City of Cornwall

ONTARIO
Budget Proposal WWTP Cornwall

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1. INTRODUCTION

Degremont has been contacted to design and supply the full range of equipments to treat the wastewater of Cornwall.

The Cornwall WWTP is undertaking a Class EA update to expand the plant from a primary plant to a secondary plant.

The existing plant provides primary treatment with chemical addition (ferric). The effluent is disinfected with chlorine.

Biosolids are digested on site with anaerobic digesters and dewatered by centrifuges. The plant also co-treats leachate and receives waste from two industrials (polymeric plasticizer plant ant a food processing plant). They pre-treat their wastewater, prior to discharge to the collection system.

Raw Water Characteristics (after the primary treatment):

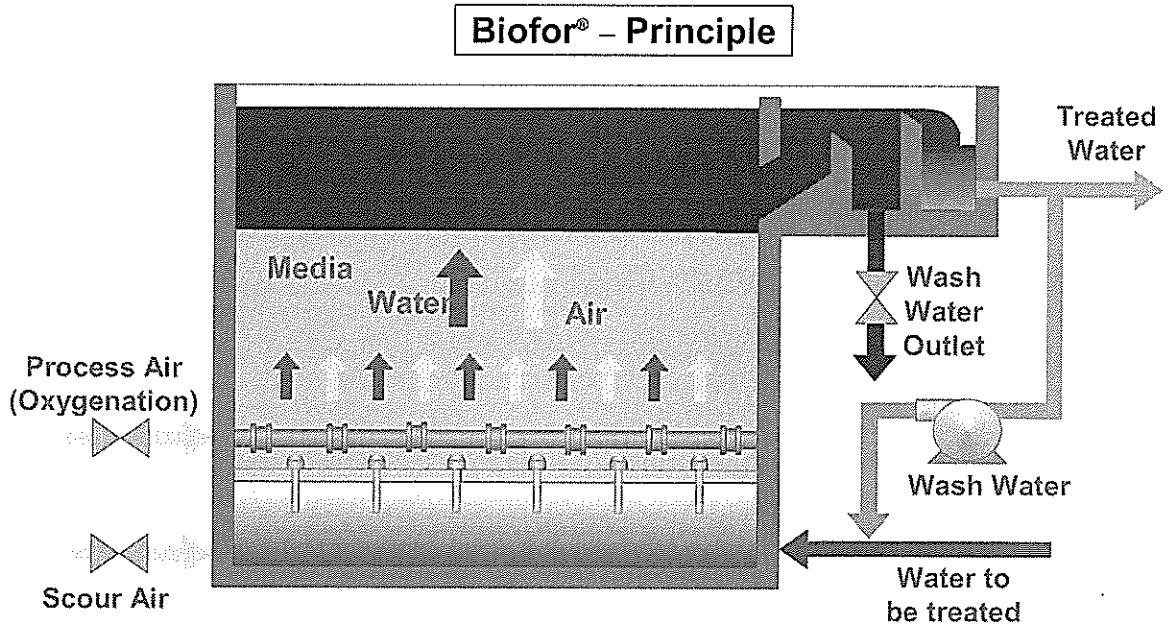
	Average	Units
Average Day Flow (ADF)	65,318	m^3/d
Peak Flow	160,000 or 135,000	m^3/d
TSS	25	mg/L
BOD_5	72	mg/L
TOC	86	mg/L
TKN	26	mg/L
TP	2.4	mg/L

We have considered our design (described in the paragraph 3.5) on the average day flow of 65,318 m^3/d.

The design of the equipment is the same with a peak flow of 160,000 m^3/d and 135,000 m^3/d.

2. PROCESS INTRODUCTION

The Biofor® filter is a Submerged Biological Aerated Filter (SBAF) designed to treat primary effluent for removal of carbonaceous and nitrification oxygen demand, and total suspended solids from the waste stream (Biofor® C and N). It can also be used as an efficient unit for the denitrification of secondary effluent. The unit operates with the injection of process air. Thanks to the module design concept, the quantity of filters can be reduced or increased to accommodate the treatment capacity today (flow and load) and in the future.



Aerated biological filtration combines in a single step both biological degradation of biodegradable soluble matter and solids retention by mechanical filtration of suspended solids. Clarifier downstream is not needed.

The biological filtration is achieved in up-flow filters loaded with a suitably sized granular support media, thus giving rise to an efficient filtration effect. The filter media provides adequate support for biomass attachment and a mechanical filtration capability.

Process air provides the necessary oxygen for aerobic biological activity and is introduced in the media through a network of diffusers (Oxazur®) located at the base of the reactor. Exceptionally high oxygen transfer is achieved in the media due to the up-flow pattern of air bubbles. The biological filtration process is of the submerged bed type.

Co-current up-flows of air and water allow for the finest particles to accumulate towards the upper reaches of the support media thus avoiding system clogging; suspended matter becomes

attached through the full height of the media which allows for long filter runs. The influent must be screened to avoid clogging of the filter nozzles.

During the treatment, the biomass accumulates in the support bed because of:

- the bacterial growth due to the elimination of dissolved pollution and
- the retention of suspended solids in the raw water, and of the biological flocs;

Periodic back-washings are then necessary. Their frequency varies from 24 hours to 48 hours depending on the loadings applied and the treatment objectives. The filter wash is of the co-current type and the techniques are similar to those applied to sand filters for potable water using simultaneous water and air. Treated water is used for running the wash sequences. The wash sequence is designed so that it causes no damage to the support medium yet retains the biomass required for rapid restart of the bio-filter after backwash. This ensures that the bio-filter can immediately return to service with the desired treatment efficiency.

The screened influent will be conveyed to the biological filter units via a flow distribution channel and individual adjustable weirs to ensure a near equal flow distribution over each filter. Each filter is equipped with an automatic valve on the influent side for isolation purposes.

Each aerated biological filter consists of a concrete rectangular basin (by others) with a support floor above the basin grade, called a "false floor". The false floor supports the filtering medium; it is made of perforated concrete slabs equipped with air/water distribution nozzles. These nozzles ensure uniform distribution of the screened water during the filtration cycle and of the backwash water and the scour air during the backwashing cycle.

Influent is introduced at the bottom of the filter; flows upward through the filter bed designed for biomass attachment and leaves the filter over an outlet weir in a filtered water channel. The water flows to the treated water well of a minimal volume for one filter backwash requirement by overflow, or directly to the disinfection step when the treated water well is full.

Back washing is carried out automatically on a regular basis either by time, by head loss in the individual filter cell, or by any other process parameter, using filtered water from a concrete reservoir (by others).

A so-called "energetic" automatic wash sequence must also be integrated in the filter wash programming and be initiated by push button, periodically (at least once per month). The wash system will be designed to wash one or two filters at a time. In normal operation, it is recommended to run washes during off-peak hours.

Each filter is equipped with an outlet for dirty backwash water, which conveys it to dirty backwash water well common to each filter battery. The dirty backwash water channel is automatically isolated by two valves during filtration cycles.

During treatment, the filter is fed screened water, and process air is introduced into the media bed at the bottom. This flow rate is delivered to each filter cell by positive displacement type blowers. No regulating device is required since each filter is individually fed by its own blower. In normal filtration mode, process air is introduced to each filter on a continuous basis.

3. BIOFOR® DESIGN BASIS

3.1 DESIGN CAPACITY

The design capacities used in the selection and sizing of equipment are summarized in the following table:

Design capacity	Units	Value
Average flow rate	m^3/day	65,318

3.2 RAW WATER QUALITY

The proposed process is designed to treat the clarified effluent water with the following characteristics:

Parameters	Units	Average
Total Suspended Solids	mg/L	25
BOD_5	mg/L	72
DOC	mg/L	TBA
TOC	mg/L	86
TKN	mg/L	26
$N\text{-}NH_3$	mg/L	TBA
$N\text{-}NH_4$	mg/L	TBA
$N\text{-}N0_3$	mg/L	TBA
Total Phosphorus	mg/L	3.6
Alkalinity	mg/l as CaCO3	TBA
pH	-	7.3
Temperature	°C	From 6 to 22

TBA = To be Analyzed

Note: additional inlet water characteristics will be required for detailed engineering.

We have supposed that the inlet alkalinity is almost around 250 mg/L as $CaCo_3$ so no additional chemical for alkalinity adjustment is required.

3.3 SECONDARY TREATMENT DESIGN INFLUENTS PARAMETERS

Parameters	Inlet Loads (Kg/d)	Concentration (mg/L)
BOD_5	3566	66
TSS	1217	22
TP	193	3.6
TKN	1367	25.2

Parameters	Ratio
DCO/DBO	1.9
N-NTK/N-NH_4	1.07
DBO5/N-NTK	2.6

3.4 TYPICAL EFFLUENT QUALITY (AFTER THE SECOND BIOFOR® STAGE)

The **typical** effluent quality to be expected under normal operation at the outlet of the Biofor® process, considering water temperature range of 6 °C to 22 °C (depending year seasons), is as followed based on monthly average values:

Parameters	Units	Objective	Compliance
TSS	mg/L	<15	25
BOD_5	mg/L	< 15	25
N-NH_4 (January-march)	mg/L	6	8
N-NH_4 (April June)	mg/L	4	6
N-NH_4 (July September)	mg/L	3	5
N-NH_4 (October-December)	mg/L	5	7
Total Phosphorus	mg/L	0.8	1

3.5 TYPICAL BACKWASH WATER

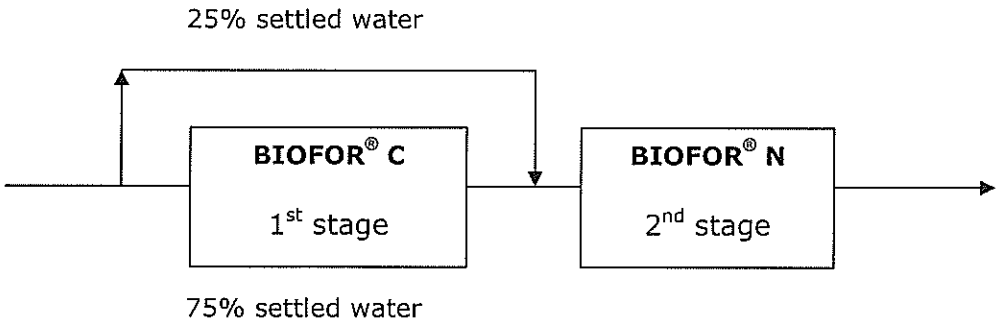
1. Maximum Biofor® C running cycle is 24h.
2. Maximum Biofor®N running cycle is 48h.
3. Backwash cycles are started once maximum pressure drop is reached.

Parameters	Units	Design Objective
Sludge production	Kg/d	2750
Backwash water volume/Biofor® C	m^3	930
Backwash water volume/Biofor® N	m^3	1050
TSS in the mixed backwash water	g/L	Around 0.4

3.6 BIOFOR® FILTER OVERVIEW

In order to attempt the objectives of C and N removal, a two stages design is proposed. The process can be improved by bypassing a part of the first stage (Biofor® C).

In this option described herein, the process is:



- **N + 1 filters (1 filter in backwash)**
  - Total quantity of Biofor® C filters : **6** of 72 m^3 each
  - Total quantity of Biofor® N filters : **9** of 81.75 m^3 each
  - Raw water supply : by gravity
  - Filtration direction : upward flow filtration
- **Option 1 : with intermediate tank and intermediate lifting pumps**
- **Option 2 : without intermediate tank and intermediate lifting pumps**

3.7 GENERAL CHARACTERISTIC OF ONE BIOFOR® FILTER

	BIOFOR® C	BIOFOR® N
Surface for each filter (m^2)	72	81.75
Dimensions (H)	6.75	6.75
Average filtration rate (all filters in operation) (m/h)	5.2	3.7
Average filtration rate (one filter in wash) (m/h)	6.2	4.2

UNDERDRAIN AND SUPPORT MATERIAL

Each filter will be supplied with Degremont Technologies cast-in-place filter floor. The following equipment is included:

- Specially designed polystyrene forms slabs as per Degremont Technologies standard, including PVC support columns;
- Levelling shims, adapters, plugs and anchor bolts;
- Air/water distribution nozzles long tail design, type C-04-10, made of polypropylene, with threaded bushings to be screwed on the floor slabs;
- All required SS 304L hardware, chemical anchoring systems, sealing products etc. are included for a complete floor system.

These nozzles will ensure uniform distribution of screened water during filtration cycles and of backwash water and scour air during backwash cycles. They are especially designed and adapted for biological wastewater treatment. Density: 50 nozzles per square meter.

Concrete by others.

PROCESS AIR DISTRIBUTION

Each filter will be supplied with the following internal equipment:

- One (1) air distribution network including stainless steel 304L distribution ramps – 25 mm dia. w/supports, hardware and accessories;
- OXAZUR® flexible membrane air diffusers with calibrated distribution orifice;
- Process air distribution header in filter constructed of stainless steel 304L type ID piping.

SUPPORT MEDIA

Type: Gravel

Total depth: 500 mm

Grading: 25 x 19 mm and 10 x 19 mm

BIOLOGICAL FILTRATION MEDIA

Types of media: Biolite

Net total depth: 3.7 m (after backwash)

Gravel and BIOLITE® will be provided in bulk.

PROCESS AIR BLOWERS

Quantity: One per filter

One (1) process air blower will be provided for each filter Biofor® C, with the following characteristics:

Manufacturer:	Aerzen or equivalent
Type:	Lobe type / positive displacement
Capacity:	2870 Nm^3/h
Absolute discharge pressure:	0.75 Bar
Motor:	125 HP
Acoustical enclosure:	Not included

One (1) process air blower will be provided for each filter Biofor® N, with the following characteristics:

Manufacturer:	Aerzen or equivalent
Type:	Lobe type / positive displacement
Capacity:	3253 Nm^3/h
Absolute discharge pressure:	0.75 Bar
Motor :	125 HP
Acoustical enclosure:	Not included

3.8 COMMON FILTER EQUIPMENT

3.8.1 Backwash Air Blowers

The system is designed to allow one filter backwash at a time. Three (3) backwash blowers (2 in duty, 1 in standby) will be provided, with the following characteristics:

Manufacturer:	Aerzen or equivalent
Type:	Lobe type / positive displacement
Capacity:	7356 Nm^3/h
Absolute discharge pressure:	0.9 bar
Motor :	400 HP
Acoustical enclosure:	Not included

3.8.2 Backwash Pumps

Three (3) backwash pumps (2 in duty (strong backwash), 1 in standby) will be provided, each with the following characteristics:

Manufacturer:	Goulds ITT, Aurora, or equivalent
Type:	Centrifugal end-suction
Capacity per pump:	1650 Nm^3/h
Total discharge head:	10.5 m WC
Motor:	75 HP, 700rpm,600V

3.8.3 Intermediate Lifting Pumps (for the option 1 only)

Three (3) lifting pumps (2 in duty, 1 in standby) are provided in the intermediate tank to transfer the water between the Biofor® C and the Biofor N® :

Manufacturer:	Goulds ITT, Aurora, or equivalent
Type:	Centrifugal end suction, horizontal
Capacity:	1360 m3/h
Total discharge head:	15 m WC
Motor:	100 HP

Note: this is based on average flow, for the peak flow, additional pumps must be considered.

3.8.4 Oxazur® Flushing Pumps to the primary clarifiers

Two (2) Oxazur® flushing pump is provided for the cleaning of the process air diffuser network in each filter. This procedure should be carried out once every one to two months on each filter.

Manufacturer:	Goulds ITT, Aurora, or equivalent
Type:	Centrifugal end suction
Capacity:	573 m3/h
Total discharge head:	30 m WC
Motor:	100 HP, 1750 rpm, 600V

3.8.5 Dirty Backwash Return Pump

By others

3.8.6 Auxiliary Equipment

FINE SCREEN

Two (1 in duty, 1 in standby) automatic curved screens are supplied for installation upstream of the Biofor® filters in concrete channels.

FILTERED WATER COLLECTION

Each filter is equipped with a full width front-mounted adjustable PVC weir, for collecting the treated water and the wash water. Each weir is protected by an inclined material trap comprised of a patented stilling picket fence eliminating turbulence, particularly in the air scour and water washing sequence of the washing cycle. The full width-stilling fence is made of vertical PVC shapes and SS 304L channel bars.

ACCESS MANHOLES

One access manhole, 600 mm (24 inch) dia., will be provided for access under each filter underdrain floor from the BAF gallery, complete with galvanized steel cover and arm.

3.8.7 Piping, Valves and Accessories

Each filter will be supplied with the necessary butterfly valves (electric and manual) for proper operation.

Valve location	Quantity	Type	Construction	Actuator
Raw water inlet	1 per filter	Butterfly	Cast Iron /Wafer Style	Auto/Pneumatic
Backwash water inlet	1 per filter	Butterfly	Cast Iron /Wafer Style	Auto/ Pneumatic
Backwash water outlet	1 per filter	Butterfly	Cast Iron /Wafer Style	Auto/ Pneumatic
Air Scour Inlet Valve	1 per filter	Butterfly	Cast Iron /Wafer Style	Auto/ Pneumatic
Manual Drain	1 per filter	Gate	Cast Iron /Wafer Style	Manual hand wheel
Air Blanket Purge	1 per filter	Butterfly	Cast Iron /Wafer Style	Auto/ Pneumatic
Process Air isolation valve	1 per filter	Butterfly	Cast Iron /Wafer Style	Manual
Flushing/Air isolation valve	1 per filter	Butterfly	Cast Iron /Wafer Style	Manual
Common Rapid drain down	1	Butterfly	Cast Iron /Wafer Style	Auto/ Pneumatic
Backwash air	1	Butterfly	Cast Iron /Wafer Style	Auto/Pneumatic

total release				
Backwash air partial release	1	Butterfly	Cast Iron /Wafer Style	Auto/Pneumatic
Backwash pump isolation	2	Butterfly	Cast Iron /Wafer Style	Manual
Backwash air blower isolation	2	Butterfly	Cast Iron /Wafer Style	Manual
Oxazur rinse pump isolation	2	Butterfly	Cast Iron /Wafer Style	Manual

All automatic valves are installed with pneumatic (excepted otherwise indicated) actuator complete with solenoid valve and limit switch. Valves manufacturers: Bray or equivalent.

3.9 INSTRUMENTATION AND CONTROL

The Biofor® control system is supplied with

- One main control panel, EEMAC 12, to be located in the building above the filter gallery. This panel includes the programmable logic controller (PLC) "ALLEN BRADLEY" model "Controllogix" CPUL55 with 3.5 MB of memory and the operator interface (HMI) "Panelview plus 10" colour touch screen.
- Filter console(s) EEMAC 12, each common to two filters, including the PLC remote I/O's for these two filters. And the selector switches for manual operation in case of PLC failure.

The filter consoles are in communication with the main PLC by "Controlnet" network. The main PLC also includes an Ethernet module for communication with the main SCADA of the plant supplied by others.

In general, the equipment status is represented at the interface (OIT). The screen pages reproduce the P&ID's and show the process and operating stages of the filters and auxiliary equipment.

The operator interface is designed in a user-friendly way with simple and effective user menus. All the interactions with various processes (pumping, fine screens, filtration, etc.) are visual and explicit. These allow the operation of the visualisation of the status and alarms in a straightforward fashion.

The following instrumentation is included:

Instrument Location	Quantity	Instrument type	Manufacturer	Model	Output
Filter headloss	1 per filter	Pressure indicator transmitter	Endress & Hauser	PMC41	4-20 mA
Filter level	1 per filter	Gulded radar	Endress&Hauser	FMP41C	4-20 mA
Inlet channel ahead of screens	1	High level switch	Flygt	ENM10	Contact
Backwash and process air blowers	1 per blower	Pressure indicator	WIKA	233.5	n/a
Backwash and air blowers	1 per blower	Temperature indicator	WIKA	TI 30	n/a
Backwash air blowers	1	Flow indicator	FCI	GF-90	4-20 mA
Backwash supply tank	1	High/Low level switch	Flygt	ENM-10	Contact
Backwash supply tank	1	Ultrasonic level transmitter	Endress & Hauser	FMU90	4-20 mA
Waste Backwash tank	1	High/Low level switch	Flygt	ENM-10	Contact
Waste Backwash tank	1	Ultrasonic level transmitter	Endress & Hauser	FMU90	4-20 mA
Backwash line / drain down	1	Magnetic flow meter	Endress & Hauser	Promag 50W	4-20 mA
Backwash and Oxazur rinse pump	1 per pump	Pressure indicator	WIKA	233.5	n/a

3.10 ESTIMATED POWER CONSUMPTION

The estimated power consumption for the system at the nominal flow is:

- **Option 1 : with intermediate tank and intermediate lifting pumps**

Equipment	Quantity		Installed Power (HP)	Effective Power Consumption (kW)	Running Time (h/h)	Estimated Power Consumption (KW.h)
	Installed	Operation				
Biofor® C process air blowers	6	6	125	84.6	1.0	508
Biofor® N process air blowers	9	9	150	92.9	1.0	836
Backwash air blowers	3	2	400	253	0.13	63
Lifting pumps	3	2	100	67	1.0	134
Backwash water pumps	2	1	75	50	0.15	7.8
Oxazur® Cleaning pumps	2	1	100	67	0.0004	0.0235
Fine Screens	2	1	1.0	0.5	1.0	0.5
					TOTAL	1549.3

- **Option 2 : without intermediate tank and intermediate lifting pumps**

Equipment	Quantity		Installed Power (HP)	Effective Power Consumption (kW)	Running Time (h/h)	Estimated Power Consumption (KW.h)
	Installed	Operation				
Biofor® C process air blowers	6	6	125	84.6	1.0	508
Biofor® N process air blowers	9	9	150	92.9	1.0	836
Backwash air blowers	3	2	400	253	0.13	63
Backwash water pumps	2	1	75	50	0.15	7.8
Oxazur® Cleaning pumps	2	1	100	67	0.0004	0.0235
Fine Screens	2	1	1.0	0.5	1.0	0.5
					TOTAL	1415.2

4. WORK AND SERVICES INCLUDED

Degremont Ltd will supply the following work and services:

- Design and engineering;
- Drawings (general arrangement, foundation, equipment assembly and erection);
- Installation, operating and maintenance manuals (3 copies);
- Site installation supervision;
    - 20 days (includes 16 days on site and 4 days for travelling) with 1 person(s) over 4 trip(s);
- Start-up and training;
    - 30 days (includes 25 days on site and 5 days for travelling) with 1 person(s) over 5 trip(s).

5. BUDGET PROPOSAL

5.1 PROPOSAL

Our budget proposal for the supply of equipment and service as described in this proposal is in the order of magnitude of:

- **Option 1 (with intermediate tank and intermediate lifting pumps)**

Budget Proposal	**8,700,000.00 $CAD**
Taxes	**Extra**
Validity	**30 days**

- **Option 2 (without intermediate tank and intermediate lifting pumps)**

Budget Proposal	**8,500,000.00 $CAD**
Taxes	**Extra**
Validity	**30 days**

5.2 PRELIMINARY DELIVERY SCHEDULE

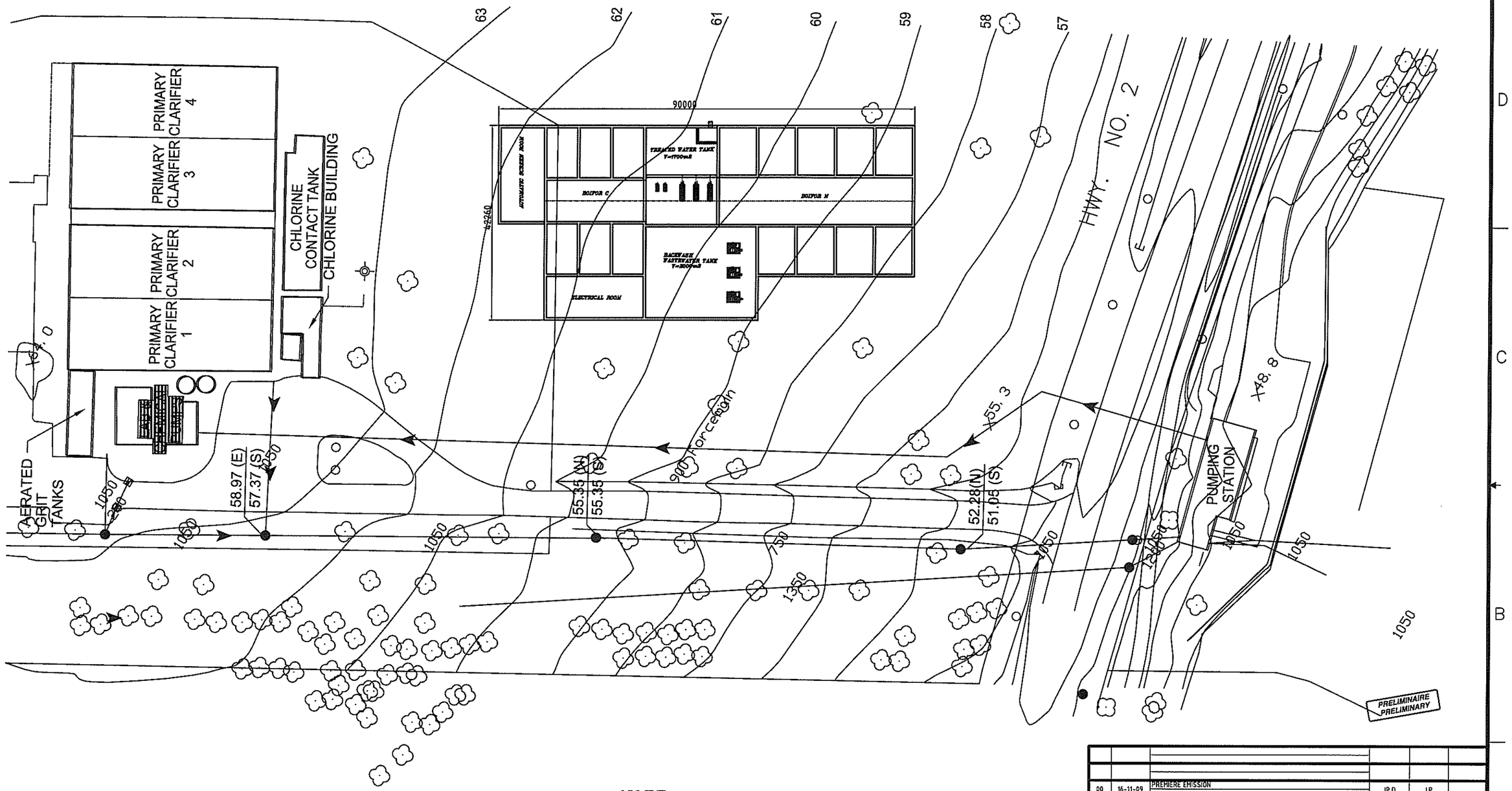
The following is our preliminary delivery schedule for the supply of equipment and materials described in this document:

General arrangement drawings, P&ID, assembly and erection drawings, bill of materials	12 to 18 weeks following acceptance of P.O. by Degrémont
Approval period for drawings	2 weeks (10 business days)
Equipment and material delivery	24 to 30 weeks following approval of drawings

6. LIMIT OF SUPPLY

In our technical offer and price list, we assume that the following will be supplied by others.

- All civil work
- All piping, hardware, wiring and tubing to and from the equipment and accessories shipped loose (except the one mentioned above)
- Any building or drainage work including cutting away and making good.
- Design of reinforced concrete for floors, basins, drains, sumps, supports, concrete pads, etc.
- Installation of concrete sub-fill and exchange material in units where required.
- Design and sizing of drain lines and sewers for waste flows.
- Design and supply of pipe hangers for supports external to skids.
- Design, supply and installation of anchor bolts.
- Supply of interconnecting pipe work and system isolating valves.
- Pump or turbine bearing cooling, seal or drain piping and pump shaft alignment.
- Design and supply of compressors, etc. for instrument or operating air or auxiliary water supplies.
- Design and supply of bulk chemical storage and dosing facilities.
- Supply of chemicals required for start-up, operation or testing.
- Supply of test kits, reagents, glassware, cabinets, etc.
- Weather protection for motors, instruments, etc., when equipment is installed outdoors.
- Operating facilities such as chemicals, instrument air, electrical power and raw water in sufficient quantities and pressure for operation of the system.
- Sludge treatment.
- Site installation.
- Storage at job site.
- Start-up and commissioning services (can be provided on a per diem basis).
- Any other item not described in the above scope of supply.
- All the motor starters (MCC) and VFD (variable frequency drive).
- Grounding, wiring between skids, panels, junction boxes, VFDs and motors
- Heating, lighting, and ventilation of the building.
- 460V / 600V power supply to motors and VFD's and 120VAC supply to control panels



NOTE:

1. THIS IS THE OPTION WITHOUT LIFTING PUMP STATION IN PROCESS.

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CLIENT/ CUSTOMER: CITY OF CORNWALL, ONTARIO
XCG CONSULTANTS LTD.

PROJET/ PROJECT: WWTP CORNWALL

TITRE/TITLE: GENERAL LAYOUT
BIOFOR C AND BIOFOR N

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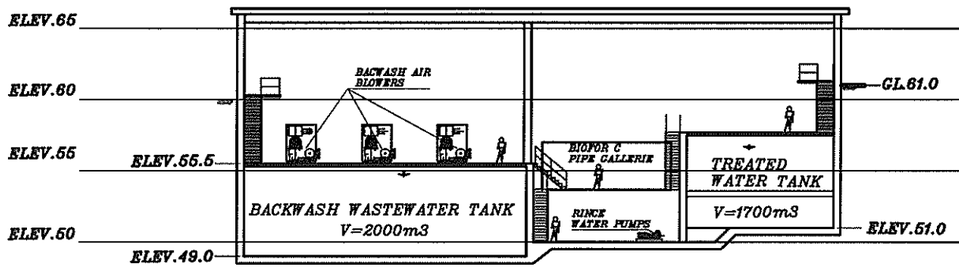

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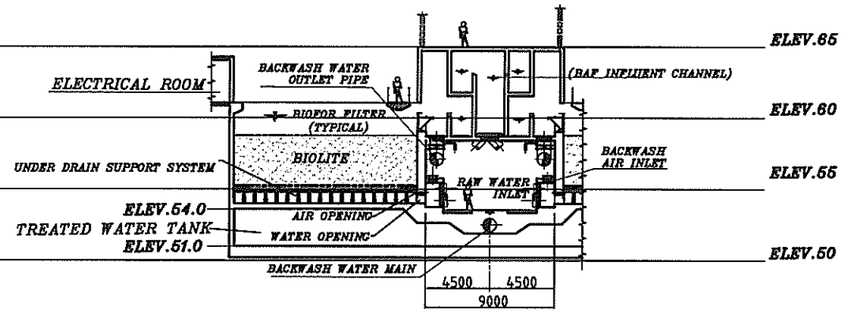

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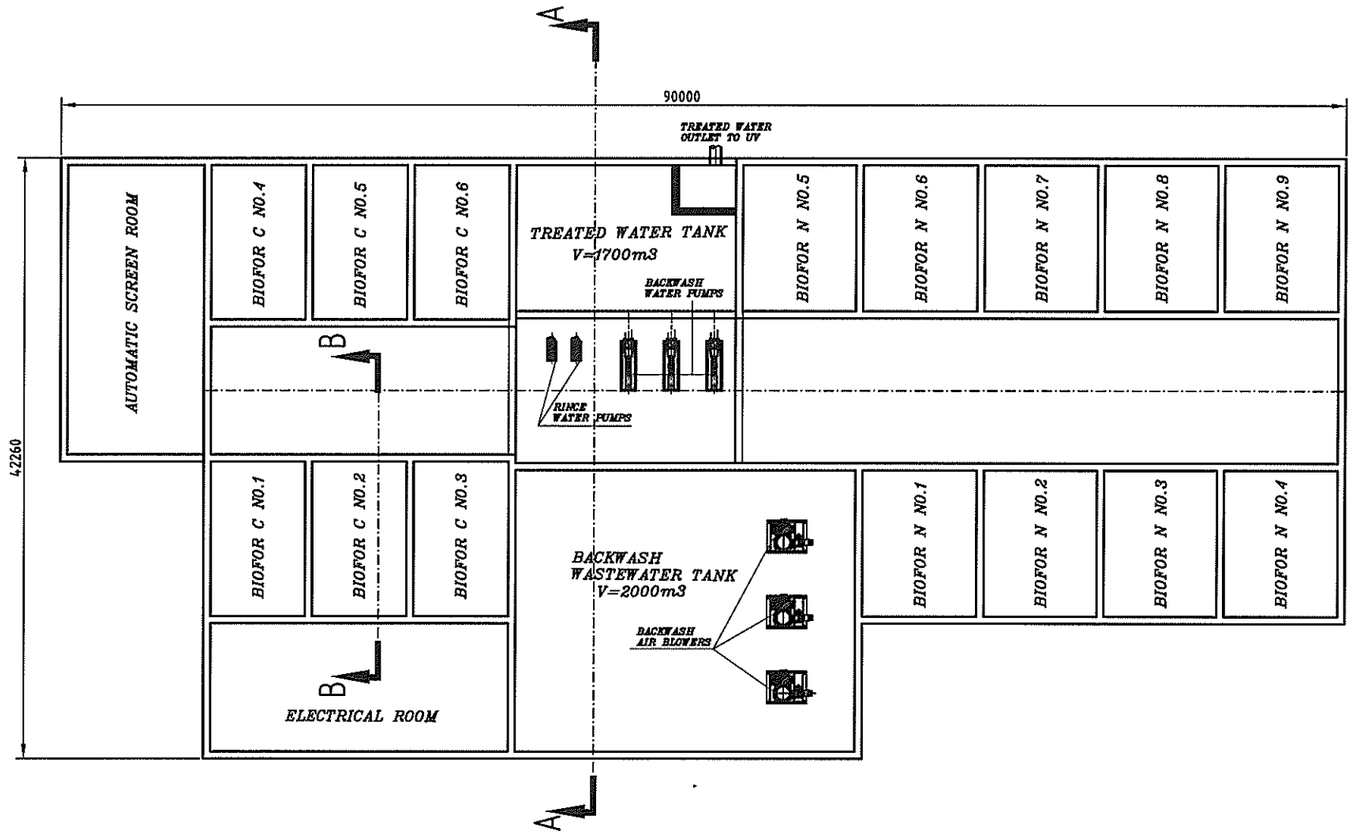

PLAN VIEW

NOTE:

1. THIS IS THE OPTION WITHOUT LIFTING PUMP STATION IN PROCESS.

PRELIMINAIRE
PRELIMINARY

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00	16-11-09	PREMIERE EMISSION	JP.D	M.P.	

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CLIENT/ CUSTOMER: CITY OF CORNWALL, ONTARIO
XCG CONSULTANTS LTD.

PROJET/ PROJECT: WWTP CORNWALL

TITRE/TITLE: PLAN VIEW AND SECTIONS
BIOFOR C AND BIOFOR N

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