APPENDIX J

On-Site Leachate Pre-treatment Design Report

December 2014

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On-Site Leachate Pre-Treatment Design Report
Volume IV Design and Operations Report
Capital Region Resource Recovery Centre

REPORT

Report Number: 12-1125-0045/4500/vol IV

Golder Associates

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1.0 INTRODUCTION

1.1 Objectives

The objectives of this leachate pre-treatment design report are to:

- Identify the background, design basis, and scope of the proposed on-Site leachate pre-treatment system prior to assumed final treatment at the City of Ottawa Municipal Wastewater Treatment Plant (ROPEC);
- Present the proposed design concept;
- Outline proposed environmental protection provisions, monitoring programs and reporting requirements; and,
- Provide supporting documentation for submission of an Environmental Compliance Approval (ECA) application.

2.0 WASTEWATER QUANTITY

The leachate quantity is estimated to be approximately 20,000 m^3/year during the initial years, which will increase to 88,000 m^3/year by year 10 and continue to increase until the landfill is in its final phase to an estimated 230,000 m^3/year. Once the landfill is closed using the proposed permeable final cover approach, it is estimated that approximately 228,000 m^3 of leachate will require treatment per year.

Additionally, liquor from the organics processing will require treatment. The amount of organics to be processed at the Site is estimated to be approximately 50,000 tonnes per year and the liquor produced from this process is estimated to be 30,000 m^3 to 35,000 m^3 per year. During the initial years the Biopower demonstration project will likely produce a limited amount of liquor that would be re-used in the process, if possible. Hence, during this time no liquor has been accounted for requiring treatment. Table 1 shows the total estimated quantity of wastewater requiring treatment:

Table 1: Estimated Wastewater Quantity

Year	Landfill Leachate (m^3)	Organics Processing Liquor (m^3)	Total (m^3)
Initial years	20,000	-	20,000
By year 5	40,000	20,000	60,000
By year 10	88,000	30,000 – 35,000	118,000 – 123,000
Maximum	230,000	35,000	265,000
After landfill is closed	228,000	-	228,000

2.1.1 Surface Water Diversion

In order to reduce the quantity of water requiring on-Site pre-treatment, the non-impacted runoff generated from the covered sideslopes of the landfill will be captured by a separate stormwater runoff system. This is addressed in a separate part of the Design and Operations (D&O) Report.

3.0 WASTEWATER QUALITY

Leachate age, precipitation, waste type and composition are the main factors that affect leachate quality. The leachate quality from the CRRRC landfill component is expected to be less in strength than typical landfills accepting municipal waste; however, similar to the leachate quality observed at Otter Lake Waste Processing and Disposal Facility in Nova Scotia (Otter Lake) which has a front end processor, waste stabilization facility and residual disposal facility somewhat similar to the proposed Capital Region Resource Recovery Centre (CRRRC) facility. The following table provides a comparison of typical leachate parameters from a municipal waste landfill to Otter Lake Landfill leachate data. The typical values are based on analytical results from municipal waste containing landfill sites within Ontario, literature and values used in the Ontario Landfill Standards (MOE, 1998). Actual values will not be known until the landfill is in operation and the leachate quality is monitored.

Table 2: Estimated Leachate Quality

Parameters	Typical Peak Concentration for Municipal Landfill Leachate (mg/L)	Otter Lake		
		Minimum (mg/L)	Maximum (mg/L)	Average (mg/L)
BOD	8,000	14	5,600	761
NO2+NO3		0.05	270	35
NO3	5	<0.1	87	22
NO2		<0.1	190	15
Ammonia	800	4.2	620	260
Phenols	4			
P	50	0.10	16	2.5
SO4		2	530	215
TSS	1,500	14	8,700	290
Al	2	0.1	157	5.3
As		0.01	1.4	0.16
B	9	0.3	17	7
Cd	0.05			
Cr		0.02	2.8	0.3
Co	0.05	0.01	0.38	0.04
Cu	0.4	0.02	4.2	0.5
Pb		0	0.2	0.03
Mn		0.09	11	2
Ni	0. 4	0.06	2.3	0.25
Ag	0.003			
Ti		0.01	3.7	0.2
V	0.5	0.01	1	0.10
Zn	2	0.06	2.5	0.5
pH	5.2 – 8.0	6.2	8.6	7.8
Fe	50	0.3	229	14

The organics processing liquor quality was similarly estimated based on information found in the literature. Based on data obtained from a full scale treatment plant designed to treat the source separated organic fraction of municipal solid waste (OFMSW) in Spain, the effluent liquor has average ammonia, phosphorous and total organic carbon concentrations of 1,360, 30 and 14,400 mg/L, respectively (Pognani, et al., 2012). Similarly the average ammonia concentrations in a bench scale reactors anaerobically treating mechanically recovered OFMSW was reported as 1,470 mg/L (Zhang et al., 2012). The metal concentrations were reported by Pognani et al. (2012) as the following: Cd 0.16 mg/L, Cr 10.9 mg/L, Cu 19.2 mg/L, Ni 9.1 mg/L, Pb 17.4 mg/L and Zn 55.2/L. During the first five years, the CRRRC wastewater will have a higher proportion of liquor to leachate, which, when combined, will initially affect overall quality. However, after year 10 the effect of liquor quality on the overall mixed influent to the pre-treatment system is expected to be less. Table 3 summarizes the estimated digested organics processing liquor quality. Similar to leachate quality estimates, the actual values will not be known until the organics processing is in operation and the quality is monitored.

Table 3: Estimated Digested Organics Processing Liquor Quality

Parameters	Estimated Liquor concentrations (mg/L)
Ammonia	1,700
BOD	2,000
TP	50
All metals	Same or less than maximum concentrations in leachate

4.0 PROPOSED ON-SITE PRE-TREATMENT SYSTEM DESIGN

4.1 General Design Considerations

The overall design philosophy of the CRRRC on-Site pre-treatment facility utilizes proven and cost-effective components. After analyzing the available options, pre-treating the wastewater on-Site and hauling it to ROPEC was chosen as the preferred wastewater treatment system to both minimize potential environmental effects and minimize the complexity, infrastructure and operational costs of the on-Site pre-treatment. A Sequencing Batch Reactor system was chosen for its high treatment efficiency and scalability. All design components are sized based on the estimated maximum averaged flow rate. The pre-treatment system development will be phased based on the actual leachate and liquor incoming flow rates from the landfill and organics processing facility operations. Some components may not be required based on actual quality and quantity of wastewater.

4.2 Effluent Discharge Criteria

For the effluent to be accepted by ROPEC, it is required to meet the City of Ottawa Sewer Use By-Law (City of Ottawa, 2003). An agreement with the City of Ottawa will be required. Table 4 shows parameters anticipated to require treatment based on the conservative quality estimates for these parameters compared with the Sewer Use By-law limits.

Table 4: Estimated CRRRC Wastewater Parameters Compared to the City of Ottawa Sewer Use By-law (City of Ottawa, 2003)

Parameters	City of Ottawa Sewer Use By-law Limits (mg/L)	Estimated Maximum Leachate Concentrations (mg/L)	Estimated Liquor Concentrations (mg/L)
BOD	300	8,000	2,000
TKN	100	>800	>1,700
Ammonia	--	800	1,700
TP	10	50	50
TSS	350	8,700	Same or less than maximum concentrations in the leachate
Al	50	157	
Cd	0.02	0.05	
Cu	3	4.2	

To be conservative, the highest values for each parameter from municipal leachate quality and Otter Lake Landfill leachate data (Table 2) were considered as design criteria.

4.3 Pre-treatment System Description

4.3.1 Collection

The leachate collection system consists of a series of sloped perforated pipes within a granular drainage blanket underneath the landfill. The piping is separated into nine different drainage areas with each area sloping into a manhole. Leachate pumps in each of the nine manholes will pump the raw leachate to the equalization tank in the leachate pre-treatment building. The pumps will be controlled by level switches such that as the leachate level in the manholes rises, the pumps turn on and remove the leachate. The design of the leachate collection system is discussed in the landfill design section of the D&O report.

4.3.2 Equalization and Storage

The collection system will pump the leachate into a 1,520 m^3 equalization tank located within the main pre-treatment building. Excess leachate will overflow from the equalization tank into the leachate storage pond where it will be kept until treatment capacity is available. The liquor from the organics processing facility will be pumped into the liquor storage tank, also located in the main pre-treatment building. The liquor from the organics facility will be combined with the landfill leachate at a ratio determined by the operator before entering heat exchangers prior to the sequencing batch reactors.

4.3.2.1 Leachate Storage Pond/Tank(s)

The leachate storage pond/tank(s) will have approximately 44,000 m^3 storage capacity. If a pond is used, it will have a maximum liquid depth of 3 metres. Total excavation depth will be 3.6 metres providing a 0.6 metre freeboard at maximum liquid capacity. The pond will be constructed with minimum 4H:1V sideslopes and will be lined using a geomembrane liner having properties suitable for chemical compatibility/resistance to leachate impacted waters and long term performance in an exposed liner application. If a tank(s) is to be used, the volume noted above will be provided within the tank(s). The leachate storage volume available will be approximately two months of storage based on the maximum yearly flow rate estimate. This volume will be used to store excess leachate from the landfill during periods when the supply of leachate is greater than the design flow of the pre-treatment system. The storage is projected to be utilized primarily during the spring runoff season and periods of high precipitation. An aeration system will be implemented in the storage pond for the reduction of odours.

Once leachate generation slows and there is capacity in the pre-treatment system, liquid from the leachate storage pond will be pumped back into the equalization tank. A pumping chamber will be provided at the discharge of the storage pond to house the transfer pump to pump the liquid back into the equalization tank.

Consideration may be given to the use of a floating cover for the leachate storage pond. The floating cover may be considered as a means of odour control, if required.

4.3.3 Wastewater Treatment

In order to optimize the biological processes, particularly for ammonia reduction, the influent should be at a temperature of around 15°C. The operator will be able to adjust temperatures to optimize performance.

4.3.3.1 Boilers and Heat Exchangers

It will be necessary to use a system of boilers and heat exchangers to pre-heat the wastewater before it enters the biological treatment system at certain times of the year. During the winter months, liquid stored in the leachate storage pond may need to be heated from < 4°C to about 15°C, while in the summer months the heating requirements will decline. The boilers and heat exchangers will also be needed to heat the facility building. It is anticipated that the boilers and heat exchangers will use heat recovered from the flare/generator, biogas from the organics processing facility and/or landfill and/or fuel oil.

4.3.3.2 Sludge Digestion Tank

Pre-heated raw influent from the heat exchangers initially flows into the sludge digestion tank (1,520 m^3). The sludge digestion tank is kept full of liquid and overflows into one of up to three liquor holding tanks (1,520 m^3 each). In the sludge digestion tank, anaerobic conditions facilitate the breakdown of sludge that accumulates at the bottom of the tank using carbon in the incoming raw influent stream.

As sludge builds up in the bottom of the sludge digestion tank, it is pumped to the sludge management system as described in Section 4.3.5.

4.3.3.3 Air Scrubbing Equipment

Since there is a potential for anaerobic bacterial activity, the vents from the sludge digestion tank, equalization tank, and liquor storage tank will be combined before being directed to a discharge stack on the roof of the building. Once the plant is operational, if the air discharge from the stack has parameters exceeding the applicable Ministry of the Environment and Climate Change's (MOECC) regulations regarding air emission, a scrubber will be installed on the stack to limit the release of parameters such as methane and hydrogen sulphide.

4.3.3.4 Mixed Liquor Holding Tanks

As the liquid overflows the sludge digestion tank, it flows equally to each of the mixed liquor holding tanks (1,520 m^3 each). Two mixed liquor holding tanks are anticipated based on the estimated maximum average daily flow. One mixed liquor holding tank will be provided for redundancy. All mixed liquor tanks will be operated continuously at lower rates than design capacity; this could change based on actual flows. When the mixed liquor holding tanks are full, the wastewater is transferred to one of the leachate digestion tanks in a batch process with a portion of the transferred liquid cycled back to the sludge digestion tank where the biological solids settle. Once the leachate digestion tank is full, the pumps continue to run and nitrified mixed liquor overflows from the leachate digestion tank back into the mixed liquor holding tank. This recycled flow mixes with carbon-rich raw influent allowing denitrifying bacteria to convert nitrates into nitrogen gas in the mixed liquor holding tank.

The mixed liquor holding tanks fill the leachate digestion tanks with liquid in a batch process. Once one digestion tank is full, the system fills the next digestion tank in the cycle.

4.3.3.5 Leachate Digestion Tanks

The leachate digestion tanks (1,520 m^3 each) receive liquid from the mixed liquor holding tanks in a batch process. As the tank is being filled, a blower system aerates the liquid encouraging aerobic bacteria to break down organic compounds and nitrify ammonia in the wastewater. Four leachate digestion tanks are anticipated based on the estimated maximum average daily flow; this could change based on actual flows. Similar to mixed liquor holding tanks, two additional reactors are included for redundancy purposes. All reactors will be operated to maintain biological health in each reactor.

Once the solids have settled to the bottom of the tank, a timer initiates the decanting phase where clarified effluent is drawn off the top of the tank and directed to the chemical clarification step. Once the clarified effluent is drawn off the top, the tank is filled again from the mixed liquor holding tank and the cycle repeats.

4.3.3.6 Chemical Clarification

The liquid effluent from the leachate digestion tanks is directed to a mixing tank (25 m^3) where alum and/or other chemicals for metal precipitation are added to the liquid in order to facilitate coagulation. A mechanical agitator promotes mixing. After the mixing tank, a clarifier allows the coagulated particles to settle out of suspension. If required, the pH of the clarified liquid effluent will be adjusted back to the range required by the City of Ottawa Sewer Use By-law (City of Ottawa, 2003) and described in the discharge agreement before it is directed to the treated effluent pond. The settled sludge will be directed to the sludge management system. The combination of chemical addition and clarification is designed to increase the removal of metals not already removed in the leachate digestion tanks. Additionally, if the metals concentration in the raw leachate is found to be toxic to the biological treatment, there will be a provision to divert the raw leachate to the mixing tank and clarifier prior to the sludge digestion tank to eliminate/minimize the toxicity in the influent.

4.3.4 Treated Effluent Ponds/Tanks

The treated effluent from the chemical clarification step is pumped to the effluent ponds/tanks, which will have approximately 11,000 m^3 storage capacity. If the ponds are used, it will have a liquid depth of approximately3 metres. Total excavation depth will be approximately 3.6 metres providing a 0.6 metre freeboard at maximum liquid capacity. The ponds will be constructed with minimum 4H:1V side slope and will be lined with a geomembrane liner having properties suitable for chemical compatibility/resistance and long term performance in an exposed liner application. If tanks are selected, the volume noted above will be provided within the tanks. The liquid storage volume is divided into two compartments each with approximately one week of storage based on the design flow rate of the leachate pre-treatment system. Pumps will mix/circulate/aerate water in each compartment and transfer water from the first compartment to the second compartment.

The tanker trucks will be filled by pump from the second compartment. . The tanker trucks will transport the pre-treated effluent to ROPEC where it will be further treated in the wastewater plant prior to discharge. If in future a forcemain is used for conveying the pre-treated effluent for final off-Site treatment at ROPEC, an appropriate system to pump from the effluent ponds/tanks via forcemain to the discharge location would be provided.

4.3.5 Sludge Management

The sludge management system will receive sludge from both the clarifier and the sludge digestion tank. Sludge will be pumped to a sludge holding tank (38 m^3) where it will be mixed by a mechanical agitator in order to provide a homogeneous mixture. A liquid polymer will be added to the sludge holding tank to facilitate efficient dewatering.

From the sludge holding tank, the sludge will be dewatered using seven Geotube™ (Geotube) units. Each Geotube is a porous tube made of specifically engineered dewatering textile supported on a concrete pad. As sludge is pumped into the tube, water filters out through the fabric and is collected by the trenches on the concrete pad while the solids are trapped inside the tube. Once the tube is full, the solids will be disposed to the landfill.

The liquid passing through the Geotube textile captured by the trenches on the concrete pad would be directed to the leachate storage pond where it re-enters the treatment process.

In the summer period, four Geotubes will be located on an outdoor concrete pad. During the winter months, three additional Geotubes will be housed within a greenhouse.

4.3.6 Building Facilities

The leachate pre-treatment system will be housed in two buildings. The first, primary building will house all major process units including the equalization tank, boilers, heat exchangers, sludge holding tank, mixed liquor tanks, leachate digestion tanks, sludge storage tank, mixing tank, clarifier, pH adjustment system, and all associated pumps and control equipment. This building will be approximately 50 metres by 150 metres and have an inside height of approximately 12 metres. The building will be insulated and heated using boilers/exchangers described in Section 4.3.3, or via a fuel oil heating system.

4.3.7 Tanker Truck Filling Station

Treated effluent will be hauled to ROPEC for further treatment. At the maximum design flow rate of about 800 m^3/day, about twenty trips by 40m^3 tanker trucks will be required each day to transport the treated wastewater. In order to facilitate the filling of multiple tanker trucks simultaneously, multiple pump hose connections will be installed at the tanker truck filling station to pump effluent from the treated effluent pond into the trucks.

4.4 Equipment List

The following is a list of the major process components of the pre-treatment system. The pre-treatment system layout and process schematics are provided on Figure 1 and 2, respectively. Transfer pump sizes and locations may change based on the final hydraulic profile of the plant:

Total Design Capacity: 800,000 L/day

1) Equalization Tank

One (1) equalization tank, 19 metres in diameter by 6.7 metres top water level (TWL) with two (2) 30 hp pumps to transfer liquid through a 150 mm pipe to the leachate storage pond. Two (2) 20 hp leachate feed pumps feed the sludge digestion/holding tank through a 200 mm pipe.

2) Liquor Storage Tank

One (1) 6.8 metre diameter by 5.6 m high liquor storage tank to hold liquid waste from organics processing with two (2) 30 hp liquor pumps to transfer the liquor to the equalization tank through a 100 mm pipe.

3) Leachate Storage Pond

One (1) storage pond with approximate volume of 48,000 m^3. Pond to be approximately 3 metres deep and hydraulically connected to a pump maintenance hole containing two (2) 50 hp effluent pumps to transfer leachate back to the equalization tank through a 150 mm line.

4) Heat Exchangers

Assumed space required approximately 2 metres long by 0.6 metres wide by 1.5 metres tall.

5) Boilers

The system shall be capable of heating 850 L/min of water to at least 15 degrees Celsius.

6) Sludge Digestion/Holding Tank

One (1) sludge digestion/holding tank to be 19 metres diameter by 6.7 metres TWL. Tank Installed with inlet and outlet baffles and one (1) jet mixing manifold with 20 hp submersible jet mixing pump. Liquid piping from equalization tank to terminate inside the tank with 200 mm flange connection. Sludge digestion tank installed with three (3) 200 mm electric operated control valves to fill mixed liquor holding tanks. Pipes from sludge digestion tank to the mixed liquor holding tanks to be 200 mm.

7) Mixed Liquor Holding Tanks

Three (3) mixed liquor holding tanks to be 19 metres diameter by 6.7 metres TWL. Each tank installed with one (1) jet aeration manifold and one (1) 30 hp jet mixing pump (3 total). Liquid piping from sludge digestion/holding tank to terminate inside the tank with 200 mm flanged connection. Air piping to terminate inside the tank with a 150 mm flange connection with 150 mm air feed pipe coming through the tank roof. Mixed liquor holding tank installed with two (2) 100 mm electric operated control valves (6 total) and 100 mm line to fill leachate digestion tanks and one (1) 100 mm electric waste sludge control valve (3 total) and line to return sludge to sludge digestion/holding tank. Mixed liquor holding tank also installed with one (1) aeration pressure blower package driven by one (1) 50 hp motor (3 packages total).

8) Leachate Digestion Tanks

Six (6) leachate digestion tanks to be 19 metres in diameter by 6.7 metres TWL. Tanks installed with one (1) decanter each with 250 mm flange connection and piping to mixing tank (6 total) and one (1) jet aeration manifold with 30 hp jet mixing pump each (6 total). Each leachate digestion tank installed with one (1) aeration pressure blower package driven by one (1) 60 hp motor each (6 total).

9) Mixing Tank

One (1) mixing tank to be 3.4 metre diameter by 2.8 TWL with one (1) 1.5 hp top entry agitator. Inlet and outlet piping to be 200 mm.

10) Clarifier Tank

One (1) clarifier tank to be 7.6 metre diameter by 3.7 TWL with gravity connection to effluent storage pond. Outlet piping to be 200 mm.

11) PH Adjustment

One (1) pH adjustment system with chemical addition pump and 5 m^3 chemical storage tank.

12) Effluent Storage Pond

One (1) effluent storage pond with approximate volume of 5,150 m^3. Pond liquid level to be 2.5 metres deep (maximum) and connected to a pumping station containing three (3) 30 hp effluent pumps to fill tanker trucks. Pond to include a high level gravity emergency overflow to drainage ditch.

13) Sludge Storage Tank

One (1) sludge storage tank to be 4.3 metre diameter by 2.8 TWL with one (1) 30 hp sludge pump to transfer sludge to sludge dewatering facility with 200 mm piped connections from the clarifier and sludge digestion tanks. One (1) 5 hp mixer installed in sludge storage tank. One (1) 5 hp sludge feed pump to feed dewatering process through a 200 mm line.

14) Greenhouse

One (1) greenhouse building to be approximately 8.5 metre by 91.5 metre for sludge dewatering. Floor to be sloped to collect liquid from solids dewatering

15) Sludge Dewatering Pad

One (1) sludge dewatering pad to be approximately 55 metres by 30 metres (excluding berms and trench) with sloped floor to collect liquid from solids dewatering.

16) Sludge Thickening Polymer Addition System

One (1) sludge thickening polymer addition system including polymer metering pump, polymer low shear dispersion mixers, one (1) ½ hp water pressure booster pump, and associated controls.

4.5 Contingency Measures and Maintenance

The following provides a summary of operational conditions that may be encountered and contingency and/or maintenance options that could be undertaken.

Operational Condition	Contingency Options
Higher Flows than Design	Treatment process can be operated at 1,200 m^3/day with minimal effect on effluent quality.
Lower Flows than Design	Treatment process can be operated with fewer leachate digestion tanks operating to reduce flows. Alternatively, leachate digestion tanks and mixed liquor holding tanks can be operated at approximately 25% of their design flow without affecting system performance.
Higher metals loading or toxic constituents than assumed	Provision within the pre-treatment building will be made to direct raw wastewater from the initial equalization tank to the chemical mixing tank and clarifier before flowing through the biological treatment processes to remove excess metals.
Disruption to hauling treated liquid effluent	During normal operations, the effluent storage pond will be kept at a minimum volume so that in the event of a disruption to the hauled effluent program, the operator has approximately two weeks of storage at the design flows to fix the issue. If the operator chooses, the flow rate through the pre-treatment system can be temporarily reduced and leachate stored in the leachate storage pond in order to gain greater than two weeks storage in the effluent storage pond. Pumping from the leachate collection system beneath the landfill can be temporarily reduced or suspended.

5.0 PROPOSED MONITORING

Environmental monitoring related to the leachate pre-treatment system of the CRRRC will be carried out concurrently with the overall Site monitoring program. As such, reference should be made to the overall facility D&O report for monitoring, trigger mechanisms and contingency measures related to groundwater, leachate, surface water, sediment, dust, noise, odour and biology.

In addition to the monitoring of process variables required to properly operate the pre-treatment system, testing of the pre-treated effluent will be completed and compared to the City of Ottawa Sewer Use Bylaw (City of Ottawa, 2003), as required by the agreement between Taggart Miller and the City of Ottawa.

GOLDER ASSOCIATES LTD.

Isil Toreci Mubarek, Ph.D.
Environmental Consultant

Dennis G. Martin, M.Sc.(Eng), P.Eng.
Senior Hydrogeologist and Environmental Engineer, Associate

DPS/ITM/DGM/sg

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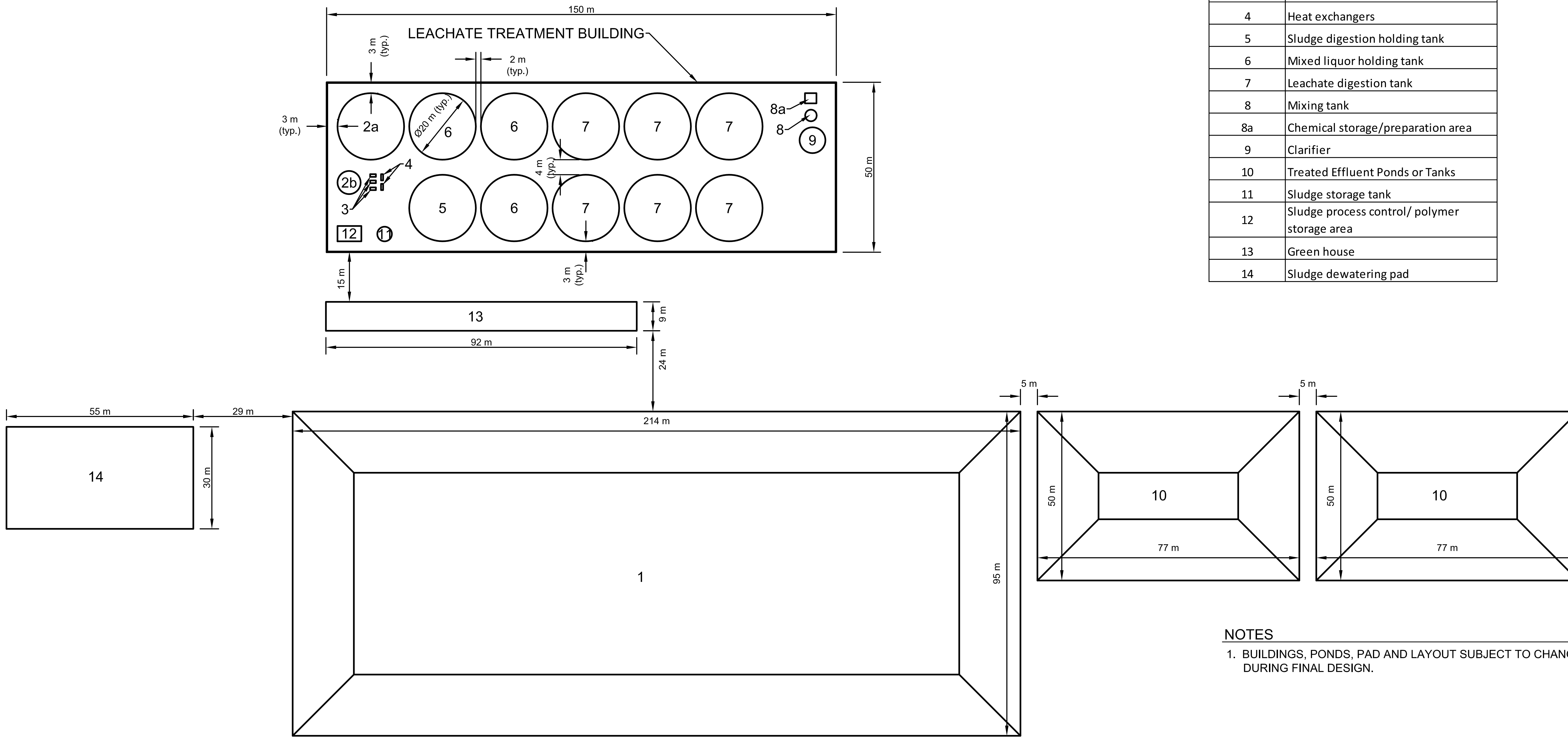

No.	Description
1	Leachate Storage pond and/or tank (s)
2a	Equalization tank
2b	Liquor storage tank
3	Boilers
4	Heat exchangers
5	Sludge digestion holding tank
6	Mixed liquor holding tank
7	Leachate digestion tank
8	Mixing tank
8a	Chemical storage/preparation area
9	Clarifier
10	Treated Effluent Ponds or Tanks
11	Sludge storage tank
12	Sludge process control/ polymer storage area
13	Green house
14	Sludge dewatering pad

NOTES

1. BUILDINGS, PONDS, PAD AND LAYOUT SUBJECT TO CHANGE DURING FINAL DESIGN.

PROJECT

CAPITAL REGION RESOURCE RECOVERY CENTRE

TITLE

LEACHATE PRE-TREATMENT SYSTEM LAYOUT

Golder Associates
Ottawa, Ontario

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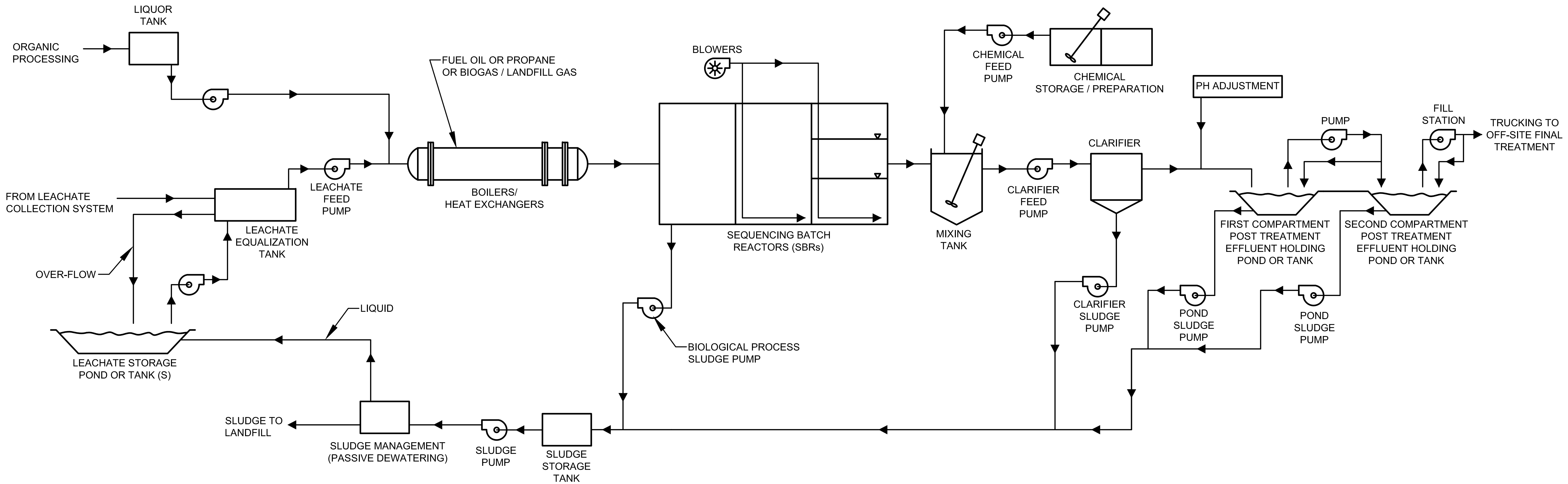
REVIEW	P.A.S.	Aug. 2014	



PROJECT

CAPITAL REGION RESOURCE RECOVERY CENTRE

TITLE

LEACHATE PRE-TREATMENT SYSTEM SCHEMATIC

Golder Associates
Ottawa, Ontario

PROJECT No. 12–1125–0045			FILE No. 1211250045-V4-lea-1-2.dwg	
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Golder Associates Ltd.
32 Steacie Drive
Kanata, Ontario, K2K 2A9
Canada
T: +1 (613) 592 9600

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For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
32 Steacie Drive
Kanata, Ontario, K2K 2A9
Canada
T: +1 (613) 592 9600