MARY RIVER PROJECT
EXPLORATION CAMP
NUNAVUT, CANADA

SEWAGE WORKS DESIGN REPORT

Baffinland Iron Mines Inc.

Prepared For:

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TABLE OF CONTENTS

1.0 BACKGROUND

B.H. Martin Consultants was retained by Baffinland Iron Mines Inc. to design the sewage works for their Exploration camp at Mary River Mine site in Nunavut.

The proposed site is located approximately 160km south of Pond Inlet, in the north-eastern section of Baffin Island. Approximate distances from the project site to other communities in the region are 270 km to Arctic Bay, and 415 km to Clyde River.

Presently the site consists of an 80-person camp of predominantly Weatherhaven^{TM} tents, two steel Quonset huts as maintenance facilities, and numerous small wooden outbuildings, situated approximately 200 meters from the shore of Camp Lake.

The Owner intends to perform their exploration work during the months of June to September, 2007 and continue with a Bulk Sampling Program following September. A Rotating Biological Contactor (RBC System) Sewage Treatment is planned to be constructed for the camp for sewage treatment for the duration of the bulk sampling program. In the meantime, temporary measures are needed for sewage treatment while waiting for the RBC system to be constructed and while exploration is being performed on site.

2.0 SUMMARY

During the exploration period, to the end of September, the maximum number of personnel at the site is expected to be 100 persons. Maximum sewage generation is assumed to be 227 liters per capita per day (227 lpcd) with an average loading of 460 BOD_5 and 490 TSS. The Owner has previously purchased a wastewater treatment system (Norweco – Singulair Model 960 Treatment System from Tanks-A-Lot) capable of handling sewage of 460 BOD_5/490 TSS for 25 people generating 227 liters of sewage per day. No non-domestic waste or stormwater will be directed to the treatment system. The capacity of the system to handle influent characteristics of 460 BOD_5/490 TSS (typical of camp influent quality) will be upgraded to 50 people by the additional of further aeration capacity incorporated into the system.

The wastewater treatment package, Tanks-A-Lot system, is capable of reducing BOD_5 and TSS levels to at least 30/30 respectively. UV disinfection is provided after clarification, prior to discharge of effluent from the treatment system. The system effluent will then be pumped through a 2-inch Forcemain to a Polishing/Waste Stabilization Pond (PWSP). The excess flows above the flow capacity of the system will be handled by overflow pumps and directed to the PWSP which will have the capacity to hold the entire volume of sewage produced during the design timeframe.

It is felt that the flow rates, sewage strength and population, used for design are at the upper limits of what will actually be experienced. However, given the remoteness of the camp, it would be difficult to increase the capacity of the equipment should actual figures be found to be much higher than those used for design. The addition of the PWSP, which will be used for further treatment of the wastewater effluent, will act as a contingency if actual flows and strengths are found to be higher than assumed.

Effluent in the PWSP will be tested during the following summer and, depending on the test results; the effluent will be either discharged to Sheardown Lake in late summer of 2008 or retained for discharge at a later date depending on the quality of the effluent.

The total maximum daily sewage flow generated at the site is estimated at 22,700 L/day based on 227 litres per capita per day for 100 people. The PWSP will have the capacity of this 120 days of maximum Daily Flow plus 3 weeks of similar Daily Flow from the new RBC system that is planned for the Bulk Sampling program (It usually takes 3 weeks for any RBC system to reach its optimal working condition) plus an additional 2 weeks storage to allow for unforeseen start-up delays, etc. This results in a total of 155 days storage. The total sewage flow for this period and thus the size of the PWSP is 3,521 cubic meters. Pond dimensions and details are shown on drawings C108 to C110 in Appendix "B". The pond will be constructed by performing cut and fill operations with the existing dozer on site.

The PWSP will allow the owner to store the effluent for sufficient time to decrease the BOD_5 and TSS levels of the retained water to acceptable levels prior to discharge into the environment. According to the "Guidelines for the Discharge of Treated Municipal Wastewater the Northwest Territories, 1992", the BOD_5/TSS/E.Coli levels required for discharge are 30/35/1000 for a residency time of more than 5 years and 40/60/10000 for a residency time of less than 5 years. The actual limits used will depend on the results of the current watershed analysis being performed on Sheardown Lake by Baffinland Mines, but in any case, shall not exceed these levels.

It is currently planned to retain the sewage in the PWSP for at least 12 months. Upon confirmation of acceptable BOD_5, TSS and E.Coli levels, the PWSP shall be discharged in the spring/summer of 2008 via a 75mm forcemain into Sheardown Lake.

This report considers the proposed design to collect and treat the sewage at the Mary River Camp during the summer of 2007 (from June to October 2007) for the exploration program only.

3.0 DESIGN CRITERIA

The daily sewage flows and strengths were estimated based on the values found in Table 10.3, 10.4 and 13.1 of the 1996 "Cold Regions Utilities Monograph, Third Edition", a publication highly respected and used in Canada and USA for the design of infrastructure in the arctic regions. Copies of these Tables are included in Appendix "A".

The characteristics of sewage in remote/cold regions, depend on the type of work being performed, work schedules, facilities provided and the type and capacity of the water supply. These factors directly affect the flow rates and the amount of dilution seen in the wastewater.

The construction/mining camp at Mary River is expected to be a 'moderately diluted wastewater' as defined in Table 10.4 in Appendix "A". The average BOD_5/TSS levels for this type of wastewater can be expected to be 460mg/l BOD_5 and 490mg/l TSS. We will use these figure as our influent design criteria.

According to the "Guidelines for the Discharge of Treated Municipal Wastewater the Northwest Territories, 1992", the BOD_5/TSS/E.Coli levels required for discharge are 30/35/1000 for a residency time of more than 5 years and 40/60/10000 for a residency time

of less than 5 years. No limit is given for Phosphorus removal. The actual limits used will depend on the results of the current watershed analysis being performed but shall not exceed these levels.

Average flow rates for similar camps have been recorded in the range of 132 to 220 lpcd. We have assumed an average flow rate of 227 lpcd for design.

This treatment system is a "temporary" system that the owner will use while performing exploration work. Prior to the next phase of work (Bulk Sampling Program), a RBC System will be constructed and put into use at the end of September. The design timeframe is therefore from the beginning of June to the end of September plus the time required to start-up the RBC System that will replace the treatment system discussed in this report. This gives 120 days to the end of September plus 21 days for RBC start-up (total of 141 days). To this we will add an additional 10% (14 days) to allow for unforeseeable events for a total of 155 days of sewage generation that will require treatment from this system.

During the design period, to the end of September, the maximum number of personnel at the site is expected to be 100 persons.

A summary of the typical and design sewage flows and strengths are set out in Table 1 below as derived from the 1996 "Cold Regions Utilities Monograph, Third Edition".

Table 1: Typical design and sewage flows in cold regions

Facility Type	Water/Sewage Quantity (lpcd)	BOD_5/TSS (Avg. – mg/l)	No. of Persons (Capita)	Total Daily Flow (l/d)	Total Flow 155 days (m^3)
Drilling Camp	83 to 227	460/490	-	-	
Average Work Camp	170	460/490			
Average Construction Camp	220		-	-	
Design Criteria for Mary River Camp	**227**	**460/490**	**100**	**22,700**	**3,521**

Sewage generation is expected to be 227 liters per capita per day (227 lpcd) with a loading of 460 BOD_5 and 490 TSS. If the entire two week contingency storage is used, the total sewage generated (volume sent to pond) will be 3,521 cubic meters.

4.0 PRIMARY SEWAGE TREATMENT

The primary sewage treatment shall be done by an existing Tanks-A-Lot system that the owner will transport from another site. Details of the Tanks-A-Lot system, Wet Well/Pumping Stations, forcemain and PWSP are attached in Appendix "B". This system includes 2 Norweco Singulair Model 960 treatment units with 1,500 U.S. Gallons per day capacity each (5700lpd X 2 = 11400 liters per day). In order to increase the flow handling

of the system, the existing grit tank will be fitted with a blower package to convert it to an aerated flow equalization tank, doubling the aerated retention time of the system.

This wastewater treatment system utilizes patented, extended aeration, activated sludge and filtration process to achieve treatment. In the activated sludge process, micro-organisms remove soluble contaminants from the wastewater, utilizing them as a source of energy for growth and production of new micro-organisms. The organisms tend to be flocculant and form clumps, or floc, that physically entraps particulate organic matter. The organic matter is attacked by extracellular enzymes that solubilise the solids to make them available to the micro-organisms as a food source. The conversion of the organic matter from soluble to biological solids allows for removal of the organic matter by settling of the solids in the treatment process.

The long aeration period allows for the organisms in the system to consume themselves, reducing the total amount of solids produced by the treatment process. The aeration chamber provides a retention time of at least 24 hours.

The system achieves treatment by a flow-equalized, flow-through process, starting with a pre-treatment chamber, followed by an aeration chamber provided with an infused air system operating on a timed run cycle. Settling is accomplished in a clarification chamber following the aeration chamber. A Bio-kinetic® system located in the clarification chamber provides flow equalization, final filtration/settling and UV Disinfection prior to effluent discharge.

The modified Tanks-A-Lot system is capable of handling daily sewage flows for 50 people based on the influent criteria of 460 BOD_5 and 490 TSS. The effluent characteristics of the system are expected to be 30 BOD_5/30 TSS. A Wet Well (#1) will be added to the front of the treatment process to collect the sewage from the camp and redirect it to the Tanks-A-Lot System. This wet well will be sized (operating volume) to hold approximately 1/4 of the Average Daily Flow (ADF) as well as providing a connection point for bypass pumps. Wet Well #2 will collect the effluent from the Treatment System for pumping to the PWSP.

During normal operation, Wet Well #1 will provide some flow equalization for the Treatment System, the system will treat the sewage, and effluent will be collected by Wet Well #2 and be pumped to the PWSP. If sustained flows beyond the flow capability of the Tanks-A-Lot system increase the level of the Wet Well to the ‘bypass’ level, a float will turn on the bypass pump, diverting sewage to Wet Well #2 where it will mix with the treatment process effluent and be pumped utilizing grinder pumps via the forcemain to the PWSP. Given the flow equalization realized by the operation of Wet Well #1 at the front end of the process train, we expect these bypass situations to be reduced. Given the difference in capacity of the Treatment system to the influent expected, bypassing of maximum influent to the PWSP will occur. The PWSP will need to be sized to hold the entire amount of sewage generated in order to provide further reduction of BOD5/TSS levels in the PWSP. This system is presented in the Process Schematic in Appendix ‘B’. Pump flow rates are shown on the Process schematic.

5.0 POLISHING /WASTE STABILIZATION POND (PWSP) DESIGN

The PWSP cell is designed so that it can maintain the sewage flows of 120 days (June to September, 2007) plus an additional 3 weeks (for RBC start-up) of sewage flows plus an additional 2 weeks flow as a contingency. Generally it requires a 3-week period for any RBC units to accumulate enough floc to operate at its optimum conditions. During that 3 week start up period, the effluent from the RBC System will be diverted to the PWSP.

This 155 day period could produce 3,521 cubic meters of sewage. The pond is sized to be large enough to hold the entire amount of sewage.

PWSP dimensions:

If a width $b1$ = 30.0 m is selected, then the length l_1 = 63.4 m

This is obtained by the following formula for the volume of a bermed lagoon.

All the berms will have a top width of 3.0 m. The exterior berm slopes will be 4:1 and the interior berm slopes will be 3:1.

$$V = \int_0^{1.5} (b_1+6y)(l_1+6y)dy$$

$$V = \int_0^{1.5} (b_1 l_1 + 6 b_1 y + 6 l_1 y + 36y^2)\, dy$$

$$V = \left| (b_1 l_1 y + \frac{6}{2} b_1 y + \frac{6}{2} l_1 y + \frac{36y^3}{3}) \right|_0^{1.5}$$

$$V = b_1 l_1 (1.5) + 3 b_1 (1.5)^2 + 3 l_1 (1.5)^2 + 12(1.5)^3$$

$$V = 1.5 b_1 l_1 + 6.75 b_1 + 6.75 l_1 + 40.5)$$

$$l_1 = \frac{(V-6.75 b_1-40.5)}{(1.5 b_1+6.75)}$$

The PWSP cell will have a total lined height of 2.4 m. This includes the bottom 0.3 m that will always be retained after discharge, the 1.5 m operating depth and the 0.6 m freeboard allowance.

Review of soil samples taken near the proposed PWSP site as well as elsewhere in the general area indicate that the available material is very low in silt content and therefore is not suitable for lining the pond. As such, a 2.0mm (80 mil) HDPE liner will be used to prevent the sewage from percolating into the ground. The native soil will be used as the subgrade under the liner. It will be important to ensure that no native or foreign objects that could perforate the liner are present. If, during construction, it is found that there is a danger that native materials could damage the membrane, the material under the liner shall be made up of screened sand of approximately 0.15m in thickness. However, our review of material on site indicates that this may not be necessary.

The pond will be located at the east end of the site. The desirable separation distance from the pond to the camp is 450 meters. The site chosen for the pond is approximately 480 meters from the existing camp and approximately 1400 meters from the discharge location at Sheardown Lake.

The pond site will be fenced and access will be controlled by a locked gate. Warning signs will be provided along the fence to indicate the nature of the facility, to prohibit trespassing and to provide emergency contact information.

The PWSP will be filled by the forcemain from Wet Well #2 at the Treatment unit. The inlet piping will be installed over the berm and terminate 0.3 m above the cell bottom with a supported, upturned elbow.

The effluent drainage system will be comprised of a 3-inch diameter valved pipe (0.3 meters above the pond bottom) extending from 3 meters inside the pond to the outer toe of the berm. The outer termination will be complete with a cam-lock connection for hose attachments. A “T”-connection will be constructed with the 3-inch forcemain leading to Sheardown Lake (part of the RBC System construction). A cam-lock connection will be constructed at this connection for future hose attachment. When/if the PWSP is to be discharged to Sheardown Lake, a portable pump and hose will be connected at the berm connection with a hose to the T-connection. Details of the effluent discharge and the PWSP are attached in Appendix “B”.

6.0 PHOSPHOROUS REMOVAL

Prior to the PWSP being discharged to Sheardown Lake, phosphorus removal will be performed by batch dosage of alum prior to discharge to the lake. Assuming that raw sewage contains 7 mg/L of phosphorus and that 15 mg of alum is required to treat 1 mg of phosphorus, 105 mg of alum will be required to treat every litre of sewage. Therefore it is estimated that 370 kg of alum will be required to treat the pond containing 3,521 m^3 of sewage.

7.0 SLUDGE REMOVAL

The Tanks-A-Lot system requires approximately 3 weeks for the cultivation of floc for the system to operate properly. Some solids are expected to be bypassed to the PWSP in this period. The effluent, even during the first three weeks, does not have much solids and as such we do not expect sludge to be a problem in the PWSP. We have allowed for 300mm in the bottom of the PWSP. As a result, we expect that this volume shall allow for all of the possible sludge even with further use in the future years.

8.0 SAMPLING AND MONITORING

To ensure that the required guideline for effluent discharge is met and to forecast how much, if any, further treatment will be required, effluent samples will be taken from the pond (on both ends) on a monthly basis (when unfrozen). These samples will confirm and provide a record of sewage treatment performance by determining BOD_5, TSS, E.Coli and Phosphorus levels. From this information, the owner will be able to plan the pond effluent discharge and foresee if any further treatment may be required prior to discharge. These records would be kept by the operating authority for periodic examination by the Nunavut Water Board.

The contents of the PWSP will be tested in the following year. If testing shows further treatment is required, the timing for release of effluent from the PWSP will be extended. This process can be repeated until the contents of the pond are found to be within acceptable parameters for discharge into Sheardown Lake.

9.0 SHEARDOWN LAKE CAPACITY

The assimilative capacity of the receiving water body, Sheardown Lake, shall be determined. The allowable BOD_5 loading rates during discharge into the Sheardown Lake shall be calculated and the minimum discharge period needed to meet the limiting conditions would be determined. This shall be done as part of the RBC installation for the Bulk Sampling work.

9.1 POLISHING POND DISCHARGE

The discharge rate from the pond is governed by the size of the discharge pipe and the head in the pond. Because the flow into Sheardown Lake would have to be controlled, it was decided to ensure that discharge flow is controlled. The maximum rate of discharge into the lake is currently expected to be 1.2 lps or 0.0012 cubic meters per second (20 GPM). Based on an average flow of 1.2 lps, it would take 34 days to empty the pond. The actual pumping rate will be determined prior to discharge occurring as part of the RBC installation work.

Filling Period:	June 1st to September 30th, 2007
Estimated Retention Period:	June 1st to August/September, 2008 or longer
Estimated Discharge Period:	August 1st to September 4th , 2008
Empty Period:	Available for future storage

9.2 EFFLUENT EFFECT ON SHEARDOWN LAKE

Baffinland Mines Inc. have contracted Knight Piésold Ltd. to perform watershed analysis (background BOD, inflow and outflow to/from lake, bathymetric survey along shore at discharge location, etc) for Sheardown Lake. Their report is expected to be completed in the next few months. Prior to discharge, we will measure BOD5/TSS and Phosphorus levels in the PWSP. The results of the watershed analysis will then be used to calculate the

resulting effect of the effluent during discharge as well as to determine the optimum timing of the discharge so that no adverse affect to the Lake and its environment will take place.

The data collected at that time will also allow us to determine whether or not further treatment is required. Should the effect of the effluent discharge on Sheardown Lake and its environment be determined to be unacceptable at that time, the timing for release of effluent from the PWSP will be extended.

Prior to discharge, low flow conditions to the lake will be determined using the discharge statistics and the watershed analysis. At the point of discharge the resultant BOD_5 level in the lake after the discharge will be calculated using the following formula:

$$L_O = \frac{Q_W L_W + Q_R L_R}{Q_W + Q_R}$$

- effluent flow from the PWSP (**Q_W**)
- the effluent BOD_5 (**L_W**)
- the receiving body flow rate (**Q_R**)
- the receiving body BOD level (**L_R**)

The pond will be emptied during the higher flow periods in the month of August.

Severe dissolved oxygen depletion is unlikely to occur with a BOD_5 of less than 2 mg/L therefore a BOD_5 level of less than 2 mg/L in the lake after mixing will be targeted assuming that a background BO D_5 of 1 mg/L exists at Sheardown Lake.

10.0 CONCLUSION

The overall site has been designed to limit the impact of this development on the immediate environment. The proposed PWSP shall provide additional mitigation measures in case of treatment system overload and/or failure. The PWSP will later serve as a retaining pond for the annual cleanup of the RBC treatment system that will be constructed in the fall of 2007.

Proper system maintenance will be an important and on-going factor to ensure that the system will operate in a non-polluting manner. An Operation and Maintenance Manual for the Tanks-A-Lot system is included in Appendix “C”.

It is felt that the flow rates, sewage strength and population used for design are at the upper limits of what will actually be experienced. Given the remoteness of the camp, it would be difficult to increase the capacity of the equipment should actual figures be found to be much higher than those used for design. The additional storage available in the PWSP will act as contingency storage if actual flows and strengths are found to be higher than assumed. Being sized for total containment of the flows over the operation period, the PWSP can easily be used for further treatment of the wastewater effluent.

❖ APPENDIX “A”

TABLE 10-3 TYPICAL QUANTITITES OF SEWAGE FLOW

Source		Quantity L/(p•d)
1. Communities and Permanent Military Bases		
a. 1,000 population with conventional piped water and sewage		
Thule Air Force Base, Greenland		303
College, AK		265
Fairbanks, AK		303
Ski resorts in Colorado and Montana		345
	Average	300
b. 1,000 population with conventional piped water and sewage		
Bethel, AK		265
DEW Line, Greenland		208
	Average	240
c. with truck-haul systems, conventional internal plumbing	Average	140
d. with truck-haul systems, low-flush toilets	Average	90
e. no household plumbing, water tanks and honey-bucket toilet	Average	1.5
f. same as (e) above but with central bathhouse and laundry	Average	15
2. Construction Camps		
North Slope, Ak (1971)		189
"Typical" Canadian		227
Alaska Pipeline (1976)		258
	Average	220
3. Remote Military with Limited Availability of Water		
McMurdo, Antarctica		151
Barrow, AK (DES Sta)		114
"Typical" Army Field Camp		129
	Average	130

wastes and extra amounts of garbage and grease from institutional kitchens.

10.3.1 Quantity. The resulting quantities of sewage flow depend on the type of installation and its permanence. Table 10-3 summarizes typical sewage flows for various cold-regions situations.

Separate facilities such as schools, laundries, restaurants, and hotels with conventional plumbing tend to have loadings similar to those in conventional temperate zone practice.

Projected data for the community should be used to establish a design value for per-person flow. The average values given in Table 10-3 may be used to

TABLE 10-4 CHARACTERISTICS OF BASIC WASTEWATER CATEGORIES

Parameter	Units	Undiluted (Heinke, 1973)	Moderately Diluted (Eggener & Tomlinson, 1978)	Conventional Diluted (Metcalf & Eddy Inc., 1979)	Greatly Diluted (Bethell, 1981)	Greywater (Hrudey & Raniga, 1981)
BOD_5	mg/L	–	460 280 to 700	220 110 to 400	55 40 to 60	–
COD	mg/L	110,400 80,800 to 134,800	1,000 700 to 1,300	500 250 to 1,000	–	(TOC) 210 40 to 900
Suspended solids (NFR)	mg/L	78,200 66,000 to 85,000	490 370 to 820	220 100 to 350	50 20 to 150	290 40 to 2,000
Total nitrogen	mg/L as N	8,100 7,300 to 9,500	–	40 20 to 90	(NH_3) 10 6 to 30	(NH_3/N) 1.4 8
Phosphorus	mg/L as P	1,200 1,100 to 1,400	–	8 4 to 15	3 2 to 6	9 4 to 20
Calculated flow*	L/(p•d)	1.2 1.1 to 1.4	170 110 to 290	360 200 to 730	1,500 1,300 to 2,000	310 50 to 2,300

All values rounded off from published data.

* Calculated based on 80 g BOD_5 per person per day and 90 g suspended solids (SS) per person per day (where applicable), modified activated sludge, and septic tanks. In some instances, lagoon treatment is followed by land disposal.

TABLE 13-1 WATER DEMAND VALUES FOR VARIOUS CAMPS

Camp Type	Population	Water Demand	
		Range*	Average*
Drilling camp		83 to 227	132
Base camp (Trink, 1981)		121 to 348	200
Exploration base (Murphy et al., 1977)	40 to 100 w/o bleeding		250
	40 to 100 with bleeding		445
Alaska pipeline construction (Eggener and Tomlinson, 1978)	200 to 1,300		265
Alaska pipeline construction (Murphy et al., 1977)	200 to 400		257
Alaska drilling camp (Alaskan Dept. of Health & Welfare, 1969)			212
Correctional camp (Grainge et al., 1973)	44		
Hydro generation construction camp (Belanger and Bodineau, 1977)	4,000 summer 2,000 winter		340**
Artificial island (Heuchert, 1974)			108**
U.S. military camps (Lufkin and Tobiasson, 1969)			
Main base	3,000 to 6,000	442 to 514	514
Ice research camp	25		79
Other camp with snow melt for water supply	96 to 227		121
Other camp with steam to melt snow for water supply	85 to 200		189
Alaska drilling rig camps (North Slope) (Tilsworth and Damron, 1973)			313
Value most frequently quoted	44	227 to 681	149**

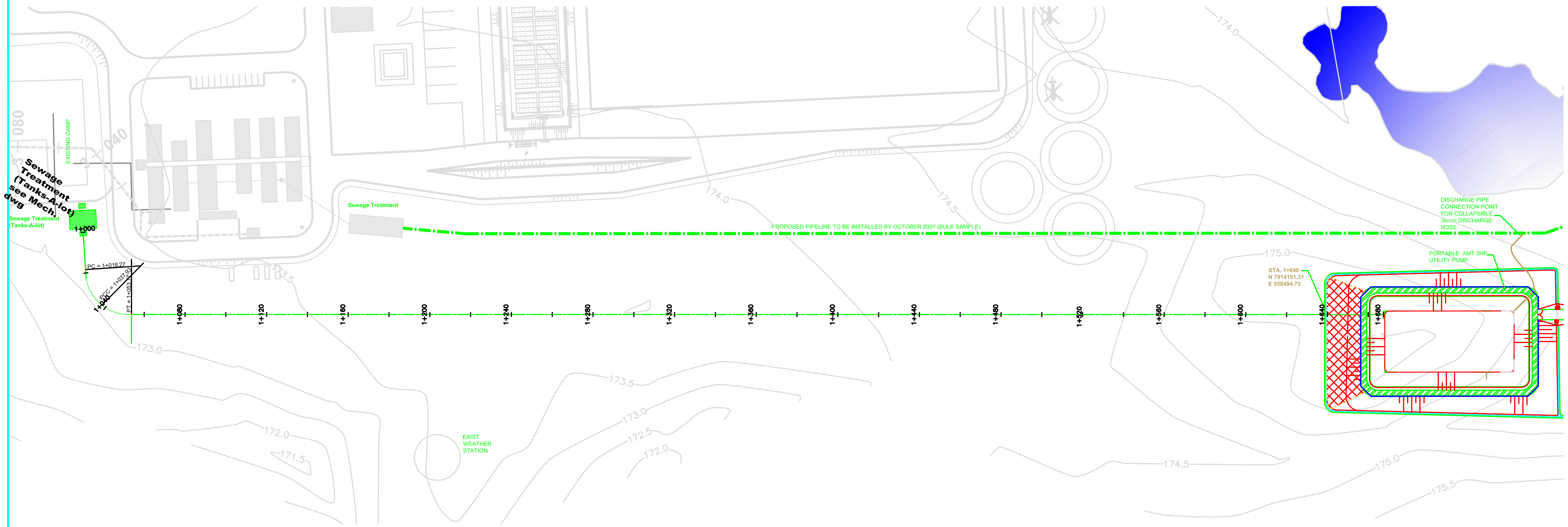
* flow rate (L/(p•d))
** wastewater flow rate (L/(p•d))

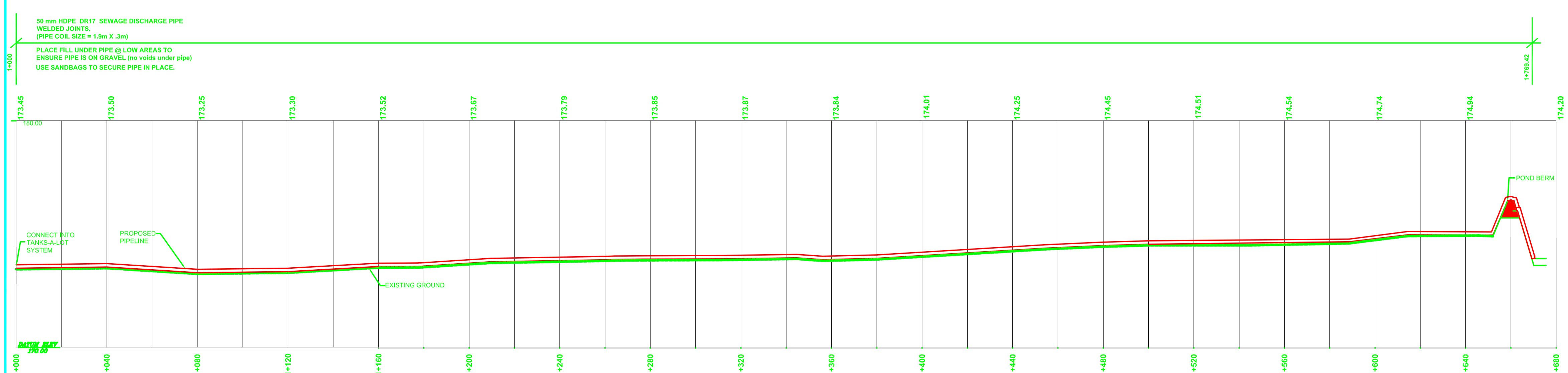
vary from 1.4 to 1.77 (Lufkin and Tobiasson, 1969; Murphy et al., 1977; Given, 1978). These values do not represent a drastic change from those found for the households in small communities.

In addition to life support, water requirements specific to the work camp activity, for example, equipment washdown, pressure testing, and fire protection must be included in the estimate of total camp water supply.

An evaluation of water usage of various facilities at an Alaskan drilling camp and base camp is shown in Tables 13-2 and 13-3. The percentage of water

❖ APPENDIX “B”





PROFILE THRU SEWAGE DISCHARGE PIPE
SCALE 1:1000 HORIZONTAL
SCALE 1:100 VERTICAL

SCALE
50.0m 0 50.0m

THE POSITION OF POLE LINES , CONDUITS, WATERMAINS, SEWERS, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THIS DRAWING AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

Description	Date	No.

Revisions and Issues

NORTH | Date Printed

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BAFFINLAND IRON MINES CORPORATION
BAFFIN ISLAND NUNAVUT

Drawing
FORCEMAIN TO RETENTION POND PLAN/PROFILE

Date: MAY 2007	CADD File Number: civil\design\maincamp\dwg\c107-RA
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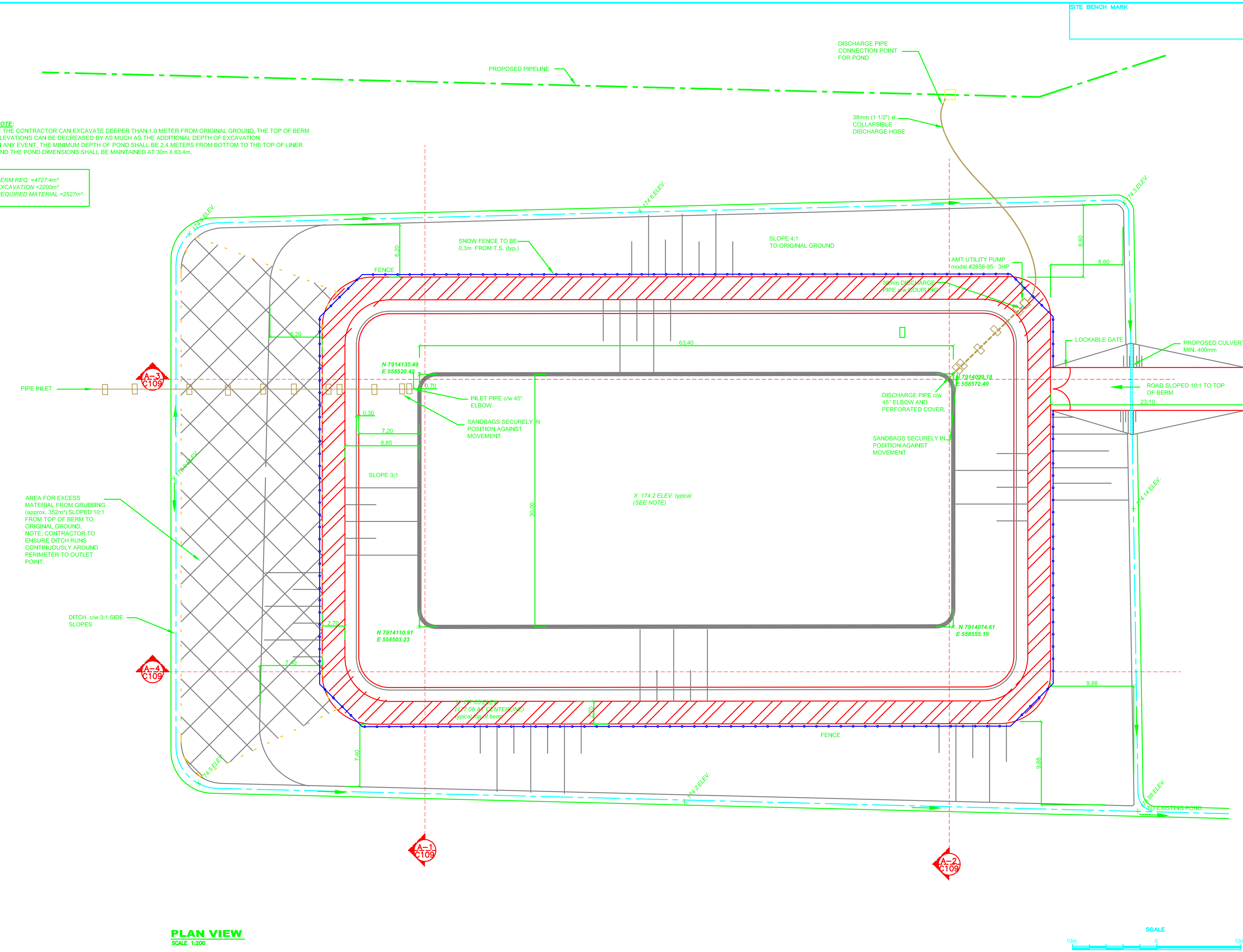
Checked:	Drawing Number: **C107**
Approved:	



PLAN VIEW
SCALE 1:200

NOTE:
IF THE CONTRACTOR CAN EXCAVATE DEEPER THAN 1.0 METER FROM ORIGINAL GROUND, THE TOP OF BERM ELEVATIONS CAN BE DECREASED BY AS MUCH AS THE ADDITIONAL DEPTH OF EXCAVATION.
IN ANY EVENT, THE MINIMUM DEPTH OF POND SHALL BE 2.4 METERS FROM BOTTOM TO THE TOP OF LINER AND THE POND DIMENSIONS SHALL BE MAINTAINED AT 30m X 63.4m.

BERM REQ. =4727.4m³
EXCAVATION =2200m³
REQUIRED MATERIAL =2527m³

Description	Date	No.

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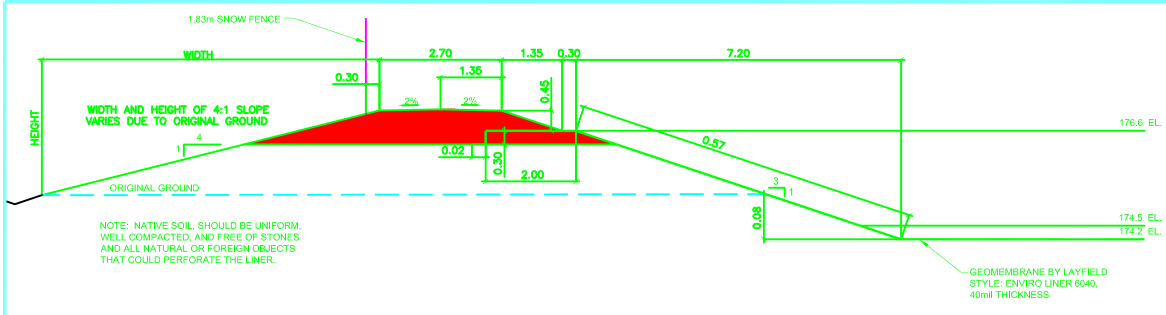
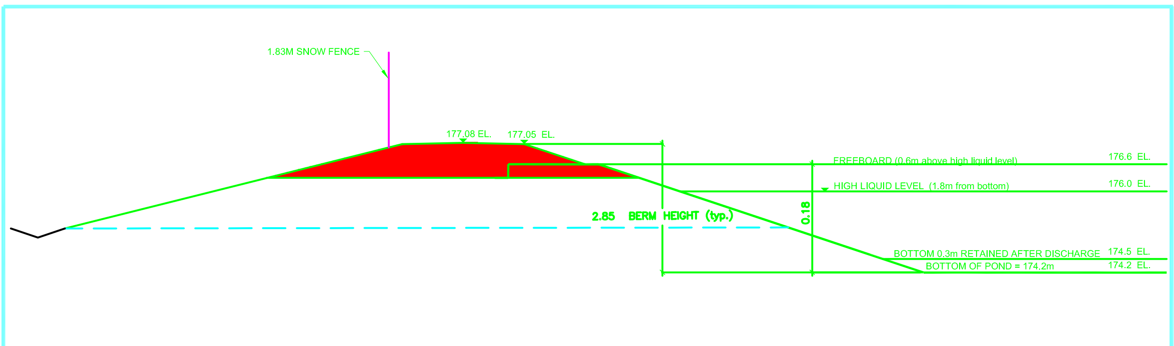
Drawing
POLISHING POND
PLAN VIEW

Date: MAY 2007	CADD File Number
Scale: 1:200	Job Number: 06-090
Drawn: CM/SO	
Checked	Drawing Number: C108
Approved	



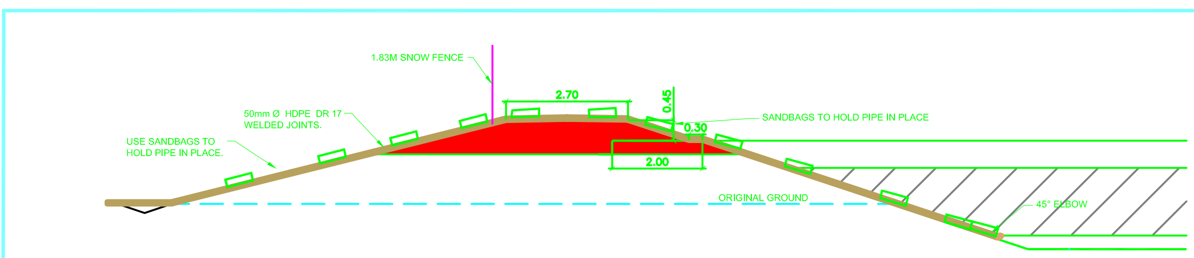
TYPICAL LAGOON BERM

SCALE 1:75



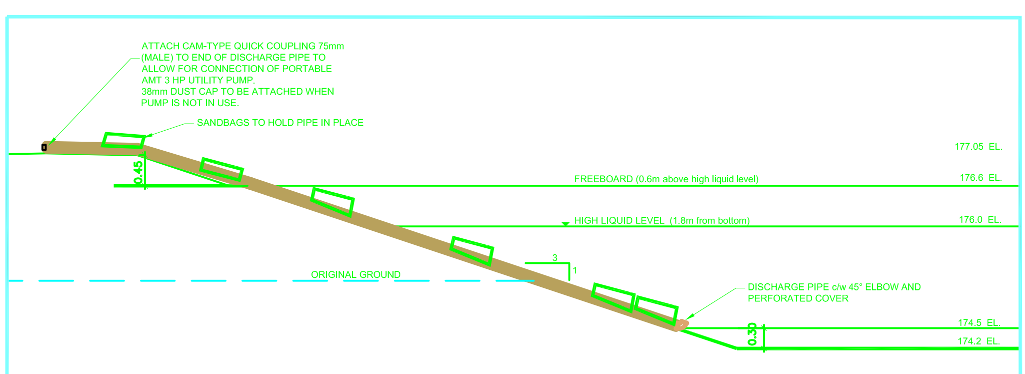
TYPICAL LAGOON BERM ELEVATIONS

SCALE 1:75

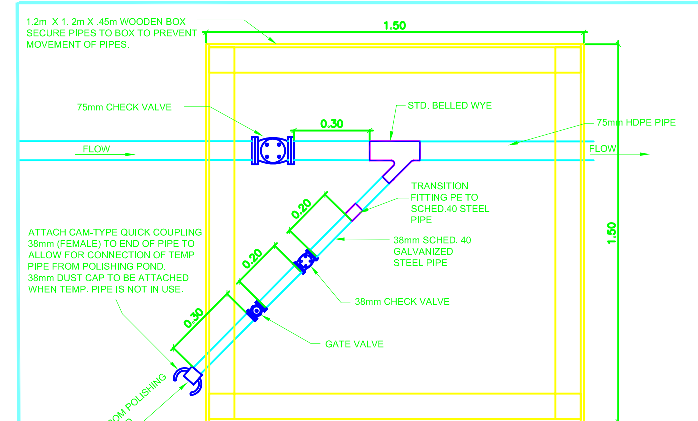


INLET SECTION

SCALE 1:75

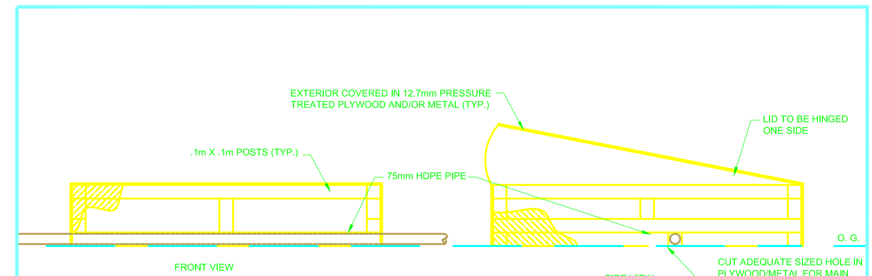


DISCHARGE PIPE DETAIL



PIPE CONNECTION

SCALE 1:50



PIPE CONNECTION PROTECTION BOX

SCALE 1:50

NOTE: IF THE CONTRACTOR CAN EXCAVATE DEEPER THAN 1.0 METER FROM ORIGINAL GROUND, THE TOP OF BERM ELEVATIONS CAN BE DECREASED BY AS MUCH AS THE ADDITIONAL DEPTH OF EXCAVATION.
IN ANY EVENT, THE MINIMUM DEPTH OF POND SHALL BE 2.4 METERS FROM BOTTOM TO THE TOP OF LINER AND THE POND DIMENSIONS SHALL BE MAINTAINED AT 30m X 53m.

Description	Date	No.

Revisions and Issues

NORTH | Date Plotted

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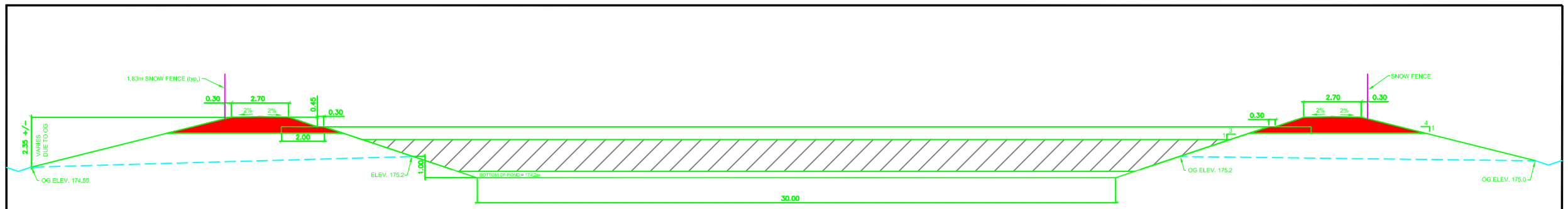
ARCHITECT | STRUCTURAL/CIVIL

MECHANICAL | ELECTRICAL

Project
MARY RIVER PROJECT
BAFFINLAND IRON MINES CORPORATION
BAFFIN ISLAND | NUNAVUT

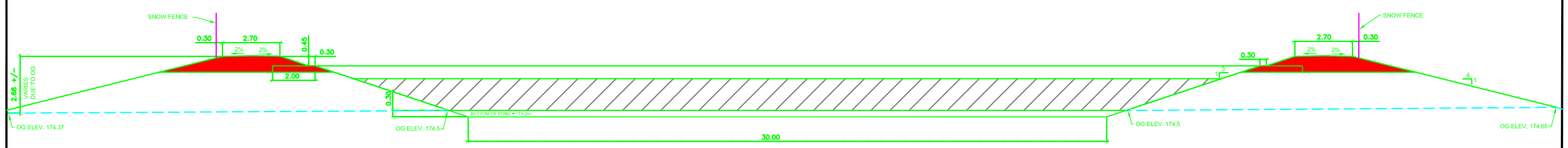
Drawing
POLISHING POND SECTIONS AND DETAILS

Date: MAY 2007	CADD File Number
Scale: AS NOTED	Job Number: 06-090
Drawn: CM/SD	
Checked	Drawing Number: C109
Approved	

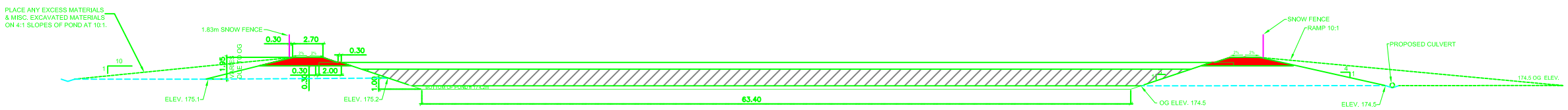


NOTE: IF THE CONTRACTOR CAN EXCAVATE DEEPER THAN 1.0 METER FROM ORIGINAL GROUND, THE TOP OF BERM ELEVATIONS CAN BE DECREASED BY AS MUCH AS THE ADDITIONAL DEPTH OF EXCAVATION.
IN ANY EVENT, THE MINIMUM DEPTH OF POND SHALL BE 2.4 METERS FROM BOTTOM TO THE TOP OF LINER AND THE POND DIMENSIONS SHALL BE MAINTAINED AT 30m X 63.4m.

A-1 / C108 **CROSS-SECTION**
SCALE 1:100



A-2 / C108 **CROSS-SECTION**
SCALE 1:100



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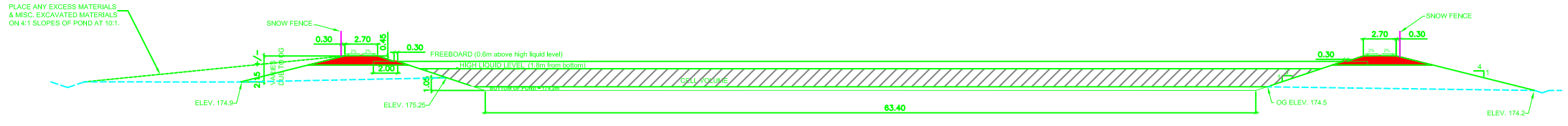

A-4 / C108 **CROSS-SECTION**
SCALE 1:200

Description	Date	No.
Revisions and Issues		

NORTH

Date Printed

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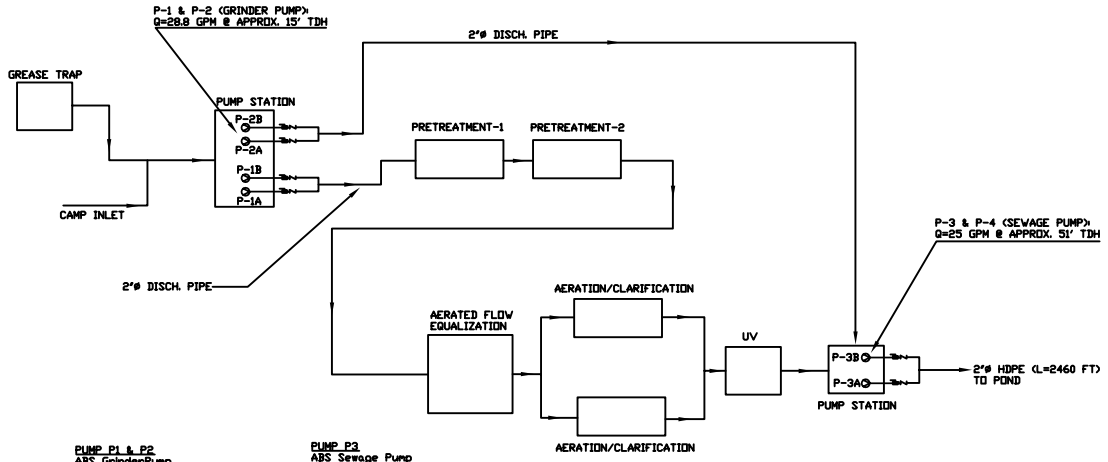
Drawing
POLISHING POND CROSS-SECTIONS

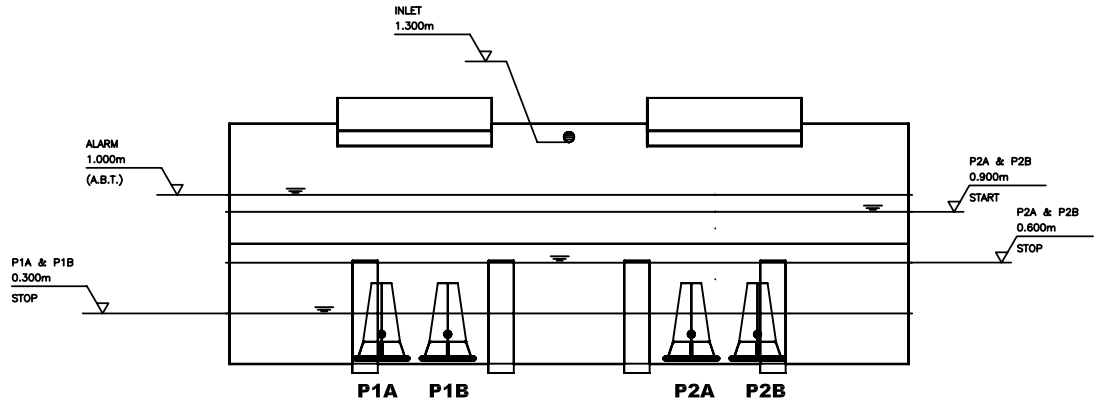
Date: MAY 2007	CADD File Number: c\#design\MAIN\CAMP\dwg\C108.MX
Scale: AS NOTED	Job Number: **06-090**
Drawn: CM/SO	
Checked:	Drawing Number: **C110**
Approved:	



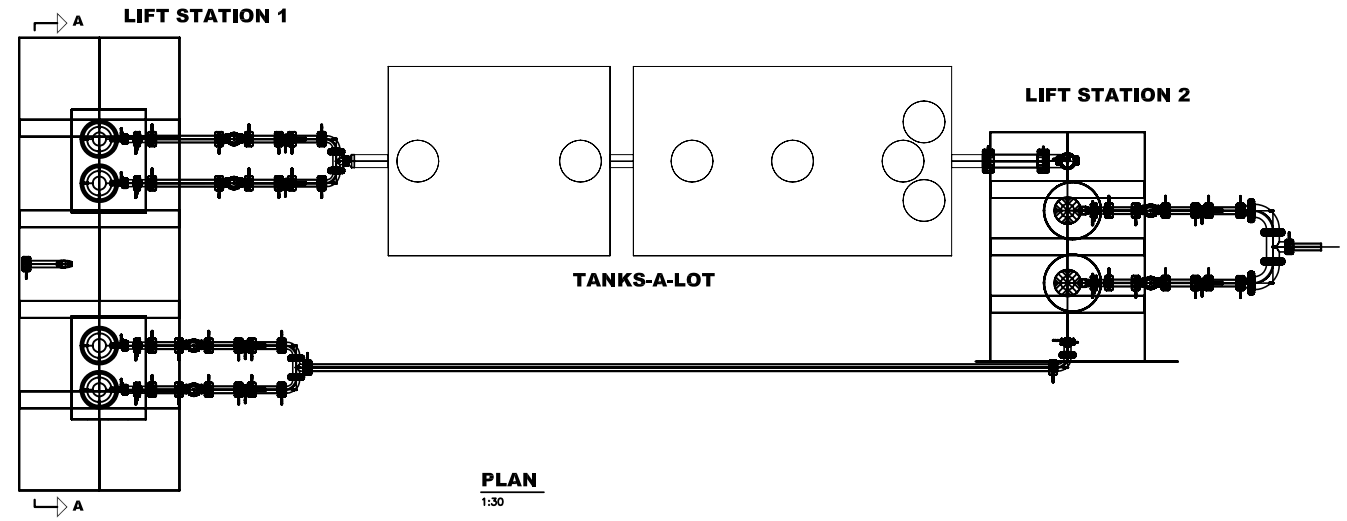
PUMP P1 & P2
ABS GrinderPump
PIR S10-4D
Delivery rate : 28.8 US g.p.m.
Delivery head : 15 ft
Hydr. efficiency : 10.1 %
Shaft power : 1.07 hp
Speed : 1715 rpm
Impeller type : Macerator
Motor output : 1.34 hp
Voltage : 208 V

PUMP P3
ABS Sewage Pump
AS 0530
Delivery rate : 24.9 US g.p.m.
Delivery head : 49.8 ft
Hydr. efficiency : 18 %
Shaft power : 1.79 hp
Speed : 3395 rpm
Impeller type : Vortex Impeller
Motor output : 2.41 hp
Voltage : 208 V
Frequency : 60 Hz
Discharge outlet : DN50

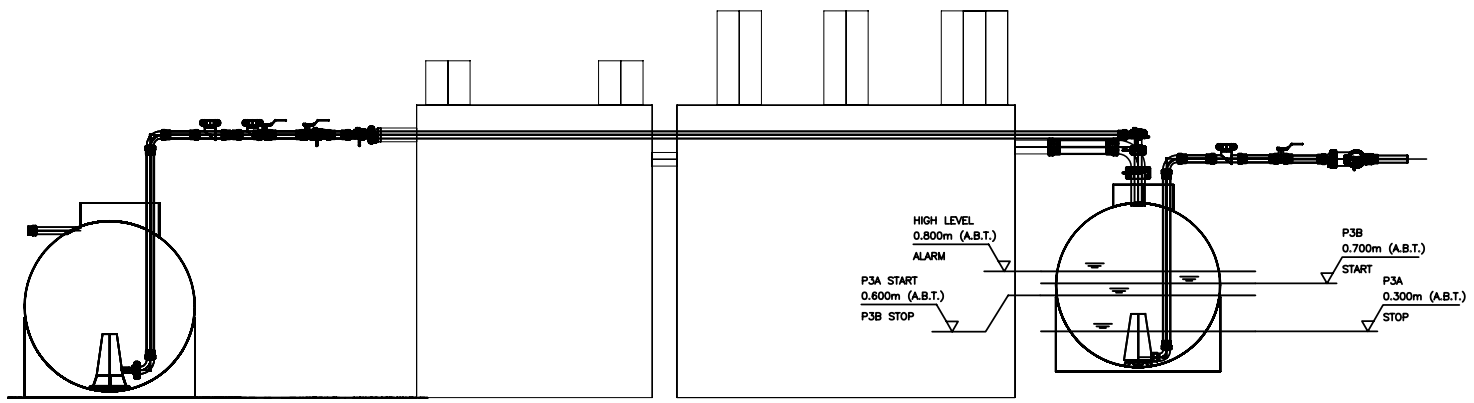
FLOW DIAGRAM
N.T.S.



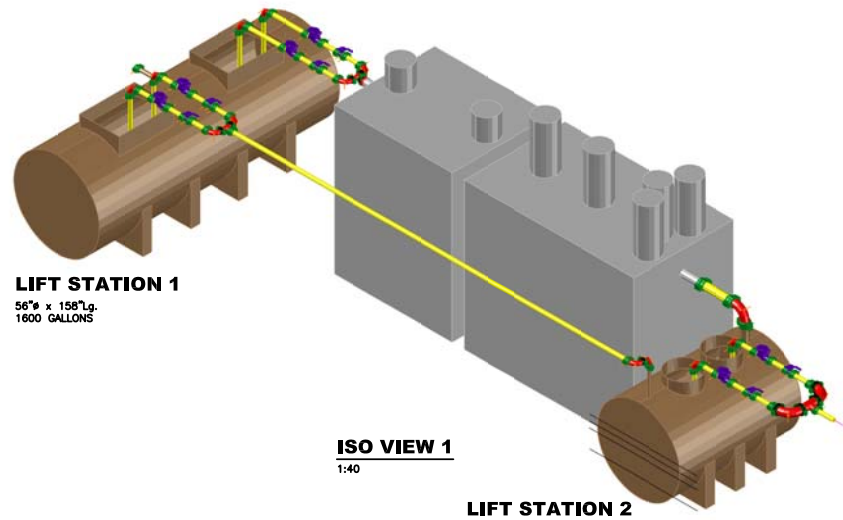
SECTION A-A
1:20



PLAN
1:30



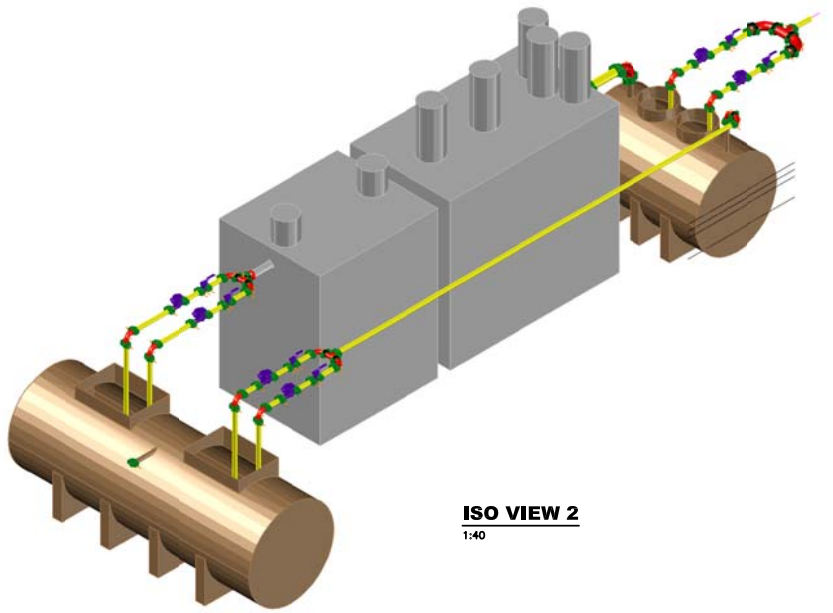
FRONT VIEW
1:30



LIFT STATION 1
56"ø x 156"Lg.
1600 GALLONS

ISO VIEW 1
1:40

LIFT STATION 2
54"ø x 80"Lg.
730 GALLONS



ISO VIEW 2
1:40

Description	Date	No.
Revisions and Issues		

NORTH Date Printed

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Project
BAFFINLAND IRON MINES CORP.
MARY RIVER PROJECT
BAFFIN ISLAND NUNAVUT

Drawing
-
SEWAGE TREATMENT SYSTEM PLAN & VIEWS

Date: MAY 2007	CADD File Number: dlscdp\mech\M103-RA
Scale: AS NOTED	Job Number: **06-090**
Drawn: SD	
Checked: -	Drawing Number: **M103-RA**
Approved: -	

❖ APPENDIX “C”

norweco®

SINGULAIR® BIO-KINETIC®

WASTEWATER TREATMENT SYSTEM WITH SERVICE PRO® CONTROL CENTER

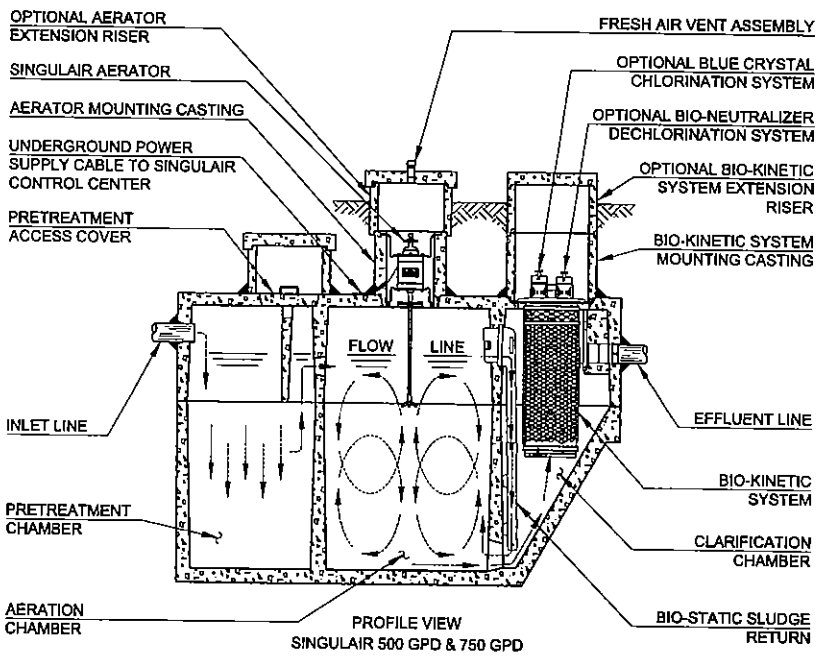
MODELS 960 AND TNT OWNER'S MANUAL

INTRODUCTION

The Singulair system is the finest equipment available and utilizes the most up-to-date wastewater treatment technology. It is a sound investment that protects you and the environment. Please take the time to familiarize yourself with the contents of this manual.

HOW THE SINGULAIR® SYSTEM WORKS

Developed to serve homes and small businesses beyond the reach of city sewers, the Singulair system employs the extended aeration process. Similar to the treatment method used by most municipal wastewater treatment facilities, this process involves a natural, biological breakdown of the organic matter in wastewater.



Wastewater enters the pretreatment chamber where anaerobic bacterial action combines with the effects of gravity to precondition the waste before it flows into the aeration chamber. Once in the aeration chamber, aerobic bacteria utilize the organic matter in the wastewater to biologically convert the waste into stable substances. Following aeration, flow is transferred to the clarification chamber where the effects of gravity settle out biologically active material. The Bio-Static sludge return, located in the clarification chamber, creates hydraulic currents that gently transfer settled particles back to the aeration chamber. As clarified liquids pass through the Bio-Kinetic system, they are filtered, settled and flow equalized. As a result, complete pretreatment, aeration, clarification and final filtration are assured. The Singulair system reliably protects you, your property and the environment.

FEATURES AND ADVANTAGES

Singulair tanks are reinforced precast concrete, manufactured by the licensed Norweco distributor. Internal walls and baffles are cast-in-place to insure uniformity and maximum strength. Risers and access covers are either heavy duty plastic or concrete construction. All components within the system that will contact the wastewater are constructed entirely of molded plastic, stainless steel or rubber.

The Singulair aerator is powered by a 1725 RPM, 115 volt, 60 hertz, single-phase, fractional horsepower motor. It is the only electrically powered component in the Singulair system. The aerator has been designed specifically for use in the Singulair system. It costs less to operate and consumes fewer kilowatt hours of electricity than most major appliances.

Singulair aerators are supplied with a Service Pro control center with MCD technology. The NEMA rated control center contains a power switch and time clock that control aerator operation. The local distributor's name, address and telephone number are displayed on the control center cover. All system controls and necessary owner information are conveniently located at your fingertips.

Non-mechanical flow equalization and final filtration is accomplished within the Singulair tank by the Bio-Kinetic system. This revolutionary device is installed in the clarification chamber and connected to the system outlet. Optional chlorination and dechlorination may be included in the Bio-Kinetic system if required. All Singulair components work together to assure complete pretreatment, aeration, clarification and final filtration.

SINGULAIR® SYSTEM PERFORMANCE

Rivaling the performance of the most advanced wastewater treatment plants in the world, the Singulair system complies with USEPA wastewater treatment guidelines for secondary treatment systems and meets all requirements of NSF/ANSI Standard 40. In ecologically sensitive areas, the most stringent effluent standards are 10 mg/L CBOD and 10 mg/L TSS. Rated Class I after successfully completing the 7 month Standard 40 test protocol, the Model 960 system averaged effluent of 6 mg/L CBOD and 10 mg/L TSS. The Model TNT system averaged effluent of 4 mg/L CBOD, 9 mg/L TSS and 12 mg/L Total Nitrogen.

OPERATIONAL REQUIREMENTS

The Singulair system is designed to treat only domestic wastewater. Domestic wastewater is defined as the waste generated from a typical residence. This includes flows originating from: bathtubs, clothes washers, dishwashers, drinking fountains, water coolers, food grinders, kitchen sinks, lavatories, mop basins, service sinks, shower stalls, sinks, wash sinks, water closets and whirlpool baths. While the use of bio-degradable detergents is recommended, the Singulair system has been designed to handle any reasonable amount of bathroom, kitchen or laundry waste. However, some care should be exercised to insure that non-biodegradable and/or toxic materials are not disposed of via the domestic wastewater plumbing. Do not use the plumbing system for disposal of lint, cooking grease, scouring pads, diapers, sanitary napkins, cotton balls, cotton swabs, cleaning rags, dental floss, strings, cigarette filters, rubber or plastic products, paints and thinning agents, gasoline, motor oil, drain cleaners or other harsh chemicals. These items could plug portions of the plumbing, interfere with biological treatment, accumulate in the treatment system and adversely affect system performance. Never connect roofing down spouts, footer drains, sump pump piping, garage and basement floor drains or water softener backwash to the domestic wastewater plumbing or the treatment system. Water softener backwash will interfere with biological treatment and must be disposed of separately.

ELECTRICAL REQUIREMENTS

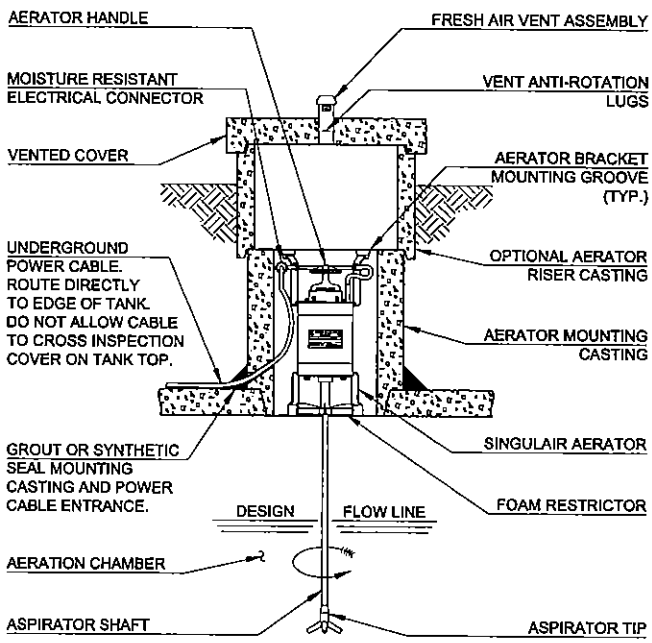
Each Singulair control center must be wired to a dedicated 115 VAC, single-phase circuit at the main electrical service panel. A 15 amp circuit is recommended (10 amp minimum). A pictorial wiring diagram is provided inside the control center enclosure. All electrical work must be performed in accordance with the requirements of the National Electrical Code and all applicable local codes. Electrical connections should be made only by a qualified electrician following proper procedures and using safe tools.

CAUTION: Any time service is required, first shut off the dedicated circuit breaker in the main electrical service panel. Next, shut off the power switch in the Singulair control center. Failure to do so could result in personal injury or equipment damage.

SINGULAIR® AERATOR

The aerator has been specifically designed for use in the Singulair system and includes special alloy and molded plastic parts to prolong aerator life. Aerator bearings are pre-lubricated and sealed. Singulair aerators are installed in a concrete mounting casting above the aeration chamber. Fresh air enters the aerator through four intake ports located under the aerator handle. The air is drawn down the hollow aspirator shaft where it is introduced below the liquid surface. Only the molded plastic aspirator and the lower portion of the stainless steel aspirator shaft are submerged.

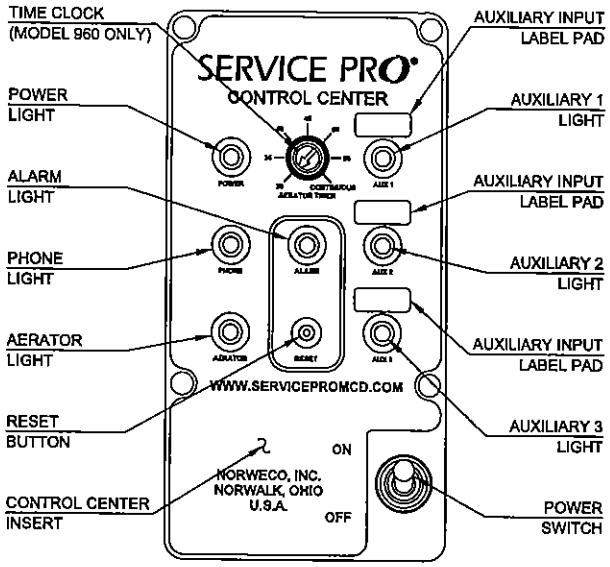
The aerator is not designed to run under water and will automatically shut off if a high water condition occurs. If the liquid rises to the level of the foam restrictor, the control center will shut off power to the aerator. Next, an automatic diagnostic sequence begins, as outlined in the section titled "Service Pro Control Center".



Each Singulair aerator is a precision engineered electro-mechanical device. Do not remove it from its installed position. Do not attempt any type of repair. Contact your Singulair service provider if service is needed. Unauthorized tampering or repair will void important provisions of the limited warranty and exchange program.

FRESH AIR VENTING SYSTEM

An aerator vent assembly is cast into the concrete access cover above each aerator. The vent assembly supplies fresh air to the aerator, which is drawn through the aspirator and into the wastewater. Finished landscaping should be maintained six inches below the top of the vented access cover and graded to drain runoff away from the cover. Do not allow plants, shrubbery, mulch or landscaping of any type to restrict the flow of air to the vent assembly or obstruct the access cover.



SERVICE PRO® CONTROL CENTER

Every Singulair aerator is supplied with a prewired Service Pro control center featuring MCD technology to permit fully automatic aerator operation. The control center provides MONITORING, COMPLIANCE and DIAGNOSTIC functions complete with telemetry for communication with the Service Pro remote monitoring center. If an alarm condition occurs for any reason within the Singulair system or monitored auxiliary equipment, the red alarm light will flash. If aerator operation has been interrupted, the Service Pro control center will attempt to restart the aerator every five minutes for two hours. If the aerator does not restart after two hours, the audible alarm will sound. If the Singulair system is covered by a Service Pro monitoring agreement, the Singulair service provider will be automatically notified and the alarm condition will be displayed on the remote monitoring center website, **www.servicepromcd.com**. Each control center for the Model 960 treatment system is supplied with a time clock adjustable in five minute increments up to continuous run. The Model 960 time clock is factory preset to run 30 minutes per hour and should only be adjusted by an authorized Singulair service provider. Each control center for the Model TNT system is supplied with a non-adjustable time clock.

SERVICE PRO® MONITORING CENTER

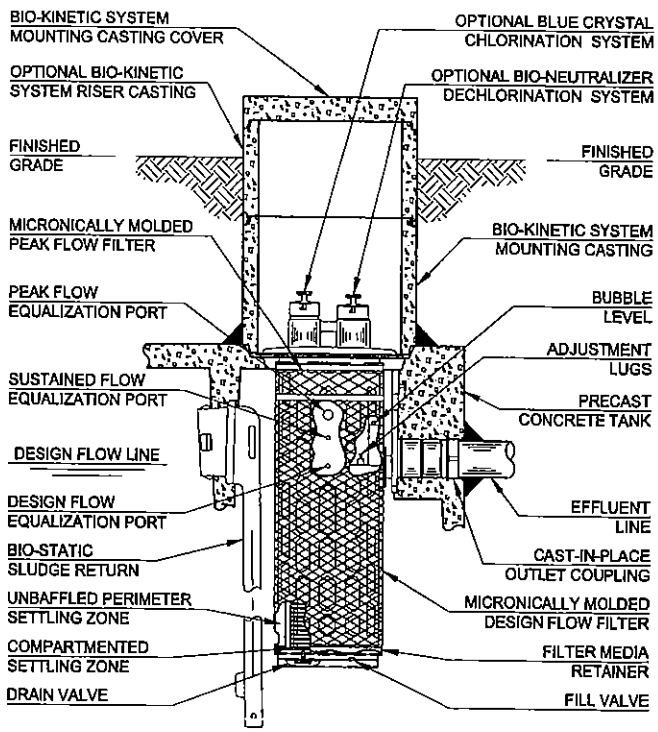
When connected to a telephone line, the control center will automatically notify the Service Pro monitoring center of any service required by the Singulair system or accessory components. The Service Pro monitoring center will automatically record the time and date of any alarm condition and post this information to your system's history record accessible at **www.servicepromcd.com**. The monitoring center will also notify your Singulair service provider that the system needs attention and record the time and date when service is performed. All information regarding your system is available to you on the secure, password protected Service Pro website. Contact your Singulair service provider for your user name and password.

BIO-STATIC® SLUDGE RETURN

Each Bio-Static sludge return is securely installed in the aeration/clarification chamber wall to provide return of settled solids. Aeration chamber hydraulic currents enter the sludge return(s) and are directed through the Bio-Static device into the clarification chamber. The hydraulic currents containing resuspended sludge are directed through the clarification chamber inlet zone and back to the aeration chamber for additional treatment. The Bio-Static sludge return accomplishes resuspension and return of settled solids without disturbing the contents of the clarification chamber. It has no moving parts and does not require service but its operation will be checked by your service provider during each semi-annual service inspection.

BIO-KINETIC® SYSTEM

Bio-Kinetic systems provide non-mechanical flow equalization through all plant processes. The Bio-Kinetic system contains 3 separate filtration zones, 8 independent settling zones, optional chlorination and dechlorination tablet feed systems and serves as its own chlorine contact chamber. When used with Blue Crystal residential disinfecting tablets, the performance of the Bio-Kinetic system as a chlorination device is certified to NSF/ANSI Standard 46, Section 11. All components are manufactured from plastic, stainless steel or rubber. Do not remove a Bio-Kinetic system from the clarification chamber without disengaging the locking lugs. Your service provider has the necessary training, tools and equipment for removal and cleaning. If your Bio-Kinetic system is in need of service contact your service provider. During each semi-annual service inspection your service provider will remove and clean the Bio-Kinetic system or replace it with a unit from their service stock.



NON-MECHANICAL FLOW EQUALIZATION

The patented design of the Bio-Kinetic system provides non-mechanical flow equalization for the Singulair wastewater treatment plant. Equalization reduces incoming hydraulic surges (e.g. typical shower of 10 minutes duration, bathtub discharge of 5 minutes duration, clothes washer discharge of 2 minutes duration and dishwasher discharge of 2 minutes duration) throughout the system. The flow equalization provided by the Bio-Kinetic system causes wastewater to be held upstream of the final outlet during hydraulic surges, which preserves treatment integrity and enhances system operation. The actual rate of equalization varies and depends upon specific loading patterns and the duration of each flow surge. At the design loading pattern used during the NSF/ANSI Standard 40 performance evaluation, the Singulair system equalizes all flow an average of 48%. As a result, hydraulic surges and periods of high wastewater flow are automatically reduced to protect the environment and all treatment plant processes on a demand use, as needed, basis.

BLUE CRYSTAL® RESIDENTIAL DISINFECTING TABLETS

If local regulations require, an initial supply of Blue Crystal disinfecting tablets will be placed in the Bio-Kinetic system chlorine feed tube(s) at system start-up. Specifically formulated for use in the Singulair system, Blue Crystal disinfecting tablets provide efficient and reliable disinfection when effluent chlorination is desirable. Manufactured from calcium hypochlorite, Blue Crystal disinfecting tablets provide effective, economical bacteria killing power. Liquid entering the Bio-Kinetic system contacts the installed Blue Crystal disinfecting tablets, just downstream of the equalization ports. A fully charged feed tube will last an average of six months. During each semi-annual inspection, your Singulair service provider will check system operation, the rate of tablet consumption and install tablets during routine service inspections.

NOTE: USEPA guidelines state "On the average, satisfactory disinfection of secondary wastewater effluent can be obtained when the chlorine residual is 0.5 ppm after 15 minutes contact." Retention time must comply with the controlling regulatory jurisdiction.

CAUTION: The improper handling of Blue Crystal tablets may cause personal injury or property damage. Keep out of the reach of children and do not allow the tablets or feed tube to contact skin, eyes, or clothing. Tablets may be fatal if swallowed and tablet dust is irritating to the eyes, nose and throat. Do not handle the tablets or feed tubes without first carefully reading the product container label, MSDS information and the handling and storage instructions. Mixing of chemicals may cause a violent reaction leading to fire or explosion. For additional information about Blue Crystal tablets contact your Singulair service provider.

BIO-NEUTRALIZER® DECHLORINATION TABLETS

In environmentally sensitive areas, environmental regulations may require the use of Bio-Neutralizer dechlorination tablets. Manufactured as an efficient and dependable means to chemically neutralize both free and combined chlorine, Bio-Neutralizer dechlorination tablets provide consistent reduction or elimination of chlorine residual without unnecessarily reducing the level of dissolved oxygen in the treatment system effluent. Bio-Neutralizer dechlorination tablets utilize a unique chemical mixture for chlorine reduction and environmental protection. As liquid passes through the final discharge zone of the Bio-Kinetic system, the flow contacts the installed Bio-Neutralizer tablets and residual chlorine is removed from the system effluent. A fully charged Bio-Neutralizer feed tube will last an average of six months. During each semi-annual inspection, your Singulair service provider will check system operation, the rate of tablet consumption and install tablets during routine service inspections.

CAUTION: Bio-Neutralizer tablets or feed tubes should not be mixed with Blue Crystal tablets. Do not handle the tablets or feed tubes without first carefully reading the product container label, MSDS information and the handling and storage instructions. For additional information about Bio-Neutralizer tablets contact your Singulair service provider.

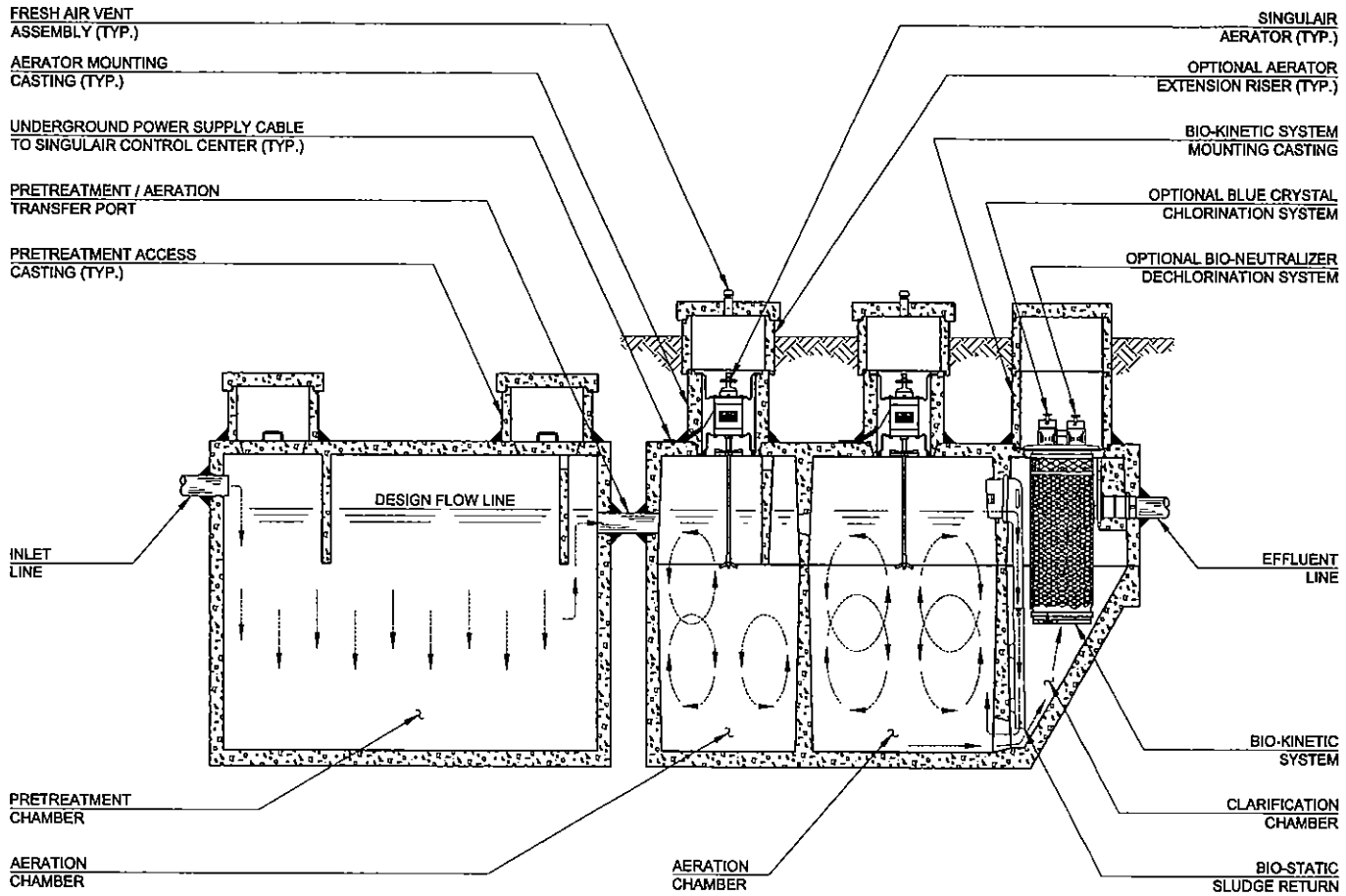
NO OWNER MAINTENANCE

The Singulair system is inspected and serviced by a local, factory-trained service provider, therefore, no owner maintenance is required during the warranty period. The Singulair system does not require pumping as often as a septic tank. Under normal use only the pretreatment chamber should be pumped. How often pumping is necessary depends on system use. The local Singulair service provider will inspect the aeration chamber contents and plant effluent at six month intervals to determine if the pretreatment chamber is discharging excessive solids. Every three years, the pretreatment chamber should be inspected. The pretreatment chamber will normally require pumping at three to five year intervals. Contact your local service provider prior to tank pumping for complete information on removal of equipment, access to individual chambers, coordination of services and proper disposal of tank contents. A tank pumping service licensed by the local regulatory agency must be used for removal and disposal of tank contents. The tank pumper should consult with local authorities to determine the proper disposal method.

If a period of intermittent use, or an extended period of non-use of the Singulair system is anticipated, contact your Singulair service provider for instructions. Your service provider has comprehensive Singulair service instructions and has been factory-trained in troubleshooting procedures. Contact your service provider if you require service or information regarding tank pumping.

SINGULAIR® SERVICE PROGRAM

Semi-annual service inspections, at six month intervals for the first two years of system operation, are provided by your local Norweco distributor and are included in the original purchase price of the Singulair system. Costs for travel and labor are not charged to the owner. During an inspection, each mechanical aerator, Bio-Kinetic system and other plant components are serviced as outlined in the Singulair Service Manual. After the initial two year service program is completed, the local service provider will provide continued service at the owner's option. The service program should be renewed by the owner to insure maximum system performance.



PROFILE VIEW
SINGULAIR 1000 GPD, 1250 GPD & 1500 GPD

Ask your Singulair service provider about a renewable service contract. If you allow service coverage to expire, you can still obtain the professional assistance of a factory-trained technician. However, these special service calls will be performed on a time and materials basis. Professional service is important to proper system operation and should not be allowed to lapse. Be sure to consider the advantages of a renewable service contract.

The Singulair service provider will perform the following services during each service inspection:

- ✓ Check aerator operation
- ✓ Check aerator power consumption
- ✓ Check aerator air delivery
- ✓ Clean stainless steel aspirator shaft
- ✓ Clean aspirator tip
- ✓ Clean fresh air vent in concrete cover
- ✓ Inspect aeration chamber contents
- ✓ Check operation of control center
- ✓ Adjust time clock when required
- ✓ Remove the Bio-Kinetic system
- ✓ Scrape the clarification chamber
- ✓ Inspect the Bio-Static sludge return
- ✓ Inspect outlet coupling
- ✓ Install a clean Bio-Kinetic system
- ✓ Fill Blue Crystal feed tube
- ✓ Fill Bio-Neutralizer feed tube
- ✓ Inspect effluent quality
- ✓ Inspect outlet line
- ✓ Inspect ground water relief point
- ✓ Inspect effluent disposal system
- ✓ Complete 3-part service record
- ✓ Hang owner's record on front door
- ✓ Enter record into **www.servicepromcd.com**
- ✓ Mail health department notification

WARRANTY REGISTRATION

A Warranty Registration Card was attached to the Service Pro control center before it was shipped from the factory. If this card has not been returned to Norweco, complete and mail it immediately. If it is not returned within thirty days of the installation date, the two year limited warranty and fifty year aerator exchange program will begin on the date of component shipment from the factory.

If the Service Pro control center is mounted in an outdoor location, remove the aerator model number and serial number record card and store it in a safe location. Otherwise, do not remove this card from the control center. If it is necessary to call your service provider for service, make note of the information on the control center data plate and the aerator serial number before calling. Warranty and service records are cross-indexed by owner name and aerator serial number. Supplying the aerator serial number with the service request will give the service provider a ready reference so that changes in system ownership will not delay service.

SINGULAIR® LIMITED WARRANTY

The Singulair aerator enjoys the distinction of being the only aerator on the market today backed by a fifty year warranty and exchange program. Each Singulair aerator, Service Pro control center, Bio-Kinetic system and any other components manufactured by Norweco, are warranted to be free from defects in material and workmanship, under normal use and service, for a period of two years. The two year limited warranty is included in the original purchase price of every Singulair system. The comprehensive aerator exchange program offers Singulair owners an additional forty-eight years of protection. Owners with a Singulair system may exchange any aerator up to fifty years of age for a replacement unit at a prorated cost. If the Singulair aerator fails, do not use or dismantle the unit. The local, licensed distributor has detailed warranty and exchange information and should be contacted for service or replacement instructions.

SERVICE PRO® SECURITY LOG IN

For your convenience, record your **www.servicepromcd.com** access information here:

User name:	**Password:**

SUPPLEMENTAL SERVICE RECORD

For your reference, please document service performed on the following chart:

DATE	DESCRIPTION

norweco®

Engineering the future of water and wastewater treatment

DISTRIBUTED LOCALLY BY:

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