Feasibility Study of EWSWA Leachate Treatment

June 5, 2023

Prepared for:

Essex-Windsor Solid Waste Authority

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FEASIBILITY STUDY OF EWSWA LEACHATE TREATMENT

Revision	Description	Author		Quality Check		Independent Review	
0	Draft 1	H.Rindlisbacher	Mar9/23				
1	Draft2	O. Natvik	May26/23				
2	Draft3	O.Natvik	May30/23				
3	Final	O.Natvik	June2/23	H.Rindlisbacher	June 6/23		

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Executive Summary

Background:

The EWSWA (Essex-Windsor Solid Waste Authority) Regional Landfill which provides disposal services for Essex-Windsor, is located at 7700 County Road 18 in the Town of Essex. The EWSWA maintains a leachate recovery system at the Regional Landfill. The leachate collected at Regional Landfill is currently being loaded into tank truckers and taken to the LRWRP (Lou Romano Water Reclamation Plant) at 4155 Ojibway Parkway in West Windsor for treatment and disposal.

In recent years, leachate trucking and disposal has been negatively impacted by escalating trucking costs and rising fuel prices. The leachate in the Regional Landfill could last more than 75 years. The EWSWA needs a long-term sustainable solution for leachate treatment and disposal.

Assessment Options:

The EWSWA authorized Stantec Consulting to conduct a study to determine the feasibility and financial viability of alternate disposal solutions. The alternate disposal solutions assessed included:

1. **Trucking to Essex WWTP -** Trucking untreated, raw leachate to the nearby Essex WWTP for cotreatment. This option would reduce the trucking costs substantially given the reduced milage required to transport to the closer Essex WWTP vs the LRWRP.

2. **Providing on-site pretreatment and pumping effluent to the Essex WWTP for polishing -** Providing on-site pretreatment to reduce the leachate strength to less than typical sanitary sewer bylaw maximum concentrations to eliminate over-strength surcharges and permit sanitary sewer discharge. Pre-treatment options assessed included biological treatment options MBBR (by vendor Nexom) and MBR (by vendor Newterra) with a pumping station and forcemain to transfer effluent to the Essex WWTP for final treatment.

3. **Providing on-site treatment to allow nearby surface water discharge –** Pretreatment options assessed included a RO phys-chem process by vendor ROChem, and a biological MBR process by Newterra. The effluent quality will need to meet more stringent standards to allow a direct surface water discharge.

The assessments were made making certain design basis assumptions including: leachate flows, concentrations, and treatment effluent limits (see **Section 4.3**).

Key Findings:

1. The raw leachate strength is high such that there is limited capacity available within the Essex WWTP to treat the landfill leachate volumes. Current estimates suggest at most 1 tanker load or approximately 40 m^3 per day could be accommodated within the Essex WWTP.

2. Discussions with Essex WWTP officials confirm that they will not receive untreated, raw leachate but would consider receiving pretreated leachate with concentrations less than the maximum allowable per a typical sewer use bylaw.

3. The preliminary technical and financial analysis completed to assess on-site pretreatment options suggest the following:

    a. Construction cost - The lower capital cost solutions favour discharging to nearby surface water. This includes a phys-chem treatment solution like RoChem or a MBR biological solution like Newterra. The construction costs will vary $9-$20M depending upon the eventual scope of work. The construction cost to discharge to the Essex WWTP will be higher due to the additional cost estimated at $5M to construct a pumping station and forcemain.

    b. O&M cost – The operating costs are highest for RO phys-chem (primarily due to chemicals needed by the process) and for the MBBR/MBR biological treatment options discharging to sanitary sewer (primarily due to the sewer surcharges assumed at $\$4/m^3$). Annual O&M costs for these options is likely to exceed $1M/year. The lowest O&M cost option is the Newterra MBR option discharging to surface water due to reduced chemicals use and elimination of sewer surcharges. Annual O&M costs for the Newterra MBR process are approximately half the other options, estimated at approx. $0.5M/yr.

    c. 20 Year Life Cycle Cost (LCC) – The Newterra MBR option discharging to surface water provides a lower 20-year LCC versus the other options, estimated at approx. $21M vs >$31M.

    d. Given the financial analysis completed to date, the preferred treatment option is a MBR treatment option like Newterra discharging to surface water. Additional study is required to confirm its site-specific suitability. This includes: Class EA planning, ACS to confirm effluent limits, pilot testing to confirm treatment performance, and additional engineering to better define scope and costs.

Note that the design detail at this stage should be considered early conceptual level and therefore the cost accuracy should be considered Class 5 (with accuracy -35% to +50%) as per estimate definitions provided in **Appendix D**. Estimates are based on vendor budgetary proposals, using typical unit rates from other project examples, and making gross assumptions to fill missing information to provide the opinions of probable cost for construction, annual O&M, and 20-year life cycle costs (LCC). Additional engineering effort is required to better define the scope of work and the accuracy of the opinions of probable costs.

<u>Recommendations:</u>

1. **Treatment recommendation –** The LCC favours a MBR treatment option like Newterra discharging to adjacent surface water. Additional study is required to confirm the treatment process specifics, refine capital/O&M costs, and get regulatory approval from MECP.

2. **Initiate Class EA planning process –** To install a new pretreatment system discharging to surface water, a Class EA planning/consultation process is required to confirm the preferred treatment solution and meet the approval requirements of the MECP. Typically, this is a 1-year duration process that includes: further assessment of treatment solutions, public consultation, and ACS to confirm effluent limits.

3. **Initiate MECP Assimilative Capacity Study –** The design basis effluent limits and treatment options ability to meet these limits were assumed in this analysis. Additional study is required to define the effluent limits that a new treatment process will need to meet and be approved by the MECP. A receiver study, commonly referred to as “Assimilative Capacity Study” (ACS) will be required by the MECP to evaluate the receiver impacts and the site-specific effluent limits for the new wastewater treatment process that will discharge to surface waters. The ACS is typically completed in parallel with the Class EA activity. The ACS will include collecting field data such as stream flows, background water quality concentrations (e.g. $cBOD_5$, TSS, TP, TAN, DO, conductivity, etc.), aquatic life inventory, and a mass balance assessment to determine the new limits for the plant. The scope of work needs to be confirmed with MECP but could require a minimum of 9 months sampling followed by 3 months to finalize the limits with MECP. Assuming EWSWA wants to proceed with a surface water discharge solution, then it is imperative to begin the ACS work as soon as possible so as not to delay the construction start.

4. **Initiate pilot treatment study –** A surface water discharge will require an enhanced level of treatment, and therefore to increase the confidence levels of performance, a pilot study is recommended. This would include operating a process for an extended period to assess performance versus expected effluent concentration targets. This will also improve the MECP approval process. Securing a pilot will depend upon vendor pilot schedules and availability. Current vendor communications suggest at least 6 months may be required to secure a pilot unit. Assuming EWSWA approves proceeding with a MBR pilot, then preliminary discussions with Newterra suggest 7-8 months will be required to secure a unit, followed by a testing period that may last 6-12 months.

Preliminary Implementation Schedule:

A preliminary implementation schedule is provided in **Table 1.1**.

Table 1.1 - Preliminary Project Implementation Schedule

Activity	Duration	Start	Finish
Pre-consult with MECP project details (local and approvals branches)	1 week	July 2023	July 2023
Initiate and complete Class EA	1 year	August 2023	August 2023
Conduct ACS to define effluent limits (pending scope, TBD)	1 year	August 2023	August 2024
Secure MBR pilot plant	8 months	July 2023	February 2024
Run pilot plant, collect samples/analyze performance (duration TBD)	6-12 months (assume 12 months)	March 2024	March 2025
Design wastewater treatment plant	6-12 months (assume 6 months)	August 2024 (assume start overlaps with pilot testing)	May 2025
Secure MECP permit to operate WWTP	6-12 months after 60% detailed design completion	December 2024 (optimistically assuming MECP approval coincides with design completion)	May 2025
Tender & construct package WWTP	6-18 months (assume 8 months as package plant)	May 2025	December 2025
Commission/start	3 months	Early 2026	-

Abbreviations

AAF	Annual Average Flow
ACS	Assimilative Capacity Study
BOD_5	Biochemical Oxygen Demand (5 Day Test)
$cBOD_5$	Carbonaceous Biochemical Oxygen Demand (5 Day Test)
DO	Dissolved Oxygen
EA	Environmental Assessment
EAA	Environmental Assessment Act
ECA	Environmental Compliance Approval
EPA	Environmental Protection Act
EWSWA	Essex-Windsor Solid Waste Authority
Essex PCP	Essex Pollution Control Plant
LCC	Life Cycle Costs
LRWRP	Lou Romano Water Reclamation Plant
MBBR	Moving Bed Biofilm Reactor
MBR	Membrane Bioreactor
MCC	Motor Control Center
MECP	Ministry of Environment, Conservation and Parks
MMF	Maximum Month Flow
OCWA	Ontario Clean Water Agency
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PWQO	Provincial Water Quality Objectives
RAS	Return Activated Sludge
RO	Reverse Osmosis
RLF	Regional Landfill
SWMMP	Solid Waste Management Master Plan
TAN	Total Ammonia Nitrogen
TSS	Total Suspended Solids
WAS	Waste Activated Sludge
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

1.1 BACKGROUND

The EWSWA's Regional Landfill (RLF) located at 7700 County Road 18 in Essex County opened in July 1997. Established in 1994, the EWSWA manages waste generated by the County of Essex (comprised of the Town of Amherstburg, the Town of Essex, the Town of Kingsville, the Town of Lakeshore, the Town of LaSalle, the Municipality of Leamington and the Town of Tecumseh) and the City of Windsor. Through reduction, reuse, recycling, composting and landfilling of waste, the EWSWA provides Essex-Windsor with an economical and sustainable integrated solid waste management system.

The EWSWA oversees the operations established by the Essex-Windsor SWMMP (Solid Waste Management Master Plan). Their long-term solid waste management planning process was initiated in 1985 and the SWMMP was adopted in 1993 in support of the EAA (Environmental Assessment Act) and EPA (Environmental Protection Act) applications for the Essex-Windsor Regional Landfill Site.

The existing treatment and disposal process for leachate from the Regional Landfill consists of hauling the leachate to the LRWRP in the City of Windsor. The City of Windsor requested that the EWSWA pauses leachate hauling to the LRWRP for two months, as of November 25th, 2022 to assess potential impact on plant operation. The EWSWA ceased leachate hauling to the LRWRP for approximately 50 days and resumed in mid-January.

Escalating trucking costs and rising fuel prices continue to have an impact on the leachate trucking and disposal. The EWSWA advised that the leachate in the Regional Landfill could last as long as more than 75 years. A long-term sustainable solution is required for the leachate treatment and disposal.

1.2 STUDY OBJECTIVE

The EWSWA initially authorized Stantec Consulting to assess the feasibility of receiving some of the Regional Landfill's leachate loading at the Essex PCP (Pollution Control Plant) to provide a contingency outlet for the disposal of leachate. The intent was to assess the technical/financial feasibility of diverting landfill leachate to the Essex WWTP. The scope of work for the initial phase of the study included:

Analysis of background information on the leachate quantity and quality generated at the Regional Landfill, and existing Essex PCP historical operational data

Development of a design basis based on background information, including leachate quantity and quality for the feasibility study of accepting leachate at the Essex PCP.

Determine the reserve capacity within the Essex PCP to receive some fraction of the leachate from the Regional Landfill and reduce transportation costs.

Estimate of the daily volume of leachate that may be received and treated at the Essex PCP given the reserve capacity.

Identification of potential infrastructure upgrades (if any) at the Essex PCP needed to allow leachate receiving (e.g., flow/load equalization, odour control, etc.)

After completing the initial phase of work as described above and confirming the Essex plant could not receive untreated landfill leachate, a second phase scope of work was developed. The intent for this second phase was to investigate the technical/financial feasibility for pretreating the landfill leachate at the landfill suitable for direct surface water discharge or pumping through a new forcemain to the Essex WWTP for final polishing and discharge there.

This report summarizes the findings of the phase 1 and 2 analysis.

2.0 TASK 1 - EXISTING CONDITIONS

2.1 REGIONAL LANDFILL AND LEACHATE RECOVERY SYSTEM

2.1.1 Description

The Essex-Windsor Regional Landfill Site was officially opened on July 2nd, 1997. It is located in the south half of Lots 14, 15, and 16, Concession 7, in the Town of Essex (formerly the Township of Colchester North) at 7700 County Road 18 and it provides the disposal services for Essex-Windsor. The landfill site is 123.5 hectares in size with a waste footprint of 64.5 hectares, and the disposal area is divided into five different cells. The site is licensed by the MECP (Ministry of Environment, Conservation and Parks) under the Amended ECA (Environmental Compliance Approval) A011101 issued on November 16, 2020. The landfill only accepts domestic, commercial, institutional, non-hazardous solid industrial, and agricultural waste and dewatered sewage sludge generated within the service area.

The EWSWA maintains a leachate recovery system at the Regional Landfill. The leachate recovery system consists of three (3) lagoons operating in parallel that are all hydraulically tied together for equalization. However, some of the valves have not been functioning properly for at least 10 years and their location makes it difficult to repair or replace them. The leachate is collected from the waste mound that filters through the collection pipes into manholes. The leachate flows by gravity into three pumping stations, where majority of it is pumped through a forcemain into the South Lagoon and some into the Northwest Lagoon. Equalized leachate is pumped through an intake on the bottom of the southeast corner of the South Lagoon to the building adjacent the lagoons, and subsequently into the tank trucks. The tank trucks then haul the leachate to the LRWRP for treatment and disposal. Refer to **Figure 1** and **Figure 2** for aerial views of the regional landfill site and lagoons. Refer to **Appendix A**, for drawings provided by the EWSWA of the existing leachate collection system.

Figure 2-1: Aerial view of the Essex-Windsor Solid Waste Authority's Regional Landfill Site

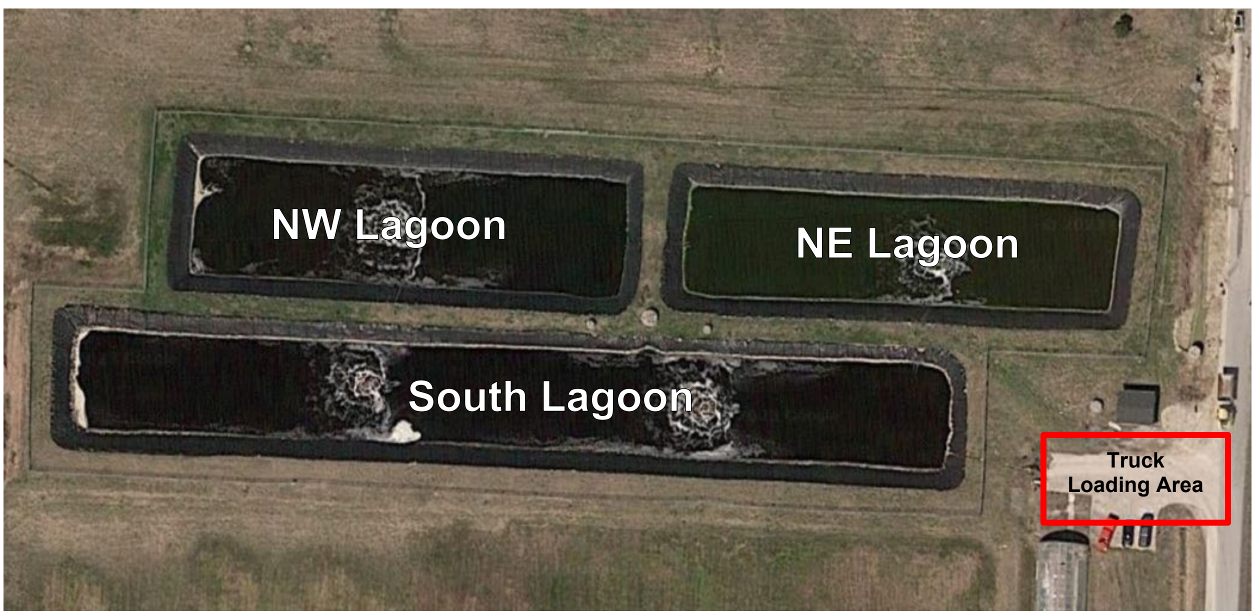


Figure 2-2: Essex-Windsor Solid Waste Authority RLF Site - Lagoons

2.1.2 Leachate Flows

Table 2.1: Average Daily Leachate Hauled from RLF to LRWRP from 2019-2023

Year	2019	2020	2021	2022	2023
Month	**m³/d**	**m³/d**	**m³/d**	**m³/d**	**m³/d**
January	255	296	261	477	169
February	310	274	189	397	220
March	338	429	215	405	234
April	670	549	245	467	
May	578	595	230	563	
June	588	393	210	500	
July	534	196	317	310	
August	208	154	372	391	
September	209	159	294	345	
October	230	124	309	317	
November	248	158	397	346	
December	193	201	347	0	
Annual Averages	**364**	**294**	**282**	**377**	**52**
Annual Totals	**4362**	**3528**	**3386**	**4520**	**623**
max4 month average	593	491	356	502	

From 2019 to 2022, the average daily leachate flow hauled to the LRWRP was approximately 330 m^3/d. Assuming tank truck capacity is around 40-45 m^3, an average of 7-8 trucks were hauling leachate to the LRWRP per day. The distance from EWSWA regional landfill site to the LRWRP is 27 km. Note that year 2023 flow data was influenced by hauling restrictions and was therefore not included in the flow calculations.

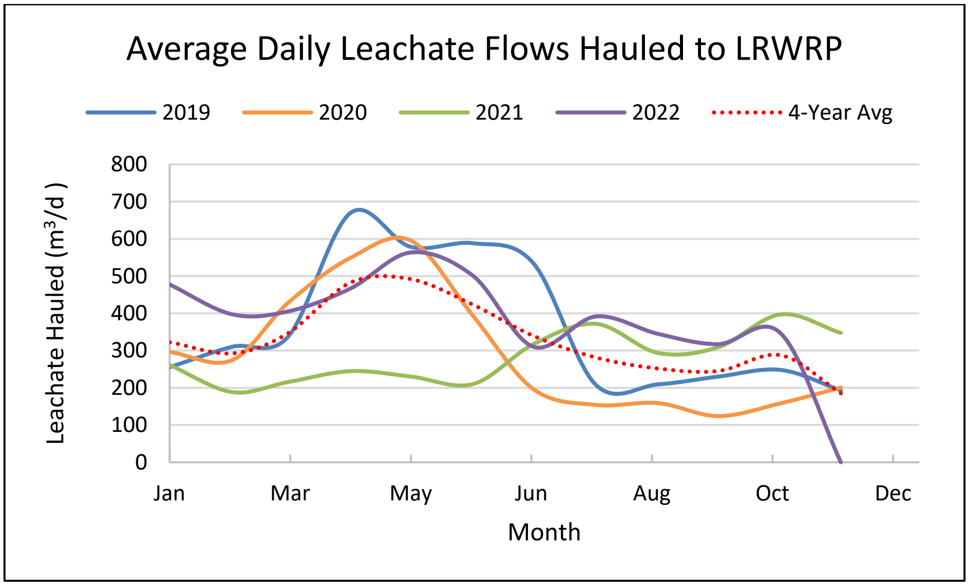


Figure 2-3: Average Daily Leachate Flows Hauled to LRWRP 2019-2022

Based on the plot above, it appears that the leachate flows to the LRWRP are usually highest in the spring (March to June) with monthly flows recorded as high as 670 m^3/d or 16 trucks per day.

2.1.3 Leachate Quality Data Analysis

In the data presented in this section, PS1, PS2 and PS3 represent grab samples of leachate collected from the manholes before flowing by gravity to their respective pumping station (Pumping Stations No.1, No.2 and No.3). As per ECA monitoring, the samples are taken twice a year, in the Spring (April) and the Summer (August) during regular work hours. The samples are representative of the leachate collected directly from the leachate collection system prior to discharge into the leachate lagoons at the regional landfill site. Pumping Station No.1 pumps the bulk of the flow from the landfill into the lagoons due to its collection area as shown in **Appendix A.** The leachate discharged into the lagoons is considered a mixture of old and new leachate generated at the regional landfill site. It is assumed that the quality of the leachate varies based on the age of the waste. The combined leachate is then pumped into trucks and transported to LRWRP.

This data analyzed in this section also includes samples collected directly from the tanker truck (representative of the leachate delivered to the LRWRP), as well as samples from the Northeast, Northwest and South lagoons in early 2023.

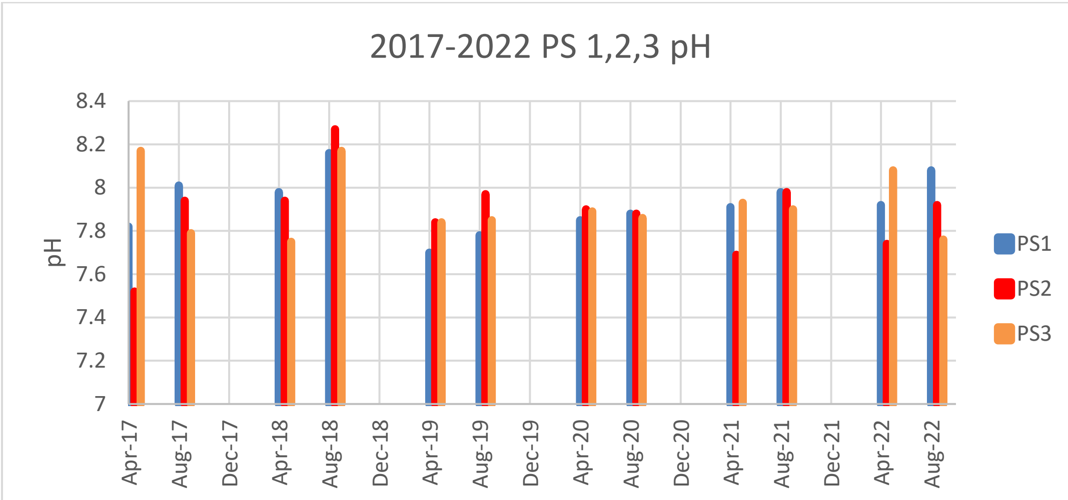


Figure 2-4: 2017-2022 pH Samples from PS 1,2,3

In **Figure 4** above, it is evident that the pH of the leachate directly from the leachate pumping stations is relatively consistent across all three pumping stations.

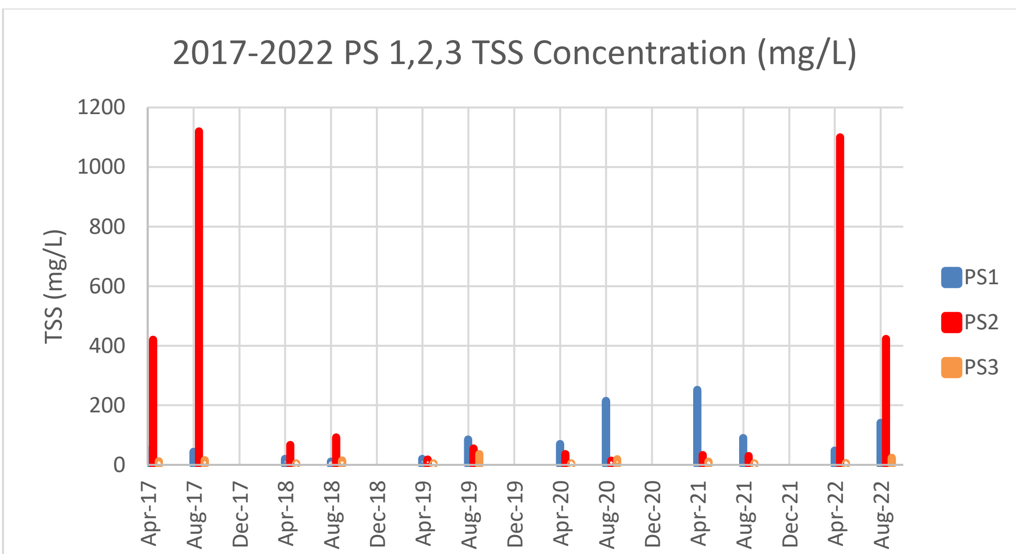


Figure 2-5: 2017-2022 TSS Concentrations from PS 1,2,3

Refer to **Figure 5** above, which displays the TSS concentrations from 2017 to 2022 at three pumping stations. The TSS concentration directly from the leachate collection system is generally within 0-250 mg/L with the exception of high TSS concentrations at Pumping Station No.2 in 2017 and 2022. It is possible that these outliers may be due to an error. On January 13, 2023, a sample from the South Lagoon at the regional landfill site measured a TSS concentration of 700 mg/L.

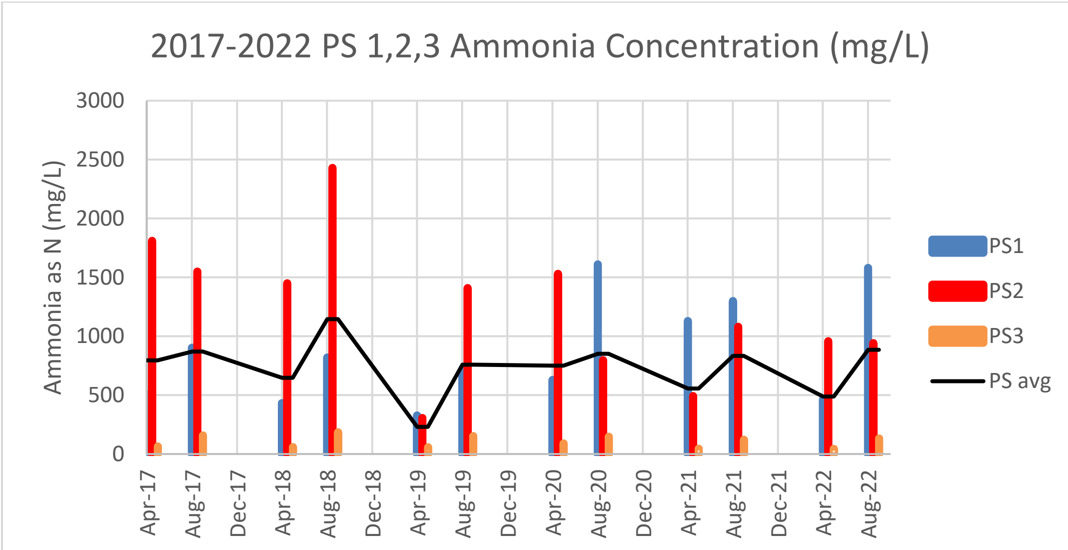


Figure 2-6: 2017-2022 Ammonia as N Concentrations from PS 1,2,3

The concentration of ammonia in the leachate directly from the collection system is presented in **Figure 6** above. The ammonia concentration in Pumping Station No.1 and No.2 seems to be significantly higher than the ammonia concentration recorded for Pumping Station No.3. The average ammonia concentration is 868, 1230 and 105 mg/L for PS 1, 2 and 3 respectively.

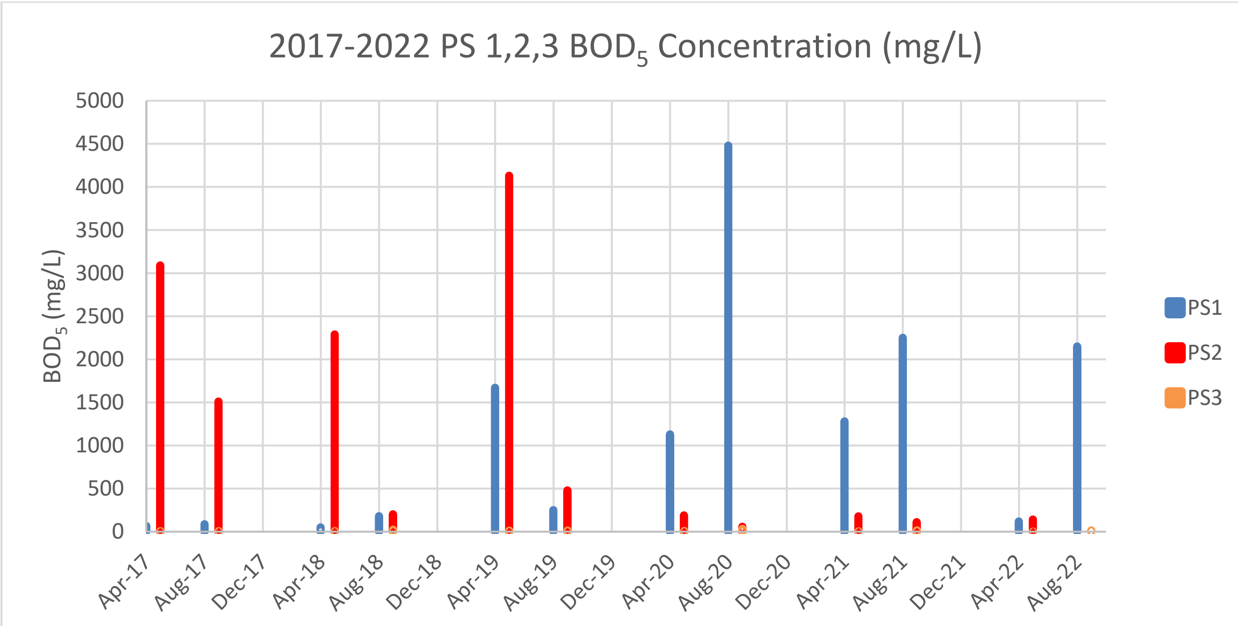


Figure 2-7: 2017-2022 BOD_5 Concentrations from PS 1,2,3

Refer to **Figure 7** above, which outlines the leachate BOD_5 concentrations from 2017 to 2022 at three pumping stations. The BOD_5 concentration in Pumping Station No.1 and No.2 seems to be significantly higher than the BOD_5 concentration recorded for Pumping Station No.3.

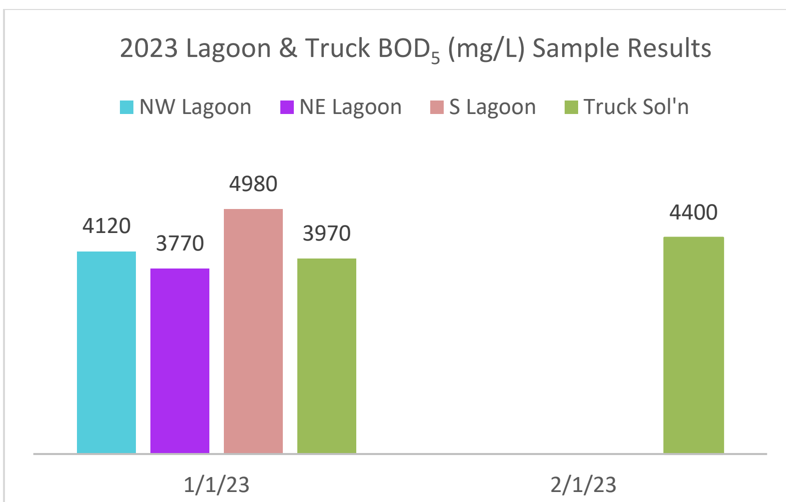


Figure 2-8: 2023 Lagoon & Truck BOD_5 Sample Results

Refer to **Figure 8**, above for the BOD_5 concentrations recorded from the truck solution, NW, NE and S lagoons. The lagoon and truck BOD_5 concentrations are much more consistent in comparison to the samples taken at the pumping stations because it represents the equalized leachate.

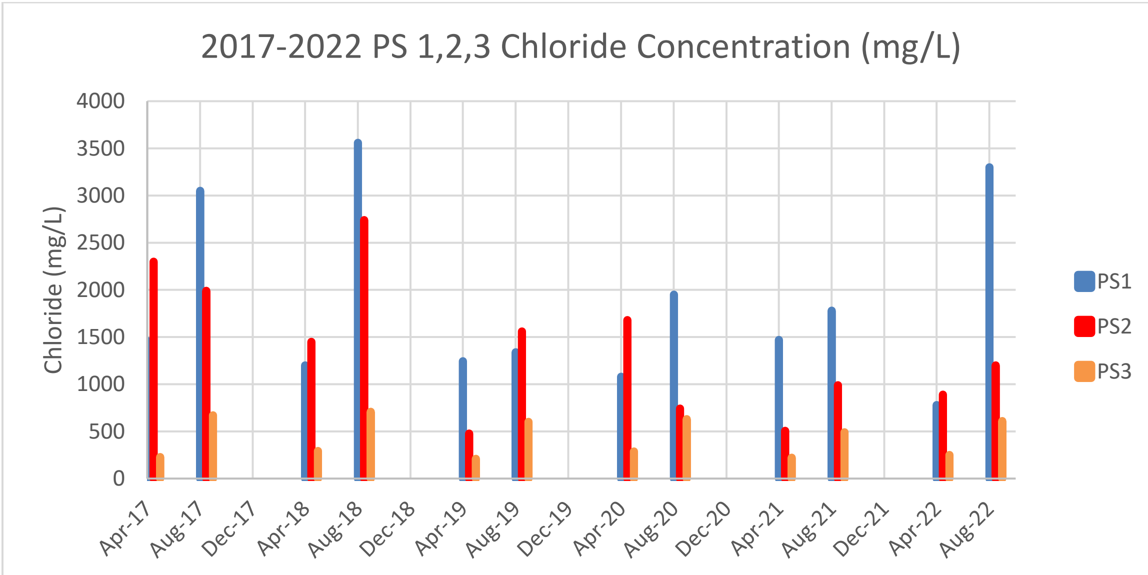


Figure 2-9: 2017-2022 Chloride Concentrations from PS 1,2,3

The concentration of chloride in the leachate at three pumping stations is presented in **Figure 9** above.

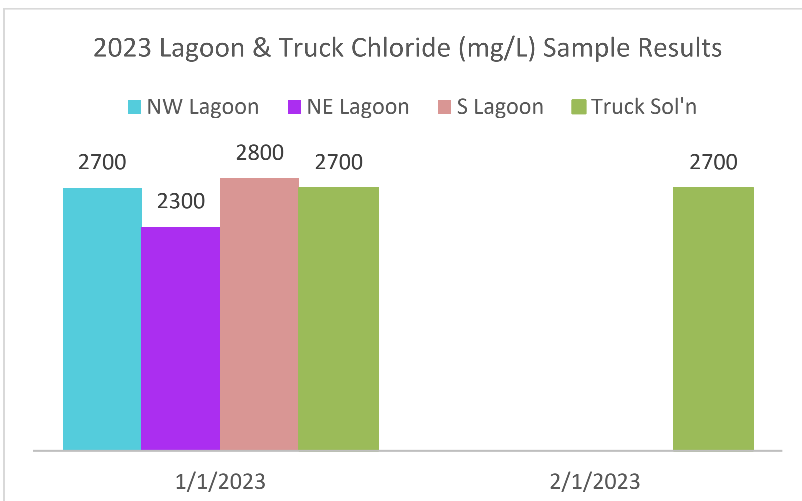


Figure 2-10: 2023 Lagoon & Truck Chloride Sample Results

See **Figure 10**, above for the chloride concentrations recorded from the truck solution, NW, NE and S lagoons. The lagoon and truck chloride concentrations vary less in comparison to the samples taken at the pumping stations because the leachate sampled in the lagoons and the truck is equalized.

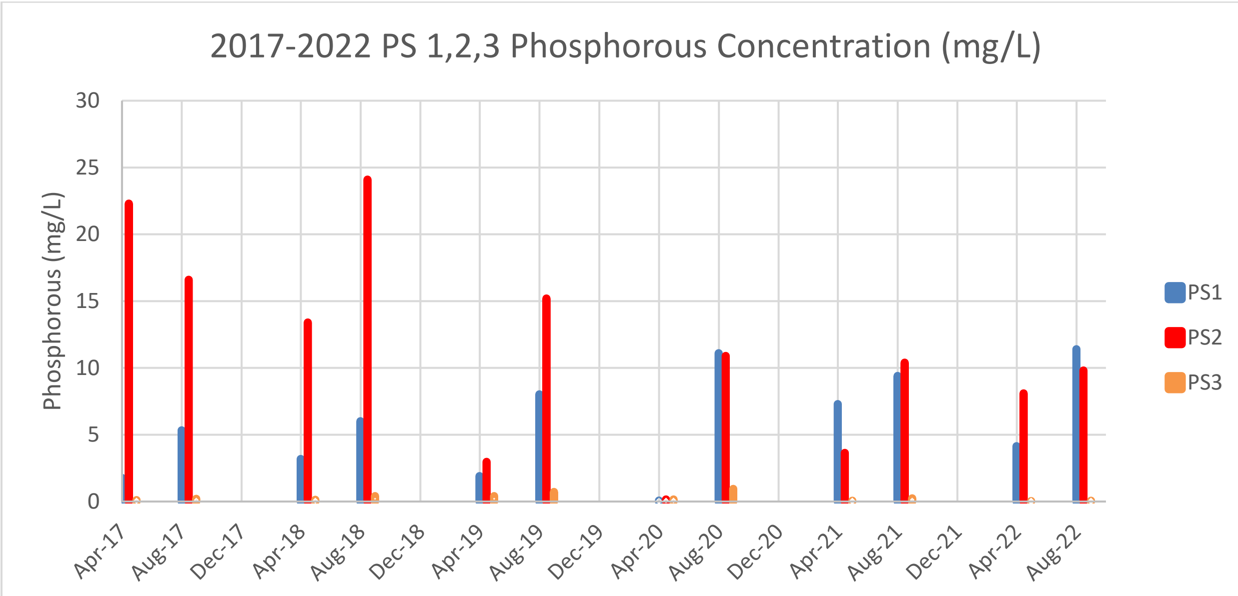


Figure 2-11: 2017-2022 Phosphorous Concentrations from PS 1,2,3

Refer to **Figure 11** above, which lays out the leachate phosphorous concentrations from 2017 to 2022 at three pumping stations.

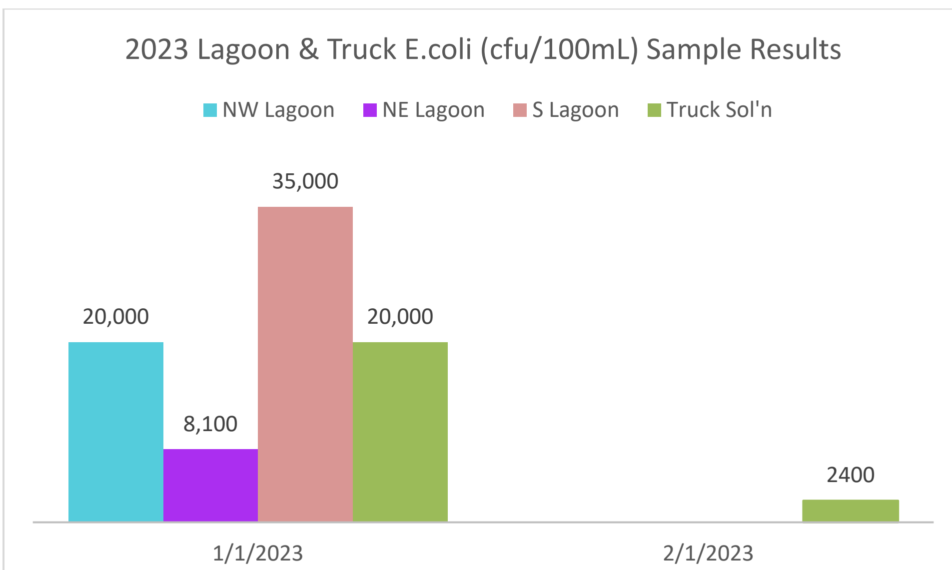


Figure 2-12: 2023 Lagoon & Truck E. coli Sample Results

See **Figure 12**, above for the E. coli concentrations recorded from the truck solution, NW, NE and S lagoons.

Refer to **Table 2.2** below, for the leachate quality data summary. Values located under '2017-2022 Pumping Station 1, 2, 3' column are grab samples of leachate collected from Pumping Stations No.1, No.2 and No.3 that collect leachate directly from the leachate collection system prior to pumping into the lagoons. The maximum and minimum month are the maximum and minimum values across all three pumping stations. Despite significant variability across the three pumping stations, the average month is calculated as an average across all three pumping stations. In the last column '2023 Lagoon/Truck Avg' an average was calculated based on samples taken from the truck solution, NW, NE, and S lagoons (equalized leachate) in January and February 2023.

Table 2.2: Summary of Leachate Quality Data

Parameter	**Units**	**Max. Month**	**Avg. Month**	**Min. Month**	
Leachate to LRWRP	m^3/d	670	330	124	
Samples		**2017-2022 Pumping Station 1, 2, 3**			**2023 Lagoon/Truck Avg**
pH	-	8.27	7.92	7.52	8.24
TSS	mg/L	1120	128	5	700
BOD_5	mg/L	4480	761	2	4248
Ammonia	mg/L	2430	734	44	-
Chloride	mg/L	3560	1221	209	2640
Phosphorous	mg/L	24	6	0	-
E. coli	cfu/100mL	-	-	-	17,100

Refer to **Appendix B** for RLF site raw quality data.

2.1.4 Key Findings: Leachate Data Analysis

The following are key findings from the leachate data analysis summarized in **Section 2.1.2** and **2.1.3:**

- The historical data on the leachate hauled to the LRWRP identifies a seasonal flow pattern. The flow of leachate hauled to the LRWRP in the wet Spring months (March to June) is significantly higher than the rest of the year.
- The concentration of soluble constituents was analyzed to determine if there was a dilution effect on the leachate in the wet Spring months vs. drier Fall months. However, no clear correlation between the season and the concentration of soluble constituents was identified.
- The leachate receiving site will need the treatment capacity to handle the maximum month flow of 670 m^3/d during the wet Spring months.

2.2 ESSEX PCP

2.2.1 Description

The Essex Pollution Control Plant is located at 3980 North Malden Road, in the Town of Essex. The municipal sewage works facility is responsible for transmission, treatment, and disposal of domestic sewage for the Town of Essex service area. The site is licensed by the MECP (Ministry of Environment, Conservation and Parks) under the Amended ECA (Environmental Compliance Approval) 8528-A7VK6D issued on April 28, 2016.

The Essex WPCP, constructed in 2006, is located adjacent to the temporary storage lagoons, and includes an inlet pump station, screening and grit removal, chemical feed facilities, sequencing batch reactors with aeration, UV disinfection facility that disinfects from May 1st to November 3rd and a dewatering facility. The plant also has two temporary storage lagoons for wet weather events. The Essex PCP hauls their biosolids to the regional landfill site for disposal. The plant is rated for an average daily flow of 4,590 m^3/d a peak flow capacity rating of 14,400 m^3/d.

Figure 2-13: Aerial view of the Essex Pollution Control Plant

2.2.2 Flows

Table 2.3: Essex PCP Average and Max. Monthly Flows 2017-2021

Year	Flow (m^3/d)	
	Average	Max. Day Flow
2017	1,827	9305
2018	2,007	11567
2019	1,964	8391
2020	1,825	8267
2021	1,812	8763
5 Year Average:	1,887	9,259

From 2017 to 2021, the Essex PCP average daily flow was 1887 m^3/d, which is only 41% of the total rated capacity (4,590 m^3/d). The average maximum monthly flow was 9,259 m^3/d.

2.2.3 Essex PCP Effluent Criteria (MECP)

Table 2.4: MECP Effluent Criteria

Effluent Parameter	Objectives	Limits
$cBOD_5$ (mg/L)	5	10
Total Suspended Solids (mg/L)	5	10
Total Phosphorus (mg/L)	0.3	0.5
pH	6.5-8.5	6.5-8.5
Total Ammonia Nitrogen (mg/L)	2.0 (Nov-April) 1.0 (May-Oct)	3.0 (Nov-April) 1.5 (May-Oct)
E. coli	150 organisms / 100 mL (May 1 – Oct 31)	200 organisms / 100 mL (May 1 – Oct 31)

The Essex PCP effluent criteria above are from the amended ECA 8528-A7VK6D issued on April 28, 2016.

2.2.4 Raw Wastewater Quality Data

Table 2.5: Essex PCP Raw Wastewater Quality 2017-2021

Parameter	Average Concentration (mg/L)
BOD_5	270
TSS	350
TP	5.4
TKN	37

2.2.5 Historical Effluent Quality Data

Table 2.6: Summary of Essex PCP Effluent Quality

Parameter		2017	2018	2019	2020	2021
cBOD5 (mg/L)		2.02	2.08	2.33	2.08	2.39
TSS (mg/L)		2.15	2.24	2.56	2.41	2.52
Total Ammonia Nitrogen (mg/L)	Spring-Fall (1)	0.104	0.103	0.116	0.216	0.103
	Winter (2)	0.120	0.108	0.119	0.108	0.100
Total Phosphorous (mg/L)		0.134	0.125	0.160	0.162	0.128
E. coli (cfu/100mL) (Spring-Fall)		11	10	18	16	58
Note: (1) Spring-Fall period: May 1 - Nov 3 (2) Winter period: Dec 1 - April 30						

2.2.6 Essex PCP Reserve Capacity Estimate

The Essex PCP has a rated capacity of 4,590 m^3/d. From 2017 to 2021, the Essex PCP average daily flow was 1,887 m^3/d, which is only 41% of the total rated capacity (4,590 m^3/d). The average maximum monthly flow was 5,052 m^3/d. The reserve capacity for leachate flow should be limited to 25% of the total rated capacity so that there is enough capacity for monthly flow variations occurring at the Essex PCP itself. Therefore, assuming a maximum 25% load contribution from leachate can be received at the plant, this equates to reserving approximately 1,150 m^3/d of municipal wastewater equivalent load at the Essex PCP for receiving landfill leachate.

3.0 TASK 1 - DESIGN BASIS

3.1 REGIONAL LANDFILL

The average daily flow of leachate hauled to the LRWRP is approximately 330 m^3/d (7-8 trucks per day) with a maximum month hauled waste to LRWRP recorded of 670 m^3/d (16 trucks per day) based on data from 2019-2022.

There is a consistent seasonal pattern with typically 3-4 months of wetter weather in the spring (March-June) generating leachate flows generally higher than 500 m^3/d.

The existing 3 lagoon cells have a combined volume of approximately 13,000 m^3. It is assumed that the lagoons can be used to store/equalize spring flows greater than 450 m^3/d such that maximum month flows that need to be hauled offsite is limited to 450 m^3/d.

Table 3.1: Leachate Design Concentrations and Loadings

Parameter		**Avg. Month**	**Max. Month**
Leachate Flow (m^3/d)		330	450
Quality Parameter	**Design Concentrations (1)**	**Avg. Load (kg/d)**	**Max. Load (kg/d)**
TSS	500 mg/L	165	225
BOD_5	4000 mg/L	1320	1800
Ammonia	1200 mg/L	396	540
Phosphorous	15 mg/L	4.95	6.75

Notes:
1. Design concentrations per historical quality data analysis. Values were selected to fall between the average and maximum concentration calculated using historical leachate data.

Table 3.2: Equivalent Leachate Flows Based on Leachate Design Concentrations

Parameter	Essex PCP Raw WW Conc. (mg/L)	Leachate Design Conc. (mg/L)	Leachate Strength Factor	Equivalent Leachate Flow (m^3/d)
TSS	350	500	1.5	767
BOD_5	270	4000	15	77
Ammonia	37	1200	32	36
Phosphorous	5.4	15	3	383

The equivalent leachate flows were estimated in **Table 3.2** above. A leachate strength factor was determined for each quality parameter based on the concentrations from the Essex PCP historical raw wastewater data and the design concentrations identified in **Table 3.1**. The equivalent leachate flow values were determined by dividing 1,150 m^3/d (the estimated leachate reserve capacity allocated at the Essex PCP) by the leachate strength factor. Therefore, the ammonia strength factor would limit the treatment of leachate at the Essex PCP to approximately 36 m^3/d or one truck per day assuming 25% of the total plant's rated capacity is reserved for leachate receiving.

4.0 REVISED TASK 2 – TECHNICAL/FINANCIAL ANALYSIS OF LEACHATE PRETREATMENT OPTIONS

4.1 TOWN RESPONSE TO TASK #1 ANALYSIS & NEXT STEPS

Stantec sent the Task #1 analysis to the Town and its Essex PCP operator OCWA for their review and consideration. This was followed by a meeting April 13, 2023, with the Town to discuss the feasibility for receiving landfill leachate at the Essex PCP. The key decisions arising from the meeting included:

- Town will not permit receiving of high strength, untreated landfill leachate.
- Town would consider receiving landfill leachate provided EWSWA pretreats its landfill leachate to reduce constituent maximum concentration strengths in line with a typical municipal sewer by-law.

Given the Town feedback, EWSWA requested that the original Task #2 workplan be modified to assess the cost/benefit of various pretreatment options to allow discharge to the Essex PCP through a new forcemain or direct discharge to a receiving water body.

4.2 TASK #2 REVISED SCOPE OF WORK

The Task #2 objectives were modified in an approved Stantec change order request. The revised scope of work includes:

1. Perform a high-level desk review of standalone leachate treatment alternatives to identify potential preferred treatment options. The following options are to be considered for treating leachate at the landfill site.
    - Reverse Osmosis (RO) System
    - Membrane Bioreactor (MBR)
    - Moving Bed Biofilm Reactor (MBBR)

2. Recommend a preferred alternative treatment concept based on a high-level desk review and assessment of standalone leachate treatment system for partial or complete treatment onsite, including:
    - Partial treatment at Landfill Site, and then discharge to the influent pumping station at the Essex PCP via a forcemain.
    - Complete treatment at Landfill Site, and then discharge to the drain adjacent to the landfill site.

4.3 DESIGN BASIS

4.3.1 Leachate Flows

For purpose of the high-level feasibility analysis that follows it is assumed that future landfill leachate flows will remain like that recorded for the 2019-2022 period, including:

- Leachate annual average flow (AAF) = 330 m^3/d,
- Leachate maximum month flow (MMF)= 450 m^3/d, assuming the existing 3-cell lagoon volume can be used to equalize/store leachate monthly flows that have been recorded as high as 670 m^3/d.

4.3.2 Leachate Concentrations/Quality

It is assumed that leachate quality observed for the 2017-2022 period will remain similar in the future. Refer to **Section 2.1** for leachate concentration data analysis and note the wide variation in measured concentrations.

4.3.2.1 TSS, cBOD5, Ammonia, Phosphorus

The leachate design basis concentrations and loads were defined in Table 3.1 and will be assumed similar for this analysis. Table 4.1 has been shown below for reference.

Table 4.1: Leachate Design Concentrations and Loadings (source: Table 3.1)

Parameter		**Avg. Month**	**Max. Month**
Leachate Flow (m^3/d)		330	450
Quality Parameter	**Design Concentrations (1)**	**Avg. Load (kg/d)**	**Max. Load (kg/d)**
TSS	500 mg/L	165	225
BOD_5	4000 mg/L	1320	1800
Ammonia	1200 mg/L	396	540
Phosphorous	15 mg/L	4.95	6.75

Notes:

1. Design concentrations per historical quality data analysis. Values were selected to fall between the average and maximum concentration calculated using historical leachate data.

4.3.2.2 Other – Metals, Alkalinity, Temperature

Leachate metal concentrations measured Jan-Feb 2023 are presented in **Table 4.2** to assess relative metals concentrations versus a typical sewer use bylaw such as the City of Windsor.

Table 4.2: Leachate Metal Concentration Data vs Typical Sewer Use Bylaw Values

		20-Jan-23	20-Jan-23	20-Jan-23	20-Jan-23	2-Feb-23		
Parameter	Sewer By-Law	S Lagoon	NW Lagoon	NE Lagoon	Truck Sol'n	Truck Sol'n	Lagoon Avg	Truck Sol'n Avg
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
4AAP-Phenolics	1.0	**2.0**	**1.8**	**1.5**	**1.8**	**2.1**	**1.8**	**2.0**
Aluminum (total)	50.0	1.61	1.27	1.22	1.57	1.33	1.37	1.45
Antimony (total)	5.0	0.032	0.011	<0.009	0.011	0.018	0.0	0.015
Arsenic (total)	1.0	0.067	0.045	0.035	0.045	0.055	0.0	0.050
Barium (total)	5.0	0.335	0.272	0.246	0.163	0.228	0.3	0.196
Bismuth (total)	5.0	0.0005	0.0004	0.0002	0.0006	0.0006	0.0004	0.0006
Cadmium (total)	2.0	0.00135	0.00197	0.00170	0.00187	0.00235	0.00167	0.00211
Chloride	1500.0	**2800**	**2700**	**2300**	**2700**	**2700**	**2600**	**2700**
Chromium (total)	5.0	0.289	0.271	0.272	0.275	0.376	0.277	0.326
Cobalt (total)	5.0	0.0625	0.0491	0.0440	0.0492	0.0592	0.0519	0.0542
Copper (total)	5.0	0.513	0.185	0.171	0.542	0.8090	0.2897	0.6755
Cyanide (total)	2.0	<0.1	<0.1	0.14	<0.1	<0.1	0.1	0.1
Fluoride	10.0	0.74	0.75	0.73	0.72	0.89	0.74	0.805
Lead (total)	5.0	0.0866	0.0924	0.0843	0.0897	0.0981	0.0878	0.0939
Manganese (total)	5.0	2.02	1.47	1.14	1.12	1.4300	1.5433	1.2750
Mercury (total)	0.1	0.00049	0.00029	0.00027	0.00027	0.00001	0.00035	0.00014
Molybdenum (total)	5.0	0.0649	0.0189	0.0170	0.0170	0.04110	0.03360	0.02905
Nickel (total)	5.0	0.569	0.495	0.451	0.507	0.6060	0.5050	0.5565
Selenium (total)	5.0	0.0030	0.0018	0.0020	0.0028	0.0032	0.0023	0.0030
Silver (total)	5.0	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.0005
Sulphate	1500.0	510	430	57	550	560	332.3333333	555
Tin (total)	5.0	0.0371	0.0098	0.0117	0.0084	0.0316	0.0195	0.0200
Titanium (total)	5.0	0.132	0.0227	0.0282	0.0164	0.1180	0.0610	0.0672
Vanadium (total)	5.0	0.0466	0.0471	0.0456	0.0470	0.0564	0.0464	0.0517
Zinc (total)	5.0	2.82	2.08	1.55	1.77	2.0200	2.1500	1.8950
Note: Sewer By-Law = City of Windsor By-Law #11446, 1993, as per Section 2, 2. (o) Discharges to Sanitary Sewers for average water usage < 500,000 L/day.								
bold	= exceeds by law							

No information was made available for leachate alkalinity or temperatures.

4.3.3 Effluent Limits

Two potential discharge options are to be investigated:

1. Discharge to the Essex PCP assuming pretreatment is applied at EWSWA to meet typical sewer use bylaw limits, and
2. Direct discharge to a nearby surface water receiver to maintain Provincial Water Quality Objectives (PWQO) per "Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy, July 1994".

Each discharge option will require different levels of treatment. The following effluent limits have been proposed for each option for the purpose of this evaluation. The proposed effluent limits will need to be confirmed in further study including, completing an ACS and discussions with MECP to finalize site specific effluent limits.

4.3.3.1 Effluent Limits for Discharge to Essex PCP

Achieving a minimum treatment to meet a typical sewer use bylaw such as the City of Windsor has been proposed for the purpose of this evaluation. Key proposed effluent targets are listed in **Table 4.3**. Refer to Windsor City Bylaw 11446 for complete listing of sewer bylaw requirements.

Table 4.3: Effluent Limits for Discharge to Essex PCP

Parameter	Bylaw limit
Metals (see **Table 4.2**)	-
BOD5	400 mg/L
TSS	500 mg/L
Total Phosphorus	30 mg/L
TKN	100 mg/L
color	No visual discolor
pH	5.5 - 10

Note there may be additional limitations on the pretreated leachate that may be applied by MECP in their review to assess the effects of receiving pretreated landfill leachate as part of an ECA amendment that will be required for the Essex PCP.

4.3.3.2 Effluent Limits for Discharge to Nearby Surface Water

An enhanced level of treatment beyond meeting sewer use bylaw will be required to discharge to a nearby water receiver. An assimilative capacity study will be required by the MECP to determine the final effluent concentrations needed to maintain minimum water quality standards in the receiving water body. For purposes of this study, it is assumed the receiver is nearby such that a pumping station is not required and that an enhanced level of pretreatment will be required to maintain the receiver water quality. Key effluent targets are listed in **Table 4.4**.

Table 4.4: Effluent Limits for Discharge to Nearby Surface Water

Parameter	Effluent Objectives (1)	Non-Compliance Limits (2)
cBOD5	5 mg/L (3)	10 mg/L
TSS	5 mg/L	10 mg/L
Total Ammonia Nitrogen	1 mg/L	2 mg/L
Total Inorganic Nitrogen (Nitrate + Nitrite)	10 mg/L	20 mg/L
Total Phosphorus	0.2 mg/L	0.3 mg/L
Phenols (4AAP)	0.005 mg/L	-
Color	100 Pt-Co Units	250 Pt-Co Units
E.Coli	100 org/100mL (4)	200 org/100mL
pH		7.0 – 8.5

Notes:

1. Effluent objectives represent operating targets.
2. Non-Compliance limits represent “not to exceed” limits that trigger regulatory action to correct.
3. mg/L are monthly averages
4. org/100ml are geometric monthly mean.

5.0 VENDOR TREATMENT PROPOSALS

5.1 VENDOR PROCESS DESCRIPTIONS

Several wastewater treatment vendors were invited to prepare technical/budget proposals to meet the design basis information presented in **Section 4.3**, including:

1. ROChem (for surface water discharge) – This represents the use of a phys-chem treatment process to meet enhanced level treatment to allow for surface water discharge. ROChem's proposal dated March 10, 2023, is attached in **Appendix C.** The ROChem process will generally include:

    a. Using existing lagoon storage for flow equalization as noted in **Section 4.3**.

    b. New pumping station - to lift flows into a new treatment process located within a new pre-engineered building.

    c. Settling tank

    d. Acid mixing tank

    e. Filtration (sand and cartridge)

    f. First stage lower pressure RO system

    g. Second stage higher pressure RO system

    h. Air stripper to remove CO2 and raise pH

    i. Ion exchange to remove residual TAN

    j. Calcite mixing tank to resolubilize minerals needed to pass toxicity testing

    k. RO permeate blending tanks

    l. Chemical storage and delivery pump systems for: sulphuric acid, cleaning agents, etc.

    m. Concentrate handling system – this may include recycle to the landfill face or use of evaporator for volume reduction.

    n. Lab/WC/office space.

2. Nexom (for sanitary sewer discharge) –The process description that follows is based on Nexom proposal dated April 27, 2023. Nexom's proposal is included in **Appendix C**. The

Nexom process to allow for sanitary sewer discharge is based on a MBBR biological treatment process and will generally include:

a. Using existing lagoon storage for flow equalization as noted in **Section 4.3**.

b. New pumping station - to lift flows into a new MBBR treatment process.

c. Anoxic (with mixers) and Aerobic treatment tanks (with diffusers) to provide biological treatment using MBBR technology.

d. Locating associated process equipment to run the MBBR process within a pre-engineered building.

e. Associated process equipment to be located within the pre-engineered build will include:

    i. Process aeration blowers to allow biological $cBOD_5$/TN reductions.

    ii. Recirculation pumps needed for anoxic zone.

    iii. DAF for cBOD5/TSS effluent polishing.

    iv. Dewatering system to produce cake solids for disposal back to landfill.

    v. Electrical room to house associated electrical/PLC/MCC equipment.

    vi. Lab/WC/office space.

3. Newterra (for sanitary sewer and surface water discharge) – Newterra provided a proposal to permit sanitary sewer discharge dated May 19, 2023 and to provide surface water discharge dated May 29, 2023. Newterra's proposals are attached in **Appendix C**. The Newterra process is based on a MBR biological treatment process and will generally include:

    1. Using existing lagoon storage for flow equalization as noted in **Section 4.3**.

    2. New pumping station - to lift flows into a new MBR treatment process.

    3. Anoxic (with mixers) and Aerobic treatment tanks (with diffusers) to provide biological treatment using MBR technology. The surface water discharge option also includes a post-anoxic treatment tank to remove residual nitrates.

    4. Locating associated process equipment to run the MBR process within assembled shipping containers.

    5. Associated process equipment to be located within shipping containers will include:

        vii. Fine screen

viii. Pumps (recirculation, permeate, WAS, RAS, etc.)

ix. Process aeration blowers to allow biological $cBOD_5$/TN reductions

x. Membrane tanks containing ultra-filtration membranes.

xi. Membrane cleaning systems (citric acid and NaOCl).

xii. Alkalinity/nutrient dosing systems (NaOH, phosphoric acid).

xiii. Dewatering system to produce cake solids for disposal back to landfill.

xiv. Electrical room to house associated electrical/PLC/MCC equipment.

xv. Lab/WC/office space.

5.2 BASIS FOR OPINIONS OF PROBABLE COST

The design detail at this stage should be considered early conceptual level and therefore the cost accuracy should be considered Class 5 (with accuracy -35% to +50%) as per estimate definitions provided in **Appendix D.** Estimates are based on vendor budgetary proposals, using typical unit rates from other project examples, and making gross assumptions to fill missing information to provide the opinions of probable cost for construction, annual O&M, and 20-year life cycle costs that follow. Additional engineering effort is required to better define the scope of work and the accuracy of the opinions of probable costs.

5.3 CAPITAL COST ESTIMATES FOR CONSTRUCTION

A summary of the opinion of probable costs for construction for the ROChem, Nexom, and Newterra treatment systems is summarized according to major construction cost breakout items in **Table 5.1**. Note that these are Class 5 estimates. Detailed estimates for each treatment option and associated assumptions are provided in **Appendix E.**

Table 5.1 - Construction Opinions of Probable Cost

	Surface Water Discharge		Sanitary Sewer Discharge	
Major Cost Item	**ROChem**	**Newterra MBR**	**Nexom MBBR**	**Newterra MBR**
WWTP Construction	$11,096,675	$13,235,625	$13,972,747	$12,083,332
Transfer PS/Forcemain	-	-	$5,000,000	$5,000,000
Total Construction	$11,096,675	$13,235,625	$18,972,747	$17,083,332

5.4 ANNUAL O&M COST ESTIMATES

A summary of opinion of probable O&M costs for the ROChem, Nexom, and Newterra treatment systems is summarized according to major expense category items in **Table 5.2**. Note that these are Class 5 estimates. Detailed estimates for each treatment option and associated assumptions are provided in **Appendix E.**

Table 5.2 - Annual O&M Opinions of Probable Costs

		Surface Water Discharge Options		Sanitary Sewer Discharge Options	
	Cost Item	**Rochem**	**Newterra MBR**	**Nexom MBBR**	**Newterra MBR**
1	Labour	$90,000	$90,000	$90,000	$90,000
2	Heating (NG)	$10,000	$3,692	$6,462	$3,692
3	Electricity	$210,240	$140,160	$112,128	$140,160
4	Chemicals				
	RO descaling/cleaning	$110,000		-	-
	RO H2SO4 acid	$440,000		-	-
	RO calcite	$40,000		-	-
	RO IX resins	$10,000		-	-
	MBR citric acid cleaning	-	$5,000	-	$5,000
	MBR NaOCl cleaning	-	$1,000	-	$1,000
	P add- nutrient	-	$3,650	$3,650	$3,650
	NaOH - alk	-	$39,420	$39,420	$39,420
	polymers	-	$18,250	$19,345	$18,250
	micro-C		$35,000		
5	Admin	$10,000	$10,000	$10,000	$10,000
6	Sludge disposal	$37,000	$37,000	$37,000	$37,000
7	infrastructure renewal				
	membranes	$210,000	$8,000		$8,000
	mech equipmt	$75,000	$75,000	$75,000	$75,000
	misc.	-	-	$2,000	-
8	Sewer Surcharge	-	-	$481,800	$481,800
9	Contingency (10%)	$124,224	$46,617	$87,680	$91,297
10	Total ($/yr)	$1,366,464	$512,790	$964,485	$1,004,270

5.5 20-YEAR LIFE CYCLE COST ESTIMATES

A summary of the 20-year life cycle costs for construction and O&M (at 3% discount rate) for the ROChem, Nexom, and Newterra treatment systems is summarized in **Table 5.3**. Note that these are Class 5 estimates. Detailed estimates for each treatment option and associated assumptions are provided in **Appendix E.**

Table 5.3 - 20 Year LCC Opinions of Probable Costs

	Surface Water Discharge		Sanitary Sewer Discharge	
Cost Items	**ROchem**	**Newterra**	**Nexom**	**Newterra**
Construction cost (year 2023)	$11,096,675	$13,235,625	$18,972,747	$17,083,332
Annual O&M (year 2023)	$1,366,464	$512,790	$964,485	$1,004,270
Annual O&M (NPV Sum 2023-2043)	$20,329,534	$7,629,013	$14,349,101	$14,940,995
Total LCC (20 years operation)	$31,426,209	$20,864,638	$33,321,848	$32,024,327

6.0 FINDINGS

The preliminary technical and financial analysis completed herein suggest the following:

1. **Construction cost -** The lower capital cost solutions favour discharging to nearby surface water. This includes a phys-chem treatment solution like RoChem or a MBR biological solution like Newterra. The construction costs will vary $9-$20M depending upon the eventual scope of work. The construction cost to discharge to the Essex WWTP will be higher due to the additional cost estimated at $5M to construct a pumping station and forcemain.

2. **O&M cost –** The operating costs are highest for RO phys-chem (primarily due to chemicals needed by the process) and for the MBBR/MBR biological treatment options discharging to sanitary sewer (primarily due to the sewer surcharges assumed at $\$4/m^3$). Annual O&M costs for these options is likely to exceed $1M/year. The lowest O&M cost option is the Newterra MBR option discharging to surface water due to reduced chemicals use and elimination of sewer surcharges. Annual O&M costs for the Newterra MBR process are approximately half the other options, estimated at approx. $0.5M/yr.

3. **20 Year Life Cycle Cost (LCC) –** The Newterra MBR option discharging to surface water provides a lower 20-year LCC versus the other options, estimated at approx. $21M vs >$31M.

4. Given the financial analysis completed to date, the preferred treatment option is a MBR treatment option like Newterra discharging to surface water. Additional study is required to confirm its site-specific suitability. This includes: Class EA planning, ACS to confirm effluent limits, pilot testing to confirm treatment performance, and additional engineering to better define scope and costs.

7.0 RECOMMENDATIONS

1. **Treatment recommendation –** The LCC favours a MBR treatment option like Newterra discharging to adjacent surface water. Additional study is required to confirm the treatment process specifics, refine capital/O&M costs, and get regulatory approval from MECP.

2. **Initiate Class EA planning process –** To install a new pretreatment system discharging to surface water, a Class EA planning/consultation process is required to confirm the preferred treatment solution and meet the approval requirements of the MECP. Typically, this is a 1-year duration process that includes: further assessment of treatment solutions, public consultation, and ACS to confirm effluent limits.

3. **Initiate MECP Assimilative Capacity Study –** The design basis effluent limits and treatment options ability to meet these limits were assumed in this analysis. Additional study is required to define the effluent limits that a new treatment process will need to meet and be approved by the MECP. A receiver study, commonly referred to as "Assimilative Capacity Study" (ACS) will be required by the MECP to evaluate the receiver impacts and the site-specific effluent limits for the new wastewater treatment process that will discharge to surface waters. The ACS is typically completed in parallel with the Class EA activity. The ACS will include collecting field data such as stream flows, background water quality concentrations (eg cBOD5, TSS, TP, TAN, DO, conductivity, etc.), aquatic life inventory, and a mass balance assessment to determine the new limits for the plant. The scope of work needs to be confirmed with MECP but could require a minimum of 9 months sampling followed by 3 months to finalize the limits with MECP. Assuming EWSWA wants to proceed with a surface water discharge solution, then it is imperative to begin the ACS work as soon as possible so as not to delay the construction start.

4. **Initiate pilot treatment study –** A surface water discharge will require an enhanced level of treatment, and therefore to increase the confidence levels of performance, a pilot study is recommended. This would include operating a process for an extended period to assess performance versus expected effluent concentration targets. This will also improve the MECP approval process. Securing a pilot will depend upon vendor pilot schedules and availability. Current vendor communications suggest at least 6 months may be required to secure a pilot unit. Assuming EWSWA approves proceeding with a MBR pilot, then preliminary discussions with Newterra suggest 7-8 months will be required to secure a unit, followed by a testing period that may last 6-12 months.

8.0 SCHEDULE

A preliminary implementation schedule is provided in **Table 8.1**.

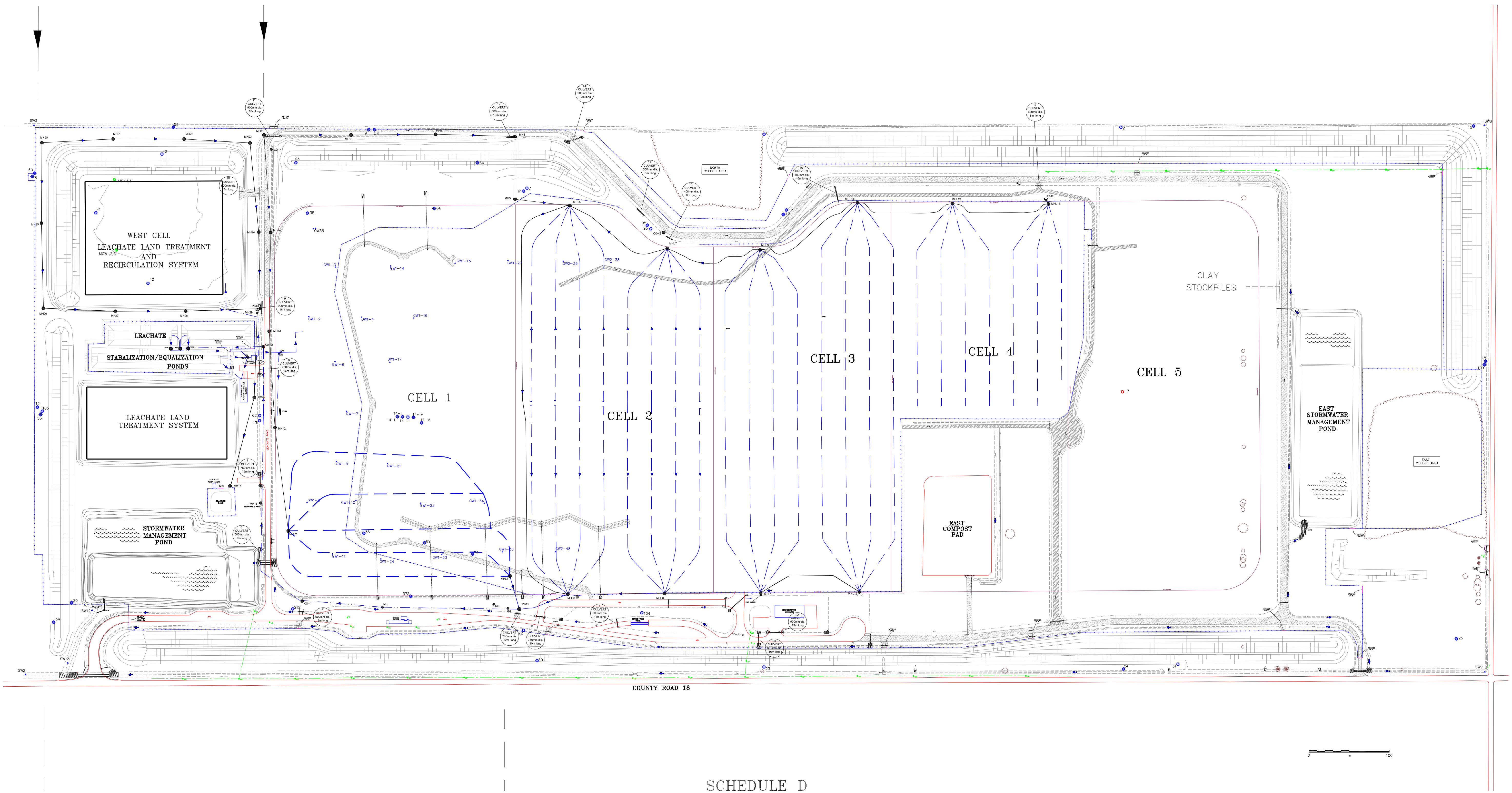
Table 8.1 - Preliminary Project Implementation Schedule

Activity	Duration	Start	Finish
Pre-consult with MECP project details (local and approvals branches)	1 week	July 2023	July 2023
Initiate and complete Class EA	1 year	August 2023	August 2023
Conduct ACS to define effluent limits (pending scope, TBD)	1 year	August 2023	August 2024
Secure MBR pilot plant	8 months	July 2023	February 2024
Run pilot plant, collect samples/analyze performance (duration TBD)	6-12 months (assume 12 months)	March 2024	March 2025
Design wastewater treatment plant	6-12 months (assume 6 months)	August 2024 (assume start overlaps with pilot testing)	May 2025
Secure MECP permit to operate WWTP	6-12 months after 60% detailed design completion	December 2024 (optimistically assuming MECP approval coincides with design completion)	May 2025
Tender & construct package WWTP	6-18 months (assume 8 months as package plant)	May 2025	December 2025
Commission/start	3 months	Early 2026	-

APPENDICES

Appendix A REGIONAL LANDFILL LEACHATE COLLECTION SYSTEM DRAWING

ESSEX-WINDSOR SOLID WASTE AUTHORITY
360 FAIRVIEW AVE. W., ESSEX, ONTARIO. N8M 1Y6
(519) 776-6441 1-800-563-3377 FAX: (519) 776-6370



SCHEDULE D

KEY

- Underdrain Leachate Collection System
- MHL1 — Underdrain Leachate Collection System Maintenance Hole
- Perimeter Leachate Collection System
- MH13 — Perimeter Leachate Collection System Maintenance Hole
- Culvert to be Cleaned

NOTES

1. THE PERIMETER LEACHATE COLLECTION SYSTEM CONSISTS OF TWENTY (20) 1200 mm DIA. MANHOLES, ONE (1) 1800mm DIA. PUMP STATION AND 2,126 METRES OF 8" HDPE COLLECTION SYSTEM.
2. THE UNDERDRAIN LEACHATE COLLECTION SYSTEM CONSISTS OF TWELVE (12) 2400mm DIA. MANHOLES, TWO (2) 3000mm DIA. PUMP STATION, 1,725 METERS OF 8" HDPE COLLECTION AND 10,926 METRES OF 8" HDPE UNDERDRAIN SYSTEM.
3. ONE (1) 1800mm WELL IS LOCATED DUE WEST OF THE LEACHATE LAND APPLICATION PUMP HOUSE IS INCLUDED IN THE TENDER.
4. ONE PUMP CHAMBER IS TO BE CLEANED AND IS IDENTIFIED ON MAP.
5. EIGHTEEN (18) CULVERTS OF VARYING SIZES TO BE FLUSHED ARE IDENTIFIED ON MAP.

ESSEX – WINDSOR SOLID WASTE AUTHORITY REGIONAL LANDFILL
LEACHATE COLLECTION SYSTEM

AUTOCAD FILE: RLF-LCS-LDS-2023.dwg	DRAWN BY: A.E.B.B.
CARLSON	DATE: NOV 23, 2022
	SCALE: AS SHOWN

③

Appendix B REGIONAL LANDFILL LEACHATE QUALITY DATA

GENERAL CHEMICAL RESULTS - Leachate Collector System: PS1, PS2, PS3
ESSEX - WINDSOR REGIONAL LANDFILL SITE - 2021/2022 BIENNIAL MONITORING PROGRAM

PARAMETER	UNITS	ODWQS	SEWER USE BY-LAW	PS1													
				14-Apr-16 AGAT	29-Aug-16 AGAT	12-Apr-17 AGAT	22-Aug-17 AGAT	09-Apr-18 AGAT	31-Aug-18 AGAT	30-Apr-19 AGAT	27-Aug-19 AGAT	30-Apr-20 AGAT	31-Aug-20 AGAT	09-Apr-21 AGAT	30-Aug-21 AGAT	30-Apr-22 SGS	23-Aug-22 SGS
pH	units	6.5 to 8.5***		8.20	7.96	7.82	8.01	7.98	8.16	7.70	7.78	7.85	7.88	7.91	7.98	7.92	8.08
Specific Conductance	µS/cm			12900	13400	9980	18000	8800	17200	9630	13500	13800	23800	15100	12600	12200	27800
Chloride	mg/L	250**	1500.0	3050	1940	1460	3050	1200	3560	1245	1340	1080	1950	1470	1780	780	3300
Sulphate	mg/L	500**	1500	154	164	162	117	193	90	136	350	38	108	292	39	300	36
Alkalinity (as CaCO3)	mg/L	30 - 500***		479	4050	3320	6010	2950	4570	3130	4570	4280	9560	5800	8900	4740	11900
Nitrate (as N)	mg/L	10.0*		<5	<5	<5	<25	<2.5	<5	<5	<10	<5	<10	<5	<0.7	< 0.6	< 0.6
Ammonia (as N)	mg/L			641	644	509	902	433	820	328	712	630	1610	1130	1300	463	1580
Calcium	mg/L			92.9	197	175	60.0	147	96.6	331	360	95	186	38	75	120	51.8
Potassium	mg/L			456	460	365	650	295	644	454	940	927	2000	1650	1520	1320	2784
Aluminum	mg/L	0.10***	50.0	0.112	0.108	0.126	0.1	0.073	0.201	0.125	0.261	0.303	0.399	0.704	1.11	0.373	1.21
Barium	mg/L	1.0*	5.0	0.252	0.286	0.232	0.22	0.245	0.469	0.395	0.162	0.162	0.138	0.130	0.290	0.204	0.173
Beryllium	mg/L			<0.001	<0.001	<0.001	<0.02	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005	<0.005	<0.02	0.000121	0.000070
Boron	mg/L	5.0*		4.69	5.57	4.36	8.4	3.91	7.96	3.74	6.49	4.50	11.70	8.06	17.80	5.53	10.7
Cadmium	mg/L	0.005*	2.0	<0.002	<0.002	<0.002	<0.05	<0.004	<0.004	<0.004	<0.004	<0.010	<0.010	<0.010	<0.04	0.000154	0.000320
Chromium	mg/L	0.05*	5.0	0.099	0.121	0.069	0.16	0.068	0.153	0.076	0.133	0.089	0.280	0.221	0.600	0.156	0.482
Cobalt	mg/L		5.0	0.015	0.017	0.013	0.03	0.013	0.032	0.007	0.038	0.010	0.026	0.047	0.050	0.0195	0.0553
Copper	mg/L	1.0**	5.0	<0.003	0.012	<0.003	<0.05	<0.006	<0.006	<0.006	0.034	<0.015	<0.015	0.844	0.07	0.0751	0.111
Iron	mg/L	0.30**		1.16	3.68	1.74	1.8	1.32	1.39	0.25	9.92	<0.050	10.30	13.40	4.49	1.34	4.00
Lead	mg/L	0.01*	5.0	<0.002	<0.002	<0.002	<0.1	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005	0.035	0.02	0.00801	0.01260
Magnesium	mg/L			169	246	204	171	139	189	191	301	123	258	51	149	150	127
Manganese	mg/L	0.05**	5.0	0.202	1.080	0.454	<0.05	0.174	0.106	1.98	2.800	0.896	2.780	0.800	0.330	0.19	0.223
Molybdenum	mg/L		5.0	0.005	0.01	0.004	0.08	<0.004	0.007	<0.004	0.022	<0.010	0.015	0.045	<0.04	0.014	0.0701
Nickel	mg/L		5.0	0.147	0.184	0.130	0.23	0.099	0.218	0.110	0.390	0.166	0.463	0.400	0.710	0.182	0.436
Phosphorous	mg/L			2.80	4.62	1.78	5.33	3.19	6.02	1.9	8.03	0.07	11.10	7.30	9.41	4.15	11.4
Silver	mg/L		5.0	<0.002	<0.002	<0.002	<0.03	<0.004	<0.004	<0.004	<0.004	<0.010	<0.010	<0.010	<0.04	0.00007	0.00058
Sodium	mg/L	200**		1260	1250	1040	1970	874	1980	832	1060	726	1550	939	1210	768	1284
Strontium	mg/L			3.45	3.47	3.88	2.60	3.67	3.92	3.99	3.54	2.49	3.06	3.00	3.20	2.8	1.08
Tin	mg/L		5.0	0.016	0.010	0.008	<0.1	0.008	0.019	<0.004	0.01	<0.010	0.013	0.038	0.050	0.0123	0.0465
Titanium	mg/L		5.0	0.062	0.056	0.041	0.09	0.044	0.109	0.035	0.070	0.057	0.366	0.183	0.240	0.101	0.195
Vanadium	mg/L		5.0	0.023	0.018	0.008	<0.1	0.012	0.025	0.015	0.030	0.016	0.041	0.038	0.110	0.0325	0.0733
Zinc	mg/L	5.0**	5.0	0.028	0.022	0.018	<0.1	0.013	0.024	0.014	0.042	0.038	<0.025	0.965	0.130	0.18	0.225
Total Susp. Solids	mg/L			82	51	50	44	20	11	20	85	70	215	252	90	48	141
Biochemical Oxygen Dem	mg/L			160	845	67	88	50	181	1670	251	1130	4480	1280	2250	119	2150
Total Kjeldahl Nitrogen	mg/L																
Chemical Oxygen Demar	mg/L			985	3070	825	1800	996	1200	2690	6630	2020	7450	4920	1970	780	6050

GENERAL CHEMICAL RESULTS - Leachate Collector System: PS1, PS2, PS3
ESSEX - WINDSOR REGIONAL LANDFILL SITE - 2021/2022 BIENNIAL MONITORING PROGRAM

PARAMETER	UNITS	ODWQS	SEWER USE BY-LAW	PS2													
				14-Apr-16 AGAT	29-Aug-16 AGAT	12-Apr-17 AGAT	22-Aug-17 AGAT	09-Apr-18 AGAT	31-Aug-18 AGAT	30-Apr-19 AGAT	27-Aug-19 AGAT	30-Apr-20 AGAT	31-Aug-20 AGAT	09-Apr-21 AGAT	30-Aug-21 AGAT	30-Apr-22 SGS	23-Aug-22 SGS
pH	units	6.5 to 8.5***		7.46	7.25	7.52	7.94	7.94	8.27	7.84	7.97	7.90	7.88	7.69	7.98	7.74	7.92
Specific Conductance	µS/cm			1790	10100	26500	23200	18000	29900	7110	17700	26400	11900	7830	13100	14200	13600
Chloride	mg/L	250**	1500.0	35.0	654	2300	1990	1450	2740	477	1560	1680	743	506	990	890	1200
Sulphate	mg/L	500**	1500	599	589	389	<100	49	134	309	248	135	316	454	43.5	230	210
Alkalinity (as CaCO3)	mg/L	30 - 500***		394	3330	12600	10200	9330	12700	3060	7260	10200	4990	3000	1320	6240	6080
Nitrate (as N)	mg/L	10.0*		<0.5	<5	<5	<50	<10	<5	<5	<10	<10	<5	6.9	<0.7	< 0.6	< 0.6
Ammonia (as N)	mg/L			1.60	414	1810	1550	1450	2430	306.0	1410	1530	797.0	493	1080	958	942
Calcium	mg/L			204	747	733	82	90.7	77.6	126	117	31	77.3	134	75	153	138
Potassium	mg/L			20.7	547	4380	2320	3200	3770	564	1900	1980	913.0	585	1080	1470	1218
Aluminum	mg/L	0.10***	50.0	0.165	0.264	0.434	0.3	0.316	1.060	0.094	0.567	0.789	0.155	0.176	0.630	0.484	0.296
Barium	mg/L	1.0*	5.0	0.051	0.538	0.089	0.24	0.161	0.371	0.136	0.250	0.295	0.170	0.107	0.260	0.301	0.262
Beryllium	mg/L			<0.001	<0.001	<0.002	<0.02	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005	<0.005	<0.02	0.000159	0.000020
Boron	mg/L	5.0*		0.389	7.27	23.0	22.0	14.4	27.1	4.15	15.3	16.9	10.2	5.80	13.5	11.6	9.36
Cadmium	mg/L	0.005*	2.0	<0.002	<0.002	<0.004	<0.05	<0.004	<0.004	<0.004	<0.004	<0.010	<0.010	<0.010	<0.04	0.000089	0.000120
Chromium	mg/L	0.05*	5.0	0.006	0.132	0.458	0.56	0.330	0.988	0.088	0.652	0.683	0.330	0.193	0.380	0.384	0.363
Cobalt	mg/L		5.0	0.006	0.025	0.64	0.03	0.029	0.058	0.008	0.034	0.038	0.007	0.012	0.030	0.0269	0.0249
Copper	mg/L	1.0**	5.0	0.025	0.014	0.016	<0.05	0.013	0.043	<0.006	<0.006	0.020	<0.015	<0.015	0.006	0.0077	0.0031
Iron	mg/L	0.30**		0.169	41.4	29.6	2.5	0.439	1.080	0.172	0.528	0.780	2.160	2.130	2.190	1.73	1.39
Lead	mg/L	0.01*	5.0	<0.002	0.003	0.006	<0.1	<0.002	0.005	<0.002	0.002	<0.005	0.007	<0.005	<0.02	0.0029	0.00134
Magnesium	mg/L			99.2	302	553	215	198	221	136	165	56	64.5	77	89	133	109
Manganese	mg/L	0.05**	5.0	0.269	4.71	8.44	0.56	0.271	0.495	0.261	0.215	0.219	0.380	0.318	0.380	0.402	0.392
Molybdenum	mg/L		5.0	0.038	0.003	0.037	0.15	0.017	0.036	0.006	0.025	0.024	0.019	0.016	<0.04	0.0129	0.00609
Nickel	mg/L		5.0	0.027	0.360	1.03	0.61	0.364	0.794	0.128	0.417	0.481	0.215	0.144	0.330	0.282	0.256
Phosphorous	mg/L			0.45	4.84	22.3	16.6	13.4	24.1	2.97	15.2	0.16	10.9	3.65	10.4	8.1	9.81
Silver	mg/L		5.0	<0.002	<0.002	<0.004	<0.03	<0.004	<0.004	<0.004	<0.004	<0.010	<0.010	<0.010	<0.04	0.00011	0.00033
Sodium	mg/L	200**		49.3	572	1570	1660	865	1640	365	1230	1200	633	405	765	832	696
Strontium	mg/L			2.34	4.78	4.19	2.05	1.38	1.59	1.58	2.01	1.88	1.96	1.83	2.40	2.46	2.36
Tin	mg/L		5.0	<0.002	0.005	0.017	0.1	0.009	0.042	<0.004	0.043	0.041	0.029	0.019	<0.04	0.0253	0.0158
Titanium	mg/L		5.0	0.010	0.038	0.285	0.25	0.185	0.480	0.044	0.426	0.466	0.279	0.112	0.300	0.294	0.217
Vanadium	mg/L		5.0	0.004	0.025	0.082	<0.1	0.059	0.129	0.015	0.104	0.101	0.056	0.034	0.060	0.0717	0.0616
Zinc	mg/L	5.0**	5.0	0.124	0.079	0.321	<0.1	0.043	0.075	0.014	0.032	0.069	0.033	0.025	<0.10	0.054	0.022
Total Susp. Solids	mg/L			70	326	420	1120	67	92	18	55	36	14	33	30	1100	423
Biochemical Oxygen Den	mg/L			238	6650	13500	3090	1510	2290	203	4130	479	189	58	178	111	141
Total Kjeldahl Nitrogen	mg/L																
Chemical Oxygen Demar	mg/L			444	11300	18000	8120	4800	5960	628	1620	2680	1160	1930	1520	1240	1380

GENERAL CHEMICAL RESULTS - Leachate Collector System: PS1, PS2, PS3
ESSEX - WINDSOR REGIONAL LANDFILL SITE - 2021/2022 BIENNIAL MONITORING PROGRAM

PARAMETER	UNITS	ODWQS	SEWER USE BY-LAW	PS3																				
				14-Apr-16	29-Aug-16	14-Oct-16	12-Apr-17	22-Aug-17	31-Oct-17	09-Apr-18	31-Aug-18	31-Oct-18	30-Apr-19	27-Aug-19	29-Oct-19	30-Apr-20	31-Aug-20	23-Oct-20	09-Apr-21	30-Aug-21	15-Oct-21	30-Apr-22	23-Aug-22	13-Oct-22
				AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	AGAT	SGS	SGS	SGS
pH	units	6.5 to 8.5***		8.15	7.85	7.55	8.17	7.79	8.13	7.75	8.17	8.05	7.84	7.85	7.97	7.89	7.86	7.86	7.93	7.90	8.06	8.08	7.76	7.98
Specific Conductance	µS/cm			2620	3600	4890	2640	5160	4150	2430	5010	2360	2730	5090	3560	3750	5180	4270	2510	4280	3960	2280	4860	5110
Chloride	mg/L	250**	1500.0	243	623	626	228	671	658	293	708	261	209	602	442	288	631	539	222	492	486	250	610	680
Sulphate	mg/L	500**	1500	237	231	245	223	284	394	191	210	94.0	145	197	303	194	232	382	293	234	233	230	260	400
Alkalinity (as CaCO3)	mg/L	30 - 500***		972	742	1430	932	1630		952	1340	607	1130	1610	968	1180	1530	1210	809	1320	1200	774	1450	1520
Nitrate (as N)	mg/L	10.0*		<0.5	<1.0	<1.0	1.3	<2.0	9.2	1.1	<1.0	4.3	<1.0	<2.5	6.1	<2.5	<2.5	13.6	1.9	<0.36	<0.36	1.85	< 0.06	0.65
Ammonia (as N)	mg/L			72	44.0	145	65.0	158		58.8	186	<1.0	58	153.0	80.5	90.2	148.0	98.0	46.0	121	107	43.5	132	147
Calcium	mg/L			176	141	180	182	178	175	139	169	109	150	193	154	146	193	199	184	184	182	211	235	227
Potassium	mg/L			64.7	89.0	147	62.2	140	151	104.0	170	107	147	159.0	99.6	70.7	143	130	46.6	115	115	69.6	145	187
Aluminum	mg/L	0.10***	50.0	0.007	0.023	0.009	0.005	<0.1	0.011	<0.008	0.014	0.030	0.016	0.017	0.006	0.008	<0.008	0.018	<0.008	0.011	0.032	0.007	0.007	0.015
Barium	mg/L	1.0*	5.0	0.370	0.197	0.218	0.222	0.29	0.218	0.180	0.287	0.177	0.165	0.283	0.237	0.268	0.317	0.229	0.153	0.224	0.277	0.217	0.324	0.326
Beryllium	mg/L			<0.001	<0.001	<0.001	<0.001	<0.02	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.002	<0.002	<0.001	0.000012	< 0.000007	< 0.000007
Boron	mg/L	5.0*		0.900	1.53	2.00	0.977	2.6	2.68	1.42	2.6	2.31	1.21	2.32	1.77	1.26	2.54	2.36	0.977	2.70	2.02	0.99	1.91	3.46
Cadmium	mg/L	0.005*	2.0	<0.002	<0.002	<0.002	<0.002	<0.05	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.004	<0.004	<0.002	0.000022	0.000023	0.000020
Chromium	mg/L	0.05*	5.0	0.006	0.026	0.042	<0.003	<0.02	0.008	0.008	0.007	0.044	0.017	0.013	0.014	0.004	<0.006	0.013	<0.006	<0.006	0.004	0.00208	0.00521	0.00796
Cobalt	mg/L		5.0	0.002	0.003	0.004	0.002	<0.02	0.007	0.002	0.006	0.004	0.002	0.005	0.003	0.003	<0.002	0.005	0.003	0.004	0.004	0.0017	0.00598	0.00778
Copper	mg/L	1.0**	5.0	<0.003	<0.003	<0.003	<0.003	<0.05	<0.003	0.017	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.006	<0.003	<0.006	<0.006	<0.003	0.0018	0.0012	0.0016
Iron	mg/L	0.30**		4.40	1.78	0.362	0.095	0.6	0.376	0.215	1.29	1.51	0.985	0.448	0.143	0.081	5.47	0.304	0.210	0.281	0.351	0.144	0.805	0.640
Lead	mg/L	0.01*	5.0	<0.002	<0.002	<0.002	<0.002	<0.1	<0.002	<0.002	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.002	<0.002	<0.001	< 0.00009	< 0.00009	0.00010
Magnesium	mg/L			99.7	99.2	145	102	170	162	94.8	149	54.7	70.9	159.0	99.3	91.4	154	145	93.4	136	139	109	151	196
Manganese	mg/L	0.05**	5.0	0.261	0.234	0.268	0.298	0.25	0.135	0.247	0.148	0.131	0.255	0.200	0.212	0.257	0.261	0.209	0.295	0.238	0.198	0.294	0.408	0.231
Molybdenum	mg/L		5.0	0.003	0.011	0.005	0.002	<0.05	0.018	<0.004	0.004	0.012	0.002	0.002	0.013	<0.002	<0.004	0.010	0.005	<0.004	0.004	0.00357	0.00329	0.00585
Nickel	mg/L		5.0	0.009	0.025	0.025	0.006	<0.05	0.034	0.020	0.026	0.057	0.026	0.023	0.022	0.012	0.027	0.025	0.014	0.019	0.020	0.0102	0.0223	0.0298
Phosphorous	mg/L			2.87	0.32	0.29	0.11	0.21	0.18	0.13	0.41	0.20	0.41	0.72	0.14	0.16	0.95	0.20	0.06	0.24	0.04	0.044	0.063	0.189
Silver	mg/L		5.0	<0.002	<0.002	<0.002	<0.002	<0.03	<0.002	<0.04	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.004	<0.004	<0.002	< 0.00005	< 0.00005	< 0.00005
Sodium	mg/L	200**		177	338	393	155	390	421	189	418	173	153	378	241	163	395	332	141	289	303	168	326	512
Strontium	mg/L			1.78	1.91	2.82	1.85	3.20	3.34	1.79	3.25	1.43	1.43	3.33	2.68	2.06	3.52	3.41	1.96	3.13	3.33	2.54	4.31	3.72
Tin	mg/L		5.0	<0.002	0.003	<0.002	<0.002	<0.1	<0.002	<0.004	0.003	0.002	<0.002	0.003	<0.002	0.005	<0.004	<0.002	<0.004	<0.004	<0.002	0.00151	0.00230	0.00245
Titanium	mg/L		5.0	0.005	0.005	0.010	<0.002	<0.05	0.006	0.005	0.005	0.015	0.012	0.006	0.005	0.003	0.025	0.006	<0.004	<0.004	0.002	0.00054	0.00133	0.00351
Vanadium	mg/L		5.0	0.004	<0.002	0.006	<0.002	<0.1	<0.002	<0.004	<0.002	0.008	0.004	0.003	0.002	<0.002	<0.004	<0.002	<0.004	<0.004	<0.002	0.0006	0.00132	0.00244
Zinc	mg/L	5.0**	5.0	<0.005	0.016	0.028	0.028	<0.1	0.047	0.020	0.016	0.012	0.012	0.013	0.018	0.008	<0.010	0.027	0.033	0.058	0.050	0.026	0.084	0.041
Total Susp. Solids	mg/L			8900	5	14	12	16	5	5	15		5	36	5	5	19	12	11	5	12	6	24	711
Biochemical Oxygen Dem	mg/L			95	8	10	7	8	20	8	25		14	16	11	9	33	32	6	17	4	2	16	257
Total Kjeldahl Nitrogen	mg/L																							
Chemical Oxygen Demar	mg/L			341	147	167	83	334	164	183	220		164	142	120	126	191	140	81	99	130	67	168	880

NOTES: 1) ODWQS - Ontario Drinking Water Quality Standards (2006).
2) * - denotes Objective is a health-related parameter.
** - denotes aesthetic objective.
*** - denotes operational guideline for treatment systems.
< denotes parameter concentration is below the estimated quantitation limit.
3) Blank denotes parameter not analysed.
4) µs/cm denotes microsiemens per centimetre.
NTU denotes nephelometric turbidity unit.
mg/L denotes milligrams per litre.
5) Sewer Use By-Law refers to City of Windsor By-Law Number 11446 Section 2, 2. (o) Column II.

EWSWA Regional Landfill
Leachate Compared to City of Windsor
Sanitary Sewer ByLaw

BOD_5

Sample Date	Units	NW Lagoon	NE Lagoon	S Lagoon	PS1	PS2	PS3	Cell3S Leachate	Truck Sol'n
31-May-22	mg/L	219	230	432					
17-Jun-22	mg/L	225	377	777					
7-Jul-22	mg/L	142	310	235					
23-Aug-22	mg/L				2150				
31-Aug-22	mg/L	181	444	1160					
29-Sep-22	mg/L	215	257	5020					
28-Oct-22	mg/L	61	283	2390					
25-Nov-22	mg/L	1400	212	379					
15-Dec-22	mg/L	2620	1120	4670					
5-Jan-23	mg/L			4180					
13-Jan-23	mg/L			4240	7320	39	33	7460	
20-Jan-23	mg/L	4120	3770	4980					3970
2-Feb-23									4400

pH

Sample Date	S Lagoon	PS1
23-Aug-22		8.08
13-Jan-23	8.24	

TSS

Sample Date	Units	S Lagoon	PS1
23-Aug-22	mg/L		141
13-Jan-23	mg/L	700	

E coli

Sample Date	Units	NW Lagoon	NE Lagoon	S Lagoon	PS1	PS2	PS3	Cell3S Leachate	Truck Sol'n
11/Nov/22	C FU/100mL	30	20	20					
18/Nov/22	C FU/100mL	400	100	>20,000					
9/Dec/22	CFU/100mL			470,000					
5/Jan/23	CFU/100mL			79,000	103,000	110	< 2		
13-Jan-23	CFU/100mL			120,000	110,000	<1000	<1000	1000	
20-Jan-23	CFU/100mL	20,000	8,100	35,000					20,000
2-Feb-23	CFU/100mL								2,400

Sewer Bylaw

Sample Date

Parameter	Units	Sewer By-Law	23-Aug-22 RLF PS1	25-Nov-22 S Lagoon	9-Dec-22 S Lagoon	5-Jan-23 S Lagoon	13-Jan-23 S Lagoon	20-Jan-23 S Lagoon	20-Jan-23 NW Lagoon	20-Jan-23 NE Lagoon	20-Jan-23 Truck Sol'n	2-Feb-23 Truck Sol'n
4AAP-Phenolics	mg/L	1.0		0.17	**1.8**	**2.11**	**2.2**	**2.0**	**1.8**	**1.5**	**1.8**	**2.1**
Aluminum (total)	mg/L	50.0	1.2	0.673	2.83	3.53	1.81	1.61	1.27	1.22	1.57	1.33
Antimony (total)	mg/L	5.0		0.0042	0.0299	< 0.009	0.0149	0.032	0.011	<0.009	0.011	0.018
Arsenic (total)	mg/L	1.0		0.0406	0.0648	0.061	0.0624	0.067	0.045	0.035	0.045	0.055
Barium (total)	mg/L	5.0		0.133	0.299	0.298		0.335	0.272	0.246	0.163	0.228
Bismuth (total)	mg/L	5.0		0.00026	0.00156	0.0005		0.0005	0.0004	0.0002	0.0006	0.0006
Cadmium (total)	mg/L	2.0	0.0000320	0.000700	0.00396	0.00289	0.00267	0.00135	0.00197	0.00170	0.00187	0.00235
Chloride	mg/L	1500.0		**2000**	**3100**	**2900**		**2800**	**2700**	**2300**	**2700**	**2700**
Chromium (total)	mg/L	5.0	0.482	0.321	0.535	0.311	0.403	0.289	0.271	0.272	0.275	0.376
Cobalt (total)	mg/L	5.0	0.0553	0.034	0.0607	0.0579	0.0689	0.0625	0.0491	0.0440	0.0492	0.0592
Copper (total)	mg/L	5.0	0.111	0.478	2.14	0.641	0.703	0.513	0.185	0.171	0.542	0.809
Cyanide (total)	mg/L	2.0		0.05	< 0.1	< 0.1	0.08	<0.1	<0.1	0.14	<0.1	<0.1
Fluoride	mg/L	10.0		0.95	0.29	0.80	0.75	0.74	0.75	0.73	0.72	0.89
Lead (total)	mg/L	5.0	0.01260	0.0383	0.176	0.134	0.130	0.0866	0.0924	0.0843	0.0897	0.0981
Manganese (total)	mg/L	5.0		0.167	1.07	1.83		2.02	1.47	1.14	1.12	1.43
Mercury (total)	mg/L	0.1		0.00009	0.00050	***	0.00029	0.00049	0.00029	0.00027	0.00027	0.00001
Molybdenum (total)	mg/L	5.0	0.0701	0.0110	0.0842	0.0188	0.0364	0.0649	0.0189	0.0170	0.0170	0.0411
Nickel (total)	mg/L	5.0	0.436	0.347	0.570	0.538	0.684	0.569	0.495	0.451	0.507	0.606
Selenium (total)	mg/L	5.0		0.00066	0.00321	0.0024	0.00355	0.0030	0.0018	0.0020	0.0028	0.0032
Silver (total)	mg/L	5.0	0.00058	0.00012	0.00151	< 0.0005	0.00012	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sulphate	mg/L	1500.0		66	46	540		510	430	57	550	560
Tin (total)	mg/L	5.0	0.0465	0.00781	0.0691	0.0106	0.0249	0.0371	0.0098	0.0117	0.0084	0.0316
Titanium (total)	mg/L	5.0	0.195	0.0532	0.239	0.0153	0.0558	0.132	0.0227	0.0282	0.0164	0.1180
Vanadium (total)	mg/L	5.0		0.0567	0.0685	0.0550		0.0466	0.0471	0.0456	0.0470	0.0564
Zinc (total)	mg/L	5.0	0.225	0.514	2.41	2.72	2.54	2.82	2.08	1.55	1.77	2.02

Note: Sewer By-Law = City of Windsor By-Law #11446, 1993, as per Section 2, 2. (o) Discharges to Sanitary Sewers for average water usage < 500,000 L/day.

Bold Exceeds ByLaw

Appendix C TREATMENT VENDOR PROPOSALS

ROCHEM AMERICAS

Economic Projection - ROCHEM DTRO®-TS Membrane System

Ver:20A

Capital and Operating Costs

Project: Essex Windsor Solid Waste Authority
Capacity and Type: 100,000 gpd, 2-Pass, 2-Stage RO system
Date of Projection: March 10, 2023

Data of the plant:

Capacity of the plant (Influent):	100,000	[gal/day]
Operating time per year:	350	[d]
Capacity per year:	35,000,000	[gal]
Total membrane area:	1,752	[m^2]
Capital cost of the plant:	2,700,000	[$]

Category:

Cost for energy:		
Running power	150	kW
Annual power	1,260,000	kWh
Price for the energy:	0.14	[$/kWh]
Energy cost per year:	176,400	[$/yr]
specific energy costs :	**0.0050**	**[$/gal]**
Cost for membrane replacement:		
Lifetime of the membrane:	3	[yr]
Specific price for membrane replacement:	105	[$/$m^2$]
Cost for a total membrane replacement:	183,960	[$]
Membrane replacement cost per year:	61,320	[$/yr]
specific membrane replacement costs:	**0.0018**	**[$/gal]**
Cost for maintenance/spares:		
Share of the capital cost as maintenance cost:	3.5	[%/yr]
Maintenance costs per year:	94,500	[$/yr]
specific maintenance costs:	**0.0027**	**[$/gal]**
Cost for cleaning chemicals:		
Count of alkaline cleanings per year:	80	[times/yr]
Chemicals per cleaning:	60	[l]
Price of the cleaning chemicals (Cleaner AA):	7.2	[$/l]
Cleaning costs per year:	34,560	[$/yr]
Count of acid cleanings per year:	40	[times/yr]
Chemicals per cleaning	60	[l]
Price of the cleaning chemicals (Cleaner B):	8.7	[$/l]
Cleaning costs per year:	20,880	[$/yr]
specific cleaning costs:	**0.0016**	**[$/gal]**
Cost for labor:		
Manpower per year	1.00	[-]
Labor costs per man:	75,000	[$/yr]
Labor cost per year:	75,000	[$/yr]
specific labor costs:	**0.0021**	**[$/gal]**
Cost for antiscalent chemical		
Antiscalent consumption per 1000 gal	10.0	[ppm]
Specific weight	1.2	[kg/l]
Consumption per year	350	[gal/year]
Price of antiscalent	68.9	[$/gal]
Antiscalent cost per year	24,115	[$/yr]
specific chemical costs:	**0.0007**	**[$/gal]**
Cost for pH adjustment		
Acid consumption (H_2SO_4 98%) per 1000 gal	2.57	[gal/1000 gal]
Acid consumption (H_2SO_4 98%) per year	89,950	[gal/yr]
Acid consumption (H_2SO_4 98%) per year	1,351,049	[pounds/yr]
Acid price (H_2SO_4 98%)	0.24	[$/pound]
Acid cost per year	324,252	[$/yr]
specific chemical costs:	**0.0093**	**[$/gal]**
total operational costs:	**0.0232**	**[$/gal]**

ROCHEM® AMERICAS

Rochem DTRO™-TS Systems
RO Projection

Project:	Essex Windsor		**Date:**	3/9/2023
Stream:	Leachate		**Calc. By:**	BMT

Temperature (°C):	25		**Acid**	H2SO4
System Recovery:	87%		**gal/kgal**	2.5703
Leachate Stage Recovery:	75%			
Permeate Stage Recovery:	92%		**V25.050322**	
HP Stage Recovery:	50%			

				Leachate Stage		**HP Stage**	**Permeate Stage**
Parameter	**Units**	**Leachate**	**Feed**	**Concentrate**	**Permeate**	**Concentrate**	**Permeate**
Flow Rate	GPD	100000	107527	26882	80645	13441	86559
pH	-	8	6	6	4.00	7	4
Conductivity	µmhos/cm	21786	20338	74761	2196.5	141000	116.64
TDS	mg/L	12455	7241.2	27169	598.61	51295	31.232
Total Alkalinity	mg/L	9228	406.5	1558	22.77	2985	3.075
BOD	mg/L	1522	1417	5221	149.3	9856	7.788
COD	mg/L	4406	3987	15120	276.4	28670	19.83
TOC	mg/L	1055	954.5	3619	66.18	6862	5.056
TSS	mg/L	148	131	504	7.18	968	0.268
Aluminum	mg/L	0.88	0.75	3	0.02	5.8	<0.01
Barium	mg/L	0.21	0.17	0.7	<0.01	1.4	<0.01
Boron	mg/L	8.81	10.5	32.7	3.07	51	<2
Bromide	mg/L	15.04	12.52	49.89	0.06678	99.37	0.0002489
Calcium	mg/L	98	81	320	<0.5	650	<0.5
Chloride	mg/L	2552	2311	8542	234.2	16640	5.673
Fluoride	mg/L	1.22	1.13	4.23	0.0997	7.9	0.00613
Iron	mg/L	3.1	2.6	10	<0.1	20	<0.1
Magnesium	mg/L	130	110	430	0.43	860	<0.1
Manganese	mg/L	0.28	0.23	0.93	<0.01	1.8	<0.01
Ammonia-Nitrogen	mg/L	1226	1227	4578	110.3	7873	<4.9
Nitrate	mg/L	0.24	0.21	0.81	<0.5	1.6	<0.5
Total Phosphorus	mg/L	8.97	7.68	30.1	0.205	59	<0.01
Silica	mg/L	10.25	10.09	36.31	1.345	65.37	0.1253
Sodium	mg/L	1034	927.9	3463	82.89	6753	<5
Strontium	mg/L	1.87	1.58	6.23	0.0252	12.3	<0.005
Sulfate	mg/L	98	4200	15000	570	27000	53

*Influent values are based on 70% SP1, 10% SP2, 10% SP3, and 10% SPDUP blends from SGS Canada lab report dated 8/23/22

Newterra Ltd.
1291 California Avenue, Brockville, ON K6V 5W3
(800) 420-4056/www.newterra.com

05/19/2023

Tom Marentette
Essex-Windsor Solid Waste Authority
360 Fairview Ave. W. Suite 211
Essex, ON N8M 3G4
519.776.7941/tommarentette@ewswa.org

Re: Budget Quote # 2302303R0 / Landfill Leachate - Essex-Windsor Solid Waste Authority

Dear Mr. Marentette:

Thank you for thinking of us as a potential partner for your upcoming project. We have provided initial budgetary pricing for your equipment. The scope of work for the equipment would contain the below described items.

Influent Flow Rate	Design Value	Metric Unit
Average Daily Flow (ADF)	*330*	m^3/d
Maximum Month Flow (MMF)	*450*	m^3/d
Maximum Daily Flow (MDF)	*660*	m^3/d
Peak Instantaneous Flow (PIF)	*82.5*	m^3/h

Influent Wastewater Characteristics	Design Value	Metric Unit
Biochemical Oxygen Demand, BOD	*4000*	mg/L
Total Suspended Solids,TSS	*500*	mg/L
Total Kjeldahl Nitrogen, TKN	*400*	mg/L
Total Phosphorus, TP	*15*	mg/L
Fat, Oil and Grease, FOG	*30*	mg/L
Minimum water temperature	*10*	˚C
Maximum water temperature	*25*	˚C
Site elevation	*100*	m

Effluent Water Specification	Effluent Limit	Metric Unit
$cBOD_5$	< 400	mg/L
TSS	< 500	mg/L
TKN	< 100	mg/L
TN	< 100	mg/L
TP	< 30	mg/L

It is assumed that:

- Influent wastewater to be equalized (by others) such that the variability of daily mass loading rate does not exceed more than 1.5 times the average of the previous seven (7) days.
- Influent wastewater does not contain compounds in high enough concentrations to inhibit nitrification.
- Influent wastewater will be pretreated with an air stripper or equivalent, capable of reducing the influent ammonia concentration to 400 mg/L or less.
- Influent TN = Influent TKN = Influent Ammonia concentration.

Newterra Ltd.
1291 California Avenue, Brockville, ON K6V 5W3
(800) 420-4056/www.newterra.com

Scope of Supply:

The following scope is to be shipped loose to be installed in tanks by others:

- Pre-Anoxic tank instrumentation
- Pre-Anoxic tank mixing eductors
- Aeration tank instrumentation
- Aeration tank diffuser grid

Note: equipment under the above section has been selected for above ground glass fused tanks only, if different tanks are to be used, changes in the equipment may be required and additional costs may apply.

The following scope is to be installed in Newterra's enclosures (6 – 8'x40' modular buildings):

- Fine screen with inlet flowmeter and Pre-Anoxic tank feed pumps
- Pre-Anoxic mixing pumps
- Membrane feed pumps
- Recirculation to Pre-Anoxic pumps
- Aerobic tank blowers (selected for a side water depth of 20 feet)
- Membrane tanks (2 duty) populated with submerged UF membranes
- Membrane tanks blowers
- RAS tanks (2 duty) and pumps
- Permeate extraction system
- Permeate pumps
- Backwash tank and pump
- WAS pumps
- UV disinfection
- Chemical dosing pumps (Sodium Hydroxide and Phosphoric Acid)
- Chemical dosing for backwash (Sodium Hypochlorite and Citric Acid)
- Sludge holding tank with diffuser grid and blowers
- Dewatering press feed pump
- Sludge dewatering unit with polymer makeup system and filtrate pump
- Power, control panels and transformer
- Modular building footprint: 48' x40'

Note: Power assumed to be 575V/3P/60Hz.

Customer's Scope

- Above ground insulated and covered glass fused Pre-anoxic and Aerobic tanks supply and installation
- Installation of all shipped loose equipment supplied by newterra
- Potable water to site
- Interconnecting piping and electrical
- Piping for mixing eductors grid for Pre-Anoxic tank and diffuser grid for Aerobic tank
- Electrical power supply to Newterra's panels
- All in-ground tanks piping and electrical (if applicable)
- Stairs, railings, foundation, etc., as required
- Placement and anchoring of equipment and buildings
- Permitting
- Seed sludge
- Wastewater testing
- Chemicals supply and storage (safety equipment as per local regulations)
- Treated effluent and waste sludge disposal (including sludge dewatered solids bin)
- All civil works including design
- Anything not mentioned in the scope of supply above

Newterra Ltd.
1291 California Avenue, Brockville, ON K6V 5W3
(800) 420-4056/www.newterra.com

Budgetary equipment purchase price: $ 2,500,000 – 3,000,000 CAD

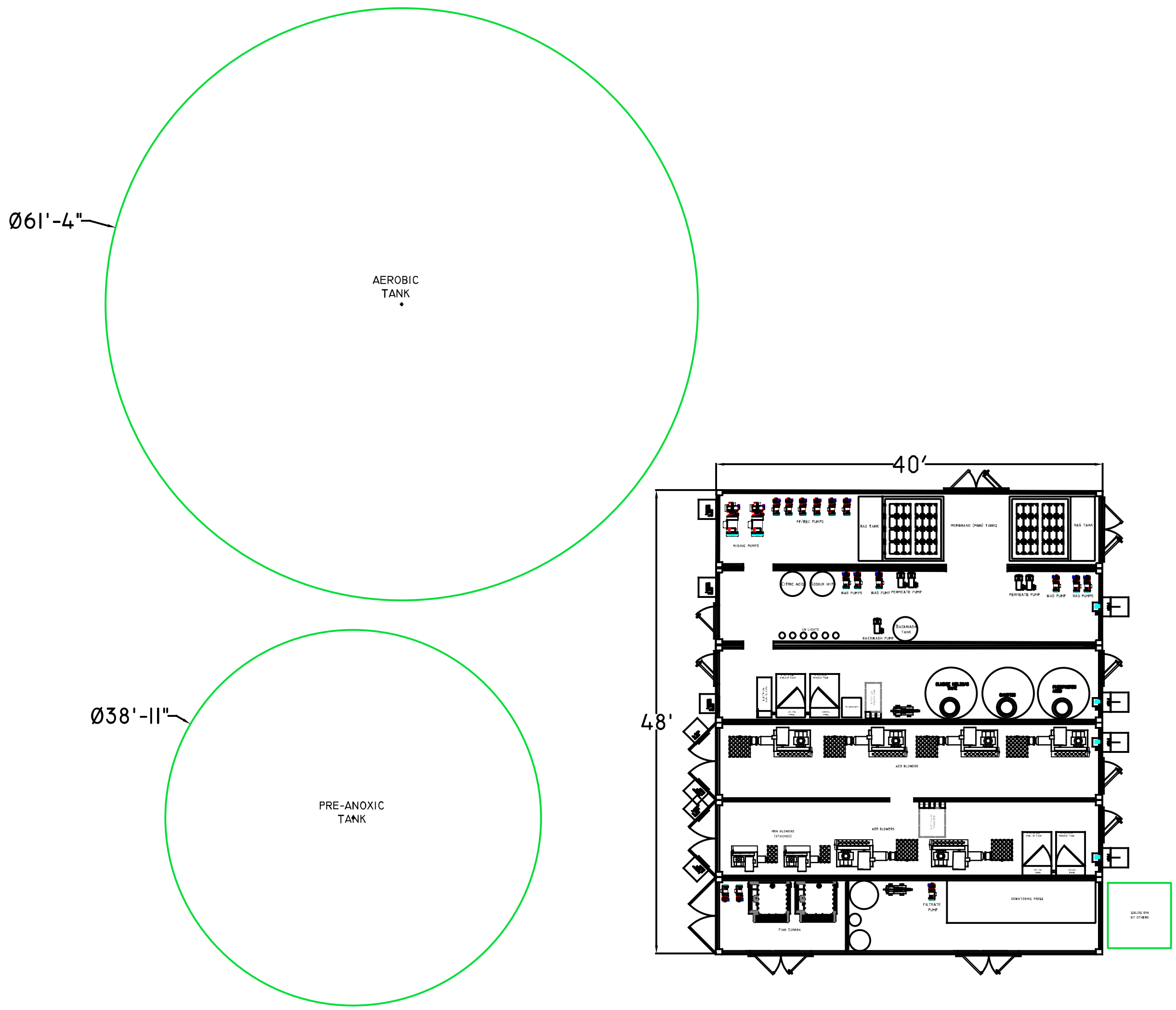
Please note that the stated price above does not include freight to site, taxes, duties, onsite startup or technical services from our field technicians. This is an equipment supply price.

When you are ready to move forward with a firm price proposal request, we can provide a detailed proposal and estimated project lead time. If you would like to discuss the project or have any questions about this quote please call us.

Sincerely,

Anthony Amendola
Regional Sales Manager – Industrial
Cell: 289-707-3036
aamendola@newterra.com

Romina Ferrada
Newterra Applications Engineering
Office: 800-420-4056 x1132
rferrada@newterra.com



NOTES

SUPPLY BY OTHERS, INSTALL BY OTHERS

SUPPLY BY NEWTERRA, INSTALL BY NEWTERRA (INSIDE MODULAR BUILDING)

SUPPLY BY NEWTERRA, INSTALL BY OTHERS

INTERCONNECTING PIPING BETWEEN BUILDING AND TANKS, AND BETWEEN TANKS, TO BE SUPPLIED AND INSTALLED BY OTHERS.

newterra

PHONE:
(800) 420-4056

www.newterra.com

LEVEL	REVISION	DATE (mm/dd/yy)	BY
R0	PRELIMINARY FOR QUOTE	2023/05/16	RF

PROJECT NUMBER: 2302003

TITLE AND LOCATION: PRELIMINARY LAYOUT LANDFILL LEACHATE

CUSTOMER: ESSEX-WINDSOR SOLID WASTE AUTHORITY

DRAWN BY | DATE | SHEET | SHEETS

Nexom™

ESSEX ON LANDFILL LEACHATE: BIOPORTS MBBR PROPOSAL

April 27, 2023

BioPorts™

technologies for cleaner water

5 Burks Way · Winnipeg MB · R2J 3R8
888·426·8180 · **www.nexom.com**

Project Overview

Nexom has proposed a BioPorts™ wastewater treatment system comprising:

- A two-stage Moving Bed Biofilm Reactor (MBBR) for BOD and TKN removal
    - MBBR configured to operate in series (typical) or parallel as required
- Chemical dosing systems for pH adjustment and coagulant/polymer addition
- Dissolved Air Flotation (DAF) for secondary solids removal

Nexom's proposed treatment system has been designed with the following benefits:

- Small footprint and intensified treatment with low civil and land acquisition costs.
- Treatment to the limit with simple to operate and reliable processes.
- Energy efficient coarse bubble aeration that does not require membrane replacement.

Assumptions

- pH shall be within 6.5-8.5.
- Water temperature shall not exceed 35 °C.
- Biocidal or inhibiting compounds shall not be present at concentrations detrimental to biological treatment.
- FOG shall not exceed 120 mg/l.
- Calcium, magnesium, and other scale forming compounds shall not be present at concentrations detrimental to system performance.
- Macro- and micro-nutrients shall be present in quantities that are not limiting to biological growth.
- Approximately 5 mg/l bioavailable nitrogen and 1 mg/l bioavailable phosphorus are required per 100 mg/l influent cBOD5.

System Design Parameters

Basis of Design

Design influent flows and characteristics are presented in the following table:

Parameter	Unit	Dry	Wet
Flow	m^3/day	250	450
Temperature	˚C	5-30	5-30
TSS	mg/l	500	500
cBOD5	mg/l	2,500-4,000	2,500
TKN	mg/l	800	800

Design effluent objectives are presented in the following table:

Parameter	Unit	Design
TSS	mg/l	<250
cBOD5	mg/l	<200
TKN	mg/l	<40

Treatment Processes

Process Equipment Details

BioPorts MBBR design parameters are presented in the following table:

Parameter	Unit	Zone 1	Zone 2
Function		BOD Removal	Nitrification
No. Parallel Trains		1	1
Per Train:			
Diameter	m	12.12	12.12
Water Depth	m	7.6	7.6
Freeboard	m	0.9	0.9
Media Filling Fraction	%	58.5	58.5
No. Effluent Screens		1	1
Screen Diameter	mm	200	200
Effective Length	mm	736	736
No. Drain Screens		1	1
Screen Diameter	mm	150	150
Effective Length	mm	500	500
Dissolved Oxygen	mg/l	2	4-8
No. Diffusers		40	40
Diffuser Type		CoarsAir MaxAir SS	CoarsAir MaxAir SS
Diffuser Configuration		24” Simplex	24” Simplex

Blower design parameters are presented in the following table:

Parameter	Unit	Zone 1	Zone 2
Elevation	m	187	187
No. Blowers		2	
Duty		1	1
Standby		1	0
Per Blower:			
Installed Power	HP	125	125
Max Airflow	scfm	1,332	1,332
Normal Pressure	psi	11.6	11.6
Max Pressure	psi	12.8	12.8

Chemical dosing design parameters are presented in the following table:

Parameter	Unit	Caustic	Coagulant	Flocculant
Dosing Location		MBBR Tanks	Pipe Flocculator	Pipe Flocculator
Maximum Dose	kg/d	1,744	4.5 as Me^{3+}	0.9

- Actual chemical doses to be determined during commissioning.

DAF design parameters are presented in the following table:

Parameter	Unit	DAF
No. Parallel Trains		1
Per Train:		
Skimmer Drive	HP	1
Recycle Pump	HP	2 x 15 (1 duty, 1 standby)
Air Required:		
Aeration System	scfm/psi	1/100

Scope of Work

General

- Nexom System Process Design including CAD Drawings and Specifications
- Operation and Maintenance Manuals and Project Record Drawings
- Installation Inspection / Start-up / Commissioning of Nexom Supplied Equipment
    - Two (2) trips with up to a total of six (6) days on site for Installation Inspection
    - One (1) trip with up to a total of three (3) days on site for Start-up / Commissioning
- Shipping to Site

Equipment Supply

MBBR ZONE 1

- One (1) 12.12m x 8.53m bolted GFS tank (installation of tank only included)
    - Insulation and cladding
    - Geodesic dome
    - Stairway
    - ***Installation of Nexom supplied tank materials only***
- One (1) lot BioPorts™ media for the specified fill fraction
- 316SS aeration grid including diffusers/laterals/floor-mounted header/drop-pipe
- One (1) 316SS 200mm flanged media retention screen for effluent penetration
- One (1) 316SS 150mm flanged media retention screen for drain penetration
- One (1) float switch for water level monitoring
- One (1) DO sensor with automated cleaning and mounting hardware
- One (1) pH sensor with automated cleaning and mounting hardware

MBBR ZONE 2

- One (1) 12.2m x 8.53m bolted GFS tank
    - Insulation and cladding
    - Geodesic dome
    - Stairway
    - ***Installation of Nexom supplied tank materials only***
- One (1) lot BioPorts™ media for the specified fill fraction
- 316SS aeration grid including diffusers/laterals/floor-mounted header/drop-pipe
- One (1) 316SS 200mm flanged media retention screen for effluent penetration
- One (1) 316SS 150mm flanged media retention screen for drain penetration
- One (1) float switch for water level monitoring
- One (1) DO sensor with automated cleaning and mounting hardware
- One (1) pH sensor with automated cleaning and mounting hardware

DAF SYSTEM

- One (1) pipe flocculator
- One (1) PCL-5 High-Rate Plate Pack DAF
    - 316SS wetted material construction
    - One (1) rotating top-skimmer
    - One (1) lot white water aeration system
    - One (1) lot plate pack system
    - One (1) pneumatic control panel
    - One (1) float chamber
- One (1) local compressor
- One (1) I-shaped DAF Mounted OSHA Compliant Catwalk with Ladder

AIR SUPPLY SYSTEMS

- Three (3) 125HP positive displacement blowers with sound attenuating enclosures
- One (1) lot local compressor for water-quality sensor cleaning

CHEMICAL DOSING SYSTEMS

- Two (2) duplex chemical dosing skids for caustic, one per MBBR tank
- One (1) duplex chemical dosing skid for coagulant
- One (1) polymer makedown/dosing system

PROCESS CONTROLS

- One (1) NEMA 12 panel with PLC/HMI and VFDs/motor starters for Nexom supplied equipment

BUDGETARY COST FOR THE SCOPE OF WORK ABOVE:

$5,500,000 CAD plus all taxes / fees

All prices are subject to final design review.

The quote(s) being provided will be in effect only for a period of 30 days. Should the company be awarded a purchase order during that 30-day period, it is understood that shipment of the product will be allowed within a period of 180 days from the date of the purchase order. Should the goods not be required to be delivered until after that time horizon, the company reserves the right to adjust pricing to reflect inflationary changes incurred and expected until the shipment date is reached.

Exclusions

- Anything, including services and equipment, not listed in the Scope of Work above
- Material offloading and secure on-site storage of equipment supplied by Nexom
- Installation of equipment supplied by Nexom (exception for MBBR tankage)
- Any civil / mechanical / electrical works, including but not limited to:
    - Site preparation and restoration
    - Process / instrumentation building or upgrades to existing building
    - Interconnecting process piping
    - Tank overflow splash pad
    - Tank foundation installation and design
    - Interconnecting air supply piping
    - Structural elements for mounting of equipment such as screens, mixers, etc.
    - Catwalks, walkways, staircases, or ladders
    - Main electrical supply and any electrical work
    - Chemical storage
    - Sludge conveyance / storage / management

Questions or Comments?

Any questions or comments can be directed to:

Nexom
Info@nexom.com
888-426-8180

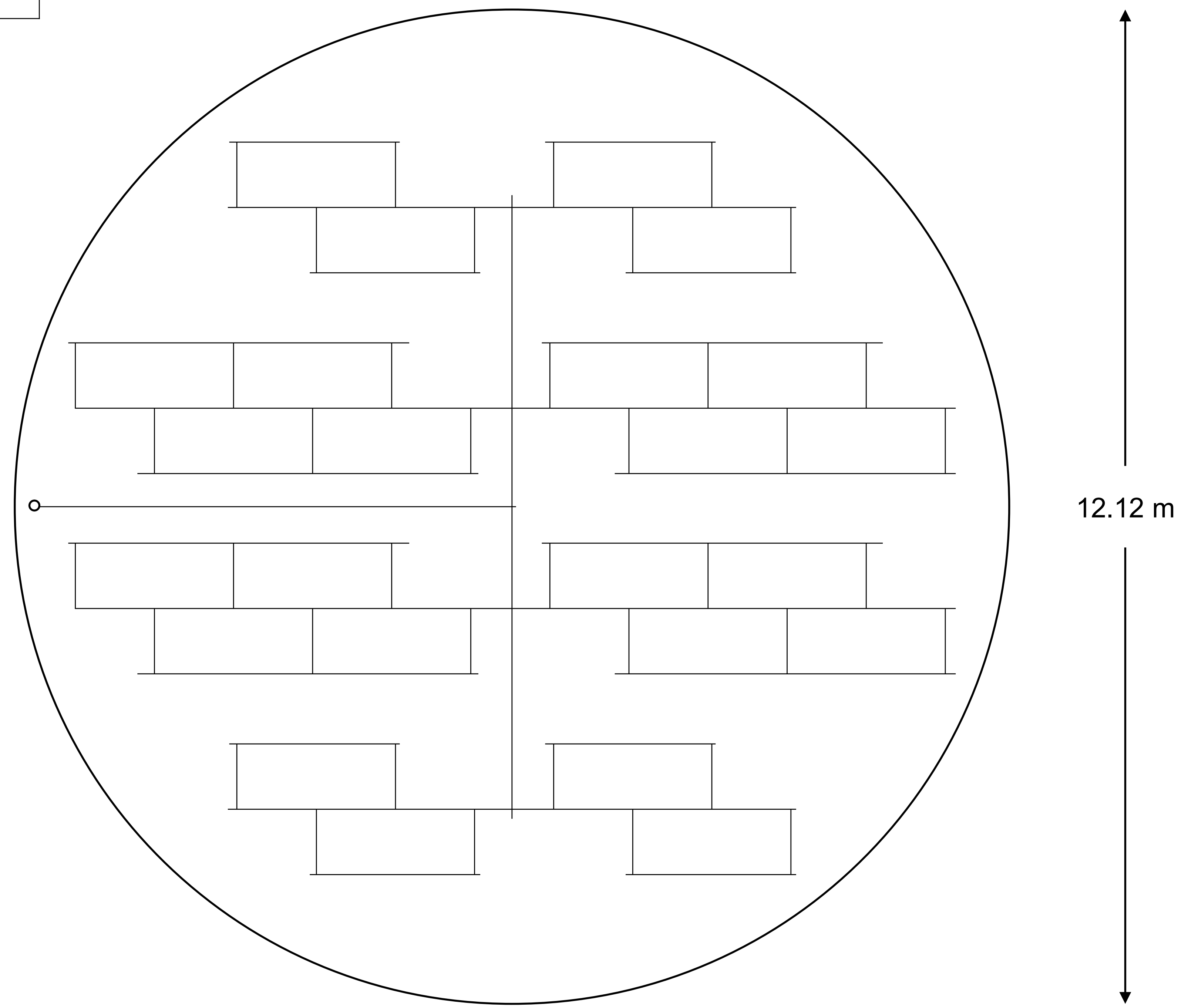
5 Burks Way · Winnipeg MB · R5T 0C9

www.nexom.com

ITEM	QTY	MATERIAL
Drop	1	8" SCH10 316L S.S.
Subheader	1	8"x6" SCH10 316L S.S.
Lateral	8	4" SCH10 316L S.S.
Diffuser	40	MaxAir SS Simplex
Diffuser End Support	Lot	FRP Rail

Notes:

1. Side Water Depth = 7.6 m
   Diffuser Submergence = 7.3 m
2. 1 of 1 Basin Shown



Nexom

5 Burks Way
Winnipeg, Manitoba
Canada R5T 0C9

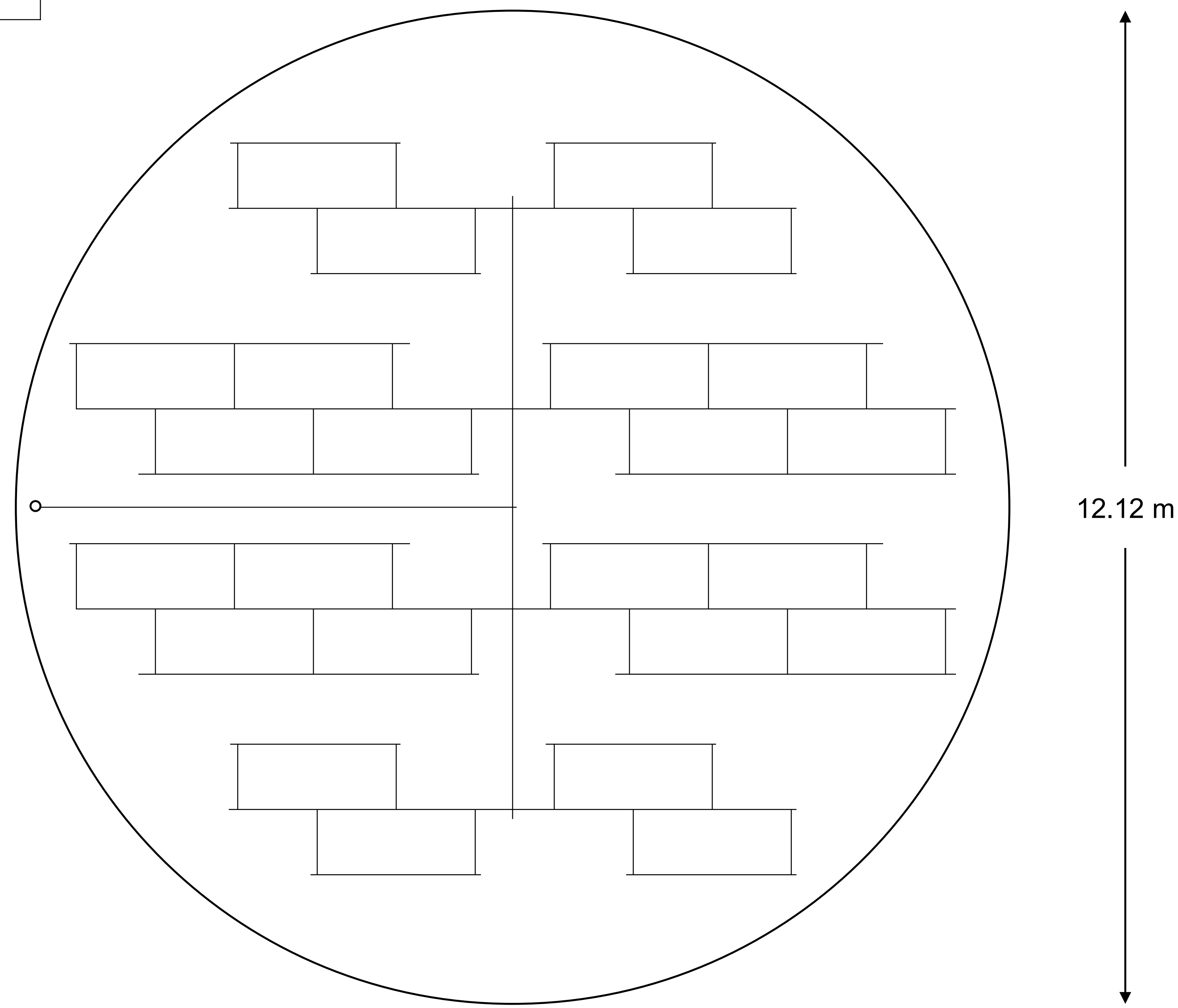
888-426-8180
www.nexom.com

PROJECT: Essex ON Landfill Leachate				
TITLE: Zone 1		SCALE: N.T.S.	SHT. 1 of 5	REV. 01
DATE: 4/26/2023	DRAWN BY: NJG			

ITEM	QTY	MATERIAL
Drop	1	8" SCH10 316L S.S.
Subheader	1	8"x6" SCH10 316L S.S.
Lateral	8	4" SCH10 316L S.S.
Diffuser	40	MaxAir SS Simplex
Diffuser End Support	Lot	FRP Rail

Notes:

1. Side Water Depth = 7.6 m
   Diffuser Submergence = 7.3 m
2. 1 of 1 Basin Shown

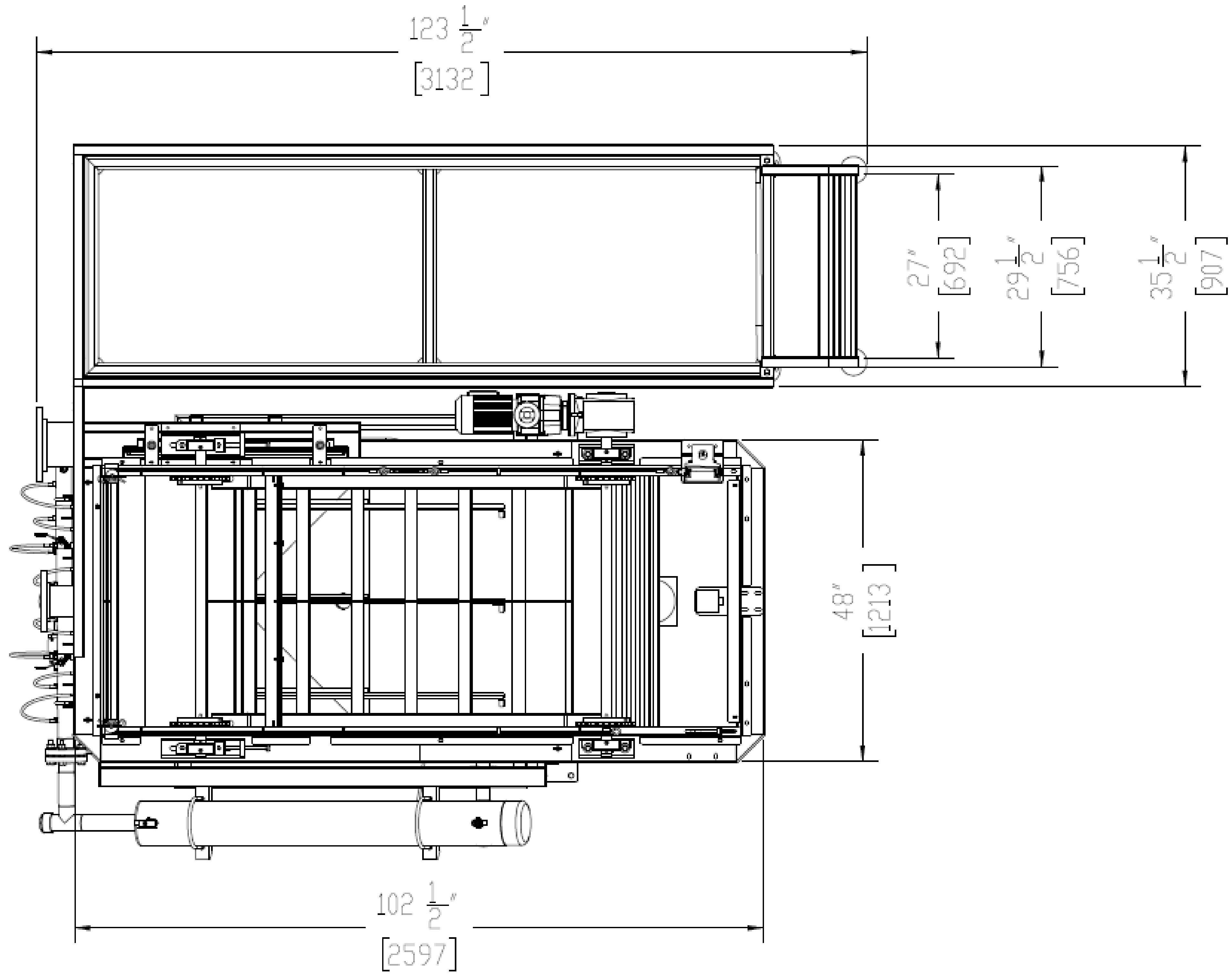


Nexom
5 Burks Way
Winnipeg, Manitoba
Canada R5T 0C9
888-426-8180
www.nexom.com

PROJECT: Essex ON Landfill Leachate				
TITLE: Zone 2		SCALE: N.T.S.	SHT. 2 of 5	REV. 01
DATE: 4/26/2023	DRAWN BY: NJG			

Notes:

1. 1 of 1 Basin Shown



Nexom

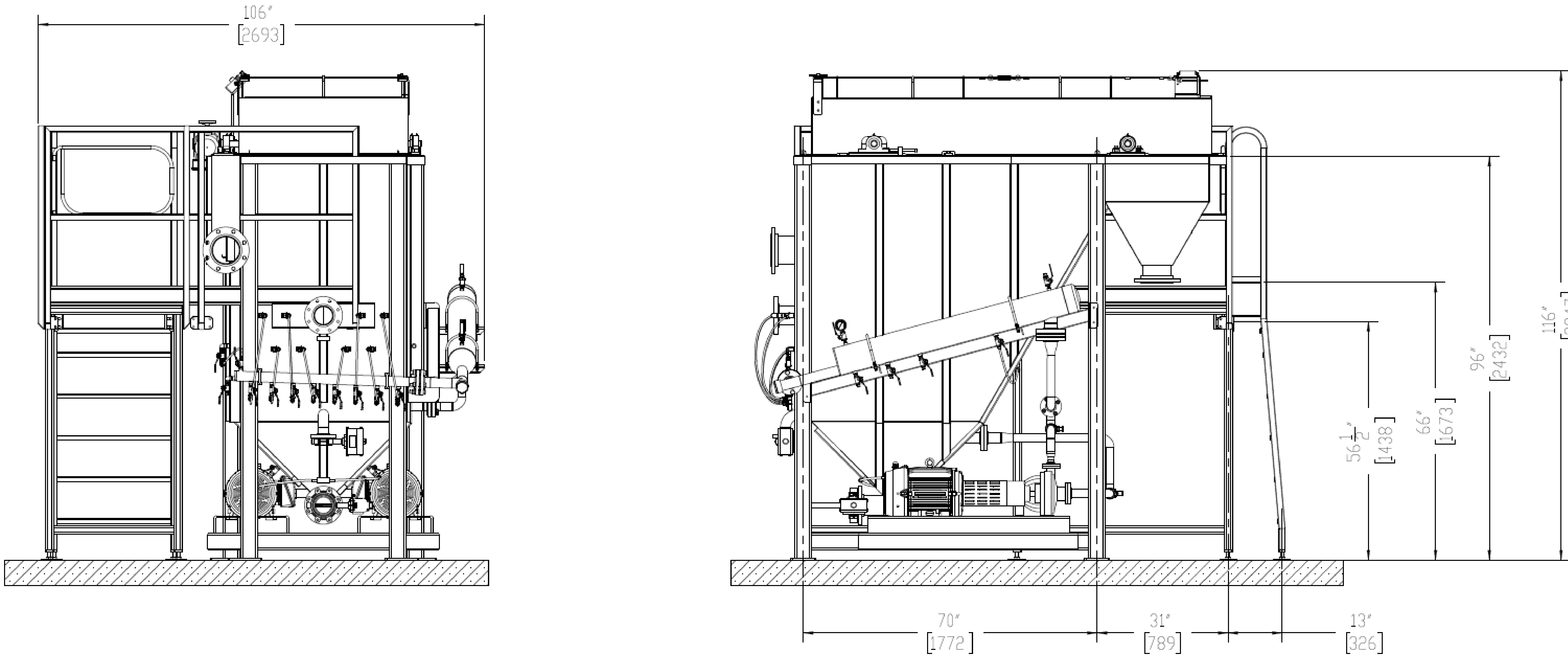
5 Burks Way
Winnipeg, Manitoba
Canada R5T 0C9

888-426-8180
www.nexom.com

PROJECT: Essex ON Landfill Leachate				
TITLE: DAF – Plan View		SCALE: N.T.S.	SHT. 3 of 5	REV. 01
DATE: 4/26/2023	DRAWN BY: NJG			

Notes:

1. 1 of 1 Basin Shown



Nexom

5 Burks Way
Winnipeg, Manitoba
Canada R5T 0C9

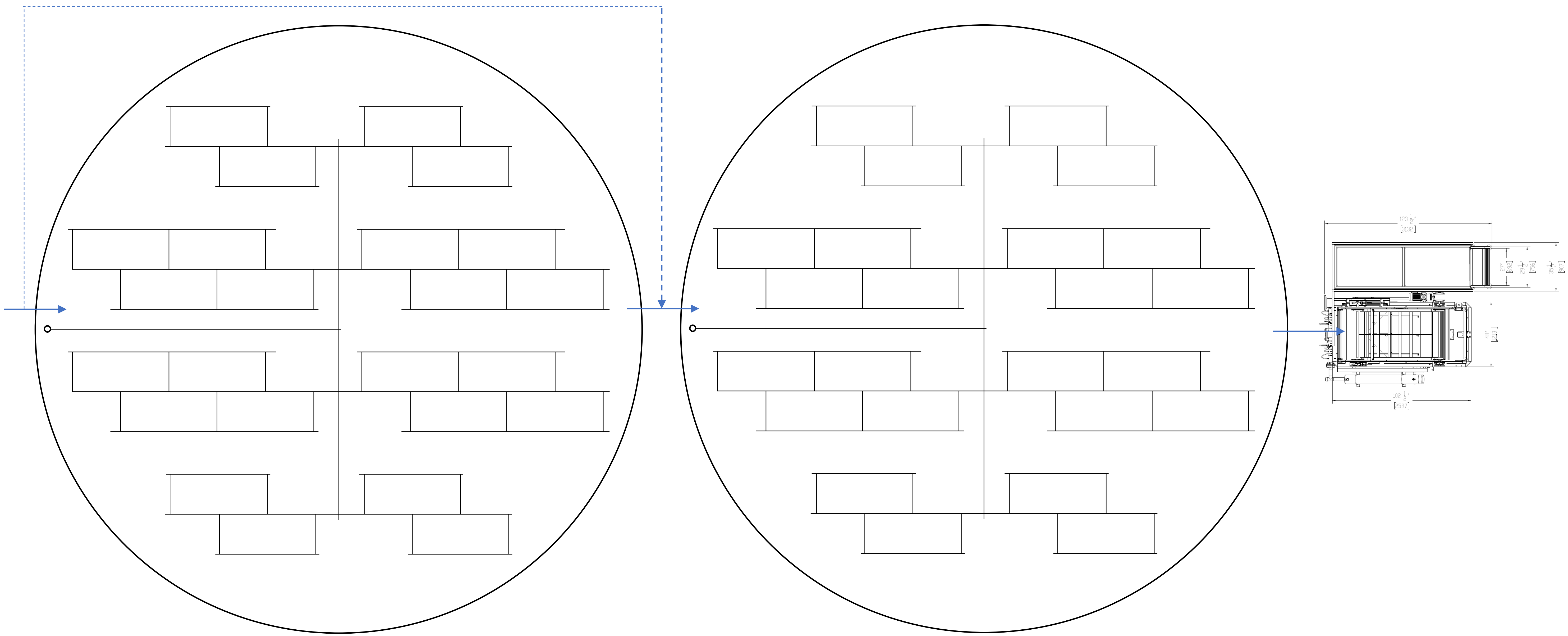
888-426-8180
www.nexom.com

PROJECT: Essex ON Landfill Leachate				
TITLE: DAF – Section View		**SCALE:** N.T.S.	**SHT.** 4 of 5	**REV.** 01
DATE: 4/26/2023	**DRAWN BY:** NJG			

Notes:

1. 1 of 1 Train Shown

Normally Closed Partial Bypass for Parallel Operation



Nexom
5 Burks Way
Winnipeg, Manitoba
Canada R5T 0C9
888-426-8180
www.nexom.com

PROJECT: Essex ON Landfill Leachate				
TITLE: Treatment Train Layout		SCALE: N.T.S.	SHT. 5 of 5	REV. 01
DATE: 4/26/2023	DRAWN BY: NJG			

Newterra Ltd.
1291 California Avenue, Brockville, ON K6V 5W3
(800) 420-4056/www.newterra.com

05/29/2023

Tom Marentette
Essex-Windsor Solid Waste Authority
360 Fairview Ave. W. Suite 211
Essex, ON N8M 3G4
519.776.7941/tommarentette@ewswa.org

Re: Budget Quote # 2302303R0 / Landfill Leachate - Essex-Windsor Solid Waste Authority

Dear Mr. Marentette:

Thank you for thinking of us as a potential partner for your upcoming project. We have provided initial budgetary pricing for your equipment. The scope of work for the equipment would contain the below described items.

Influent Flow Rate	Design Value	Metric Unit
Average Daily Flow (ADF)	*330*	m^3/d
Maximum Month Flow (MMF)	*450*	m^3/d
Maximum Daily Flow (MDF)	*660*	m^3/d
Peak Instantaneous Flow (PIF)	*82.5*	m^3/h

Influent Wastewater Characteristics	Design Value	Metric Unit
Biochemical Oxygen Demand, BOD	*4000*	mg/L
Total Suspended Solids,TSS	*500*	mg/L
Total Kjeldahl Nitrogen, TKN	*400*	mg/L
Total Phosphorus, TP	*15*	mg/L
Fat, Oil and Grease, FOG	*30*	mg/L
Minimum water temperature	*10*	˚C
Maximum water temperature	*25*	˚C
Site elevation	*100*	m

Effluent Water Specification	Effluent Limit	Effluent Objective	Design Value	Metric Unit
cBOD5	< 10	< 5	< 5	mg/L
TSS	< 10	< 5	< 5	mg/L
NH4-N + NH3-N	< 2	< 1	< 1	mg/L
TIN	< 20	< 10	< 8	mg/L
TP	< 0.3	< 0.2	< 0.2	mg/L

It is assumed that:

- Influent wastewater to be equalized (by others) such that the variability of daily mass loading rate does not exceed more than 1.5 times the average of the previous seven (7) days.
- Influent wastewater does not contain compounds in high enough concentrations to inhibit nitrification.
- Influent wastewater will be pretreated with an air stripper or equivalent, capable of reducing the influent ammonia concentration to 400 mg/L or less.
- Influent TN = Influent TKN = Influent Ammonia concentration.
- Piloting would be required to offer a performance guarantee.

Newterra Ltd.
1291 California Avenue, Brockville, ON K6V 5W3
(800) 420-4056/www.newterra.com

Scope of Supply:

The following scope is to be shipped loose to be installed in tanks by others:

- Pre-Anoxic tank instrumentation
- Pre-Anoxic tank mixing eductors
- Aeration tank instrumentation
- Aeration tank diffuser grid
- Post-Anoxic tank instrumentation
- Post-Anoxic tank mixing eductors

Note: equipment under the above section has been selected for above ground glass fused tanks only, if different tanks are to be used, changes in the equipment may be required and additional costs may apply.

The following scope is to be installed in Newterra's enclosures (6 – 8'x40' modular buildings):

- Fine screen with inlet flowmeter and Pre-Anoxic tank feed pumps
- Pre-Anoxic mixing pumps
- Recirculation to Pre-Anoxic pumps
- Aerobic tank blowers (selected for a side water depth of 20 feet)
- Post-Anoxic mixing pumps
- Membrane feed pumps
- Membrane tanks (2 duty) populated with submerged UF membranes
- Membrane tanks blowers
- RAS tanks (2 duty) and pumps
- Permeate extraction system
- Permeate pumps
- Backwash tank and pump
- WAS pumps
- UV disinfection
- Chemical dosing pumps (Sodium Hydroxide, Phosphoric Acid, Aluminum Sulphate, MicroC)
- Chemical dosing for backwash (Sodium Hypochlorite and Citric Acid)
- Sludge holding tank with diffuser grid and blowers
- Dewatering press feed pump
- Sludge dewatering unit with polymer makeup system and filtrate pump
- Power, control panels and transformer
- Modular building footprint: 48' x40'

Note: Power assumed to be 575V/3P/60Hz.

Customer's Scope

- Above ground insulated and covered glass fused Pre-anoxic, Aerobic and Post-Anoxic tanks supply and installation
- Installation of all shipped loose equipment supplied by newterra
- Potable water to site
- Interconnecting piping and electrical
- Piping for mixing eductors grid for Pre-Anoxic and Post-Anoxc tank and diffuser grid for Aerobic tank
- Electrical power supply to Newterra's panels
- All in-ground tanks piping and electrical (if applicable)
- Stairs, railings, foundation, etc., as required
- Placement and anchoring of equipment and buildings
- Permitting
- Seed sludge
- Wastewater testing

- Chemicals supply and storage (safety equipment as per local regulations)
- Treated effluent and waste sludge disposal (including sludge dewatered solids bin)
- All civil works including design
- Anything not mentioned in the scope of supply above

Budgetary equipment purchase price: $ 2,600,000 – 3,000,000 CAD

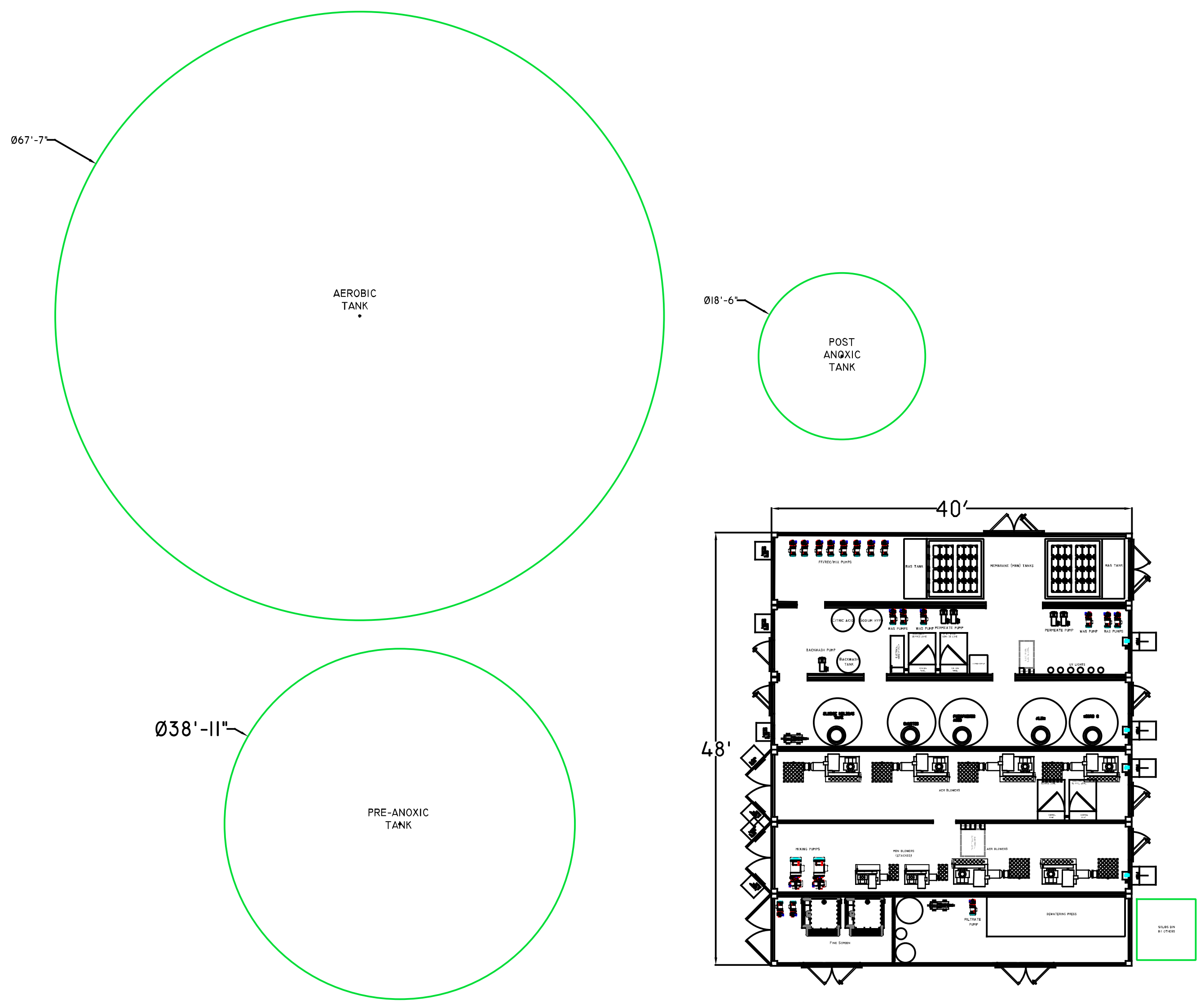
Please note that the stated price above does not include freight to site, taxes, duties, onsite startup or technical services from our field technicians. This is an equipment supply price.

When you are ready to move forward with a firm price proposal request, we can provide a detailed proposal and estimated project lead time. If you would like to discuss the project or have any questions about this quote please call us.

Sincerely,

Anthony Amendola
Regional Sales Manager – Industrial
Cell: 289-707-3036
aamendola@newterra.com

Romina Ferrada
Newterra Applications Engineering
Office: 800-420-4056 x1132
rferrada@newterra.com



NOTES

SUPPLY BY OTHERS, INSTALL BY OTHERS

SUPPLY BY NEWTERRA, INSTALL BY NEWTERRA (INSIDE MODULAR BUILDING)

SUPPLY BY NEWTERRA, INSTALL BY OTHERS

INTERCONNECTING PIPING BETWEEN BUILDING AND TANKS, AND BETWEEN TANKS, TO BE SUPPLIED AND INSTALLED BY OTHERS.

newterra

PHONE:
(800) 420-4056

www.newterra.com

LEVEL	REVISION	DATE (mm/dd/yy)	BY
R0	PRELIMINARY FOR QUOTE	2023/05/16	RF

PROJECT NUMBER: 2302003

TITLE AND LOCATION: PRELIMINARY LAYOUT
LANDFILL LEACHATE

CUSTOMER: ESSEX-WINDSOR SOLID WASTE AUTHORITY

DRAWN BY | DATE | SHEET | SHEETS

Appendix D CLASS DEFINITIONS FOR OPINIONS OF PROBABLE COST

OPINION OF COST

LEVELS OF COST OPINIONS

GENERAL

ASTM E 2516-06 (Standard Classification for Cost Estimate Classification System) provides a five-level classification system based on several characteristics, with the primary characteristic being the level of project definition (i.e. percentage of design completion). Section 7.5.4 of ASTM E 2516 acknowledges that other "secondary" characteristics drive the accuracy of the estimate, and provides as follows:

> "In summary, estimate accuracy will generally be correlated with estimate classification (and therefore the level of project definition), all else being equal. However, specific accuracy ranges will typically vary by industry. Also, the accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as differing technological maturity, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by-estimate basis, usually in conjunction with some form of risk analysis process."

The ASTM standard is shown in Table 1.1 also includes a table copied below, that illustrates the typical accuracy ranges that may be associated with the general building industries.

TABLE 1.1 - ASTM E 2516-06 ACCURACY RANGE OF COST OPINIONS FOR GENERAL BUILDING CONSTRUCTION INDUSTRIES

Cost Opinion Class	Expressed as % of complete definition	Anticipated Accuracy Range for Building and General Construction Industry
5	0% to 2%	-20% to -30%/ +30% to +50%
4	1% to 15%	-10% to -20%/ +20% to +30%
3	10% to 40%	-5% to -15%/ +10% to +20%
2	30% to 70%	-5% to -10%/ +5% to +15%
1	50% to 100%	-3% to -5%/ +3% to +10%

Following is a general description of the various classes within a typical five-level cost opinion classification system. Always keep in mind that many factors influence cost opinion accuracy and any cost opinion accuracy must be evaluated on a case-by-case basis. Figure 1.0 summarizes the cost opinion levels of assumed accuracy.

Class 5

Other definitions: Class V, Level 1, Class D. This is an order of magnitude cost opinion, also referred to as a parameter or conceptual cost opinion. It is generally used for strategic business or capital planning, assessment of viability, or for comparative purposes to establish a base ranking of alternatives. There is usually a very low level of project definition and limited information available. The cost opinion accuracy can be up to +100%. A Class 5 cost opinion is based upon historical sources, other analogous work, and the experience of the individual. Some percentage breakdown by major work category may be inferred from a review of similar projects that have been completed or estimated in detail. Its basis can be "cost per square meter", "cost per unit" or multiplier of primary equipment cost. Sometimes expression as a range of values is better received and understood than a single number with a stated accuracy of ±50% ($50,000 to $150,000 rather than $100,000 ±50%). This cost opinion is usually not detailed, except perhaps for subtotals of major components and with qualifications as to accuracy. As with all levels, the accuracy must be kept in mind when rounding off the significant figures. For example a $100,000 Class 5 cost opinion would be rounded up to the nearest $10,000 and never the nearest $100 or $1000.

Class 4

Other definitions: Class IV, Level 2, Class C. This is generally referred to as a preliminary, feasibility, schematic design, predesign, authorization or basic system cost opinion. It is used for detailed planning, evaluation of alternatives; confirm economic viability, preliminary budget approval and cash flow projections. At this stage the project concept and scope have been established and enough work completed to define capacities and processes resulting in block schematics, plot plans, process flow diagrams, general arrangement drawings and infrastructure requirements. The cost opinion is based on elemental units using historical costs, standard estimating references, supplier quotes and historical data from similar projects.

Class 3

Other definitions: Class III, Level 3, Class B. This is a target, budget, or control cost opinion, also referred to as a design development cost opinion. It is used for budget authorization and set the design control budget to confirm and monitor design direction. This is the point at which the project begins to have firm definition, and we have begun detailed work. This cost opinion is usually prepared when our work is from 10% to 40% complete. It is based on unit takeoffs from general arrangements, definitive discipline layouts, P & ID's, single lines, block diagrams, preliminary equipment selection, etc. Unit pricing is obtained from supplier quotes, pricing inquiries, historical data from similar work, pricing data books, all viewed toward industry pricing trends and factors.

Class 2

Other definitions: Class II, Level 4, Class A. A Class 2 cost opinion is known as a definitive, detailed or master control, tender/bid or pre-tender/pre-Bid Cost opinion and is based on 90% completion of construction documents. It is prepared using detailed material take-offs and is really a "shadow" cost opinion of what is expected to be bid by the contractors. It is used to:

- Prepare the bid form;
- Anticipate bid prices and update project cost opinion;
- Check pricing during evaluations; and
- Prepare the format for construction progress payments, cost tracking, and change/variation control.

Class 1

Other definitions: Class I, Level 5. A Class 1 cost opinion is known as a detailed, final execution phase, definitive, current control, or change order cost opinion. It is prepared from fully completed design documentation employing a high level of takeoff breakdown. These may be used for contractor bid negotiations, subcontractors for bid preparation, as the final control base for bid checking, change/variation control, and claim or dispute resolution. These require a significant level of effort and are not typically prepared for all projects. They may only be prepared for critical or selected parts of the project for specific reasons. All levels of cost opinions must be expressed in appropriate significant figures. For example even a Class 1 cost opinion would be rounded up to at least the next $1000, or higher depending on project size. A "round off" budget item line can be inserted just above the project total.

Appendix E EXCEL COST OPINION CALCULATION SHEETS

ROChem (surface water discharge) - Construction Opinion of Probable Cost DRAFT - may 30, 2023

Cost Item	Value	Subtotals	Subtotals	Assumptions
1. Construction Scope				
Vendor package				
LS-ROChem equipment supply	$3,600,000			based on $2.7M US ROChem budget number for 378 m3/d plant, 1 CAD=$0.75 USD, poorly defined scope
LS - ion exchange process for TAN polishing	$200,000			LS placeholder - needs to be updated,qoute not provided by ROChem
LS-evaporator	$400,000			LS placeholder needs to be updated,qoute not provided by ROChem
LS-Rochem equipment (labour for installation)	$630,000			LS placeholder - based on 15% equipment supply cost (include IX, evaporator) for installation.
subtotal=		$4,830,000		
Structural/arch components				
LS - Pre-Eng bldg	$886,167			per Matazza quote for 4800 ft2, assumed Orchard hill bldg area needed at 5200 ft2, pro-rated cost
LS-building insulation, interior walls	$200,000			LS placeholder - need insulation and interior walls to suit.
LS- misc process tanks (acid, mixing, calcite, etc.)	$200,000			LS placeholder - 5 tanks @ $40k each installed
subtotal=		$1,286,167		
Process/building mechanical components				
LS-raw sewage pumping station	$100,000			LS placeholder - manhole with feed pump, forcemain to new process
LS- lagoon mods to allow flow EQ	$50,000			LS placeholder - need to store portions of wet weather flows that exceed RO capacity.
LS-misc process piping/valves	$200,000			LS placeholder - will depend upon eventual process design
LS- pre-eng building HVAC/drainage/plumbing	$100,000			LS placeholder - need buiding HVAC/drainage/plumbing to suit
subtotal=		$450,000		
Civil				
LS-roadways/fencing/grading/grass	$50,000			gravel roads, stormwater grading, fencing, grass seeding
LS-utilities - water, NG, etc.	$30,000			LS placeholder - extend utilities to new building
subtotal=		$80,000		
Subtotal 1=			$6,646,167	Subtotal1 = Vendor + struct/arch + process/bldg mech+Civil
Electrical / I&C				
electrical power supply extension	$47,000			buried 400 AMP service extension per Anchor electrical quote with $10k for digging
elec. dist./wiring/MCCs for process equipment	$465,232			LS assumed @ 7% of subtotal 1, MCC supply not stated by Rochem, excludes backup generator
I&C allowance for process equipment	$199,385			LS assumed @3% of subtotal 1, I&C scope not clear in Rochem proposal
I&C programming	$40,000			LS placeholder for PLC programming; reduced scope as package supply assumed
subtotal=		$751,617		
Subtotal 2=			$7,397,783	Subtotal 2 = Subtotal 1 + Electrical/I&C
LS -estimating contingency (@ 25%)	$1,849,446			contingency for unaccounted construction items
Subtotal 3 =			$9,247,229	Subtotal 3 = Subtotal 2 + estimating contingency
General Contractor (mob/demob/insurance/etc @ 5%)	$462,361			GC misc. general charges
General Contractor (OH & profit @ 15%)	$1,387,084			GC OH & profit
Subtotal 4 - Total Construction Scope Cost =			$11,096,675	Subtotal 4 = Subtotal 3 + estimate for GC services
2. Engineering Scope				
LS - detailed design services	$0			assumed x% of construction value
LS - contract administration & supervision services	$0			assumed x% of construction value
Subtotal 1 Engineering Scope =		$0		estimate for engineering services
3. Total Implementation Opinion of Probable Cost	$0			excluding taxes, permits, inflation; Class 5 level accuracy estimate

Newterra (surface water discharge) - Construction Opinion of Probable Cost DRAFT - may 30, 2023

Cost Item	Value	Subtotals	Subtotals	Assumptions
1. Construction Scope				
Vendor package				
LS-Newterra equipment supply	$2,800,000			scope per Newterra vendor supply proposal dated May 29, 2023, quoted $2.6M - $3.0M range; excludes tanks
LS - ammonia stripper column	$400,000			LS placeholder - needs to be updated,qoute not provided by Newterra; ammonia stripper packed column with steam or pH?
LS-Newterra equipment (labour for installation)	$480,000			LS placeholder - based on 15% equipment supply cost (include ammonia stripper) for installation.
subtotal=		$3,680,000		
Structural/arch components				
LS - Pre-Eng bldg (excluded)	$0			using shipping containers instead of pre-engineered structure
LS - shipping container -eng fills/concrete pad	$152,500			LS placeholder - shipping container area = 48'x40' with 0.25m thick, $2500/m3 installed + A gravel
LS-GFS tanks	$3,000,000			LS placeholder - based on 3 tanks with volumes = 3330 m3, 1100 m3, 250m3, GFScost = $650k/1000 m3 volume
LS-GFS tank foundations	$630,000			LS placeholder - Newterra quote excludes tank foundations, 3 circular pads 0.5 thick, $2500/m3 installed + A gravel
LS-building insulation, interior walls	$0			using shipping containers instead of pre-engineered structure
LS- misc process tanks (NaOH, P addition)	$50,000			LS placeholder - 2 tanks @ $25k each installed
subtotal=		$3,832,500		
Process/building mechanical components				
LS-raw sewage pumping station	$100,000			LS placeholder - manhole with feed pump, forcemain to new process
LS- lagoon mods to allow flow EQ	$50,000			LS placeholder - need to store portions of wet weather flows that exceed RO capacity.
LS-misc process piping/valves	$200,000			LS placeholder - will depend upon eventual process design
LS- pre-eng building HVAC/drainage/plumbing	$0			using shipping containers instead of pre-engineered structure, Newterra HVAC/drainage/plumbing scope is unclear
subtotal=		$350,000		
Civil				
LS-roadways/fencing/grading/grass	$50,000			gravel roads, stormwater grading, fencing, grass seeding
LS-utilities - water, NG, etc.	$30,000			LS placeholder - extend utilities to new building
subtotal=		$80,000		
Subtotal 1=			$7,942,500	Subtotal1 = Vendor + struct/arch + process/bldg mech+Civil
Electrical / I&C				
electrical power supply extension	$47,000			buried 400 AMP service extension per Anchor electrical quote with $10k for digging
elec. dist./wiring/MCCs for process equipment	$555,975			LS assumed @ 7% of subtotal 1, MCC supply not stated by Rochem, excludes backup generator
I&C allowance for process equipment	$238,275			LS assumed @3% of subtotal 1, I&C scope not clear in Rochem proposal
I&C programming	$40,000			LS placeholder for PLC programming; reduced scope as package supply assumed.
subtotal=		$881,250		
Subtotal 2=			$8,823,750	Subtotal 2 = Subtotal 1 + Electrical/I&C
LS -estimating contingency (@ 25%)	$2,205,938			contingency for unaccounted construction items
Subtotal 3 =			$11,029,688	Subtotal 3 = Subtotal 2 + estimating contingency
General Contractor (mob/demob/insurance/etc @ 5%)	$551,484			GC misc. general charges
General Contractor (OH & profit @ 15%)	$1,654,453			GC OH & profit
Subtotal 4 - WWTP Construction Cost =			$13,235,625	Subtotal 4 = Subtotal 3 + estimate for GC services
2. Engineering Scope				
LS - detailed design services	$0			assumed x% of construction value
LS - contract administration & supervision services	$0			assumed x% of construction value
Subtotal 1 Engineering Scope =		$0		estimate for engineering services
3. Total Implementation Opinion of Probable Cost	$0			excluding taxes, permits, inflation; Class 5 level accuracy estimate

Nexom (sanitary sewer discharge) - Construction Opinion of Probable Cost DRAFT - may 30, 2023

Cost Item	Value	Subtotals	Subtotals	Assumptions
1. Construction Scope				
Vendor package				
LS-Nexom equipment supply	$5,500,000			scope per Nexom vendor supply proposal dated April 27, 2023 - includes GFS tank supply/installation minus foundations
LS - dewatering system	$400,000			LS placeholder - needs to be updated,qoute not provided by Nexom; pumps/screw press/polymer dosing/cake bin
LS-Nexom equipment (labour for installation)	$885,000			LS placeholder - based on 15% equipment supply cost (include dewatering) for installation.
subtotal=		$6,785,000		
Structural/arch components				
LS - Pre-Eng bldg	$572,600			per Matazza quote for 4800 ft2, assumed 70% area needed, pro-rated cost
LS-GFS tank foundations	$331,641			LS placeholder - Nexom quote excludes tank foundations, 2 circular pads 6.25m radius, 0.5 thick, $2500/m3 installed + A gravel
LS-building insulation, interior walls	$150,000			LS placeholder - need insulation and interior walls to suit - more walls
LS- misc process tanks (NaOH, P addition)	$50,000			LS placeholder - 2 tanks @ $25k each installed
subtotal=		$1,104,241		
Process/building mechanical components				
LS-raw sewage pumping station	$100,000			LS placeholder - manhole with feed pump, forcemain to new process
LS- lagoon mods to allow flow EQ	$50,000			LS placeholder - need to store portions of wet weather flows that exceed RO capacity.
LS-misc process piping/valves	$200,000			LS placeholder - will depend upon eventual process design
LS- pre-eng building HVAC/drainage/plumbing	$70,000			LS placeholder - need buiding HVAC/drainage/plumbing to suit, pro-rated to smaller bldg
subtotal=		$420,000		
Civil				
LS-roadways/fencing/grading/grass	$50,000			gravel roads, stormwater grading, fencing, grass seeding
LS-utilities - water, NG, etc.	$30,000			LS placeholder - extend utilities to new building
subtotal=		$80,000		
Subtotal 1=			$8,389,241	Subtotal1 = Vendor + struct/arch + process/bldg mech+Civil
Electrical / I&C				
electrical power supply extension	$47,000			buried 400 AMP service extension per Anchor electrical quote with $10k for digging
elec. dist./wiring/MCCs for process equipment	$587,247			LS assumed @ 7% of subtotal 1, MCC supply not stated by Rochem, excludes backup generator
I&C allowance for process equipment	$251,677			LS assumed @3% of subtotal 1, I&C scope not clear in Rochem proposal
I&C programming	$40,000			LS placeholder for PLC programming; reduced scope as package supply assumed
subtotal=		$925,924		
Subtotal 2=			$9,315,165	Subtotal 2 = Subtotal 1 + Electrical/I&C
LS -estimating contingency (@ 25%)	$2,328,791			contingency for unaccounted construction items
Subtotal 3 =			$11,643,956	Subtotal 3 = Subtotal 2 + estimating contingency
General Contractor (mob/demob/insurance/etc @ 5%)	$582,198			GC misc. general charges
General Contractor (OH & profit @ 15%)	$1,746,593			GC OH & profit
Subtotal 4 - WWTP Construction Cost =			$13,972,747	Subtotal 4 = Subtotal 3 + estimate for GC services
Subtotal 5 - New effluent PS/forcemain to discharge to Essex WWTP			$5,000,000	Subtotal 5 = Subtotal 4 + new PS/forcemain to discharge to Essex WWTP
Subtotal 6 - Total Construction Scope Cost			$18,972,747	Subtotal 6 = Subtotal 4 + SubtotaL 5
2. Engineering Scope				
LS - detailed design services	$0			assumed x% of construction value
LS - contract administration & supervision services	$0			assumed x% of construction value
Subtotal 1 Engineering Scope =		$0		estimate for engineering services
3. Total Implementation Opinion of Probable Cost	$0			excluding taxes, permits, inflation; Class 5 level accuracy estimate

Newterra (sanitary sewer discharge) - Construction Opinion of Probable Cost **DRAFT - may 30, 2023**

Cost Item	Value	Subtotals	Subtotals	Assumptions
1. Construction Scope				
Vendor package				
LS-Newterra equipment supply	$2,800,000			scope per Newterra vendor supply proposal dated May 19, 2023, quoted $2.5M - $3.0M range; excludes GFS tanks
LS - ammonia stripper column	$400,000			LS placeholder - needs to be updated,qoute not provided by Newterra; ammonia stripper packed column with steam or pH?
LS-Newterra equipment (labour for installation)	$480,000			LS placeholder - based on 15% equipment supply cost (include ammonia stripper) for installation.
subtotal=		$3,680,000		
Structural/arch components				
LS - Pre-Eng bldg (excluded)	$0			using shipping containers instead of pre-engineered structure
LS - shipping container -eng fills/concrete pad	$152,500			LS placeholder - shipping container area = 48'x40' with 0.25m thick, $2500/m3 installed + A gravel
LS-GFS tanks	$2,600,000			LS placeholder - 2 GFS tanks, 10m depth, 20.6m diameter & 11.9m diameter; GFS tank cost = $650k per 1000m3 vol.
LS-GFS tank foundations	$331,641			LS placeholder - Newterra quote excludes tank foundations, 2 circular pads 6.25m radius, 0.5 thick, $2500/m3 installed + A gravel
LS-building insulation, interior walls	$0			using shipping containers instead of pre-engineered structure
LS- misc process tanks (NaOH, P addition)	$50,000			LS placeholder - 2 tanks @ $25k each installed
subtotal=		$3,134,141		
Process/building mechanical components				
LS-raw sewage pumping station	$100,000			LS placeholder - manhole with feed pump, forcemain to new process
LS- lagoon mods to allow flow EQ	$50,000			LS placeholder - need to store portions of wet weather flows that exceed RO capacity.
LS-misc process piping/valves	$200,000			LS placeholder - will depend upon eventual process design
LS- pre-eng building HVAC/drainage/plumbing	$0			using shipping containers instead of pre-engineered structure, Newterra HVAC/drainage/plumbing scope is unclear
subtotal=		$350,000		
Civil				
LS-roadways/fencing/grading/grass	$50,000			gravel roads, stormwater grading, fencing, grass seeding
LS-utilities - water, NG, etc.	$30,000			LS placeholder - extend utilities to new building
subtotal=		$80,000		
Subtotal 1=			$7,244,141	Subtotal1 = Vendor + struct/arch + process/bldg mech+Civil
Electrical / I&C				
electrical power supply extension	$47,000			buried 400 AMP service extension per Anchor electrical quote with $10k for digging
elec. dist./wiring/MCCs for process equipment	$507,090			LS assumed @ 7% of subtotal 1, MCC supply not stated by Rochem, excludes backup generator
I&C allowance for process equipment	$217,324			LS assumed @3% of subtotal 1, I&C scope not clear in Rochem proposal
I&C programming	$40,000			LS placeholder for PLC programming; reduced scope as package supply assumed.
subtotal=		$811,414		
Subtotal 2=			$8,055,555	Subtotal 2 = Subtotal 1 + Electrical/I&C
LS -estimating contingency (@ 25%)	$2,013,889			contingency for unaccounted construction items
Subtotal 3 =			$10,069,443	Subtotal 3 = Subtotal 2 + estimating contingency
General Contractor (mob/demob/insurance/etc @ 5%)	$503,472			GC misc. general charges
General Contractor (OH & profit @ 15%)	$1,510,417			GC OH & profit
Subtotal 4 - WWTP Construction Cost =			$12,083,332	Subtotal 4 = Subtotal 3 + estimate for GC services
Subtotal 5 - New effluent PS/forcemain to discharge to Essex WWTP			$5,000,000	Subtotal 5 = Subtotal 4 + new PS/forcemain to discharge to Essex WWTP
Subtotal 6 - Total Construction Scope Cost			$17,083,332	Subtotal 6 = Subtotal 4 + SubtotaL 5
2. Engineering Scope				
LS - detailed design services	$0			assumed x% of construction value
LS - contract administration & supervision services	$0			assumed x% of construction value
Subtotal 1 Engineering Scope =		$0		estimate for engineering services
3. Total Implementation Opinion of Probable Cost	$0			excluding taxes, permits, inflation; Class 5 level accuracy estimate

Major Cost Item	Surface Water Discharge		Sanitary Sewer Discharge	
	ROChem	Newterra MBR	Nexom MBBR	Newterra MBR
WWTP Construction	$11,096,675	$13,235,625	$13,972,747	$12,083,332
Transfer PS/Forcemain	-	-	$5,000,000	$5,000,000
Total Construction	$11,096,675	$13,235,625	$18,972,747	$17,083,332

Table x - EWSWA WWTP - Opinions of Probable Costs for O&M (+50% / -35% accuracy)

DRAFT - 5/30/2023

	Cost Item	Surface Water Discharge Options		Sanitary Sewer Discharge Options		
		Rochem	**Newterra MBR**	**Nexom MBBR**	**Newterra MBR**	**Comments/Assumptions**
1	Labour	$90,000	$90,000	$90,000	$90,000	
2	Heating (NG)	$10,000	$3,692	$6,462	$3,692	excludes: ROChem evaporator NG & Newterra ammonia stripper NG
3	Electricity	$210,240	$140,160	$112,128	$140,160	
4	Chemicals					
	RO descaling/cleaning	$110,000		-	-	per ROChem proposal;
	RO H2SO4 acid	$440,000		-	-	per ROChem proposal;
	RO calcite	$40,000		-	-	LS placeholder - TBD
	RO IX resins	$10,000		-	-	LS placeholder - TBD
	MBR citric acid cleaning	-	$5,000	-	$5,000	vs Oxford MBR chem cost @ approx 20-40k /yr
	MBR NaOCl cleaning	-	$1,000	-	$1,000	vs Oxford MBR chem cost @ approx 5-10k /yr
	P add- nutrient	-	$3,650	$3,650	$3,650	LS placeholder - assume $10/d to add P for biomass growth
	NaOH - alk	-	$39,420	$39,420	$39,420	Net 180 kg/d NaOH (50%) dosing for Alk trim addition; NaOH sol = $0.60 /kg
	polymers	-	$18,250	$19,345	$18,250	polymer cost=$10/kg: Nexom=1.3 kg/d (process) + 5 kg/d (dewatering)
	micro-C		$35,000			LS placeholder - TBD
5	Admin	$10,000	$10,000	$10,000	$10,000	
6	Sludge disposal	$37,000	$37,000	$37,000	$37,000	LS placeholder - $100/d labour/trucking, $0/wet tonne landfill tipping cost
7	infrastructure renewal					
	membranes	$210,000	$8,000		$8,000	Rochem=$210k; Newterra= $20/m3/d flow per yr given Oxford info
	mech equipmt	$75,000	$75,000	$75,000	$75,000	assume 1.5% of $5M equipment cost
	misc.	-	-	$2,000	-	LS placeholder for Nexom media replacement
8	Sewer Surcharge	-	-	$481,800	$481,800	Surcharge to be determined with Town of Essex; assumed @ $4/m3 with 330 m3/d flow
9	Contingency (10%)	$124,224	$46,617	$87,680	$91,297	
10	Total ($/yr)	$1,366,464	$512,790	$964,485	$1,004,270	

Notes:

1 1 FTE operator assumed for each process
2 LS estimates for winter heating per floor area (ROChem=5200ft2, Nexom = 3640ft2, Newterra=1920 ft2)
3 Electricity estimates assuming $0.16/kWh, electrical draws = ROCHem=150 kW, Nexom MBBR= 80 kW, Newterra MBR=100kW
4 Chemicals
5 Admin allowance for sampling and reporting
6 sludge disposal cost = $0/wet tonne assumed, returned to landfill using inhouse labour/trucking.
7 infrastructure renewal
8 Sewer Surcharge
9 Contingency to account for unforeseens set at 10%
10 Total ($/yr) O&M estimate with +50% / -35% accuracy given the level of design.

EWSWA WWTP - 20-Year Life Cycle Cost (LCC) Comparison:

DRAFT - 5/30/2023

Assumptions:

interest rate =	6%	
inflation rate =	3%	
net discount rate=	3%	(interest - inflation)

	Surface Water Discharge		**Sanitary Sewer Discharge**		
Cost Items	**ROchem**	**Newterra**	**Nexom**	**Newterra**	**Comments**
Construction cost (year 2023)	$11,096,675	$13,235,625	$18,972,747	$17,083,332	excludes: engineering, taxes, permits, inflation; Class 5 estimate
Annual O&M (year 2023)	$1,366,464	$512,790	$964,485	$1,004,270	Class 5 estimate
Annual O&M (NPV Sum 2023-2043)	$20,329,534	$7,629,013	$14,349,101	$14,940,995	20 yr NPV of Annual O&M at noted discount rate
Total LCC (20 years operation)	$31,426,209	$20,864,638	$33,321,848	$32,024,327	Construction cost + (20 year NPV of annual O&M)