardpan; no water table was found.

Typically, 150 - 200 mm topsoil over silty - sand gravel to hardpan was encountered. The grain size analysis is attached in Appendix A.

6. Mounding Calculations

*- GIVE CALCS
- mounding
- unopen B6D!*

Mounding calculations were performed, based on tile field effluent quantities only, by Darcy's Law using the hydraulic conductivity of the existing native soil as well as the imported sand. The mounding shape is shown on Section A-A of Drawing SSL based on permeabilities of 10^{-2} and 10^{-4} cm/sec for imported and native materials, respectively.

7. Hydrogeology

The direction of the bedrock ground water flow is in a southeast direction as determined from an examination of the existing well records in the area.

?

There is only one existing well in the immediate vicinity of the new tile bed as shown on the plan. It is a 46 m deep drilled well and is located over 30 m away and up-gradient from the new bed. The rest of the area around the bed is vacant land.

OLIVER, MANGIONE, McCALLA & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Job: 87-5707

- 3 -

October 29, 1987

Since the site is underlain by hardpan with no unconfined water table to be affected by tile field effluent, the proposed installation will have no effect on ground water in the area.



Ministry
Of The
Environment
Ontario

VILLAGE OF METCALFE

Township Of Osgoode



Kostuch
Engineering
Limited

Private Waterworks Project No. 8-0099

OWNER & ADDRESS METCALFE COMMUNITY CENTRE METCALFE, ONT. K0A 2P0		TELEPHONE	TENANT & ADDRESS		TELEPHONE	PERSON INTERVIEWED H. COWAN
						PREVIOUS OWNER
BUILDING DESCRIPTION BLOCK ARENA		BUILDING USE SINGLE FAMILY <input checked="" type="checkbox"/> OTHER (<input type="checkbox"/> RINK)	HALL RINK	NORMAL OCCUPANCY		NO. OF BEDROOMS
LOT DIMENSIONS (m)		BUILDING DIMENSIONS (m) 70 x 34		BASEMENT PLUMBING DEPTH FULL <input type="checkbox"/> HALF <input checked="" type="checkbox"/> NONE <input type="checkbox"/> PUMP		
M.O.E. IDENTIFICATION No. 78	SURVEYED BY R.E.S.	DATE 16 08 84		LOCATION 2785		

EXISTING SEWAGE SYSTEM

TYPE: SEPTIC SYSTEM CESSPOOL LEACHING PIT
 HOLDING TANK CLASS 4 YEAR 51
M.O.E. APPROVAL _____ No. _____
TANK SIZE 2m x 8m MATERIAL CONCRETE
LAST CLEANED 1983 TILE LENGTH 180 (6 ROWS) m
RAISED TILE BED YES NO
ROCK DEPTH 2.0 m SOIL TYPE CLAY
SEPARATION DISTANCES STANDARD
WATER TABLE DEPTH 3.5 m
INCONCLUSIVE RATING/INSPECTION REQUIRED _____
PERCOLATION RATE _____ CLASSIFICATION A B
COMMENTS:
* WELL INSIDE BUILDING SINCE ORIGINAL
RINK (1951) BURNED DOWN - NEW BLDG
(1973) BUILT OVER EXISTING WELL.
* SURFACE PONDING AT LEACHING BED SITE

RECOMMENDATIONS/COSTS

CLASS 4
SEPTIC TANK _____
TILE BED _____ m

CLASS 6
REPLACE SEPTIC TANK _____
REPLACE TILE BED _____ m
RAISED BED _____ m
PUMP INSTALLATION _____
PUMP OUT _____
HOLDING TANK _____
LAND _____ m x _____ m
OTHER: PLUMBING _____
: _____
PROVISIONAL ALLOWANCE _____

TOTAL SEWAGE \$

EXISTING WATER SUPPLY

SOURCE: DRILLED WELL DUG WELL SHARED
YEAR 51 DEPTH 26 m
WELL RECORD No. _____
DRILLERS NAME MAURICE CAYER
DRILLER'S LICENCE No. 1517
CASING: YES DIA 150 mm DEPTH 4.0 m
QUALITY: G F P QUANTITY: G 83 09 23 P
TREATMENT NONE DATE SAMPLED 84 08 13
SEPARATION DISTANCES STANDARD
BACTERIAL: TOTAL <2 - <2 FAECAL 0 - 0
HARDNESS 277 ALKALINITY 270 IRON 0.16
CHLORIDE 164 pH 7.87 CONDUCT. 1230*
AMMONIA 0.51 NITRITE 0.01 NITRATE 0.22*
CLASSIFICATION A B
★ BEYOND MAXIMUM ACCEPTABLE CONCENTRATION

COMMENTS:

- WELL SERVICES ARENA & CURLING CLUB (#2793)
- WHEN #2793 IS NOT BEING FED BY LIONS DEN (#2803)

RECOMMENDATIONS/COSTS

DRILL NEW WELL _____
SEAL OLD WELL _____
INSPECT & UPGRADE _____
SULPHUR AND/OR
IRON REMOVAL UNIT _____
NEW PUMP _____
OTHER: _____
COMMENTS: _____

TOTAL WATER \$

CLASS <u>4</u>	RATING <u>B</u>	<input type="radio"/>	RATING <u>A</u>
		TOTAL ESTIMATED COST \$	

2785 ALBERT

Geological/Hydrogeological Constraints

- generally not suitable for residential development due to potential for groundwater contamination with septic effluent
- site specific evaluation by hydrogeologist may permit construction of houses in certain localities within this terrain unit

Till Plain (Unit 1a)

General Stratigraphy

- sandy and silty, poorly sorted and compact
- grey at depth but brown where oxidized
- calcareous where not leached
- consists dominantly of lodgement till (ie. deposited beneath glacial ice lobe) showing compact fissile structure
- in areas that lie below marine limit (approx. 198 m/650 feet ASL) this unit is overlain by a discontinuous lag deposit consisting of sand, gravel and boulders
- this unit directly overlies bedrock within study area with a thickness of +/- 1 metre
- thickness of this unit over bedrock may be highly variable especially in areas where rock outcrops are nearby

Slope

- generally 0-3%
- local relief less than 5 metres

Drainage

- fair to good depending on localized relief and existing drainage pattern

Hydraulic Conductivity

- 10⁻³ to 10⁻⁶ cm/s
- generally decreasing with depth

Estimated Depth to Water Table

- +/- 1 metre below surface

Geological/Hydrogeological Constraints

- bedrock may be near the surface, therefore, site specific evaluation of residential development potential is required

Drumlinized Till (Unit 1b)

General Stratigraphy

- same as terrain unit 1a
- some of the drumlins within study area may have bedrock cores with a minimal thickness (0.5 - 1.0 metre) of sediment

100 igpm (7.4 l/s) from this zone. The potential for well interference was not assessed during our testing work. However, it is highly probable that a communal water supply sufficient for the needs of Metcalfe could be developed in this area. Several points are worthy of note.

- 1) A well field would be required to obtain the over 200 igpm of safe yield necessary to service the community.
- 2) The use of the shallow aquifer would require the isolation or 'sterilization' of the well field from any surrounding land uses that would produce contaminants. A 100 acre land parcel would probably be necessary for this purpose.
- 3) Extensive aquifer testing would be required to determine if boundary conditions exist in this fractured limestone aquifer.

5.0 DISCUSSION OF CONTAMINATION PROBLEMS

All available water chemistry data have been studied in light of our field evidence about the hydrogeological conditions present in the Village of Metcalfe. We would like to address a number of points based on these data.

- 1) The source of contamination to wells in the village is septic tank effluent. The geological conditions beneath the village have permitted the migration of contaminants between tile beds and wells throughout Terrain units 1A and R which comprise most of the village area. In clay terrain (unit 3) the impermeable soil has protected the bedrock aquifer to some extent and well contamination is not as wide spread.
- 2) It is probable that almost all the wells in present use in the village have not been cement grouted. These wells are improperly constructed for the terrain conditions present and all wells which are now free of contamination have a high potential to become contaminated in the future.
- 3) If wells are constructed to depths of greater than 21 meters low levels of hydrogen sulphide gas can be expected in the groundwater in most areas of the village. If wells are drilled to depths in excess of 30 meters, especially in the south western quadrant of the village high natural chloride concentrations will be encountered. It is important therefore that chloride levels be monitored during the drilling of new wells and that wells be terminated as soon as an adequate water supply for a domestic residence is obtained.
- 4) The contamination throughout the village is of point source origin, however many tile beds are contributing effluent to the bedrock aquifer as shown by the random and variable distribution of contaminants across the study area. Our investigations in the Mandor area showed that migration of effluent between lots is occurring but on a localized not widespread scale.

POTENTIOMETRIC SURFACE CONTOUR MAP

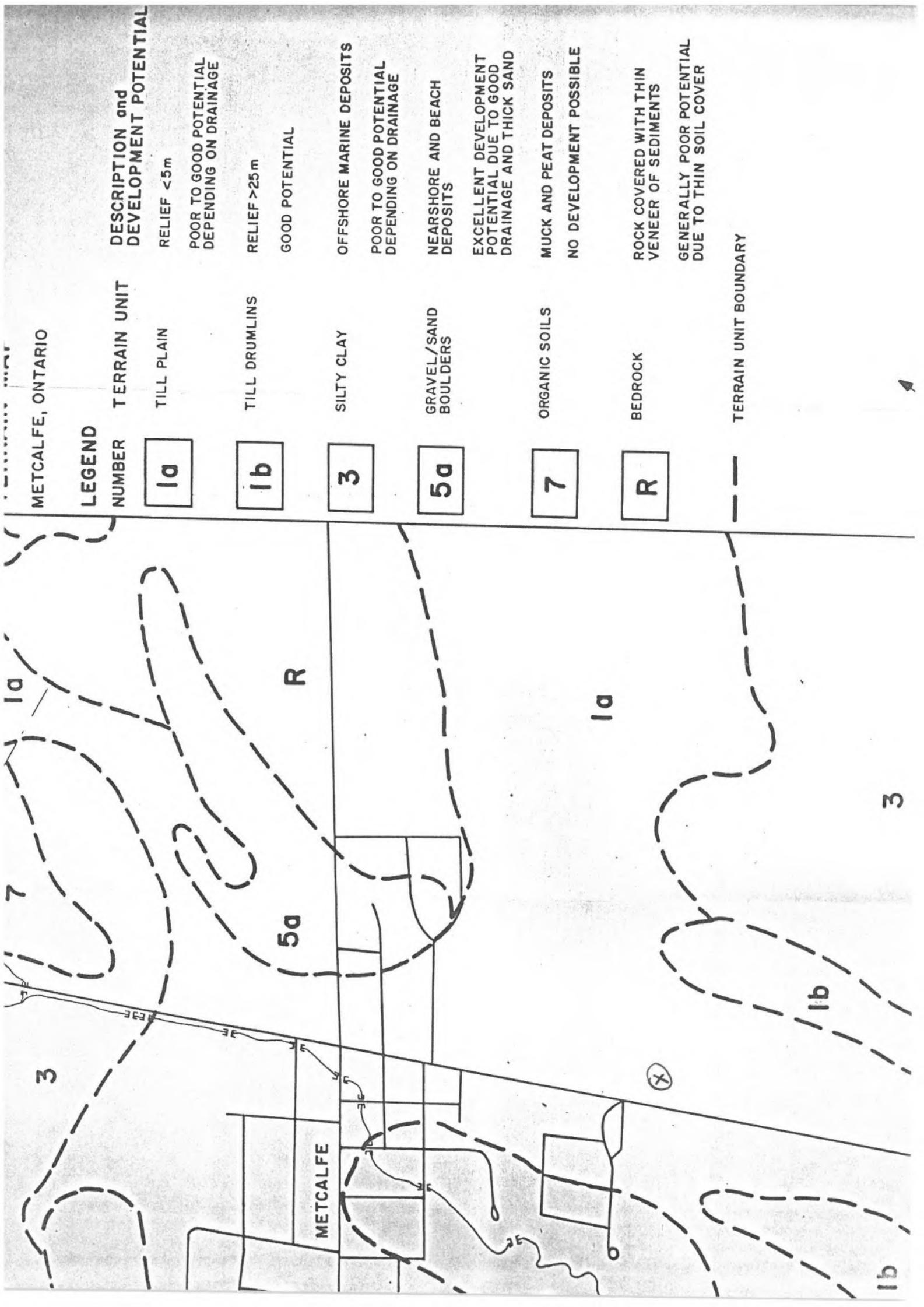
METCALFE, ONTARIO

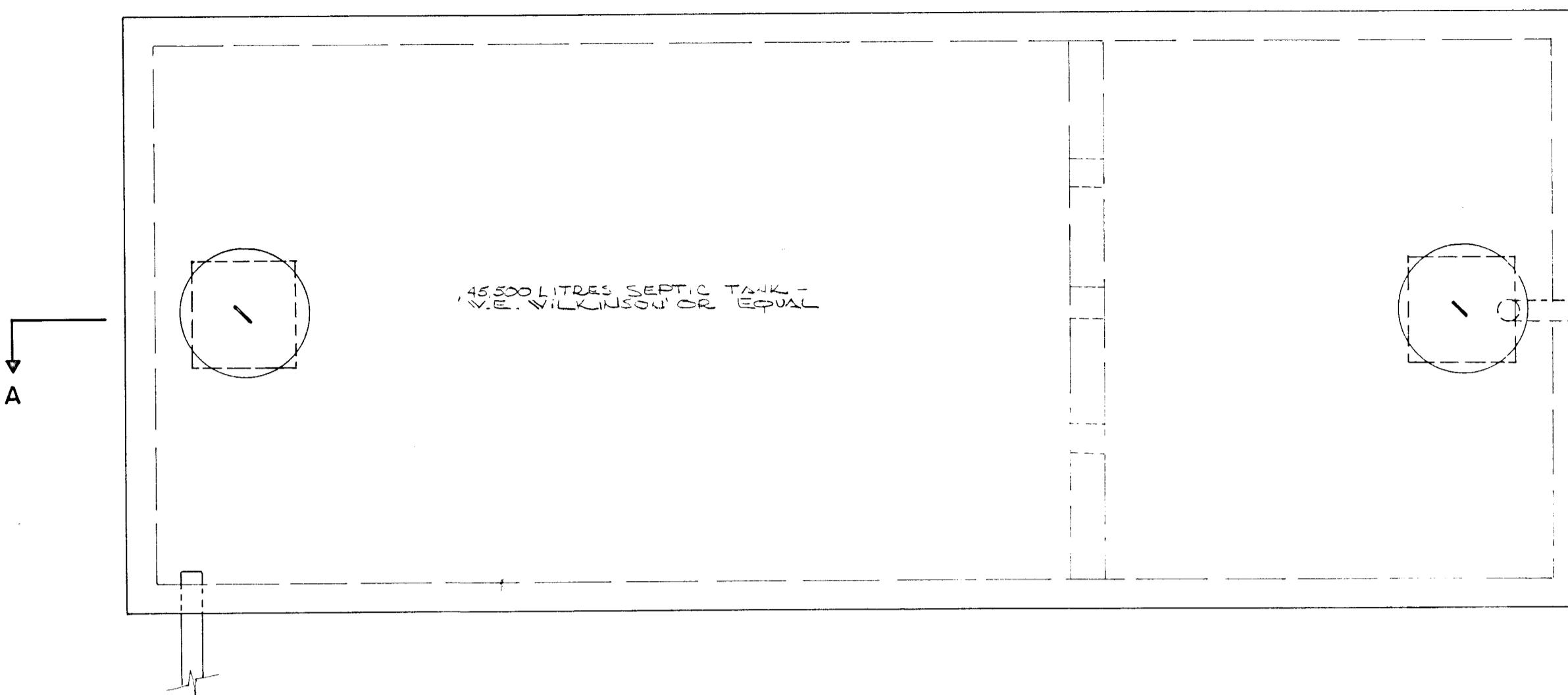
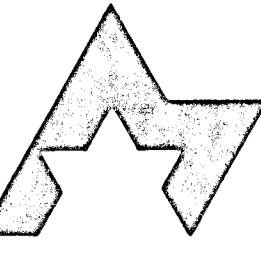
LEGEND

— 82 — POTENTIOMETRIC SURFACE CONTOUR (metres A.S.L.)

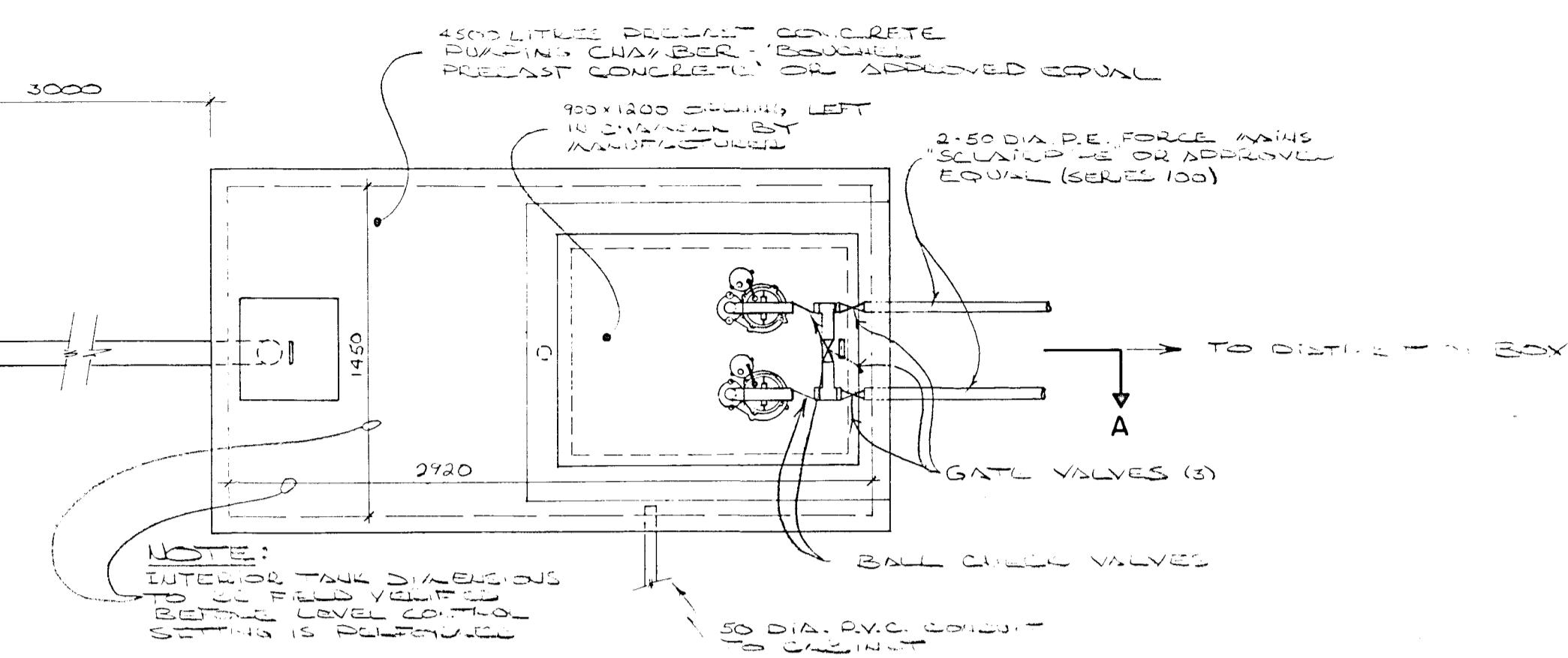
→ GROUNDWATER FLOW DIRECTION







PLAN VIEW

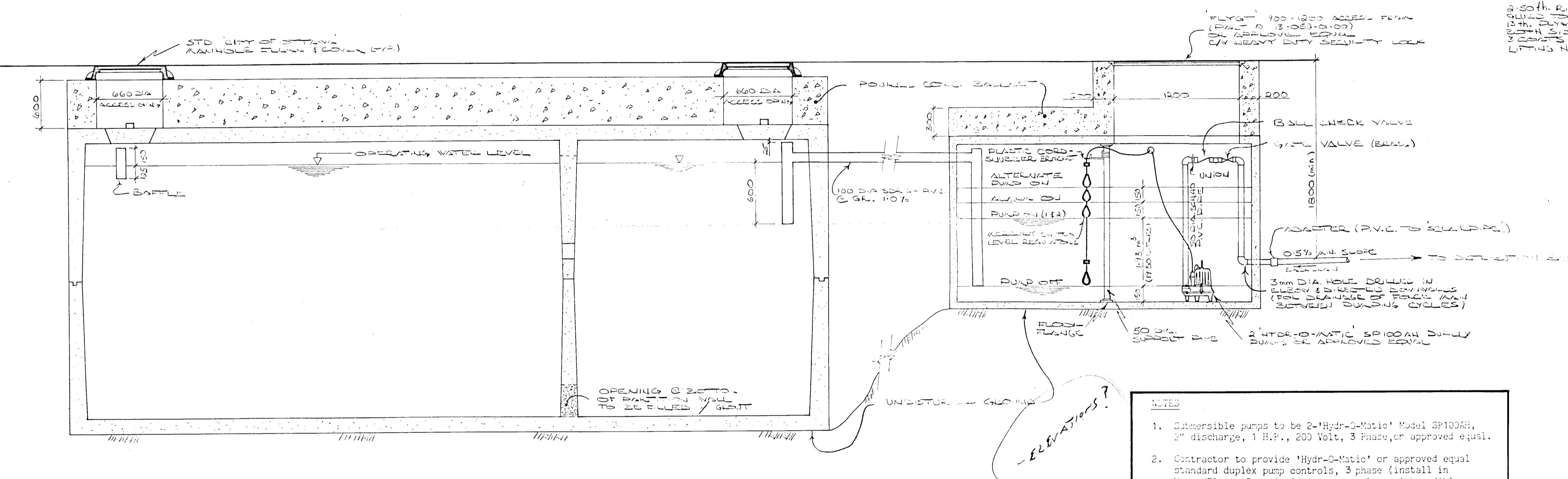


2-100 DIA. PVC. ENCLOSURES
ENSURE INVERTERS ARE IDENTICAL

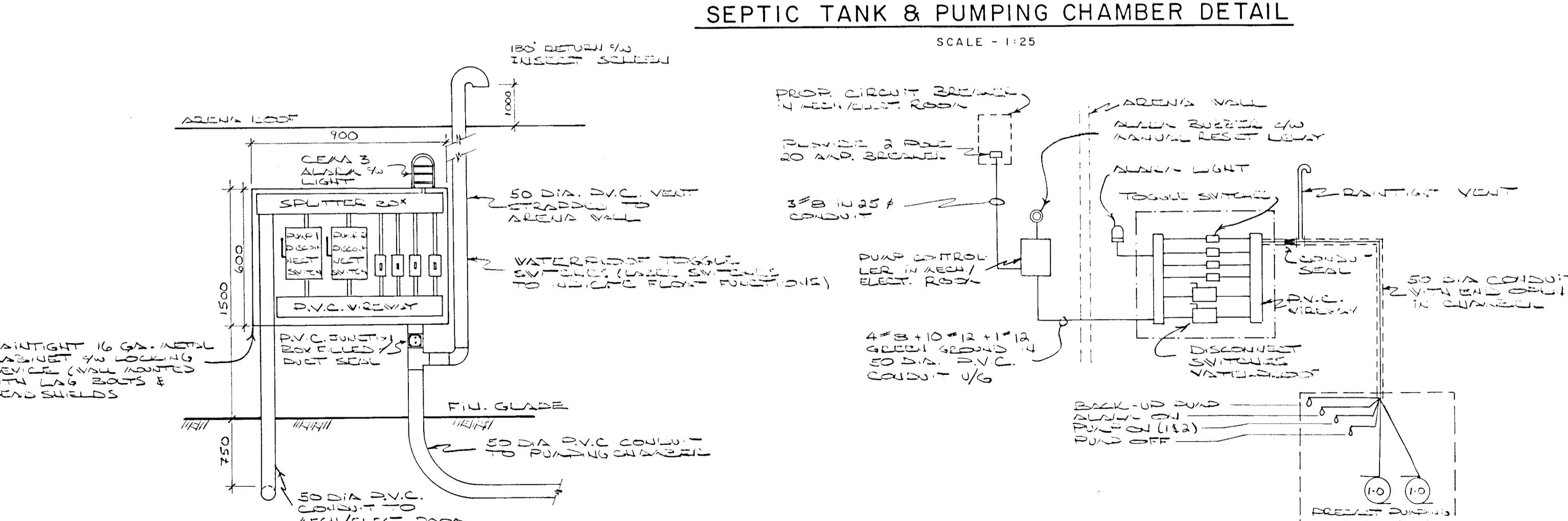
40x40 ALUM. ANGLE
SUPPORT BOLTED TO
SIDES AS SHOWN

50 DIA. FORGE NUTS

PLAN VIEW



SECTION A-A



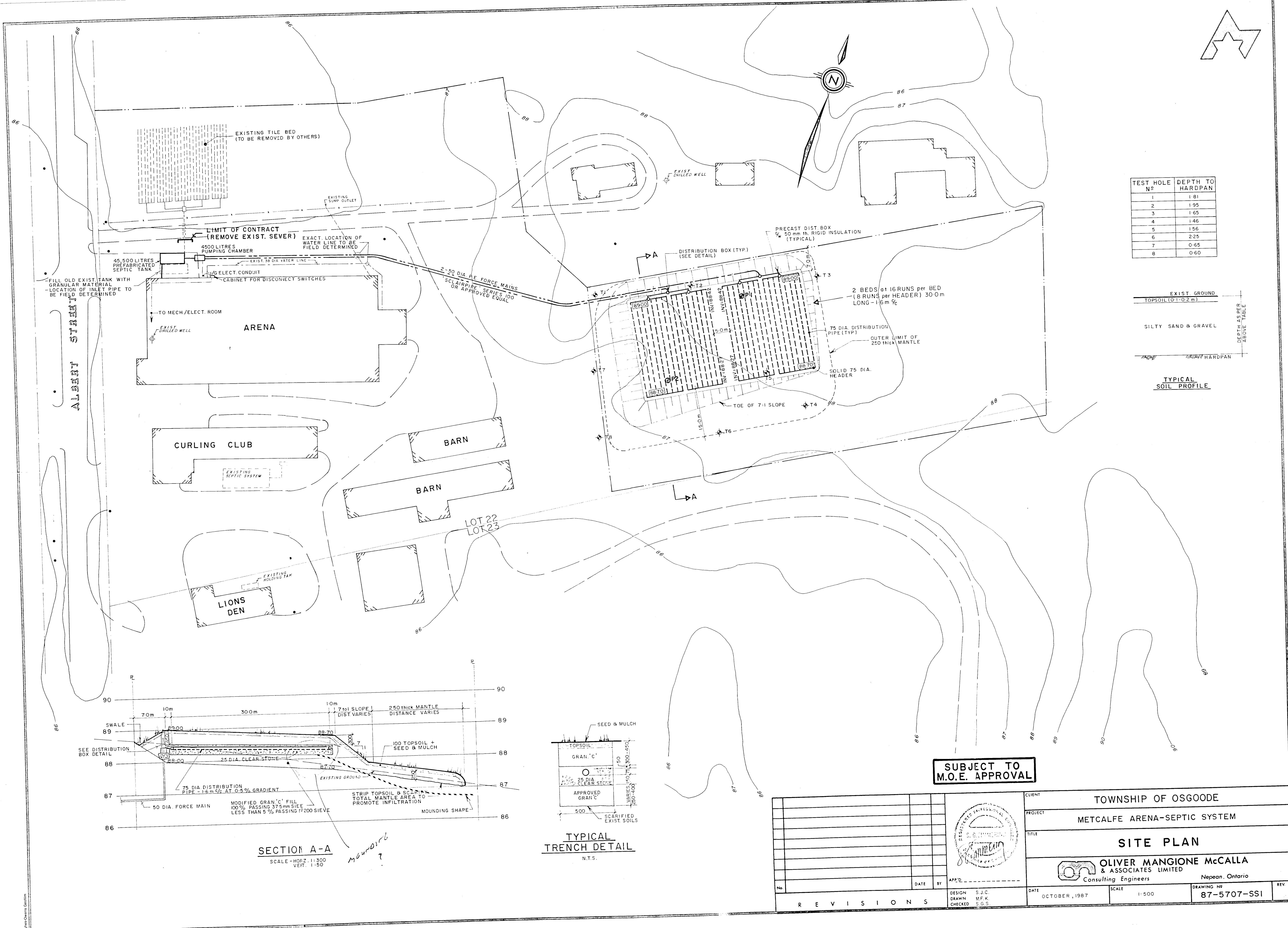
CABINET DETAIL FOR DISCONNECT SWITCHES

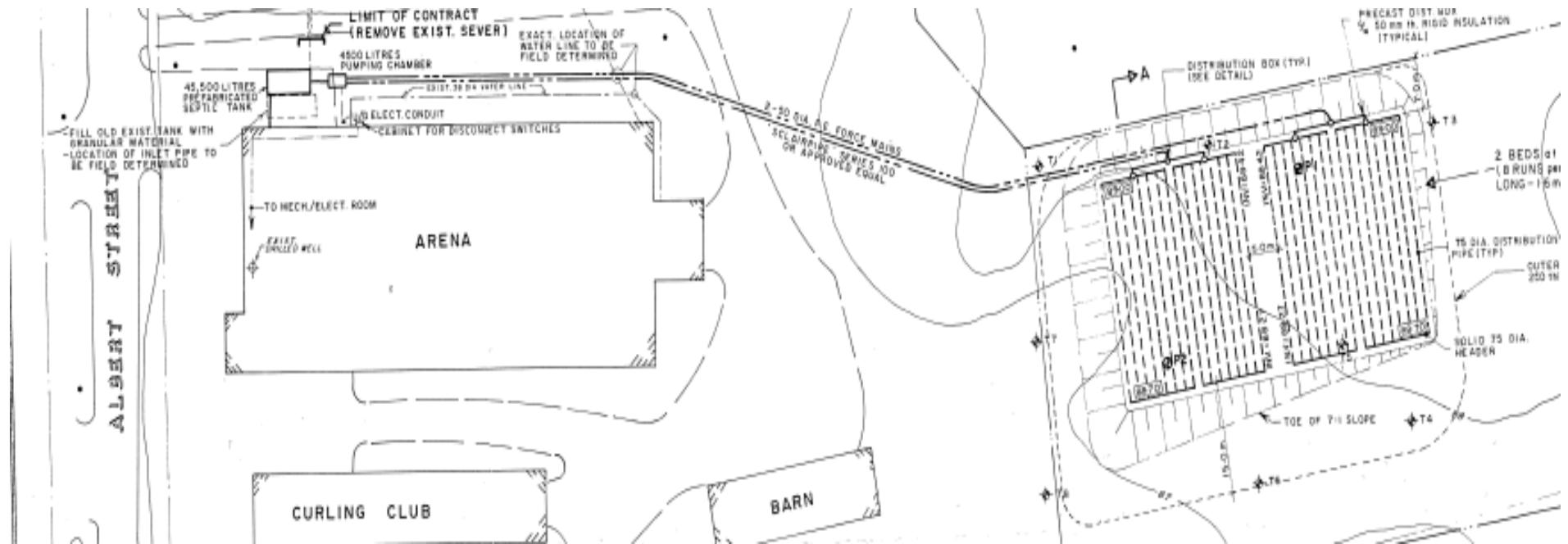
POWER DISTRIBUTION DIAGRAM

NOTES

1. Submersible pumps to be 2-'Hydr-O-Matic' Model SP100AH, 2" discharge, 1 H.P., 200 Volt, 3 Phase, or approved equal.
2. Contractor to provide 'Hydr-O-Matic' or approved equal standard duplex pump controls, 3 phase (install in Mech./Elect. Room inside arena complete with audible "buzzer" alarm) for operating pumps in an alternating sequence and activating back up pump and Cema 3 alarm light complete with protective screen and manual reset relay (mounted on top of raintight enclosure.)
3. Pump disconnect switches and separate toggle switches for controls to be located in raintight enclosure mounted on arena wall, adjacent to pump chamber.
4. All wiring shall be splice free from pump chamber to enclosure at arena wall.
5. All piping inside pumping chamber shall be schedule 40 PVC or equal.
6. All voids and any unused knockouts to be filled and made watertight with expandable grout.
7. Contractor to be responsible for complete coordination of electrical and mechanical subcontractors including; connection in Mechanical/Electrical Room; obtaining Hydro inspection and approval; delivery of duplex pump assembly in working order.

**S U B J E C T T O
M.O.E. APPROVAL**





APPENDIX C

Design Calculations

Larry Robinson Arena New Sewage Works

Sewage Pump Design Sheet



Project Name: Larry Robinson Arena
Project No.: 23211
Client: The City of Ottawa

Designed By: Adam Poapst
Reviewed By: Jamie Baker
Date: March 20, 2025

Design Flow = 3.50 L/s

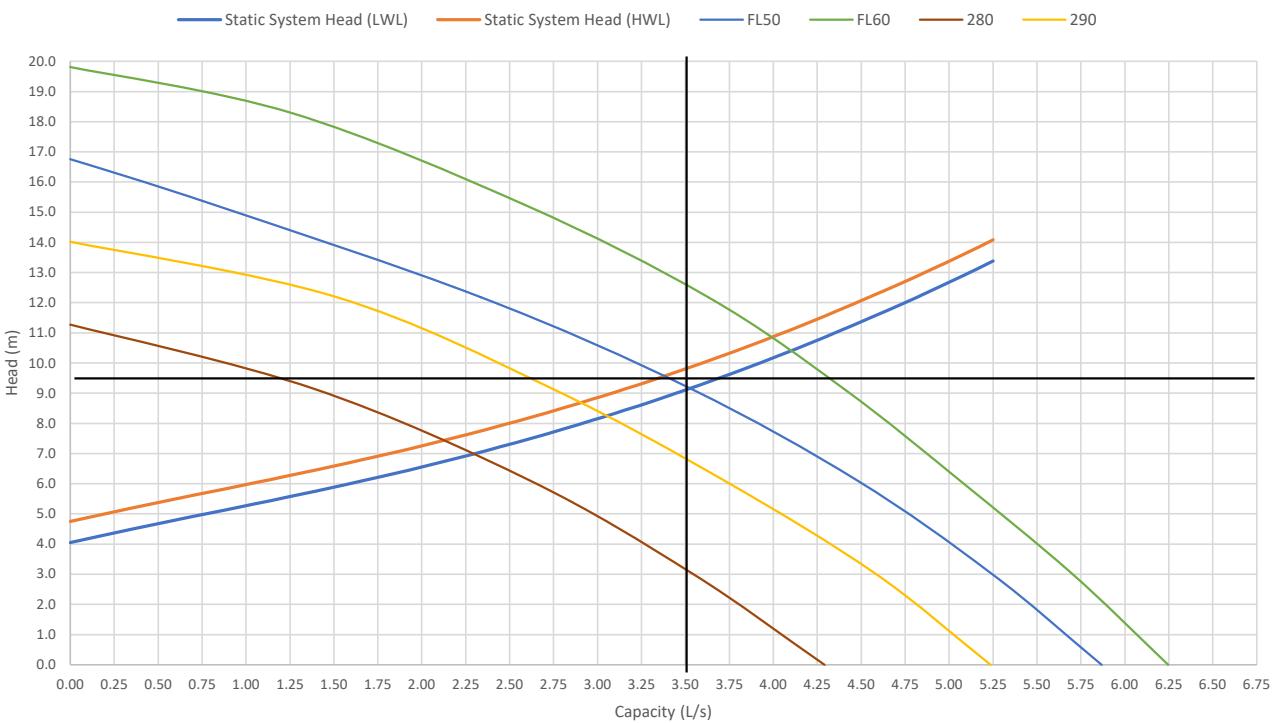
Discharge Piping			
	75mm	40mm	50mm
Flow (L/s)	3.50	1.75	1.75
Forcemain Pipe Type	PE DR11	PVC Sch 40	PVC Sch 40
Forcemain Pipe Size (mm)	75	40	75
Actual Inside Pipe Diameter (mm)	71.78	39.62	76.45
Roughness Coefficient (C)	120	120	120
Pipe Length (m)	71	0.5	29.5
Velocity (m/s)	0.865	1.419	0.381
Friction Head Loss (m/100m)	1.590	7.962	0.324
Total Minor Head Loss Coeff. (K) From Table	8.1	6.0	8.0
Total Minor Head Loss (m)	0.34	3.39	0.06
Total Friction Head Loss (m)	1.47	3.43	0.15

Head Required for Pressure Distribution Lateral 0.70

Total Dynamic Head Summary	
Total System Friction Head (m)	5.76
Static Head Losses	
Low Water Level	139.85
High Water Level	140.55
Discharge Elevation	143.90
Total Static Head - Liquid High Level (m)	3.35
Total Static Head - Liquid Low Level (m)	4.05
Total Dynamic Head - High Level (m)	9.11
Total Dynamic Head - Low Level (m)	9.81

Outlet Inv =	140.95	m
HWL =	140.85	m
Lag Start =	140.70	m
Lead Start =	140.55	m
Lead Stop =	139.85	m
LWL	139.68	m
B/Tank =	139.53	m

Performance Data



Larry Robinson Arena New Sewage Works

Multiple Orifice Flow Calculations



Project Name: Larry Robinson Arena New Sewage Works
Project No.: 23211
Client: The City of Ottawa

Designed By: Adam Poapst
Reviewed By: Jamie Baker
Date: March 20, 2025

Flow Estimate In Laterals As Per Small Waste Water Treatment Systems (attached):

Flow in Each Office:

C=	0.67	
Diameter of Orifice=	0.0047625	m
hn=	0.70	m
Q=	0.000044	m^3/s
Number of Laterals =	4	
Flow in Laterals =	0.00018	m^3/s

Orifice Diameters:

Head Loss Estimate In Laterals:

Length of Lateral:	10	m
Diameter of Lateral:	0.0764540	m
C=	100	
Headloss In lateral (no orifice):	0.001	m
Headloss Estimate In lateral (with orifice):	0.000	m
Estimated Head Req'd at First Orifice:	0.700	m
m=	1.000	

Because m is smaller than 1 ± 0.02 the Lateral Piping headloss estimate is inaccurate and the lateral piping should be calculated in detail.

Detailed Perforated Lateral Calculation:

Orifice Spacing:	1.00	m
C orifice:	0.67	
Orifice Diameter:	0.0047625	m
Length of Lateral:	10	m
Number of Laterals:	4	
Lateral Diameter:	0.0764540	m
C Lateral:	100	
Total Flow In:	0.00175	m^3/s
Flow Per Lateral:	0.00044	m^3/s

Total Flow Out= **0.00044 m³/s** (ie. Flow in must equal Flow out)

Therefore, through iterations it was calculated that in order to achieve a minimum of approx. 0.70m of head at the furthest office a flow of 4.50 L/s is required at 0.7m of head to distribute the entire flow through the 25 laterals

Sanitary Sewer Design Sheet



Project Name: Larry Robinson Arena - New Septic System Design
Project No.: 23211
Client: City of Ottawa

Designed By: Adam Poapst
Reviewed By: Jamie Baker
Date: December 16, 2024

Design Parameters	
Coefficients	Flows
Mannings Coefficient n =	Average Daily Flow/Capita (q) = 19920 L/d
Persons Per Lot = -	Peak Extraneous Flow (I) = 0.000 L/ha/s
Persons Per Lot = -	Peak Factor = 1.0

Location	Manhole		Pipe Inverts	
	From	To	U/S	D/S
Larry Robinson Arena	Bldg	MH100	86.05	85.95
	MH100	MH101	85.89	85.78
	MH101	MH102	85.73	85.16
	MH102	P.T.	85.11	84.96

APPENDIX D

iQ.MBBR Treatment System Proposal

March 13, 2025



All Bidders

EVB Engineering

800 Second St. W
Cornwall, ON K6J 1H6

Contact : **Adam Poapst, P. Eng.**

Phone : (613) 935-3775 x 320

Email : Adam.Poapst@evbengineering.com

Bergmann North America Inc.
7-20 Steckle Place
Kitchener, ON N2E 2C3
Phone: (519) 220-0698
Fax: (226) 887-0130
info@bna-inc.ca
www.bna-inc.ca

Proposal No
0288

RE: Larry Robinson Arena WWTS

We are pleased to present the following proposal for the referenced wastewater treatment system, located at **2785 8th Line Rd, Metcalfe, ON K0A 2P0**. Our proposal includes a general process description and scope of supply. The standard terms and conditions, calculation summary, and proposed layout drawing are appended. Detailed construction drawings will be provided on placement of order.

Thank you for the opportunity to provide a proposal for this project; we look forward to working with you. Should you have any questions or concerns please call me at your convenience.

Sincerely,

Bergmann North America Inc.

A handwritten signature in black ink, appearing to read "Miles MacCormack".

Miles MacCormack, P.Eng. | President
miles@bna-inc.ca

Please sign and return a copy of this cover letter as your acceptance and approval of this proposal. The specified deposit is required to begin ordering and production.

Authorization Signature: _____

Provisional Items Included (#): _____

Requested Delivery Date: _____

Table of Contents

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Appendices:

Appendix 1 – Standard Terms and Conditions

Appendix 2 – Calculation Summary

Appendix 3 – Proposed Layout Drawing

1. Project Understanding and Design Criteria

The design parameters for this facility as requested by **EVB Engineering (the Engineer)** are summarized below:

Table 1. – Process Design Parameters					
Flowrate		Influent Parameters		Effluent Objectives *	
Average	≤ 13.9 m ³ /d	BOD ₅ ≤ 300 mg/L TSS ≤ 300 mg/L TKN ≤ 80 mg/L TP ≤ 15 mg/L	CBOD ₅ ≤ 10 mg/L		
Design	≤ 19.92 m ³ /d		TSS ≤ 10 mg/L		
Equalized	≤ 0.83 m ³ /h		Nitrate** ≤ 3.2 mg/L		

* Effluent objectives are based on monthly average basis.
** Nitrate as Nitrogen.

The proposed wastewater treatment system is installed in sub-grade precast concrete tanks consisting of individual unit processes (in order of process flow) as per Table 2 below:

Table 2. – Unit Processes and Tank Volumes					
Unit Process		# of Tanks	Tank ID #	Nominal Volume	~ Working Volume *
				IG	m ³
Equalization Tank		1	1	4,000	17.1
Primary Treatment	Sludge Storage	1	2	6,600	20.0
	Primary Clarifier				9.6
Secondary Treatment	Bioreactor 1	1	3	5,000	7.5
	Bioreactor 2				7.3
	Secondary Clarifier				5.6
Tertiary Treatment	Anoxic Bioreactor	1	4	600	3.0
	Bioreactor 3	1	5	600	2.8
	Tertiary Clarifier	1	6	800	2.5
Effluent Pump Tank		1	7	1,000	7.6

* Approximate working volumes take invert levels into account; therefore, may be slightly different than rated (nominal) tank sizes. For the sedimentation tanks complete with hoppers and sloped side walls, working tank volumes would be significantly less than nominal tank sizes. Equivalent volume tanks may be considered pending cost review and proposal revision.

2. Process Description

The following summarizes process description of unit processes and associated tanks specified in Table 2:

Flow Balancing

Balancing of maximum daily inflow as per Table 1 is provided using (1) Equalization Tank equipped with duplex equalization pumps. Wastewater is pumped from the Equalization Tank at a time dose rate as noted in Table 1 into the primary treatment stage.

Primary Treatment

Dosed wastewater from an Equalization Tank undergoes primary treatment using (1) Sludge Storage / Primary Clarifier tank. The Sludge Storage chamber provides settling and storage of primary and secondary solids. The Primary Clarifier chamber provides additional settling and conditioning of the wastewater including a nominal level of pre-anoxic denitrification for process stabilization.

Secondary Treatment

Secondary treatment is accomplished through the iQ.MBBR™ system which utilizes a moving bed biofilm reactor (MBBR) process. The biological stage consists of (2) aerobic bioreactors in series containing specially designed plastic carrier media having a specific surface area of 500 m²/m³. Microorganisms attach to the carrier media and consume the organic material in the wastewater. Oxygen needed for the aerobic treatment process is supplied by (6) linear air blowers and distributed in the biological reactors stage by fine bubble diffusers. The blowers are controlled using dissolved oxygen (DO) sensor(s) to run only when required. Media retaining screens are installed in each bioreactor to keep the carrier media in place while allowing the process wastewater and excess biosolids to pass through.

In Bioreactor 2, (1) recirculation pump returns part of the process mixed liquor at up to **3.5 x design flow** to the Sludge Storage tank for pre-anoxic denitrification with carbon supplementation.

Secondary sludge is settled out in (1) Secondary Clarifier equipped with (1) sloped wall double hopper, (2) sludge return pumps and (1) floating sludge (skimmer) pump. Secondary sludge settles to the bottom of the hoppers and is returned to the Sludge Storage tank along with any floating sludge removed by the skimmer pump.

Tertiary Denitrification

Tertiary denitrification is provided using (1) Anoxic Bioreactor to remove any residual nitrate nitrogen to the objective indicated in Table 1. The Anoxic Bioreactor is an MBBR containing specially designed plastic carrier media having a specific surface area of 500 m²/m³. Denitrifying bacteria attach to the carrier media and consume the nitrate and nitrite in the secondary effluent using supplemental carbon as an energy source under low oxygen conditions. The Anoxic Bioreactor sized to remove up to **13.4 mg/L** of residual nitrate at design flow (**0.27 kgNO₃/d**) based on a recommended loading rate of

0.5 gNO₃/m²-d. Supplemental carbon dosing is flow paced based on the influent Equalization Pump operation and proportioned to limit residual nitrate. The carbon supplement is intermittently mixed with the influent to the reactor via mixing pump. The Anoxic Bioreactor is fully mixed periodically using coarse bubble diffusers and (2) dedicated linear air blowers to remove any excess biomass while limiting the oxygen added.

Effluent from the Anoxic Bioreactor may contain residual CBOD₅ and TSS. To ensure the effluent meets the required criteria, further aerobic treatment and clarification is provided.

Tertiary Effluent Polishing

Tertiary effluent polishing is provided using (1) Bioreactor 3 followed by (1) Tertiary Clarifier tank. Bioreactor 3 acts as an aerobic MBBR polisher to consume any excess carbon from the tertiary process, working on the same treatment principles as the two main bioreactors, and includes (2) linear air blowers to supply air to the process. The Tertiary Clarifier contains (1) sloped wall double hopper, (1) surface skimmer, and (2) sludge return pumps. Tertiary sludge settles to the bottom of the hoppers and is returned to the Sludge Storage tank along with any floating sludge removed by the skimmer pump.

Effluent Pump Tank

From the Secondary Clarifier, the wastewater is discharged to (1) Effluent Pump Tank complete with duplex (2) effluent pumps (to be confirmed by Engineer).

Controls and Infrastructure

Three (3) control panels are provided to control the treatment plant, equalization, and effluent pump tanks, which include GPRS remote monitoring with current sensing on each output. Flow data logging is available on the equalization and effluent pumps based on pump run time, and a flow meter is included in the base scope. A mechanical room is required to contain the blowers, chemical dosing system, and control panels (see Provisional Items below).

3. Scope of Work

Qty	Model	Description
Concrete Tanks, Precast (*may be substituted subject to availability and approval)		
1	Brooklin: BCP-18000L-H	Equalization Tank c/w (1) carbon vent lid
1	Brooklin: BCP-30000L-S	Sludge Storage / Primary Clarifier
1	Brooklin: BCP-22750L-G	Bioreactor 1 / Bioreactor 2 / Secondary Clarifier
1	Brooklin: BCP-3600L-H	Anoxic Bioreactor
1	Brooklin: BCP-3600L-H	Bioreactor 3
1	Brooklin: BCP-3600L-H	Tertiary Clarifier
1	Brooklin: BCP-7500L-H	Effluent Pump Tank

iQ.MBBR™ System Equipment Package

lot	4.8 m ³ of carrier media (500 m ² /m ³), (12) MRB20 fine bubble diffusers, (4) 3-port aeration manifolds, aeration piping, (3) 6" media retention screens, (1) 6" flap-check valve, (6) linear blowers (Hiblow model HP-200, 120 VAC), and (2) 4" carbon vent filters for Bioreactors 1 & 2
lot	1.4 m ³ of carrier media (500 m ² /m ³), (4) Tideflex model TFA-0.75 coarse bubble diffusers, (1) 4-port aeration manifold, (1) 6" media retention screen, (1) 6" flap-check valve, aeration piping, and (2) linear blowers (Hiblow model HP-150, 120 VAC) for Anoxic Bioreactor
lot	1.0 m ³ of carrier media (500 m ² /m ³), (4) MRB20 fine bubble diffusers, (1) 4-port aeration manifold, aeration piping, (2) 6" media retention screens, (1) 4" carbon vent filter, and (2) linear blowers (Hiblow model HP-150, 120 VAC) for Bioreactor 3
1	PE double hopper assembly for the Secondary Clarifier
1	PE double hopper assembly for the Tertiary Clarifier
7	Submersible sump pumps (Goulds model LSP0311F, 120 VAC) [sludge return, surface skimmer, recirculation], each c/w discharge piping assy.
2	Sewage pumps (BJM model SV400, 120 VAC, 0.5 HP), c/w (2) level floats, isolation & check valves, and discharge piping assemblies for Equalization Tank
2	Effluent pumps (Liberty model FL102M-2, 240 VAC, 1.0 HP), (2) level floats, isolation & check valves, and discharge piping assemblies for Effluent Pump Tank
2	Dissolved oxygen sensors (optical, 4-20 mA, In-Situ model RDOX)
1	Carbon dosing system, including (2) chemical dosing pumps (ProMinent model CNPb-1601), (2) back-pressure valves, (2) chemical flow meters (Keyence model FD-XS8, or eq.), tubing, 680 L storage tank, 600 L supply of chemical (MicroC-2000), and low-level float switch
1	Ultrasonic flow meter (Keyence model FD-Q50C) installed in control shed
3	Control panels [click + clean® model CP8-B12-C13-IM-4G:32A(1) CP8-C14-4G:32A(1), & CP2-B22-4G:32A(1)] c/w 1-year Remote Monitoring (GPRS)

Additional Scope

Delivery and placement of tanks onsite including 10 h crane rental
All access risers to grade (includes 24" of riser height)
Installation by our technicians of all pumps and process equipment within tanks, and internal and interconnecting piping and fittings within the treatment system envelope (<u>excludes areas in Owner scope as shown in layout drawing</u>)
Operation & Maintenance Manual
Installation assistance (2 trips, 5 days, 2 technicians)
Startup and Training for Maintenance Staff (1 trip, 1 day, 2 technicians)
(1) Year of Service (4 service visits excluding sampling)

4. Price Breakdown

Item Description	Price
Tanks & Equipment Package	\$ 170,318.00
Installation / Startup Labour	\$ 14,858.00
Transportation	\$ 13,978.00
Service (4 service visits included in first year)	\$ 3,400.00
Total	\$ 202,554.00

Availability: Estimated 6 – 8 weeks from deposit receipt.

Terms: 25% Deposit, 40% on delivery, 25% Net 30 from delivery, 10% Net 30 from commissioning, OAC subject to credit application. This price is valid for 60 days from the date of this proposal (*subject to adjustment pending any tariff impacts).

5. Exclusions to Scope of Work

- Any excavation or backfill (BNA is not responsible for any settling of tanks, pipes etc. due to improper backfill and compaction around tanks).
- Any grading to ensure surface water runoff around treatment plant area.
- Any insulation, anchoring, tank wrapping, or additional measures for high water table / flooding (BNA is not responsible for any issues caused by tank flotation).
- Any leakage or water-tightness testing of tanks or piping (tanks generally must be backfilled prior to any water filling/testing, consult BNA prior to filling).
- Any electrical works including power supply, electrical connections, wiring, or conduit (electrical scope may be quoted on request).
- Any inspections, permits, fees or locates.
- Any plumbing connections or piping outside of treatment system area.
- Control building (see Provisional Items below).
- Any additional tankage or equipment not included in this scope of work, i.e., leaching bed components, etc.

6. Provisional Items

Item	Item Description	Price
1	Control Shed: Supply and install (1) concrete control shed, Brooklin Concrete Products Model 70 (or equivalent), delivered and placed at site (electrical & lighting are by others)	\$ 9,975.00

7. Construction Requirements

To complete the installation of our product, the Owner shall procure its own Contractor(s) to complete all excavation and electrical works. BNA will provide delivery of the tanks and equipment

to the site, and our installation team will install the process equipment and provide assistance to the Contractor(s). All of the equipment and piping within the treatment system envelope will be provided and installed as part of our scope of work. Project schedule and tank delivery plan must be submitted a minimum of two (2) weeks in advance to ensure delivery timing.

The Contractor shall be required to sign a construction scope check list prior to delivery to indicate understanding and acceptance of scope.

8. Electrical Requirements

The required electrical power supply to the control building is 120 VAC/1-phase/60 Hz with a connected/peak load of approximately 24.0/12.0 at 240 VAC and 64.8/57.3 A at 120 VAC (overall peak load at 240 VAC = 40.7 A, excluding utility circuits). If electrical supply differs from this specification, Owner or Contractor must inform BNA with equipment order. The system as proposed is estimated to require the following power supply circuits (to be determined based on pump and blower specification):

- 1 x 240 VAC/1-phase @ 20 A
- 1 x 120 VAC/1-phase @ 20 A
- 6 x 120 VAC/1-phase @ 15 A

9. Service Requirements

The iQ.MBBR™ process is a cost effective and easy to operate system with relatively low maintenance requirements. In basic terms, the Owner of the system is responsible to have a service contract in place with a BNA authorized Service Provider, that the system is operated within the specified design parameters, that the system is functioning normally (i.e., no local alarms or visible problems), and that the accumulated sludge is pumped out by licensed sewage hauler as requested by the Service Provider. The Service Provider shall, using standard industry practice and based on recommended service frequency and/or remote monitoring, ensure that the system equipment is functioning properly, the system is meeting performance specifications, and if not, adjust the system operational parameters accordingly to mitigate performance requirements and/or provide additional services as required.

Basic routine maintenance on the system will take approximately 1.5 h onsite. BNA recommends for a typical commercial application that the system be serviced on at least a quarterly basis. One day of training along with one (1) year of service is included in the purchase price of the system (excluding effluent sampling and additional chemical beyond estimated 6-month supply included). Should our services be retained after the included first year, our service fees for this treatment system will be billed at current a rate of **\$850.00** for one service visit plus \$140.00 per hour for any additional hours onsite. Phone support is included in the remote monitoring package (see below).

10. GPRS Remote Monitoring

The control panel comes standard with a GPRS module that allows the maintenance provider to remotely connect to the control panel via wireless connection. This also allows for the control panel to instantly send information to the maintenance provider in case of an alarm or problem should arise with the treatment plant (i.e., power outage, mechanical failure, etc.). Through GPRS and the operation of the treatment plant, the amount of scheduled maintenance visits can be reduced as well as provide assurance of 24/7 round the clock operation. The initial cost for the module is included in the purchase price of the panel and includes one year of data monitoring fee. A yearly service fee of **\$480.00** plus taxes will be required to maintain this service for the (3) control panel(s). Ethernet options are also available on request.

11. Advantages of the iQ.MBBR™ System

iQ.MBBR™ systems offer a custom designed solution which can be installed in a small footprint and offer low energy and operating costs. The process can also be retrofit in existing tanks or to upgrade existing systems. One of the unique benefits of the iQ.MBBR™ process is the ease of operating the system. The carrier media in the system is self-cleaning, does not clog and never has to be replaced. The process is designed for intermittent aeration allowing flexible operational settings with minimal energy consumption. Aeration blower operation is controlled automatically using inline dissolved oxygen (DO) sensors and does not generally need adjustment. Should influent strength or flow increase, it is possible to add media to compensate. The operation cycle of the sludge return pump is designed so that the final clarifier is completely clear of secondary sludge. As a result of denitrification, the formation of floating sludge may occur in the final clarifier; this material is removed through a floating skimmer and returned to the sludge storage chamber. The two most common situations that cause failure in other wastewater process are overload and under-load conditions. Overloading occurs during concentrated periods of water usage in a short time while under-loading occurs during periods of inactiveness. These conditions in other biological processes cause the treatment performance to stop functioning. These problems are minimized in the iQ.MBBR™ process and unlike activated sludge processes, secondary sludge is not returned to the bioreactors in order to maintain the bacterial culture.

BNA offers a unique control unit for the electrical supply and automatic control of the system. Each control panel comes standard with GPRS remote monitoring and data logging. This allows for instant notification of alarms and also allows the operator to change settings remotely. Each output also monitors current (amperage) instead of relying on floats or pressure sensors alone for mechanical failures. Current sensors can allow for issues to be detected before major problems occur. The control panel also has analog inputs for additional sensors should they be required on any project (i.e., turbidity, dissolved oxygen, etc.). A battery backup is provided for the panel to ensure that notifications are still sent during power outages.

In summary, the iQ.MBBR™ system is a robust cost-effective wastewater treatment process that takes up a small footprint while providing optimal performance. The system allows for significant operational flexibility and provides peace of mind in cases where influent strengths and flows may vary from anticipated design.

Appendix 1 – Standard Terms and Conditions

BERGMANN NORTH AMERICA INC.
GENERAL TERMS AND CONDITIONS OF SALE

The following terms and conditions of sale ("Terms") shall apply and incorporated by reference into all transactions between the parties to any sale of goods ("Products") and/or services ("Services") by Bergmann North America Inc. ("BNA") to the purchaser ("Purchaser"). By placing an order, Purchasers accept or shall be deemed to have full knowledge of the Terms herein and agree to BNA's Terms, including the Limited Warranty, which are subject to change from time to time without prior notice.

- 1) **GENERAL:** In the event of any conflict or inconsistency between these Terms and the terms and conditions contained in Purchaser's order or in any other form issued by Purchaser, whether or not any such form has been acknowledged or accepted by BNA, these Terms & Conditions of Sale shall prevail. No waiver, alteration or modification of these Terms shall be binding upon BNA unless made in writing and signed by a duly authorized representative of BNA.
- 2) **ORDER ACCEPTANCE & CONFIRMATION:** All orders are subject to acceptance by BNA; any errors and omissions are subject to correction. BNA reserves the right to modify unordered Products from time to time, including the right to discontinue the Products.
- 3) **QUOTATIONS & ESTIMATES:** Unless waived or otherwise stated, BNA quotations and/or estimates shall be null and void unless accepted by Purchaser within thirty (30) days from the date of quotation or estimate.
- 4) **TAXES:** All prices do not include sales taxes. Applicable Canadian Federal or Provincial taxes will be added and billed at the rate in effect at the time of shipment. Payment of taxes is the sole responsibility of Purchaser unless Purchaser provides BNA with a valid exemption certificate acceptable to the applicable taxing authority.
- 5) **PRICES | COST OF TRANSPORTATION:** BNA's prevailing prices for Products and Services at the time of shipment will apply, except as otherwise provided in a written quotation or contract. BNA may, in its sole discretion, require advance payment or a deposit for Products and Services. Unless otherwise stated, all prices are in Canadian Dollars F.O.B. shipping point.
- 6) **DELIVERY SCHEDULES:** BNA makes every effort to meet delivery schedules as requested. Delivery shall depend on the prompt receipt by BNA of the information required to meet production schedules. Delivery schedules (including time for shipment) are approximate and are based on conditions at the time of BNA's quotation or estimate and acceptance of Purchaser's order.
 - (a) BNA cannot guarantee and Purchaser expressly releases BNA from any liability for any loss or damage resulting from a failure to deliver or delays in delivery caused by any conditions related to, or caused by, failure to process or inaccurate processing of time-sensitive information and/or mechanisms. BNA may extend delivery schedules or may, at its option, cancel Purchaser's order in full or in part without liability other than to return any deposit which is unearned by reason of the cancellation.
 - (b) BNA reserves the right to make partial shipments and to submit invoices for partial shipments.
- 7) **SITE DELIVERIES – CONCRETE PRODUCTS:** BNA may subcontract concrete product deliveries via 3rd party mobile crane

truck within the rated load and crane reach capacity for the equipment. Product/s will be set in to prepared excavation at the prevailing prices at the time of shipment, subject to equipment availability.

- (a) Purchaser is responsible for providing an accessible, level, and stable surface sturdy enough to accommodate the vehicle and the span of the crane stabilizers/outriggers; BNA is not responsible for driveway or other surface damage due to machine/material delivery weight; Restoration of all affected existing surfaces by others.
- (b) CRANE TRUCK OPERATORS WILL NOT ATTEMPT ANY OPERATION THAT MAY INVOLVE ANY PERSONAL SAFETY HAZARD, CONTRAVENE APPLICABLE LEGISLATION, OR JEOPARDIZE EQUIPMENT.
- (c) Any additional 3rd-Party on site delivery requirements shall be observed.
- (d) BNA does not assume any liability for delay or non-delivery caused by failure of transportation facilities, accident, or any other unforeseen cause/s beyond our control.
- (e) If pre-arranged crane equipment is unable to safely offset at a site due to adverse soil conditions or any other site condition or conditions/s beyond our control, the driver will either unload on the ground or return to the supplier plant as instructed by the Purchaser and/or their agent and/or BNA. HIRING A LONGER REACHING CRANE, ADDITIONAL PERMITS, AND/OR RE-ORDERING THE DELIVERY IS THE RESPONSIBILITY OF THE PURCHASER, AND IS AT THE PURCHASER'S EXTRA COST.
- (f) Special methods of transportation will be used upon Purchaser's request and at Purchaser's own additional expense.
- 8) **INSTALLATION:** Unless otherwise expressly stipulated, the Products shall be installed by and at the risk and expense of Purchaser. If BNA is requested to supervise such installation, or parts thereof, BNA's responsibility shall be limited to exercising that degree of skill customary in the trade in supervising installations of a similar type. Purchaser shall remain responsible for all other aspects of the work including compliance with the local regulations. Responsibility for site safety and construction means and methods remain with Purchaser and/or its agents.
- 9) **WASTEWATER TREATMENT SYSTEMS:** Wastewater treatment systems must be installed, commissioned and serviced by certified contractors at recommended intervals. Owners of treatment systems are required to operate their system according to manufacturer's requirements and government regulations.
 - (a) Manufacturers and service providers do not, and cannot control the effluent that enters the Owner's system; It is the responsibility of the Owner, as the Operator, to ensure their treatment system meets government standards for operation.
- 10) **CHANGES & CANCELLATION:** Orders accepted by BNA are not subject to changes or cancellation by Purchaser without prior written consent. In such cases where BNA authorizes changes or cancellation, BNA reserves the right to charge Purchaser reasonable costs based upon expenses already incurred and commitments made by BNA, including, without limitation, any

GENERAL TERMS AND CONDITIONS OF SALE (Continued)

labour done, material(s) purchased, BNA's usual overhead and reasonable profit and cancellation charges from its' suppliers.

11) ACKNOWLEDGMENTS: Purchaser expressly acknowledges and agrees that Purchaser has accepted the product information and/or drawings, terms and conditions and the necessary installation requirements, suitability for use, and regulatory compliance. The purchaser shall rely entirely on its own inspection and knowledge of the goods being purchased, there being no representations, conditions, warranties or collateral contracts made by or on behalf of BNA other than as set out herein.

(a) Products will be quoted and shipped according to information and specifications provided by Purchaser. Purchaser is responsible to verify all specifications and quantities of Products prior to finalizing and submitting its order;

(b) Purchaser is solely responsible for the proper installation and/or intended use of the Products.

12) NO COPYING OR REVERSE ENGINEERING: No copyrights, patents, trademarks or any other intellectual property rights are assigned to Purchaser hereunder. Purchaser is expressly prohibited and shall not copy, analyze or create derivative works, decompile, or reverse engineer or cause a third party to copy, analyze or create derivative works, decompile or reverse engineer any confidential information, product designs, or other intellectual property for any purpose. Purchaser acknowledges that its failure to comply with the provisions of this section may cause irreparable harm to BNA which cannot be adequately compensated for in damages, and accordingly acknowledges that BNA will be entitled to claim, in addition to any other remedies available to it, interlocutory and permanent injunctive relief to restrain any anticipated, present or continuing breach of this Section.

13) FORCE MAJEURE: BNA will not be responsible for any failure or delay in its performance due to causes beyond its reasonable control, including, but not limited to, labor disputes, strikes, lockouts, shortages of or inability to obtain labor, energy, raw materials or supplies, war, terrorism, riot, natural disasters or governmental action. The acceptance of delivery of Products by Purchaser shall constitute a waiver of all claims for loss or damage due to any delay whatsoever.

14) EXPORT CONTROL LAWS: BNA will not be the exporter under any circumstances. It is the sole responsibility of Purchaser at its own expense to satisfy all legal requirements for the export and use of the Products from Canada.

15) TITLE: Title and ownership of the products, goods or equipment shall remain with BNA and shall not pass to the Purchaser until all amounts owing by the Purchaser have been paid in full. Purchaser grants to BNA a security interest in such products, goods and equipment and in all other personal property owned by it.

16) TERMS OF PAYMENT: Unless otherwise stated in a quotation, invoices on approved credit accounts are due and payable within thirty (30) days of invoice date. Where credit is not established, payment is due at time of purchase through cash, cheque, Interac Debit, Visa or MasterCard, or other methods that may become available from time to time. All payments must be in Canadian dollars. Unless specifically provided in an invoice, no cash discount shall be available to Purchaser.

(a) PAYMENT IN FULL IS NOT SUBJECT TO HOLDBACKS EXCEPT BY WRITTEN AGREEMENT AT TIME OF ORDER,

AND, IN NO CASE IS PAYMENT CONTINGENT ON THE PURCHASER RECEIVING PAYMENT FROM PURCHASER'S CUSTOMER.

(b) Should payment not be made to BNA when due, BNA reserves the right to suspend all future delivery or other performance with respect to Purchaser without liability or penalty; Purchaser agrees that BNA may retain all payments which have been made on account of the purchase price as liquidated damages,

17) CREDIT: Credit requests are subject to the completion and submission of the prevailing BNA Credit Application & Agreement by the Purchaser. Credit approval is at BNA's sole discretion. The applicable terms and conditions of the BNA Credit Agreement shall prevail at the sole discretion of BNA. Charging of interest shall not be construed as BNA granting any extension of time in the terms of payment.

18) NO SET-OFF: Purchaser may not set-off any amounts due to Purchaser against any amount due to BNA in connection with any transaction. Purchaser may not make any deduction from any payment due hereunder by reason of loss or damage to Products in transit.

19) WARRANTY: BNA sub-contracts concrete Products designed for use at maximum one (1) Meter burial depth in non-traffic areas unless otherwise stated. BNA concrete Products are covered by a twelve (12) month limited warranty (the "Limited Warranty") against defects in material and workmanship from the date of delivery to Purchaser unless otherwise stipulated in writing by BNA.

(a) BNA nor its' supplier will be responsible or liable under the Limited Warranty for (i) any defects attributed to normal wear and tear, or failure of any part or parts from external forces, including without limitation corrosive effluents, corrosive soils, vehicular or other impact, frost heave, vandalism, earthquake or other Force Majeure; (ii) Products not installed and/or maintained according to applicable laws, codes and BNA's instructions (iii) use of the Products with incompatible goods or unintended use; (iv) defects in any portion or part of the Products manufactured and/or installed by others.

(b) Purchaser shall give BNA an opportunity to investigate any alleged defects; BNA will make every good faith effort to repair, or at its sole option, replace at no charge any Products found to be defective during the Limited Warranty period.

(c) The Limited Warranty specifically excludes other on-site service time and materials.

(d) For components not supplied by BNA, the warranty is determined by the original equipment manufacturer and/or supplier. Any components found to be defective must be offered at, or shipped freight prepaid to the BNA facility for inspection and examination. BNA's obligation under the manufacturer or supplier warranty is limited to repair or replacement. Manufacturer's warranties specifically exclude other on-site service time & materials.

20) SERVICES: BNA may provide Services pursuant to the specifications, assumptions and such other information set out in a quotation or estimate. Unless otherwise set out in the applicable quotation or estimate, Purchaser will pay all labour time and materials, and usual and customary fees incurred by

GENERAL TERMS AND CONDITIONS OF SALE (Continued)

BNA and its personnel during the performance of the Services. BNA may, in its sole discretion, subcontract or otherwise provide the Services (or parts thereof) through third parties. PURCHASER SHALL REMAIN RESPONSIBLE FOR ALL OTHER ASPECTS OF THE WORK INCLUDING COMPLIANCE WITH THE LOCAL

REGULATIONS. RESPONSIBILITY FOR SITE SAFETY AND CONSTRUCTION MEANS AND METHODS REMAIN WITH PURCHASER AND/OR ITS AGENTS.

(a) Services will be performed in a professional manner consistent with applicable industry standards. Except as otherwise provided in a quotation or contract, BNA will, within the period of one-hundred & twenty (120) days following the date of installation of Products, repair any defective workmanship in Services. THIS WARRANTY IS EXCLUSIVE. BNA EXPRESSLY DISCLAIMS, AND PURCHASER EXPRESSLY WAIVES, ALL OTHER WARRANTIES, REPRESENTATIONS AND GUARANTEES, WHETHER ORAL OR WRITTEN, IMPLIED OR STATUTORY IN RESPECT OF SERVICES OR ANY PORTION THEREOF, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

21) WARRANTY DISCLAIMER: BNA makes every effort to accurately describe Product information and/or drawings and its Services. Such descriptions are for identification purposes only and do not express or imply a warranty or condition that the Products are appropriate for a particular purpose. No warranty or condition, express or implied, other than as set forth in the Limited Warranty above is made or authorized by BNA.

22) LIMITATION OF LIABILITY AND TIME FOR CLAIMS: Any liability for indirect, special, exemplary, punitive, consequential or incidental damages is expressly disclaimed by BNA. BNA's liability in all events for all damages, losses and causes of action (whether in contract, tort or otherwise) shall be limited in the aggregate to, and shall not exceed, the purchase price paid by the Purchaser for the Product in question. Any claims against BNA must be brought within one (1) year after the cause of action arises, notwithstanding any applicable statute of limitations.

23) PRODUCT RETURNS: Any cancellation or return must be approved by BNA (in its discretion), be accompanied by proof of purchase, and may be subject to restocking and other charges. In the event of approval of a return request, (a) all returns must be shipped freight prepaid at Purchaser's expense; and (b) only Products of current manufacture in salable for condition will be accepted for credit.

24) INDEMNITY: Purchaser hereby assumes and agrees to indemnify, defend, and hold harmless BNA, each of its affiliates and/or all of their respective agents, directors, officers, employees, subcontractors, suppliers and invitees from and against any and all sums, losses, damages, claims, costs, duties, suits, actions, causes of action, liabilities, demands and expenses (including legal fees and other legal expenses on a full indemnity basis) of whatsoever kind and nature arising out of (a) Purchaser's purchase, use, possession, ownership, operation, condition, resale, transfer, import, export, transportation, disposal, operation of the Product or otherwise relating to, connected with in any way, arising out of, or on account of Products, Services or these Terms; and/or (b) Purchaser's violation or alleged violation of

any foreign, federal, provincial, county, municipal or local laws or regulation. This indemnity will survive termination of the Terms.

25) CONFIDENTIALITY: Except as required by law or with the express written consent of BNA, Purchaser agrees to receive and maintain all information received from BNA, including without limitation, pricing and specifications, in confidence, using the same degree of care which Purchaser employs with its own confidential information, provided this is no less than a reasonable standard of care, and Purchaser will not disclose to any person or entity or make public or authorize the disclosure of any such information and will not use such information for any purpose, except as expressly agreed to by BNA in writing or in another applicable agreement between BNA and Purchaser. Purchaser acknowledges that its failure to comply with the provisions of this section may cause irreparable harm to BNA which cannot be adequately compensated for in damages, and accordingly acknowledges that BNA will be entitled to claim, in addition to any other remedies available to it, interlocutory and permanent injunctive relief to restrain any anticipated, present or continuing breach of this Section.

26) WAIVER: BNA's failure to insist on strict performance of these Terms or to enforce a default upon the occurrence of any single, repeated, or continuing violation of any particular term or condition hereof, shall not be considered a waiver of BNA's right to insist on strict performance of these Terms or to enforce a default with respect to the violation of any other term or condition or, at any later time or upon any subsequent occurrence, with respect to that particular term or condition.

27) SEVERABILITY: If any provision of the Terms and Conditions is held to be void, null, unlawful or otherwise unenforceable, that provision shall be treated as a separate and independent clause. The remainder of the Terms and Conditions will continue to be in full force and effect.

28) GOVERNING LAW: These terms and conditions will be governed by, and interpreted and enforced in accordance with, the laws in force in the Province of Ontario and shall be treated in all respects as an Ontario Contract.

29) ENTIRE AGREEMENT: These Terms, and any quotation or estimate that incorporates these Terms by reference, are the complete and exclusive agreement between the parties and supersedes all provisions and concurrent agreements, understanding, negotiations and discussions, whether oral or written of the parties and there are no warranties, representations or other agreements between the parties in connection with its subject matter except as specifically set forth in these Terms.

30) MISCELLANEOUS: These Terms are binding upon and inure to the benefit of the parties hereto and their respective successors, permitted assigns and transferees. Each Party's obligations which by their nature are intended to survive beyond the termination, cancellation or expiration of these Terms, shall survive including without limitation, Purchaser's payment obligations, confidentiality obligations, indemnifications, any disclaimer of warranties, limitations of liability and time for claims, severability, governing law, dispute resolution, entire agreement and this Section 30. Purchaser may not assign these Terms or any rights or obligations hereunder without BNA's prior written consent.

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Appendix 2 – Calculation Summary

Wastewater Treatment System Calculation Summary

Project:

0288

Larry Robinson Arena WWTS



Design Parameters:

Influent BOD ₅	= 300 mg/L	Effluent BOD ₅	= mg/L
Influent TSS	= 300 mg/L	Effluent CBOD ₅	= 10 mg/L
Influent TKN	= 80 mg/L	Effluent TSS	= 10 mg/L
Influent TP	= 15 mg/L	Effluent TAN	= mg/L
Average Flow, Q _A	= 13.94 m ³ /d	Effluent TIN	= 3.20 mg/L (Nitrate)
Design Flow, Q _D	= 19.92 m ³ /d	Effluent TN	= mg/L
Peak Flow, Q _P	= 1.99 m ³ /h	Effluent TP	= mg/L
		Effluent EC/FC	= CFU/100 mL
Equalized Flow, Q _E	= 0.83 m ³ /h	Influent CBOD ₅ Population Equivalent	= 100 PE (@0.6 gCBOD ₅ /person-d)
Influent BOD ₅ Load	= 5.98 kg/d	Influent TN Population Equivalent	= 133 PE (@0.12 gTN/person-d)
Influent TN Load	= 1.59 kg/d		

Treatment Process Selection:

C Standard Carbon Oxidation + Nitrification

350 = % Internal Recirculation

2.91 m³/h

48.42 L/min

= % Effluent Recirculation

- m³/h

- L/min

Influent Flow Equalization (EQT):

Design Criteria

Hydraulic Retention Time (HRT)

≥ 18 h

Min. Volume

14.9 m³

EQT

Tank Selection (model)

BCP-18000L-H

Quantity

1

Specified Volume

17.1 m³

Internal Length = 4.801 m

Internal Width = 2.337 m

Nominal Depth = 1.528 m

Depth Override = m

Parameters as Specified

Hydraulic Retention Time (HRT)

= 20.7 h

Sludge Storage, Inline (SS):

Design Criteria

Min. Sludge Haulage Frequency

= 3.33 months

Min. Volume

14.7 m³

SS

Tank Selection (model)

BCP-30000L-S-2/3

Quantity

1

Specified Volume

20.0 m³

Internal Length = 3.175 m

Internal Width = 2.337 m

Nominal Depth = 2.695 m

Depth Override = m

Parameters as Specified

Total Hydraulic Retention Time

= 5.4 h

Estimated Sludge Storage Time

= 13.1 months

Primary Clarifier (PC):

Design Criteria

Hydraulic Retention Time (HRT)

≥ 2.0 h

Min. Volume

7.5 m³

PC

Tank Selection (model)

BCP-30000L-S-1/3

Quantity

1

Specified Volume

9.6 m³

Parameters as Specified

CBOD₅ Reduction in Primary

= 33.0 %

Internal Length = 1.549 m

Internal Width = 2.337 m

Nominal Depth = 2.644 m

Depth Override = m

Specified Surface Area

3.6 m²

Unit Flow w/Recirculation

= 3.74 m³/h

Hydraulic Retention Time (HRT)

= 2.6 h

Surface Overflow Rate (SOR)

= 1.03 m³/m²/h

SOR MOE Guideline ≤ 1.25 m³/m²/h

Aerobic Bioreactors (BR):**Design Criteria**

Hydraulic Retention Time (HRT)
Media CBOD₅ Surface Loading
Media TAN Surface Loading
Minimum Media Volume

	Min. Volume
≥ 3 h	12.0 m ³
≤ 2 gCBOD ₅ /m ² ·d	
≤ 1 gTAN/m ² ·d	
= 4.0 m ³	

BR1

Tank Selection (model)	Quantity
BCP-22750L-S-1/3	1
Internal Length	1.549 m
Internal Width	2.337 m
Nominal Depth	2.024 m
Depth Override	2.074 m

Specified Volume

7.5 m³
Specified Surface Area
3.6 m²

Parameters as Specified

Hydraulic Retention Time (HRT)
Media Volume
Media Surface Area
Media Filling Degree
Media CBOD₅ Surface Loading
Media TAN Surface Loading

= 4.0 h	
= 4.8 m ³	
= 2,400 m ²	
= 32 %	
= 1.67 gCBOD ₅ /m ² ·d	
= 0.66 gTAN/m ² ·d	

BR2

Tank Selection (model)	Quantity
BCP-22750L-S-1/3	1
Internal Length	1.549 m
Internal Width	2.337 m
Nominal Depth	2.024 m
Depth Override	

Specified Volume

7.3 m³
Specified Surface Area
3.6 m²

Specified Total Volume

14.8 m³
Specified Total Surface Area
7.2 m²

Aeration Design

Design Oxygen Demand
Specified Aeration Rate
Specified Aeration Running %
Specified Aeration Running Time
Specified Oxygen Transfer Efficiency
Specified Oxygen Supply @25°C
Specified Mixing per Unit Volume
Specified Mixing per Surface Area

= 9.49 kgO ₂ /d	
= 60. Nm ³ /h	Denit. Credit
= 41%	78%
= 9.8 hr/d	
= 5.8%	
= 9.49 kgO ₂ /d	
= 1.12 L/s·m ³	
= 2.30 L/s·m ²	

Blower Model	Quantity
200HP2502P	6
Diffuser Length	12 m
Design Blower Pressure	243 mbar
Design Blower Rate / Blower	10 Nm ³ /h
Specified Power / Blower	0.19 kW
Amperage	3.62 Amp

PSI WG (in)

3.52 97.4
5.9 scfm
0.3 HP
VFD spec. <not required>

Secondary Clarifier (SC):**Design Criteria**

Hydraulic Retention Time (HRT)
Max. Surface Overflow Loading

	Min. Volume
≥ 3.0 h	2.5 m ³
≤ 0.80 m ³ /m ² /h	

SC

Tank Selection (model)	Quantity
BCP-22750L-S-1/3	1
Internal Length	1.549 m
Internal Width	2.337 m
Nominal Depth	2.024 m
Depth Override	1.974 m
Number of Hoppers	Double

Specified Volume (with hoppers)

5.6 m³
Specified Surface Area
3.6 m²

Parameters as Specified

Unit Flow w/Recirculation
Hydraulic Retention Time (HRT)
Surface Overflow Rate (SOR)
Max. SOR by MOE Guideline

= 0.83 m ³ /h	
= 6.8 h	
= 0.23 m ³ /m ² /h	
≤ 1.38 m ³ /m ² /h	

Tertiary Denitrification System (ABR):**Design Criteria**

Design Flow
Remaining Nitrate to Remove
Nitrate Mass Loading
Maximum Media NO₃ Surface Loading
Minimum Media Volume

	Min. Volume
= 19.92 m ³ /d	2.1 m ³
= 13.4 mg/L	
= 0.27 kgNO ₃ /d	78% Denit. Credit.
≤ 0.5 gNO ₃ /m ² ·d	
= 1.1 m ³	

ABR

Tank Selection (model)	Quantity
BCP-3600L-S	1
Internal Length	2.286 m
Internal Width	1.118 m
Nominal Depth	1.274 m
Depth Override	1.182 m

Specified Volume

3.0 m³

Parameters as Specified

Hydraulic Retention Time (HRT)
Media Volume
Media Surface Area
Media Filling Degree
Media NO₃ Surface Loading

= 3.6 h	
= 1.4 m ³	
= 700 m ²	
= 46 %	
= 0.38 gNO ₃ /m ² ·d	

Tertiary Bioreactor (BR3):

BR3

Design Criteria

Hydraulic Retention Time (HRT) ≥ 2.5 h
 Media CBOD₅ Surface Loading ≤ 2 gCBOD₅/m²-d
 Minimum Media Volume $= 0.6$ m³

Min. Volume 2.1 m³

Tank Selection (model)	Quantity
BCP- 3600L-S	1
Internal Length	2.286 m
Internal Width	1.118 m
Nominal Depth	1.274 m
Depth Override	1.105 m

Specified Volume 2.8 m³
 Specified Surface Area 2.8 m²

Parameters as Specified

Hydraulic Retention Time (HRT) $= 3.4$ h
 Media Volume $= 1.0$ m³
 Media Surface Area $= 500$ m²
 Media Filling Degree $= 35.4$ %
 Media CBOD₅ Surface Loading $= 1.20$ gCBOD₅/m²-d

Aeration Design

Design Oxygen Demand $= 1.65$ kgO₂/d
 Specified Aeration Rate $= 20.0$ Nm³/h
 Specified Aeration Running % $= 42\%$
 Specified Aeration Running Time $= 10.0$ hr/d
 Specified Oxygen Transfer Efficiency $= 3.$ %
 Specified Oxygen Supply @25°C $= 1.65$ kgO₂/d
 Specified Mixing per Unit Volume $= 1.97$ L/s-m³
 Specified Mixing per Surface Area $= 2.17$ L/s-m²

Blower Selection (model) Quantity

150HPO2502P	2
Diffuser Length	4 m
Design Blower Pressure	147 mbar
Design Blower Rate / Blower	10 Nm ³ /h
Specified Power / Blower	0.12 kW
Amperage	2.25 Amp

PSI	WG (in)
2.13	58.9
5.89	scfm
0.16	HP
VFD spec. <not required>	

Tertiary Clarifier (TC):

TC

Design Criteria

Hydraulic Retention Time (HRT) ≥ 2.5 h
 Maximum Surface Area Loading ≤ 0.8 m³/m²-d

Min. Volume 2.1 m³

Tank Selection (model)	Quantity
BCP- 3600L-S	1
Internal Length	2.286 m
Internal Width	1.118 m
Nominal Depth	1.274 m
Depth Override	1.248 m
Number of Hoppers	Double

Specified Volume (with hoppers) 2.5 m³
 Specified Surface Area 2.6 m²

Parameters as Specified

Unit Flow w/Recirculation $= 0.83$ m³/d
 Hydraulic Retention Time (HRT) $= 3.1$ h
 Surface Area Loading (SOR) $= 0.32$ m³/m²-d

Effluent Pump Tank (EPT):

EPT

Design Criteria

Hydraulic Retention Time (HRT) ≥ 6.0 h

Min. Volume 5.0 m³

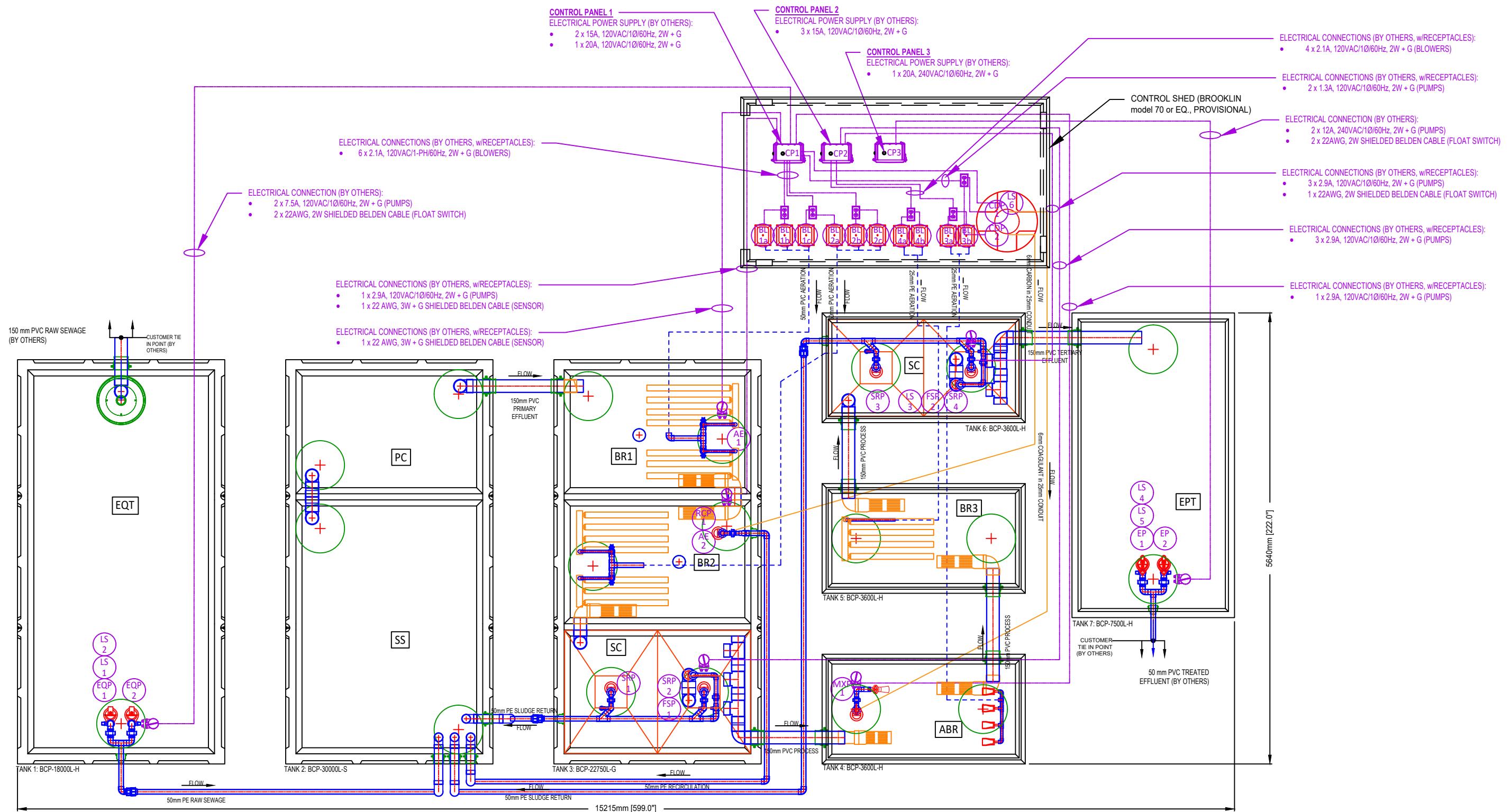
Tank Selection (model)	Quantity
BCP- 7500L-H	1
Internal Length	3.621 m
Internal Width	1.841 m
Nominal Depth	1.137 m
Depth Override	

Specified Volume 7.6 m³

Parameters as Specified

Hydraulic Retention Time (HRT) $= 9.13$ h

Appendix 3 – Proposed Layout Drawing



TANK LIST

PROCESS NAME	TANK #	~ WORKING VOLUME (m³)
EQT EQUALIZATION TANK	1	17.1
SS SLUDGE STORAGE	2	20.0
PC PRIMARY CLARIFIER	2	9.6
BR1 BIOREACTOR 1	3	7.5
BR2 BIOREACTOR 2	3	7.3
SC SECONDARY CLARIFIER	3	5.6
ABR ANOXIC BIOREACTOR	4	3.0
BR3 BIOREACTOR 3	5	2.8
TC TERTIARY CLARIFIER	6	2.5
EPT EFFLUENT PUMP TANK	7	7.6

PROCESS FLOW
 SLUDGE RETURN/RECIRC
 AERATION
 CHEMICAL DOSING
 ELECTRICAL

BL BLOWER
 VFD VARIABLE FREQUENCY DRIVE
 CDP CHEMICAL DOSING PUMP
 SRP SLUDGE RETURN PUMP
 FSP FLOATING SLUDGE (SKIMMER) PUMP
 EQP FLOW EQUALIZATION PUMP
 RCP RECIRCULATION PUMP
 EP EFFLUENT PUMP
 LS LEVEL SWITCH (FLOAT)
 MXP MIXING PUMP

NOTES:

- ALL WORK, INSTALLATION AND CONNECTIONS IN RELATION TO THE TREATMENT SYSTEM SHALL BE DONE IN ACCORDANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED BY BERGMANN NORTH AMERICA INC. AND IN ACCORDANCE WITH ALL APPLICABLE LOCAL CODES AND REGULATIONS.
- ALL ACCESS OPENINGS MUST BE INSTALLED TO GRADE AND SECURED TO PREVENT ACCIDENTAL OR UNAUTHORIZED ACCESS.
- A MAXIMUM OF 1 METRE BURIAL DEPTH IS ALLOWABLE ON TOP OF ANY TANKS IN A NON-TRAFFIC AREA. EXTRA REINFORCEMENT IS REQUIRED FOR USE IN AREAS WITH VEHICULAR TRAFFIC AND BURIAL DEPTHS OVER 1 METRE.

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LARRY ROBINSON ARENA WWTS

DRAWING: PLAN LAYOUT
FOR PROPOSAL
Rev.0

DRAWN BY: IR
APPROVED BY: MM
SHEET 1 of 1

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