September 15, 2007

Nunavut Water Board
Manager of Licensing
P.O. Box 119
Gjoa Haven, NU
X0B 1J0

Re: Baffinland Iron Mines Corporation
Mary River Bulk Sample Program
Water License 2BE-MRY0710
Sewage Management Plan

Through the course of the regulatory permitting process, Baffinland committed to the submission of a Waste Water Management Plan prior to the discharge of treated effluent to the receiving environment. Part D, Clause 13 of the above license requires Baffinland to submit this plan within thirty (30) days of commissioning its Waste Water Treatment Facilities (WWTFs). A copy of this Plan is attached.

There are two (2) pre-engineered mechanical sewage treatment plants associated with the bulk sample program. One of the systems supports camp operations at the Mary River Site and the other at Milne Inlet camp.

The sewage treatment plant associated with the new all-season camp at Mary River will be installed once road upgrades facilitate mobilization of this camp to the site. This is a Rotating Biological Contactor based system designed for tertiary level treatment with year round discharge to Sheardown Lake. In the interim, toilet wastes will continue to be managed at Mary River through the use of latrines until the planned 'Tanks-a-Lot' currently being installed is commissioned and discharging to a Polishing/Waste Stabilization Pond (PWSP). The pre-engineered mechanical treatment plant referred to as the Tanks-a-Lot system and the PWSP were described in a submission to the Board in July 2007 under Water License MRY-0708. Unforeseen delays in the installation of this system have necessitated the continued use of latrines as an interim measure.

An all-season trailer camp is currently being installed at Milne Inlet to support annual re-supply and bulk sample program operations. Milne Inlet is also the primary staging area for construction workers and equipment needed to upgrade the approximate 100 km tote road to Mary River. The WWTP at this camp will be commissioned imminently. Treated effluent will be discharged initially to a PWSP, and during normal operations to a drainage ditch that reports to Milne Inlet. The PWSP at Milne Inlet will also be used for sludge disposal, and as a contingency will receive sewage in the event of a plant malfunction.

The attached Plan provides details on the design, layout and treatment capabilities for each of these sewage treatment systems. As detailed in this document, treatment design capabilities for each of these systems exceed the discharge requirements for all parameters including Biological Oxygen Demand (BOD), Total Suspended Solids (TSS) and Faecal Coliform (FC) required under the terms of the license. Baffinland acknowledges the requirement for acute toxicity testing to be conducted on these effluents on an annual basis.

In their submissions to the NWB, Indian and Northern Affairs Canada (INAC), the Government of Nunavut (GN) and Environment Canada (EC) raised questions regarding the design and operational basis of the sewage treatment systems at Milne Inlet and Mary River. These questions and Baffinland's response are summarized below:

- ***Facility Design, Layout and Operations.*** These aspects are explicitly provided in the attached management plan.

- ***Characterization of the Receiving Environment.*** In the absence of additional site-specific information at the time of environmental review and facility planning, Baffinland elected to upgrade treatment capabilities to levels exceeding current accepted practice as a means of mitigating potential risk and is reflected in the difference between the effluent criteria licensed by the NWB and the capabilities of the systems described in the Plan. Subsequent characterization of the receiving environments is included in the Plan.

- ***Potential Effects to Receiving Water Quality.*** The environmental effects of effluent discharge have been evaluated in the Plan. Data collected at the receiving waters of Sheardown Lake in April and August 2007 have permitted the preparation of a conservative mass loading model. The sewage effluent discharge is designed to be non-acutely toxic and this simplified model indicates that it will not result in eutrophication or winterkills of fish. Sewage effluent from the plant at Milne Inlet is designed to be non-acutely toxic and will be discharged to a drainage ditch ultimately reporting to Milne Inlet during open water conditions where non-essential mixing will occur as a further contingency measure. Treated effluent will be tested in accordance with water license requirements, and Baffinland will additionally monitor receiving waters as part of its environmental baseline program.

We trust that this submission meets the requirements of the NWB under the terms of the aforementioned license. Should you have any comments or questions, please do not hesitate to contact the undersigned.

Yours sincerely,

Derek Chubb,
Vice President, Sustainable Development

Baffinland Iron Mines Corporation

cc. Nunavut Water Board, Water Resources Officer, INAC

Attachment

B.H.MARTIN CONSULTANTS LTD.
CONSULTING ENGINEERS AND ARCHITECT

834 Mountjoy Street South
P.O. Box 120
Timmins, Ontario P4N 7C5
Tel. (705) 264-9413
Fax. (705) 267-2725

September 15, 2007

Derek Chubb
Vice President
Sustainable Development
Baffinland Iron Mines Corporation
Suite 1016, 120 Adelaide Street West
Toronto, Ontario
M5H 1T1

Dear Derek,

RE:

MARY RIVER PROJECT
WASTEWATER MANAGEMENT PLAN (WWMP) REPORT
<u>OUR REFERENCE NO. 06-090</u>

Attached please find our Waste Water Management Plan Report for the Mary River Project in Nunavut, Canada. Our report, including the design drawings, has been prepared in accordance to the requirements set out in Baffinland's Water License No. 2BE-MRY0710 as well as the guidelines set out by the Regulations in Northwest Territories and Nunavut.

Yours truly,

B.H. Martin Consultants Ltd.

F. G. Kord

REGISTERED PROFESSIONAL ENGINEER
F. Kordgharachorloo
LICENSEE
Sep. 15/07
NWT/NU

Marz G. Kord, P. Eng., M.Sc., MBA
Manager of Engineering
Mk/

MARY RIVER PROJECT

WASTE WATER MANAGEMENT PLAN FOR MARY RIVER AND MILNE INLET CAMP SITES, NUNAVUT, CANADA

Baffinland Iron Mines Corporation

Prepared For:

Baffinland Iron Mines Corporation
Mr. Derek Chubb
V.P. Sustainable Development
Suite 1016, 120 Adelaide Street West
Toronto, Ontario, M5H 1T1

Prepared By:

B. H. MARTIN CONSULTANTS LTD.
834 Mountjoy St. South
P.O. Box 120
Timmins, Ontario, P4N 7C5

Tel. (705) 264-9413 Fax. (705) 267-2725

BHM # 06-090
September, 2007

B.H. MARTIN CONSULTANTS LTD.

TABLE OF CONTENTS

APPENDICES

REFERENCES

1.0 INTRODUCTION

B.H. Martin Consultants Ltd. was retained by Baffinland Iron Mines Corporation (BIMC) to design the sewage works for their Bulk Sampling Program Camp at Mary River Mine Site and their logistics camp at the Milne Inlet in Nunavut (Figure 1).

BIMC operates under Water Licence 2BB-MRY0710 issued by the Nunavut Water Board. This Waste Water Management Plan is submitted in accordance with Part D, Item 13 of the water license. The plan addresses the following elements:

- Process design
- Construction and commissioning
- Operation and maintenance
- Effluent discharge to receiving environment

The plan has been prepared with guidance from the "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories" (Duong and Kent, 1996).

<u>Mary River Site</u>

The existing camp at Mary River is a nominal 100 person seasonal camp set up and being used for the exploration work. The owner will be constructing an additional all-season camp with a nominal design capacity of 100 people. During the summer, both camps will be operational. The Mary River Camp population will vary, but it is expected to house, on average, approximately 150 people for the duration of the bulk sampling program. The Camp will consist of predominantly Weatherhaven™ tents, two steel Quonset huts as maintenance facilities, and numerous small wooden outbuildings, situated approximately 200 meters from the shores of Camp Lake (Figure 2).

A pre-engineered mechanical sewage treatment plant (referred to as the 'Tanks-a-Lot system) is currently being installed at the Mary River. Site Design details on the plant and its planned installation were previously submitted to the Board and circulated for comment in July 2007. In its submission, Baffinland indicated that effluent from this plant would be discharged to a Polishing/Waste Stabilization Pond (PWSP). Details on the PWSP were also provided in this submission.

Treated effluent stored in the PWSP will be discharged directly to Sheardown Lake during the open water season of 2008, if meeting discharge requirements of the current license. Otherwise, contents of the PWSP will be treated by the sewage treatment plant installed with the new, all season camp. The Tanks-a-Lot system with discharge to the PWSP is not yet operational, due to unexpected delays. To date, sewage generated at the Mary River site has and continues to be managed through the use of latrines.

The new Waste Water Treatment Facility at Mary River to be used for the duration of the bulk sample program will be installed once road upgrades facilitate mobilization of the camp to site. The WWTF will consist of a Rotating Biological Contactor (RBC) designed for tertiary levels of treatment with piped year round discharge to Sheardown Lake.

During the start-up of the RBC system, treated effluent from this system will be directed to the PWSP. Once the RBC system is fully operational, the effluents from the RBC system will be transmitted directly to Sheardown Lake.

The supernatant from the PWSP will be directed to the RBC system for re-treatment before discharging to Sheardown Lake if it does not meet effluent discharge requirements.

Milne Inlet Site

The Milne Inlet site is the shipping point for materials and supplies to and from the Mary River Operations. An all-season trailer camp is being installed to support annual re-supply and bulk sample program operations. Milne Inlet is also the primary staging for construction workers and equipment needed during initial periods of the bulk sample project to upgrade a 100 km tote road from Milne Inlet to Mary River. The tote road is being upgraded from seasonal to all-season use.

Primary personnel facilities consist of a Shanco^{TM} camp complex (Figure 3) with wastewater treatment plant sized for a nominal capacity of 60 workers to support peak periods of activity, primarily during the initial mobilization stage of the bulk sample program. The Milne Inlet Camp population will vary and is expected that during the majority of the time, there may be on average 40 to 45 people housed at Milne Inlet.

The WWTF at Milne Inlet consists of an RBC system discharging to a local drainage ditch, and a PWSP for sludge disposal, discharge of treated effluent during the initial commissioning, and contingency. Commissioning of this facility is expected imminently. In the interim, toilet wastes are being managed through use of latrines.

During start up of the RBC System, all sludge will be transmitted to a new Polishing/Waste Stabilization Pond (PWSP) constructed on site for that purpose. Once the RBC system is online, the treated effluents will be discharged to a local drainage ditch, which eventually reports to Milne Inlet. The supernatant from the PWSP will be directed to the RBC system for re-treatment before discharging to the local drainage ditch if it does not meet the effluent discharge requirements.

2.0 DESIGN CRITERIA

Per capita 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 “B”.

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 sewage at both camps is expected to be a ‘moderately diluted wastewater’ as defined in Table 10.4 in Appendix “B”. The average BOD_5/TSS levels for this type of wastewater can be expected to be 460 mg/l BOD_5 and 490 mg/l TSS. In addition, a loading of 65 mg/l TKN and 10 mg/l Phosphorus has been estimated by Seprotech, manufacturer of RBC units, derived from operating facilities.

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 225 lpcd for design.

A summary of design sewage flows and strengths are depicted below.

Facility Type	**Water/Sewage Quantity (lpcd)**	**BOD_5/TSS (Avg. – mg/l)**	**No. of Persons (Capita)**	**Total Daily Flow (l/d)**	**Total Flow 400 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	**225**	**460/490**	**150**	**33,750**	**13,500**
Design Criteria for Milne Inlet Camp	**225**	**460/490**	**60**	**13,500**	**5,400**

Sewage generation is conservatively assumed to be 225 liters per capita per day (225 lpcd) with a maximum loading of 460 BOD_5, 490 TSS, 65 TKN and 10 Phosphorus.

For design of the freeze protection of the forcemain, the minimum ambient temperature is assumed to be -45 degrees C and wind speed is assumed to be

40.3 kph. The heat tracing on the forcemain is designed to keep the pipe contents at 5 degrees C.

The table below provides the discharge requirements of the Water License and the design basis of the pre-engineered RBC units.

	Water License Requirements Maximum Average Concentration		**Wastewater Treatment Plant Effluent Concentrations**	
Parameter	Milne Inlet WWTF	Mary River WWTF	Milne Inlet WWTF	Mary River WWTF
BOD_5	100 mg/L	30 mg/L	20	10
TSS	120 mg/L	35 mg/L	20	10
Faecal Coliform	1,000 CFU/100mL	10,000 CFU/100mL	Less than 200 Counts per 100 ml	Less than 200 Counts per 100 ml
Oil and Grease	No visible sheen	No visible sheen	Removed by grease traps	Removed by grease traps
pH	Between 6.0 and 9.5	Between 6.0 and 9.5	Between 6.0 and 9.5	Between 6.0 and 9.5
Toxicity	Final effluent not acutely toxic	Final effluent not acutely toxic	Not acutely toxic due to nitirification	Not acutely toxic due to nitirification
Ammonia	N/A	N/A	2 mg/L NH3-N	2 mg/L NH3-N
Phosphorus	N/A	N/A	N/A	Removed by addition of Alum to 0.5 mg/L

2.1 Comments from Regulatory Agencies during Water Licensing

Comments were received during the public review period for the amendment of the water license from Environment Canada, Indian and Northern Affairs Canada (INAC), and the Government of Nunavut, Department of Environment (GN-DOE). The comments are summarized as follows:

Comment	Response / Action
Additional information is required to assess the potential effects associated with the proposed effluent discharges, and demonstrate the qualify of treated effluent will not be detrimental to the receiving waters	This Waste Water Management Plan provides the required information on the receiving waters and an assessment of the potential effects of effluent discharge.
Treated effluent must comply with Section 36(3) of the Fisheries Act (i.e., be non-deleterious). Ammonia is toxic to fish at certain concentrations.	Both sewage treatment plants will be equipped with nitrification processes with design capabilities to produce effluent ammonia concentrations of less than 2 mg/L.
Sheardown Lake and downstream receiving waters can be classified as oligotrophic to mesotrophic based on phosphorus concentrations – there has not been a thorough evaluation of the potential for eutrophication and the associated potential for winterkill	This Waste Water Management Plan provides the required information on the receiving waters and an assessment of the potential effects of effluent discharge.
A detailed analysis of the impact of treated sewage effluent in Milne Inlet be provided, considering the receiving environment and quality of treated sewage effluent.	An assessment of the potential effects of effluent discharge has been provided within this design report.
Details of the polishing pond at Mary River as a contingency measure in the event of malfunction of the RBC should be provided	Provided in this design report
Spill response measures should be incorporated into Baffinland's Spill Contingency Plan	Refer to Section 7.0
Baffinland should submit a sewage management plan that includes operation and maintenance procedures, waste management options for sewage sludge and detailed contingency measures in case of RBC failure	Provided in this design report

3.0 SEWAGE TREATMENT & DISCHARGE

BIMC will use pre-engineered package sewage treatment systems designed and constructed by Seprotech for the treatment of all domestic sewage at the Mary River and Milne Inlet camps (Appendix “A”). Treatment capabilities of these facilities have been selected to ensure adequate protection of the receiving environment, as detailed in Section 8.0.

No non-domestic waste or stormwater will be directed to the treatment systems. All sewage effluent from the RBC Systems will be non-toxic.

3.1 Treatment

Treatment of sewage at the Mary River Site will be done by a ROTORDISK®**;** N-70 packaged RBC System by Seprotech Systems Inc. Effluent from the sewage treatment system will be transmitted directly to the submerged outlet at Sheardown Lake via an insulated 75 mm forcemain.

The fully contained RBC system is comprised of a primary settlement tank, a Rotating Biological Contact (RBC) tank, and a secondary settling tank. Raw sewage is pumped into the primary settlement tank whereby heavy solids are retained through gravity settling and thickening. Supernatant from the primary settlement tank enters the RBC tank through an inlet slot located at the front section of the RBC tank. The RBC tank is made up of four stages, or disk banks. The four separate disk banks are mounted on a common rotating shaft. As the disk banks are partially submerged, the rotation serves to provide continual aeration for the fixed film biological growth and filtering process (which occurs on the disk banks). The first disc bank represents 40% of the total RBC surface area and is responsible for the most significant reduction in BOD. Subsequently, the accumulation of biological growth will be the greatest on the film disc bank and gradually decrease through subsequent sections. The growth will be generally thick and often filamentous on the 1st disk bank, becoming thinner and more compact on stages 2 through 4. Under certain operating conditions, nitrifying bacteria may become dominant in the 3rd and 4th disc banks. The 4th disc bank has a circulation device that allows well-treated liquid to be recycled to the primary settling tank. Treated water from the RBC enters the secondary settlement tank, whereby biomass sloughed from the disks and other suspended solids settle through gravity.

The N Series of ROTORDISK® plant for Mary River employs additional engineered media throughout each zone of the ROTORDISK® to take advantage of this biodiversity to provide a close to ideal environment for the nitrifying bacteria to live, grow and transform the ammonia in wastewater to Nitrates and Nitrites. The naturally occurring biological processes are enhanced by the progressively higher dissolved oxygen content in the third and fourth stages of the ROTORDISK®, and the absence of competing aerobic micro-organisms. The absence of aerobic micro-organisms is assured by controlling the BOD_5 measured in the wastewater entering the third stage to be < 30 mg/L. Thus the nitrosomonas and nitrobacters thrive and achieve their optimum growth according to the NH4 + concentration entering the third and fourth stage of the ROTORDISK®.

The ROTORDISK® exhibits high heat transfer capabilities. As a result of its slow rotation in and out of the wastewater, the core temperature remains stable along the length of the ROTORDISK® and further promotes the nitrification process.

Phosphorus removal is attained by the addition of alum. The amount of alum required, based on average flows is approximately 1.5 kg of alum per day.

The dimensions and sizes of the system can be seen in the Seprotech drawing in Appendix ‘A’.

Treatment of sewage at Milne Inlet will be done by a ROTORDISK®**;** B-30 packaged RBC System by Seprotech Systems Inc. This system is similar to the N-70 unit. In order to reduce the ammonia levels and the total Nitrates in the effluent from this system, the unit has been modified to promote the same level of nitrification as the N-70 system. The B-30 system operation is similar to the N-70 as discussed above.

3.2 Discharge

Mary River

During initial during the start up of the RBC System at Mary River, all effluents will be directed to the PWSP. The PWSP is located at the east end of the site approximately one quarter of the distance to Sheardown Lake from the RBC system location as shown in Figure 2.

The PWSP consists of a cell lined with a 1.0mm (40 mil) HDPE liner. The slopes of the PWSP are 2H: 1V with allowance for 0.3m of sludge, 1.5 m of water, and 0.6m of free board. Total operating volume of the PWSP at Mary River is approximately 3,700 cubic meters. Detailed designs of the PWSP for Mary River were previously submitted to the Board in July 2007, in accordance with Water License MRY-0708.

After successful start-up of the RBC System, the effluent from the RBC System at Mary River will be directed to a lift station wet well and pumped via the forcemain to Sheardown Lake. This lift station and forcemain system is presented in the Process Schematic, located in the design drawings in Appendix ‘C’. Pump flow rates and wet well dimensions are shown on the Process schematic.

Freeze protection has been designed by Urecon Limited. The 75 mm DR 26 HDPE pipe will be fitted with 50 mm of polyurethane insulation and a PVC jacket. Inside the insulation, an integral conduit will house a Thermocable C13-240-COJ heating cable with an output of 13 watts/meter controlled by an electronic thermostat set at 5 degrees C with a high limit of 65 degrees C for protection of the HDPE pipe. The forcemain pipe will be shipped to site in 50 foot lengths and be assembled using joint insulation kits.

The pipeline is constructed above ground from the wet well downstream of the WWTP to Sheardown Lake. At Sheardown Lake the forcemain will be constructed by assembling sections of pipe on land and pulling the assembled pipe out onto the lake, leaving it to temporarily float on the surface. The end of the pipe will be kept above the water surface until the pipe is "sunk" to the bottom of the lake. Once sufficient length of pipe is floating on the surface, sandbags (filled with locally available material) will be attached to the pipe starting at the shore, in sufficient quantity to sink the pipe below the surface. Once the pipe is sufficiently weighted and the entire length of pipe is partially submerged (approximately 30 kg of sandbag per meter), the outlet end of the pipe will be allowed to fill with water and lowered to the bottom. Additional sandbags will then be sunk, and allowed to rest over the pipe, along the pipe route, to cover the forcemain to a point where the depth of water is at least 5 meters (1.2 meters more than the recorded depth of ice on the lake). The sandbags will be placed on the pipe to at least a 1 meter thickness. The portion of pipe that will lie within the ice depth of the lake will be insulated, but not heat traced. Only the portion below 4 meters depth from the typical water/ice surface will be un-insulated. This insulation will require additional weight to initially sink the pipe to the bottom, but will provide freeze protection throughout the ice zone as well as provide some additional protection to the pipe from the ice pressure. No armouring at the outfall is planned. Plan, profile and section of the discharge outfall at Sheardown Lake are presented on drawings in Appendix "C".

Milne Inlet

During the RBC Start up at Milne Inlet, effluent from the plant will be transported to the PWSP. The PWSP at Milne Inlet is located near the Lump Ore Stockpile at the shore of the Inlet as shown in Figure 3. Once the RBC system is fully operational, the effluent will be transmitted via a forcemain to the northern mouth of a local drainage ditch in the summer months. During the winter (freezing weather), the effluents will be transported via a vacuum truck to the local drainage ditch.

The PWSP consists of a cell lined with a 1.0mm (40 mil) HDPE liner. The slopes of the PWSP are 2H: 1V with allowance for 0.3m of sludge, 1.5 m of water, and 0.6m of free board. Total operating volume of the PWSP at Milne Inlet will be approximately 575 cubic meters. Detailed design drawings of the PWSP for Mary River are presented in design drawings in Appendix "C".

The effluent from The RBC System will be transferred to a holding tank with a capacity of two days of average flow. The effluent holding tank will be housed adjacent to the RBC System to protect the tank from freezing. Inside temperature will be kept at a minimum of 10 degrees Celsius. The holding tank itself will be sized to hold twice the average daily sewage volume generated.

Once the RBC system is fully operational the effluent will be discharged to a local drainage ditch. During summer months, the contents of the tank will be continuously discharged via a 75-mm forcemain. This forcemain will be constructed above ground from the holding tank to the northern mouth of a local drainage ditch which eventually drains into Milne Inlet. The discharge outfall will be armoured with rip rap (boulders greater than 150mm) in order to protect the ditch from erosion.

During winter months (freezing conditions) the effluent is stored in the holding tank (with a capacity of two days of average flow). A vacuum truck of 1,500-gallon capacity will be utilized to pump the effluent from the holding tank and transport it to the local drainage ditch and discharging the effluents starting from the northern mouth of the ditch. No armouring of the local drainage ditch is warranted for erosion protection due to the frozen ground conditions.

4.0 STARTUP AND COMMISSIONING

Generally it requires a 3-week period for any RBC unit to accumulate enough floc to operate at its optimum conditions. Thus, during start-up of the RBC Systems, effluent will be directed to the PWSP. Some sludge is expected to be bypassed to the PWSP in this period. The effluent, even during the first three weeks, does not have many solids and as such we do not expect sludge to be a problem in the PWSP. The PWSP were designed to accommodate these 3 weeks of flow.

Both PWSP are sized to accommodate 3 weeks of flow for the RBC System start-up, plus an additional 2 weeks of flow for contingency, plus an additional volume to accommodate the wet sludge pumped from the RBC system during regular operation. In addition to the volumes as set out above, the PWSP at Mary River is sized to also store the effluents generated by Tanks-A-Lot system during the exploration phase of the project.

The PWSP are designed and bermed in such a way to ensure there is no seepage. A report on seepage shall be included as part of the Annual Report for the Water Licence.

Both Wastewater Treatment Facilities, at Mary River and Milne Inlet, will be constructed by BIMC personnel with assistance from contractors and the equipment suppliers. All Treatment systems (Tanks-A-Lot and the RBC Systems) will be commissioned by qualified personnel furnished by the equipment suppliers.

5.0 OPERATIONS AND MAINTENANCE

Both routine and non-routine O & M procedures are described in the subsections below.

5.1 Routine O & M

The following procedures associated with operation and maintenance of the sewage facilities will be performed on a scheduled basis while the camps at both Mary River and Milne Inlet are in operation:

- Visual inspection of the RBC unit to detect any leaks, malfunctions, discoloration, foul odours
- Visual inspection of camp kitchen grease traps to ensure proper operation
- Visual inspection of effluent pipeline and heat trace checks along the pipeline to detect any leaks, damage or malfunction of the heat tracing system
- Visual Inspection of the pump station at the camp to verify the liquid levels, and detect any system blockages
- Visual inspection of the discharge outfall to ensure continuous discharge and detect any leaks in the embankment

Prior to inspecting the RBC unit the operator will ensure that the unit is well ventilated and appropriate personal protective gear is worn, including disposable gloves. During routine visual inspection of the RBC unit, attention will be paid to the nature of the biological growth on the disk media. The colour of the growth will typically be dark brown to black on the 1st disk stage. The growth on disks 2-4 will typically range between medium brown to tan on the final section. Unusual discoloration/texture of the disk media growth or strong sour odours could be indicative of process malfunction. Full details of the routine inspections and troubleshooting guidelines are attached in Appendix “A”.

Mechanical maintenance of the RBC unit, including lubrication of the shaft bearings, will be conducted on a monthly basis.

5.2 Non-routine O & M

Non-routine O & M procedures will be preformed associated with the following system needs:

- Sewage sludge management (discussed in Section 6 of this report)
- Unit Start up
- Unit Shutdown

Special start-up procedures must be followed if the RBC unit has been out of operation. These procedures are outlined in detail in Appendix “D” and are briefly summarized below:

- Support bearings on shaft and coupling re-lubricated;
- Primary settling tank should be filled with fresh water;

- While the RBC is rotating, introduce wastewater at design or less than design loading rates; and
- Unit start-up normally requires 2 ½ to 3 weeks, with 50% BOD removal often occurring after one week

Shut down procedures are necessary if the treatment unit is to be taken out of operation for any significant period of time. These procedures are briefly summarized below:

- Remove all accumulated sewage sludge from settlement chambers;
- Clean disk media and flush unit clean; and
- Drain tanks and pipes and disconnect pipes.

6.0 SLUDGE MANAGEMENT

At the design capacity of the RBC System at Mary River, sludge would accumulate at a rate of approximately 13.5 kg per day at the Primary Settling Tank. This sludge will be removed to the PWSP at a frequency of 80 days (this frequency will vary according to actual conditions realized). Thus, at every 80-day interval, approximately 20 cubic meters of wet sludge will be transferred to the WSP. The accumulation of sludge can be indirectly monitored by visually observing the thickness of the scum blanket on the surface of the primary settlement tank.

At the design capacity of the RBC System at Milne Inlet, sludge would accumulate at a rate of approximately 12.9 kg per day at the Primary Settling Tank. This sludge will be removed to the PWSP at a frequency of 52 days (this frequency will vary according to actual conditions realized). Thus, at every 52-day interval, approximately 13.4 cubic meters of wet sludge will be transferred to the WSP.

After completion of the bulk sample program, and after removal of any accumulated supernatants, the sludge contents of both PWSP at Mary River and Milne Inlet will be left to dry out, effectively converting the PWSP to a sludge drying pond. Once the sludge is sufficiently dry (determined by monitoring the moisture content of the sludge), tests on the sludge content will be performed and depending on the results the contents will be buried on site. Accumulated supernatants will be directed to the WWTF for treatment should it not meet effluent discharge criteria set by the Water License.

7.0 CONTINGENCY MEASURES

Design criteria have been established at conservative levels. The WWTF's have been designed to be protective of the receiving environment and meet or exceed the requirements of the water license. In addition to using pre-engineered mechanical treatment systems and as additional contingency, Baffinland has incorporated the temporary storage ponds during periods of start-up, shut-down or during periods of system upset.

The RBC units and the PWSP are located remote from surface water bodies. The RBC is a fully enclosed unit and the PWSP is designed with an impermeable liner. In the event of a spill of untreated or partially treated sewage from these facilities, Baffinland will follow the procedures its spill response plan. Sewage spills will be treated the same as more immediately hazardous hydrocarbon based spills.

8.0 SAMPLING, MONITORING AND REPORTING

Monitoring and reporting will be described in an updated Site Water Management Plan. Sampling and monitoring will include the following:

- Regular sampling of sewage discharge at both WWTFs and PWSPs
- Record of volumes of sewage effluent discharged and sludge generated
- Record of any maintanence undertaken at site

9.0 EFFLUENT EFFECT ON RECEIVING WATERS

Knight Piesold was retained by Baffinland Iron Mines to assess potential effects on the receiving waters from the WWTF and confirm that facility design is appropriate.

9.1 Effluent Toxicity

Environment Canada has recommended toxicity testing of the treated effluent during review of Baffinland's application to amend its water license, and the Nunavut Water Board incorporated this requirement into the amended water license. The WWTF have been designed accordingly.

Environment Canada developed a guideline with respect to ammonia in wastewater effluent discharges (Canada Gazette, 2004). This guideline recommends weekly testing of ammonia and pH in wastewater effluent to establish if the effluent is acutely toxic, based on the following relationship established between ammonia concentration and pH:

$$y = 306132466.34 \text{ x } (2.7183^{(-2.0437 \text{ x } pH)})$$

This relationship between ammonia concentration, pH and acute toxicity is shown on the attached Figure 4, extracted from the Environment Canada guideline (Canada Gazette, 2004).

The acute toxicity of ammonia increases considerably with pH. Knight Piésold measured pH in the marine waters of Milne Inlet on two occasions in August 2007 and recorded pH measurements of 8.05 and 8.15. During water quality monitoring of on-ice drilling in May and June 2007, a pH of 8.27 was recorded. Based on the higher of these two summer-time pH measurements (pH= 8.15), the threshold at which ammonia is acutely toxic in the receiving waters of Milne Inlet is 17.9 mg/L. Based on a PH of 8.0 in Sheardown Lake, ammonia is acutely toxic in that receiving water at 24.3 mg/L.

The sewage treatment plant includes nitrification such that ammonia-nitrogen concentrations in the final effluent will be less than 2 mg/L, which is non-acutely toxic according to the Environment Canada guideline. The final effluent is therefore expected to be acceptable for direct discharge to the final receiving waters of Milne Inlet before mixing.

9.2 Effects of Sewage Effluent Discharges to Sheardown Lake

Baseline Water Quality and Limnology of Sheardown Lake

A description of baseline water quality and limnological conditions of Sheardown Lake was provided in the Bulk Sampling Program Environmental Screening Document (Knight Piesold Ref. No. NB102-00181/6-1, Rev.0, November 20, 2006), based on information available to that date. Since completion of the ESD, additional baseline data have been collected from Sheardown Lake, including data collected under late winter conditions. The following provides an updated overview of existing water quality and limnological data for Sheardown Lake.

As indicated in the ESD, water quality has been measured in Sheardown Lake at several locations near the surface and bottom in August and September 2006. Additional samples were obtained more recently in May and August 2007 to strengthen the baseline data. Sampling included analysis of nutrients and "routine" water quality as well as collection of in situ measurements across depth.

Water quality data collected in 2006 are presented in the ESD; laboratory data collected in 2007 are presented in Tables 1 and 2 and temperature and dissolved oxygen (DO) depth profiles are presented in Figures 5 and 6. Sampling site locations for winter 2007 and summer 2007 are presented in Figures 7 and 8, respectively.

Additionally, a detailed bathymetric survey was conducted in August 2007 of both the north and south basins of Sheardown Lake, to assist in defining aquatic habitat and limnological and hydrological conditions. A bathymetric map of the north basin of Sheardown Lake is presented in Figure 9.

Sheardown Lake exhibits vertical differences in temperature in summer, but temperature becomes uniform across depth by September. Dissolved oxygen was not depleted at depth in August 2006 or 2007 or September 2006 in the northwest basin of Sheardown Lake. However, DO was low (2.7 mg/L) at depth at one site (DL0-01-5) sampled in May 2007 under full ice cover. Additionally, water was anoxic at depth at one site sampled in the southeast basin of Sheardown Lake in May 2007. It should be noted, however, that the majority of the southeast basin of Sheardown Lake appeared to be frozen to the bottom at that time.

As indicated in the ESD, Sheardown Lake is a relatively clear lake (low turbidity and high Secchi Disk depth), is alkaline (pH > 8), soft (hardness 50 mg/L), and contains a relatively low concentration of dissolved solids (61 mg/L). Total phosphorus (TP) was measured using a lower analytical detection limit in May and August 2007 in the Study Area. Data obtained from these sampling periods indicates that the concentration of TP is very low (<0.003 mg/L) and typically not detected. Similarly, nitrate, nitrite, and ammonia concentrations are low and generally not detected.

Several lake trophic classification schemes are presented in Table 3. According to the CCME phosphorus guidance framework, Sheardown Lake would be classified as “ultra-oligotrophic” on the basis of TP concentrations measured in 2007. Similarly, Secchi disk depths reflect oligotrophic – mesotrophic conditions. On the basis of chlorophyll a concentrations measured in winter and summer 2007, Sheardown Lake would be categorized as ultra-oligotrophic.

SUMMARY OF PREDICTED SEWAGE EFFLUENT QUALITY

Sewage will undergo tertiary treatment prior to discharge to the north basin of Sheardown Lake. A summary of predicted sewage effluent quality is provided in Table 4. For the purpose of this assessment, discharge rate is estimated at 33.5 m^3/day.

POTENTIAL EFFECTS TO SHEARDOWN LAKE

The final effluent quality indicates that concentrations of nitrate and ammonia would be ≤10 mg/L N and ≤2 mg/L N, respectively. Although a concentration of nitrate of 10 mg/L N is above the CCME guideline for the protection of aquatic life (2.93 mg/L), it is well below acute toxicity levels (CCME 1999). Similarly, the anticipated concentration of ammonia at end-of-pipe while above the CCME guidelines for the protection of aquatic life (1.86 mg/L N at pH 8 and temperature of 0ºC and 0.83 mg/L N at pH 8 and temperature of 10ºC), would not be acutely toxic end-of-pipe according to the equation for acute toxicity provided in the Canada Gazette (2004), which indicates a maximum allowable concentration of 24.3 mg/L N in effluent at a pH of 8.

A mass balance modelling approach was used as an indicator for potential effects of the treated effluent on water quality in Sheardown Lake. Lake volume was obtained from the bathymetric survey conducted in August 2007 (Figure 9); biochemical oxygen demand (BOD) and faecal coliform bacteria concentrations were estimated using data collected from the adjacent Camp Lake in 2006. The approach assumed a "closed" system (i.e., no inflow or outflow), no settling or degradation of effluent parameters (i.e., conservative approach), and continuous effluent discharge to the lake for a period of 1.5 years. Results of the mass-balance model are presented in Table 4. Assumption of a "closed" system provides a worst case scenario not reflective of field conditions.

The mass-balance model results indicate that fully mixed concentrations of TSS, ammonia, and nitrate would be within CCME guidelines for the protection of aquatic life. While there are no guidelines for BOD or faecal coliform bacteria for the protection of aquatic life, the predicted increases for both parameters would likely not be detectable. The simulated increase in TP lake-wide at the end of 1.5 years indicates that TP would remain within the trophic category of "ultraoligotrophic" (which is defined as TP <0.004 mg/L) and would result in an overall increase of 50% above background. Therefore, the predicted increase is within the "triggers" specified in the CCME guidance framework for the management of phosphorus. In addition to the assumption of a "closed" system, this model does not assume any settling or decay further increasing the conservative nature of the assessment.

Any effects to water quality would be greatest near the effluent discharge point. TSS and other particulate materials may settle near the discharge point as the pipe will be located near the sediments. Therefore, some very localized effects to biota could occur in the vicinity of the outfall, including localized DO depletion and chronic effects related to TSS, ammonia, and nitrate.

Effects of the effluent on dissolved oxygen are more difficult to predict. As the predicted increase in BOD is extremely small (and likely not detectable) the effluent would not be expected to cause substantive depletion of DO in the lake as a whole, but may result in some localized depletion near the outfall, particularly at depth when the lake is stratified.

9.3 Effects of Sewage Effluent Discharges at Milne Inlet

Receiving Drainage Ditch

The receiving environment for the treated sewage effluent at Milne Inlet is a large, wide ditch, several hundred metres in length, which reports to Milne Inlet. Photographs of the discharge ditch are included in Appendix E. The drainage ditch to receive the treated sewage effluent has a very small associated catchment, approximately 0.25 km^2, and therefore provides negligible dilution.

Milne Inlet – Final Receiving Water

Available bathymetry for Milne Inlet is shown on Figure 10. The measurements shown on Figure 10 have not been corrected for tidal variations so are considered approximate. Near-shore water depths have not been collected but water depths ranging from 1.5 m to 2.8 m was measured in excess of 60 m from shore, after which water depth quickly increases to 10 to 15 m. The assumed average water depth from the shoreline to 60 m from shore is 1.0 m. Milne Inlet has semi-diurnal tides. For August 2007 through to September 2007, the lowest tide ranges from 0.1 to 0.3 m. The highest tide for this period ranges from 2.2 to 2.4 m (Department of Fisheries and Oceans, 2006). Qikiqtarjuaq and Alert gauging stations, established by Fisheries and Oceans Canada Hydrographic Service and located along the eastern coast of the Arctic, are likely the water level gauging stations used to predict tides at Milne Inlet. Current velocity within the Eclipse Sound area generally ranges from 15-35 cm/s (Buckley et a.l 1987; Dickens et al. 1990).

Data collected in Ragged Channel, located at Cape Hatt near the northern end of Milne Inlet, indicated that temperature and salinity characteristics at that site were typical of the region (Buckley et al. 1987). In the ice-free season, freshwater inputs from snow melt and rain run off establish a strong surface layer characterized by lower salinity and higher water temperature, which ultimately is mixed with underlying cooler and more saline water by wind and currents. As the open water season progresses and freshwater inputs are reduced, the strength of the surface layer is reduced and thermal and saline stratification is reduced.

At Ragged Channel, water temperature during ice covered conditions (June, 1980) was -1.5ºC throughout the water column. During open water conditions in August, 1980, at the same location, water temperature was approximately 4ºC at the surface and declined to -1ºC by about 70 m depth (Buckley et al .1987). Similarly, salinity was uniform at ~32 parts per trillion (ppt) through the water column during June, but was stratified during August. At that time, surface salinity was about 24 ppt, and increased through the upper 10 m or so of the water column to about 30 ppt (Buckley et al. 1987). Recent salinity measurements at surface where the drainage ditch reports to Milne Inlet measured 22.9 ppt (Knight Piésold, unpublished data).

In-situ water quality measurements were recorded by Knight Piésold on three occasions at the shore where the ditch discharges in August 2007, and water temperatures ranged from 4.4ºC to 9.2ºC, pH ranged from 8.05 to 8.15, and dissolved oxygen ranged from 10.75 to 11.30 mg/L (Knight Piésold, unpublished data).

Discharge Conditions – Summer / Open-Water

Discharge conditions will vary with the season. In early summer (i.e. July), the active layer thaws and sea ice deteriorates and pulls away from shore. July has the largest monthly runoff and is also the month subject to break-up. For example, in early July 2007, most of the sea ice at the lower portion of the inlet had melted, whereas sea ice in the upper half of the inlet towards the mouth was still intact. Phillips Creek would appear to have a meaningful influence on the deterioration of ice at the head of the inlet. Freeze up begins in late September or early October. Open water is present roughly from July through September.

During the open water period, the effluent will be discharged as a slow relatively constant discharge via pipeline at a rate of less than 10 litres per minute. Some infiltration of the effluent into the active layer is expected to occur as the effluent flows towards Milne Inlet, depending upon the progress of ground thaw. It is expected that at this low rate of discharge to the ditch that very little to none of the treated effluent will report directly to Milne Inlet.

Discharge Conditions – Spring Discharge of Winter Accumulation

During the roughly 8-month winter period, effluent discharged to the drainage ditch will freeze. The maximum volume of effluent that could be discharged to the ditch during this 8-month period (measured as water and not ice) is roughly 3,240 m^3 based on the peak design capacity of the WWTF. Actual volumes will be less. Due to low temperatures, the effluent will freeze within the ditch. During the spring thaw, the frozen treated effluent will melt and flow to the thawing ice or marine waters of Milne Inlet. It is estimated that the ice pack will melt over an approximate four week period from approximately mid-June to mid-July. Since the final effluent will be non-toxic, no meaningful environmental effects are anticipated under this discharge scenario. The winter storage, melting, and subsequent mixing in the final receiving waters of Milne Inlet provide some contingency if the final effluent does not achieve the expected treatment levels. A mixing zone in Milne Inlet has not been calculated on the basis that the effluent already meets discharge and acute toxicity requirements. Mixing zones are commonly incorporated into the design of sewage management facilities.

10.0 CONCLUSION

The overall sites and facilities have been designed to limit the impact of this development on the immediate environment. Conservative assumptions have been used, and the RBC systems are designed to produce effluent quality that meets or exceeds the requirements under the Water License.

Proper system maintenance and monitoring of effluent quality will be an important and on-going factor to ensure that the RBC systems will operate in compliance with the Water License and do not adversely impact receiving environments. These RBC Systems will be relatively easy to operate when compared with other systems and tolerant with varying flows and influent loadings.

Upon completion of construction, as-built drawings will be submitted to the Nunavut Water Board.

APPENDIX “A”

- Seprotech data and Manuals on the RBC System

ROTORDISK®
Aerobic Wastewater
Treatment Plant

Model N70

BAFFINLAND
Project #60052

ROTORDISK®
Aerobic Wastewater Treatment Plant
Model N70

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

BAFFINLAND
Project #: 60052

ROTORDISK®

Wastewater Treatment Plant
Model N70

INSTALLATION, OPERATION & MAINTENANCE MANUAL

AUGUST 2007

SEPROTECH SYSTEMS INC.
2378 HOLLY LANE
OTTAWA, ONTARIO
K1V 7P1
CANADA
Tel: (613)-523-1641
Fax: (613)-731-0851

Seprotech Systems Incorporated
2378 Holly Lane, K1V 7P1
Ottawa, Ontario, Canada
Telephone (613) 523-1641
Fax (613) 731-0851

INSTALLATION, OPERATION AND MAINTENANCE

MANUAL

TABLE OF CONTENTS

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS:

1.1 (applies to Steel Tankage only)

When there is a complete ROTORDISK® unit supplied, site preparation is as follows:

A level concrete or well-compacted gravel base is to be supplied by Customer/Contractor.

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. Check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED GROUP INC. will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied.

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.2 - (applies to Concrete Tankage for ROTORDISK® only)

If the ROTORDISK® unit supplied is to be encased in concrete tankage, the site preparation is as follows:

The unit is lowered into the concrete tankage, the pipe at the end of the unit is placed into the opening of the intermediate wall between the primary and final settlement chambers and lowered onto the anchor bolts (contractors supply).

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchor bolts (contractors supply) should be correctly located in concrete in a vertical position. In addition, all bolts should include a levelling nut.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. When the unit is set onto the anchor bolts in the concrete tank, it must be levelled to a slope of no more than 3/4” in 20’ along the length. The unit is then centred in the tank and completely bolted down.

After the unit has been bolted down, check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied. (As shown)

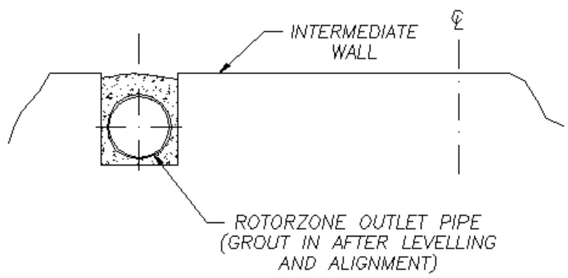


Figure a - **ROTORDISK®** tank outlet through intermediate wall between settlement tank chambers.

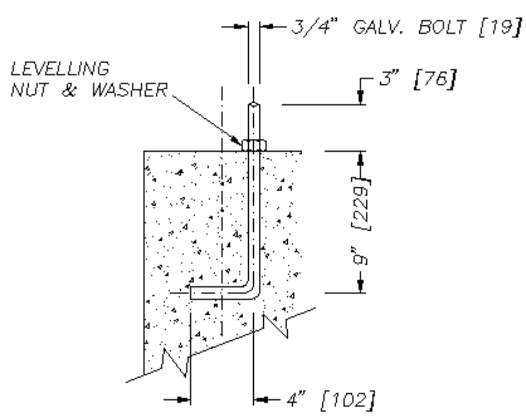
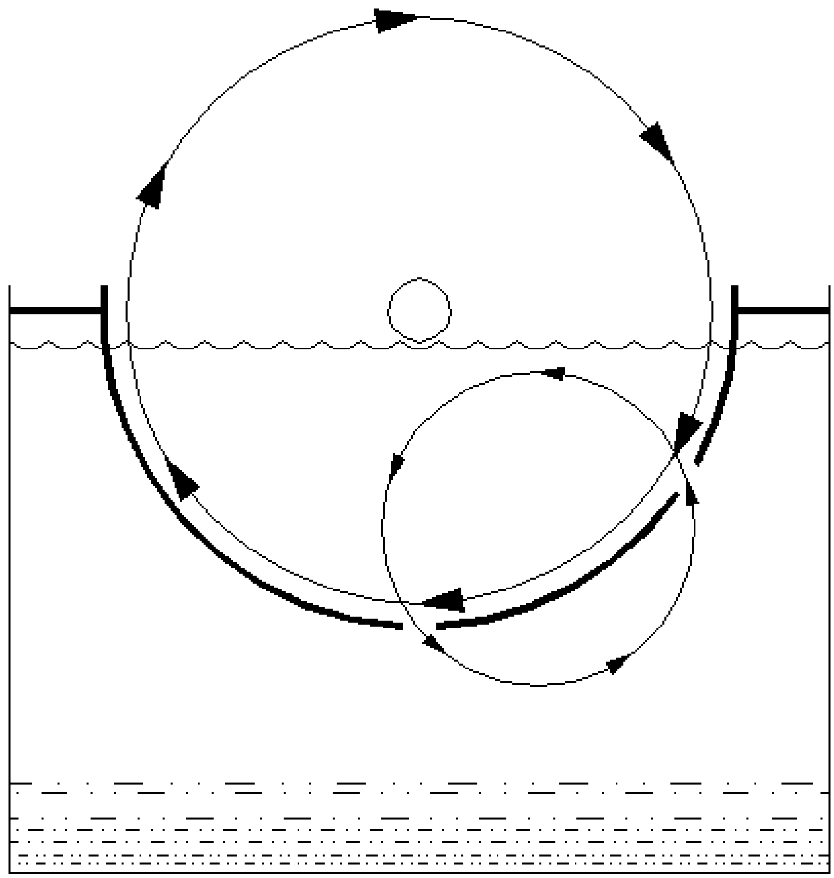


Figure b - anchor bolt detail for **ROTORDISK®** tank.

1.3 - DIRECTION OF SHAFT ROTATION



The direction of shaft rotation should be such that disks mounted on shaft will enter water on the side where inlet to "Rotorzone" is located. The electric motor driving the shaft should be wired accordingly.

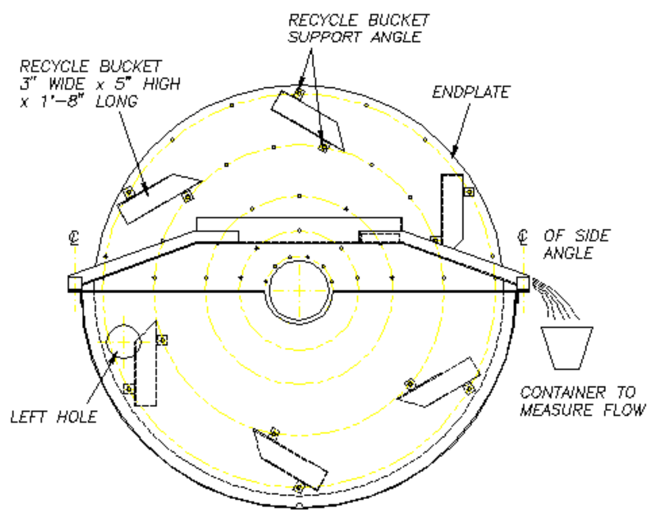
1.4 - DISSOLVED OXYGEN (D.O.) RECYCLE for ROTORDISK®

1.4.1 Recycle buckets are mounted on the last stage of the ROTORDISK®. These buckets rotate at the same speed as the disks. See the attached elevation view of the recycle buckets and trough on the Rotorzone tank.

1.4.2 As the disks rotate, the buckets scoop-up treated wastewater. As this wastewater falls into the recycle trough, it is exposed to the atmosphere, where it absorbs fresh oxygen. The wastewater then cascades on one side of the trough through a narrow steel channel and mixes back with the contents of the Primary Clarifier, thereby introducing fresh dissolved oxygen in the Primary Clarifier. See the section of diskbank assembly showing buckets and recycle trough.

1.4.3 The set-up described above is comprised of the recycle buckets and recycle trough, is what we term as our D.O. re-circulation device. This is especially advantageous to preventing septic conditions from occurring in the Primary Clarifier in small flow or low flow situations.

1.4.4 It is **important** to measure the <u>**actual recycle rate**</u> on the **ROTORDISK®**. This data is compared to our theoretical recycle rate designed. This is advantageous prior to connecting and setting-up for service. Using a container (5 gallon bucket is ideal) and a stopwatch, record the water flowing out of the effluent channel of the recycle trough. Make 3-5 readings, and report this data to SEPROTECH SYSTEMS INCORPORATED for future reference.



SECTION OF DISKBANK ASSEMBLY
SHOWING 6 BUCKETS
AND RECYCLE TROUGH

1.5 - SUMMARY OF OPERATION

(ROTORDISK® systems designed for BOD/SS/Ammonia/Nitrate removal)

A). The sewage plant (as supplied by SEPROTECH SYSTEMS INCORPORATED) is comprised of five (5) main components: the primary settling tank, the RBC tank, the denitrification tank, the secondary settling tank and the multi-media filters.

B). The RBC tank is the aerobic section of the treatment plant divided into four (4) stages.

Raw sewage is pumped and/or gravity flows into the primary settling tank (PST). When the sewage is pumped into the plant, pumping must simulate conditions encountered in gravity fed systems. Indeed, over a 24-hour period, the plant is designed to handle a flow rate corresponding to the Average Daily Flow (ADF) and can accommodate for two Peak Daily Flow (PDF) periods of two (2) hours per day. Each PDF event can be at a maximum of three times ADF.

In the PST, sedimentation separates heavy solids from the bulk of the liquid and the supernatant enters the aerobic section through the inlet slot located at the front section of the RBC tank.

The aerobic section is made up of four stages. The 1st stage is mounted on one common shaft. This 1st stage is comprised of one (1) to three (3) disk banks. The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD removal by biological oxidation occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the rest of the shaft or another common shaft. Each stage has one (1) to three (3) disk banks. It is in the 2nd stage that further BOD is removed, and nitrifying bacteria (those which convert ammonia (NH_3) in the form of ammonium ions (NH_4^+) into nitrite (NO_2^-) and, ultimately, nitrate (NO_3^-)) start to predominate in the 3rd and 4th stages. The 4th and last aerobic stage has recycle buckets that introduce both fresh dissolved oxygen into the primary settling tank and nitrifying bacteria present in the recycled water.

The rotation of the disks in and out of the water provides a mean of air and heat transfer from the ambient air to the water. The transfer of air to the water is important for aerobic bacteria to remove BOD and ammonia. The transfer of heat to the water is important to maintain the water at an optimum temperature of 15 °C and above such that BOD and ammonia removal rates by the bacteria are maximised (removal rates are a function of the water temperature). Because maintaining a temperature that provides acceptable removal rates is important to the process, RBC's are installed indoors and ambient air is maintained at 15 °C and above.

C). The media in the denitrification section is completely submerged since denitrifying bacteria convert nitrate (NO_3^-) to nitrogen gas (N_2) in an anoxic (i.e., in the absence of dissolved oxygen (DO)) environment.

(Text missing pending completion of patent application process.)

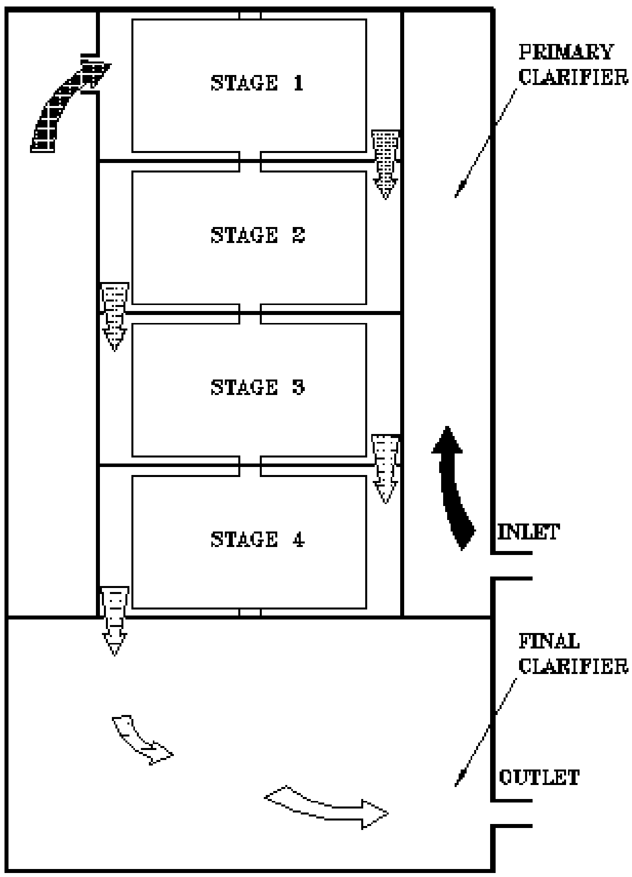
The denitrification section is comprised of two stages separated by a baffle. An equal amount of media is provided in both stages.

D). Partially treated water from the denitrification section then enters the secondary settling tank. Sloughed off biomass from the disks and media bundles and other suspended solids is further settled in this chamber.

E). The partially treated water is then fed to three (3) multi-media filters using one of two (2) submerged pumps. The purpose of these filters is to further reduce the concentration of suspended solids in the final effluent.

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS

ROTORDISK® sewage treatment plants have three major steps in the purification process. In the primary settling tank, gross solids separate from the flow by either sinking or floating. In the Rotorzone, dissolved pollutants are broken down to simple, non-pollutant compounds by the bacteria ("biomass") which grows on the rotating disks. The final settling tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Rotorzone preceding it.



2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settle-able solids at the bottom of the tank. Periodic (9-12 months) removal of sludge at the bottom of the tank is required for proper operation of the Unit.

If no sludge measuring device is available, the accumulation of 9"-12" depth of scum on the surface is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank(s).

2.2 - ROTORZONE

The Rotorzone is subdivided into four sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the denitrification zone.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the unit. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

2.2.1 - 'BATHTUB RING'

The wastewater flows by gravity within a ROTORDISK® Plant thus the water level is relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this suggests that partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction. Another condition which can lead to the level of water rising to greater levels than 1" – 2" is if the plant is fed by pumps that exceed the design limits of the plant (i.e., ADF over a period of 24 hours including a maximum of two (2) PDF events no longer than 2 hours each).

2.3 – ACETIC ACID INJECTION SYSTEM

One of the most important building blocks of life is carbon. The bacteria responsible for denitrification need carbon in an organic form to grow and thus convert nitrate to nitrogen gas. Most soluble organic carbon (often measured in terms of Biochemical Oxygen Demand or BOD) has been consumed in the aerobic section of the wastewater treatment plant and there is thus very little left for the denitrifiers by the time the wastewater reaches the denitrification section of the plant. It is for this reason that acetic acid (vinegar), an easily biodegradable organic carbon source, is injected at the inlet of the denitrification zone.

The system provided consists in a 125 imp. gal. storage tank (ϕ=30", H=49") equipped with a mixer and of a dosing pump of maximum capacity 12.3 l/h mounted on a skid.

The dosing pump can be controlled in either of two ways: by a 4-20 mA signal coming from the flowmeter located on the effluent outlet pipe (the system is programmed to be operated that way by default) or by a dry contact (by others) located outside SEPROTECH SYSTEMS INCORPORATED's main control panel. For example, that dry contact (by others) could be closed when the pumps (by others) feeding the wastewater treatment plant are running and opened when they are not.

The target dose of pure acetic acid (CH_3COOH) in the water is: 175 mg/litre. Assuming that commercial acetic acid is at a concentration of 12% by weight, this means that the target dose of commercial acetic acid at the inlet of the denitrification section would be 1460 mg of commercial acetic acid per liter of water. At ADF (i.e., 49,000 litres per day), this corresponds to a dosing rate of 2.9 litres of commercial acetic acid per hour. If the 4-20 mA signal from the flowmeter is used to control the dosing pump (again, this is the default mode), then the actual dosing rate will be $3 \times 2.9 = 8.7$ litres of commercial acetic acid per hour one third of the time since the flow exiting the plant (via the flowmeter) is pumped from the FST to the multi-media filters at a rate of $3 \times$ ADF = PDF (i.e., 147,000 litres per day).

The average daily quantity of commercial acetic acid necessary has been estimated at 70 l/day (15.4 imp. gal per day) based on an ADF of 49,000 litres/day.

2.4 – DENITRIFICATION ZONE

(Text missing pending completion of patent application process.)

In the denitrification zone, the media is completely submerged such that anoxic conditions (i.e., the absence of Dissolved Oxygen (DO) in the water) prevail and thus the denitrification process (i.e., the conversion of nitrate (NO_3^-) to nitrogen gas (N_2)) can take place. The denitrification zone includes two (2) stages that are separated by a baffle.

2.5 – FINAL SETTLING TANK (FST OR FINAL "CLARIFIER")

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. Clarity can best be judged by scooping a small volume of the final effluent into a clear glass container. This is particularly true of larger units where the depth and dark colour of the tank walls may make clarity hard to determine. (Note: Although the risk of infection is very small, the wearing of rubber gloves is a rational safety precaution when hand-scooping the effluent for a clarity check. This is particularly true if there are open cuts on the hands.)

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the accumulation of floating scum in the primary clarifier.

2.6 – FILTERS FEED PUMPS LOGIC AND LEVELS IN THE FST

The level in the FST is controlled in the following manner:

- Level Switch Low (LSL or float #1): both filter feed pumps (each of capacity = 3 × ADF) stop when this level is reached;
- Level Switch High (LSH or float #2): lead filter feed pump starts when this level is reached;
- Level Switch High High (LSHH or float #3): lag filter feed pump starts (lead filter feed pump is maintained in operation) and an alarm goes off when this level is reached (i.e., the alarm light is activated);
- Overflow: the FST is equipped with an outlet that can be connected directly to the storm sewer in the exceptional case that the plant is overflowed (piping between this outlet and the storm sewer is out of SEPROTECH SYSTEMS INCORPORATED' scope of supply).

2.7 – POST FILTRATION SYSTEM

The clarified water is pumped from the FST to three multi-media filters operating in parallel. The purpose of these multi-media filters is to reduce further the concentration of suspended solids in the treated wastewater.

The three filters operated in parallel are designed to treat peak low rates (PDF) of 3 times the design average daily flow (ADF) and are fed at this flow rate since each filter feed pump also has a capacity of PDF.

Each of the three filters is filled with anthracite, sand and garnet with gravel underbedding. The water is filtered from top to bottom of each filter with the coarser filtration media placed on top and the finer on the bottom of the filter. Each vessel is made of fibreglass. In normal operation (i.e., when all 3 filters operate in parallel), the filtration velocity is about 10 m/h on each filter.

A backwash of one of the three filters is performed approximately every 4 hours. The filters are backwashed alternately, i.e., filter no. 2 gets backwashed approximately 4 hour (exactly 4 hours + the time it takes to backwash and rinse a filter) after filter no. 1 gets backwashed and filter no. 3 gets backwashed approximately 4 hour after filter no. 2 gets backwashed. These operating parameters are adjustable on the plant's main control panel (see Section 2.9). When a backwash occurs, the water pumped at PDF from the FST is fed to two of the filters and the filtrate from these is used to backwash the third filter from bottom to top (inverse direction than in filtration mode). The two filters used to produce the filtrate operate at velocities of approximately 15 m/h while the third filter gets backwashed at a velocity of approximately 30 m/h.

The filtration system is controlled by the main control panel for the plant. The automatic diaphragm valves installed on the filtration unit are pneumatic and are thus opened and closed using compressed air. A compressor is provided with the plant. The compressed air transits through a filters solenoid valves panel.

2.8 – MONITORING OF DISCHARGE FLOW RATE

The plant is equipped with a magnetic flow meter located on the clean effluent's discharge pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant. As mentioned in paragraph 2.3, the flow meter is also used to control the injection rate of acetic acid. A thermal chart recorder was also provided in order to produce hardcopies of the flow measurements taken by the flowmeter.

2.9 – OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL

The following operating parameters were set as default in the Programmable Logic Control (PLC) panel provided with the plant but are adjustable within the ranges shown below. Making changes and adjustments to the default plant's operating parameters requires a good understanding of the wastewater treatment process and should therefore only be performed by qualified and trained staff. Please contact SEPROTECH SYSTEMS INCORPORATED if assistance is needed to optimise the operation of the plant.

	T1 Time between backwashes	T2 Time for a backwash	T3 Time for rinse	T4 Time between sludge pumping	T5 Time for sludge pumping
Factory Setting	4 h	10 min	5 min	1.0 h	0.25 min
Minimum	1 h	5 min	2 min	0.5 h	0.10 min
Maximum	18 h	30 min	30 min	12.0 h	1.00 min

2.10 - FREQUENCY OF INSPECTION

Visual checks every week should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through. A standard operator checklist should be prepared and used by the person responsible for periodic maintenance of the plant at every visit. SEPROTECH SYSTEMS INCORPORATED can assist in preparing such checklist upon request.

The acetic acid storage tank should be topped off every time the plant is being visited.

The pressure loss on every filter should also be controlled. Two pressure gauges were provided for this purpose, one on the inlet pipe and one on the outlet pipe of each filter. The pressure drop across a filter shouldn't exceed 15 PSI. If it does even after a filter has been backwashed, the frequency and/or duration of backwashes should be increased.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of ROTORDISK®, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

A more accurate procedure of determining sludge levels is to directly measure actual accumulations, and compare these to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the ROTORDISK® model in question.

A variety of sludge measuring devices is commercially available. The two most common are the weighted hollow tube type, and, the (electronic) turbidity-change detector type. The former is less costly, relatively easy to use, and more appropriate because of the low frequency with which measurements need to be made in a ROTORDISK® unit.

Whatever means of measuring the sludge may be selected, it must be kept in mind that the sludge is <u>not</u> a firm solids substance. Domestic wastewater sludge is mostly trapped water and other liquids. Only to determine sludge levels by "feeling" for a solid layer with a stick or pole. The settled sludge is far more liquid than the surface scum, which is perhaps 30-40% solids by volume.

Irrespective of the type of device used, sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone trough.

Once an average sludge height has been determined, multiply by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. For smaller ROTORDISK® units, the entire liquid contents of the treatment plant can be withdrawn. For larger installations, the haulage contractor should be instructed to get the suction hose directly to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible. Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank to expose the secondary sludge. The suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed. Haulage contractors should be given a brief description of the unit and its operation if they are not already familiar with it. A particular point to emphasise is that the biological growth on the disks should <u>not</u> be washed off, but should be left in place. The exception to this is if the disks have accumulated excess biomass due to sludge pump out being delayed past the indicated intervals.

Sludge removed from the unit is normally hauled away by the pumping truck and disposed of at municipal facilities, or, by controlled spreading on farmland. On-site disposal in shallow trenches and/or some form of on-site volume reduction (prior to export) may be feasible or desirable depending on the specific opportunities and limitations afforded by the site of a given installation.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Rotorzone at this time (and since start-up) will be in the range of 180-200 mg BOD/1 and 50-250 mg SS/1. The supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Rotorzone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/1 and 10,000 mg BOD/1, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Rotorzone. If, for example, the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the ROTORDISK® unit in question.

3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK®

UNIT OPERATING AT-, AND ABOVE-,
RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

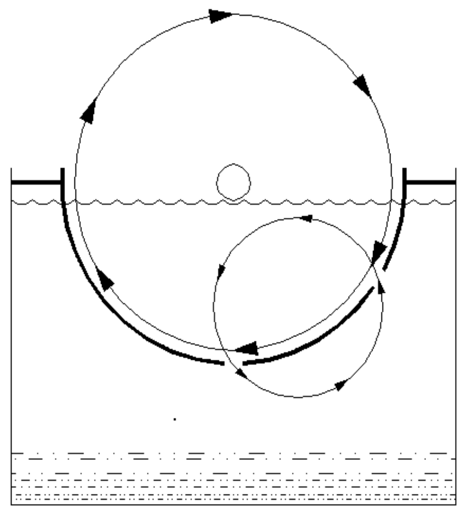


Figure c-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

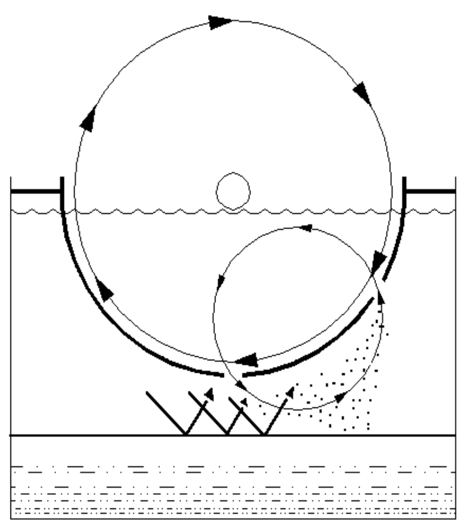


Figure d- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Rotorzone to levels above treatment design.

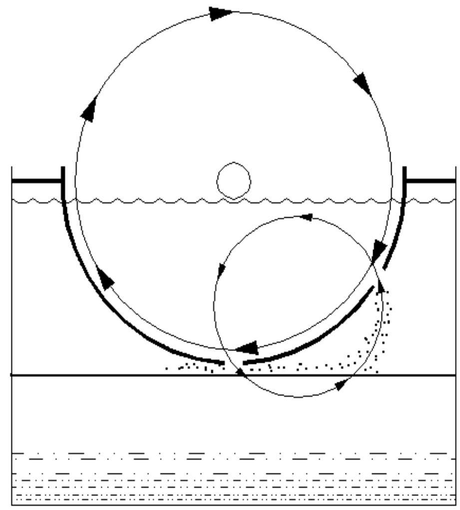


Figure e-Unit operating with excess sludge accumulated to base of Rotorzone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Rotorzone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF ROTORDISK®

WARNING: A VALVE LOCATED AT THE BOTTOM OF THE DENITRIFICATION TANK AND EQUIPPED WITH A REMOTE ACTUATION MECHANISM WAS PROVIDED WITH YOUR UNIT. THIS VALVE:

- Needs to be OPEN: when the plant is first filled with water, during draining if the plant ever requires such operation and during subsequent refilling operations. FAILURE TO OPEN THIS VALVE DURING FILLING AND DRAINING WILL RESULT IN SERIOUS DAMAGE TO THE PLANT. This is because, during a filling operation, the water rising in the PST would push the denitrification tank upwards while it is empty (this tank wouldn't have had a chance to fill with water until the water level reaches the inlet slot between the PST and the aerobic ROTORDISK®. Th open valves provide a mean of filling the PST and the through (denitrification tank included) at the same time.

- Needs to be CLOSED: during normal operation of the plant. Indeed, the denitrification section contains water already partly treatment thus this water and that contained in the PST shouldn't mix. FAILURE TO CLOSING THIS VALVE DURING NORMAL OPERATION OF THE PLANT WILL RESULT IN A POOR QUALITY EFFLUENT.

The ROTORDISK® sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a ROTORDISK® with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the ROTORDISK® with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

Alternately, seeding can be accomplished using dry bacteria and a source of organic carbon such as raw molasses or sugar. This can be done, for example, in situations where wastewater or activated sludge are not available and the plant needs to be ready to treat wastewater very shortly after it begins receiving it. By simulating the conditions encountered in wastewater (where large amounts of organic carbon and bacteria are present), biomass will establish on the ROTORDISK® and the plant can thus be prepared to work under actual conditions before these are actually encountered. SEPROTECH SYSTEMS INCORPORATED can help find appropriate supplies of both dry bacteria and raw molasses.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is <u>not</u> an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is <u>not</u> recommended. This is especially true of the ROTORDISK® process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a ROTORDISK® is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for “pre-starting” a ROTORDISK® unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.

The ROTORDISK® concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of ROTORDISK® is maintained.

<u>4.0 - STORAGE OF **ROTORDISK®** SEWAGE TREATMENT EQUIPMENT</u>

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

2. Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).

3. Support bearings on main ROTORDISK® shaft(s) should be re-lubricated prior to start-up.

4. The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. <u>Water level in the primary settlement tank to be dropped to below the bottom of the Rotorzone tank level, if freezing of the tank contents is possible.</u>

<u>5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED</u>

1. Upon receipt of mechanical components:

   a. Check packing list for any missing items on delivery.

   b. Motor/Reducer is shipped loose, for assembly on the reducer flange. The reducer is shipped completely filled with synthetic lubricant.

   c. Bearing components are shipped as a set. Open only when ready for assembly, to avoid moisture contamination.

   d. Chain and sprockets are shipped as a set. Check for the following:

      -Large sprocket bushing (O.D.) fits into the large sprocket bore.
      -Large sprocket bushing bore (I.D.) fits the Rotordisk® shaft drive end.
      -Small sprocket bore (I.D.) fits on the reducer output shaft.
      -Cottered chain fits or matches the teeth on the sprockets.

   e. Coupling (applicable only to split-shaft ROTORDISK® is shipped as a set. Check the coupling hubs if they fit the center stub ends of the ROTORDISK®shafts.

   f. Disk banks are shipped pre-assembled on the shaft by SEPROTECH SYSTEMS INCORPORATED and are shipped on A-frames. Handle with care, as the Fiberglass of the disk banks is brittle.

   g. Hardware (bolts, nuts, washers) for mounting the following items are provided:

      -Bearings
      -Reducer
      -Recycle trough

2. If, for any reason, the diskbanks must be removed from the shaft, the procedure for remounting them is as follows:

If disk banks are 5 ft. in diameter or larger (supplied in semicircular sections)

Mount them on shaft(s) as shown on Dwg.# GL-28D, with 1/2-20NFX1-1/2 Bolts. Connect two half sections with two connecting plates (see sketch of typical mounting details) Remove outer nuts on required tie rods, fit connecting plate on tie rods over the end plates, then fasten them together with nuts and washers.

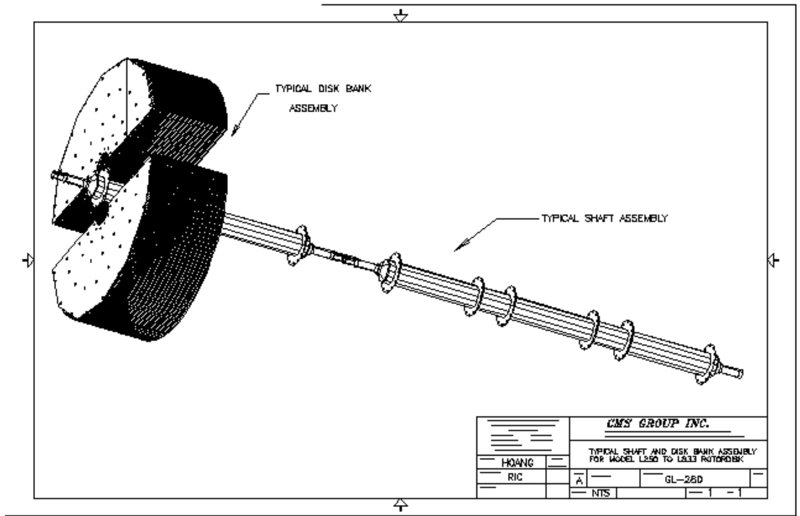


Figure f - typical mounting of disk banks on the shaft(s).

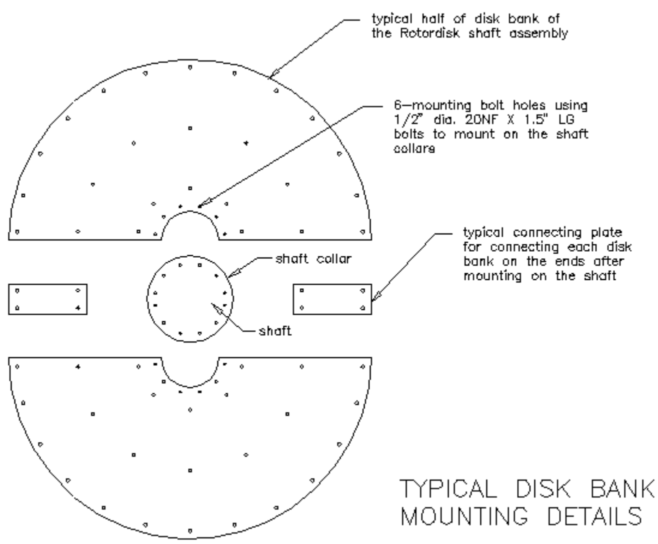


Figure g - exploded view of disk bank mounting parts.

3. Mount Bearings on Shaft(s).

   a) Bearing should be mounted at the centre of stub end. Follow bearing manufacturer's installation instructions.
   b) Use of the bearing fixing rings: one bearing of each pair is "fixed", the other "floating". Install the fixed bearing on the drive end of the shaft and the floating bearing on the non-drive end.

   FOR 'L'Rotordisk® models ONLY: On the shaft where the large sprocket will be mounted, fix the bearing into its housing closest to the sprocket. On the other shaft fix the bearing into its housing closest to the coupling (i.e. one bearing should be fixed on every shaft).

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in the manual, using a bearing locking tool or equal. See installation, operation and maintenance instructions section of this manual regarding bearings.

4. Mount coupling hubs on their respective shafts (if applicable) so that hub face is flush with the end of its shaft (for direct drive and 'L' models). See installation, operation and maintenance instructions section of this manual regarding couplings.

5. Install shaft(s) in ROTORDISK® tank.

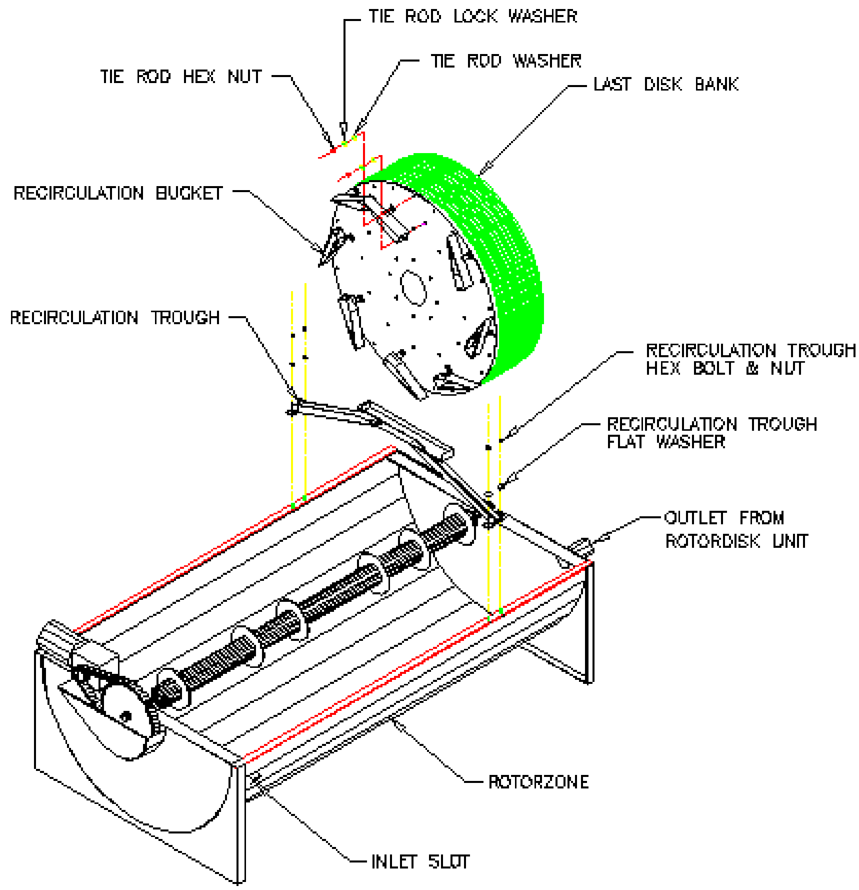
6. Mount small sprocket/coupling hubs on reducer output shaft (whichever is applicable).

7. Install Reducer-Motor Assembly in place. The reducer comes completely filled with synthetic lubricant. Ensure that the breather plug (mounted on top of one of the reducer oil intake ports) is installed on the reducer, after it is mounted on the ROTORDISK®. It is recommended that the motor be mounted into the reducer prior to assembly into the ROTORDISK® tank. Allow for some play in the reducer mounting bolt tightness so the chain tightness can be adjusted later.

8. Connect sprockets with chain. Check the axial alignment of the sprockets while tightening the chain. Tighten the previously loosened reducer mounting bolts after the sprockets are aligned and set in place. See installation, operation and maintenance instructions section of this manual regarding roller chain drives.

9. Connect two coupling hubs, grease, and fit coupling cover (if applicable). Before mounting, check bore on both hubs to match the shaft diameter. See installation, operation and maintenance instructions section of this manual regarding couplings.

10. Mount the stainless steel recycle trough on the ROTORDISK® tank with the bucket opening points to the proper rotation of the shaft.



NOTES:

1. Follow manufacturers instructions in the "Installation & Maintenance Manuals" included by SEPROTECH SYSTEMS INCORPORATED for mounting bearings, couplings (if applicable), reducer, sprockets and chain (if applicable).

2. Make sure all setscrews on sprockets and coupling hubs; bolts on reducer and bearings, are all well tightened before machine goes into operation.

6.0 - ROUTINE MECHANICAL MAINTENANCE OF **ROTORDISK®** SEWAGE TREATMENT PLANTS

6.1 - MOTOR:

If motor is equipped with grease fittings and relief plugs, it should be re-lubricated using a low-pressure gun once a year with Shell Alvenia R2" grease (DO NOT OVER-LUBRICATE). There is no lubrication required for motors without grease fittings and relief plugs

6.2 - REDUCER:

Reduction gear on ROTORDISK® units is filled with synthetic long life lubricant. No inspection or maintenance outside of periodic visual inspection is normally required. If there are no evidence of oil leaks on the seals, the synthetic lubricant must be changed every five (5) years for ROTORDISK® units running 24 hours a day.

Reduction Gear on medium and large ROTORDISK® size units are filled with Shell Tivela 75 oil and does not require oil changes (permanent lubrication). Periodic visual inspection is required. Check oil level and top up to required level with same oil, if necessary.

6.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

6.4 - SPROCKETS AND CHAIN:

(Applicable to non-direct drive ROTORDISK® units)

Chain drive should be inspected every six- (6) months for following points:
- If Chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated.
- Inspect oil for contamination, such as chips, dirt or grit. Replace oil if necessary (Oil with viscosity of SAE30 at ambient temperature 40^o to 100^o F is recommended).
- Milky white colour of the oil is indicative of flooding. Replace oil and determine the cause of the flood.
- Check Chain tension and adjust if required.

6.5 - COUPLING:

(Applicable for direct drive ROTORDISK® units and 'L' models)

Coupling should be checked for lubricant level. Lubricant is to be added if required. Re-lubrication with NLGI#2 or LTG Grease once a year is usually adequate.

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won't start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and "fry" motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn't turn	1. Power failure 2. Motor failure 3. Reducer failure 4. chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

7.2 - ROTORDISK® PROCESS

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	**a.** Pre-aerate RBC influent **b.** For severe organic overloads, increase recycle rate **c.** De-sludge unit **d.** Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or sulfate concentration	**e.** Determine the cause of the problem and correct it at source. For example, aerate equalization tank **f.** Pre-aerate influent wastewater **g.** Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	**a.** Check dissolved oxygen levels to confirm overload problem **b.** Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	▪ See Problem 2, solutions a and b above
	2. Grease on the disks	**a.** Remove grease at source **b.** Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances in influent, including abrupt pH changes	**a.** Eliminate source of toxic or inhibitory substances **b.** Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant **c.** Dilute influent using plant effluent or any other source of water **d.** See Problem 7.4
	2. Variation in flow or organic loading	**a.** - During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit **b.** - During high flow or loading conditions, attempt to throttle plant inflow during peak periods **c.** - For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
7. Decrease in process efficiency	1. Reduced wastewater temperature	**a.** Decrease air opening in RBC building **b.** Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	▪ See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	▪ Install additional treatment units
	4. High or low pH values	▪ Adjust pH to near neutral
	5. Improper rotation of media	▪ Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	**a.** Improve pre-treatment efficiencies **b.** Provide supplemental aeration to help prevent solids from settling **c.** De-sludge primary tank
9. Floating or rising sludge in the secondary clarifier	Removal of sludge from the clarifier is inadequate	**a.** Increase the duration of pumping sludge from the clarifier **b.** Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	▪ Decrease organic loading
	2. Stage loading too high	**a.** Increase number of recycle buckets
	3. Inorganic solids accumulation because of inadequate pre-treatment	▪ Check primary treatment and grit removal equipment for proper operation
	4. Accumulation of minerals	▪ Use chemical pre-treatment to eliminate minerals
	5. Digester supernatant adding excessive BOD or sulfides	▪ Modify supernatant pumping frequency
11. Shaft rotation non-uniform or “jerky”	1. Normal variations in balance	▪ Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	**a.** If severe, shut unit down and wash down disks **b.** Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting **c.** Decrease or stop flow of wastewater to affected units **d.** contact manufacturer for assistance

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
12. Effluent quality apparently below requirements	1. Organic loading too high	**a.** Add additional operating RBCs **b.** Identify cause of additional loading and eliminate at source **c.** Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	**a.** If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor **b.** Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	**a.** Clean and de-sludge clarifier **b.** Modify sludge removal procedures to eliminate BOD kickback **c.** Install filters after clarifier **d.** Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	▪ Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails ($^1/_8$" - $^1/_2$" in size)	**a.** Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily **b.** Contact manufacturer

Contact SEPROTECH SYSTEMS INCORPORATED for advice on how to resolve problems related to the process before making changes to the process or equipment.

Adapted from Water Pollution Control Federation "Manual of Practice OM-10", 1988.

8.0 - MAINTENANCE PROGRAM – Do’s and Don’ts

DO'S

1. Do use biodegradable soap if at all possible. The system will however handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.

2. Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

3. Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.

4. For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.

5. If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.

6. If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.

7. If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

DON'Ts

1. Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.

2. Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.

3. Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.

4. If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.

5. Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.

6. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLE-FREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE **ROTORDISK®** AND OTHER EQUIPMENT SUPPLIED

9.1 INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES

CHAIN TENSIONING:
The proper fit of a chain may be obtained by adjusting the sprocket centres. When a chain is correctly tensioned, the total mid-span movement (double amplitude) in the slack span should be 4-6% of the span length for normal drives.

Where there is no adjustment means, adjustment may be made by removing links to compensate for elongation due to wear (Drives with fixed centres). Proper lubrication and proper drive maintenance may minimize chain wear.

LUBRICATION:
Although many slow speed drives operate successfully with little or no lubrication beyond the initial factory lubrication, proper lubrication will greatly extend the useful life of every chain drive.

A good grade of clean petroleum oil without additives, free from flowing at the prevailing temperatures should be used.

Chain drives should be protected from abrasive and corrosive conditions, and the oil supply kept free of contamination. Periodic oil change is desirable. The lubricant viscosity recommended for ambient temperature 40^{o} - 100^{o}F is SAE 30.

OIL BATH:
With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest point while operating. Only a short length of chain should run through oil.

INSTALLATION RECOMMENDATIONS:

Shafting, bearings and foundations should be supported rigidly to maintain the initial alignment. Roller chain should be free of grit and dirt. Wash chain in kerosene when required. Re-lubricate!

Misalignment results in uneven loading across the width of the chain and may cause roller link-plate and sprocket tooth wear. Drive alignment involves two things:

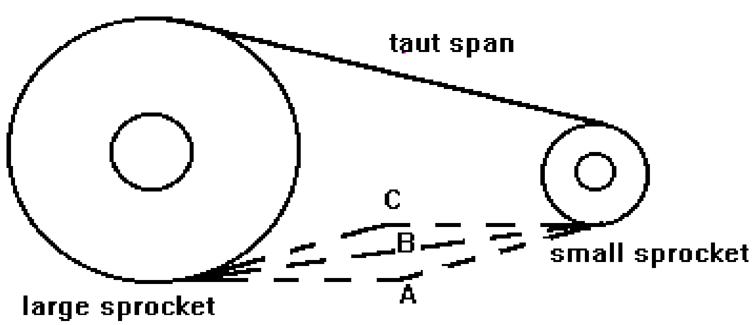
a) Parallel shaft alignment: Shafts should be parallel and level.
b) Axial sprocket alignment: Sprocket axial alignment can be checked with a straight edge, which will extend across the finished sides of the two sprockets.

Normally, it is good practice to align sprockets as close to the shaft bearings as possible.

Installing the Chain: Recheck all preceding adjustments for alignment and make sure all setscrews, bolts and nuts are tight. Fit chain around both sprockets and bring free ends together around one sprocket for connection.

Chain Tension: Check chain tension to be sure that the slack span has 4-6% mid-span movement in horizontal drives.

Recommended Possible Mid-Span Movement AC									
Drive	Tangent Length Between Sprockets								
Center-Line									
	5”	10”	15”	20”	30”	40”	60”	80”	100”
Horizontal to 45	.25”	.5”	.75”	1”	1.5”	2”	3”	4”	5”
Vertical to 45	.12”	.25”	.38”	.5”	.75”	1”	1.5”	2”	2.5”



AC = Total Possible Mid-Span Movement
Depth of Free Sag = .866 AB, approximately

MAINTENANCE RECOMMENDATIONS:

Regular maintenance schedules should be followed for all chain drives. Each drive should be inspected every six months. At each inspection period the following points should be checked:

a) Check Lubrication: If chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated before reinstalling. With bath lubrication, oil should be maintained at the proper level, as shown in lubrication instructions. Add oil if necessary. At each inspection, oil should be checked for contamination, such as chips, dirt or grit.

b) Check sprocket alignment: If the chain is properly aligned, no wear will show on the inner surfaces of the chain roller link-plates. If wear is apparent, this is evidence that sprockets are misalign and should be realigned as outlined in the installation instructions to prevent further chain and sprocket wear.

c) Check sprocket tooth wear: If sprocket shows evidence of wear high on the sprocket teeth, this is evidence of excessive wear in the chain, the chain should be replaced. If the sprocket teeth are severely worn, the sprocket should be replaced. Do not run new chain on worn sprockets.

d) Check chain tension: At each inspection period, the chain tension should be adjusted. If excessive slack has accumulated which cannot be removed by available shaft centre adjustment (i.e. by moving reducer away from large sprocket using chain tensioning bolts), two or more pitches of chain should be removed and chain reconnected.

9.2 PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation
Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip 'G' type seal

MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline. A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings
Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing
Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings
Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

PREPARATION OF PILLOW BLOCK HOUSING

Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

FIXING RINGS

On each shaft one bearing is generally "Held" and other bearings are "Free", to permit shaft expansion. For "Held" bearing housings, use two fixing rings. Place one on each side of bearing.

CAPPING THE PILLOW BLOCK

Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are not manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

GREASE LUBRICATED BLOCKS

Lubrication Notes

Grease Lubrication

If grease is used as a lubricant, it should be smeared between the rolling elements and worked in. The lower half of the housing should be packaged $^1/_2$ to $^3/_4$ full.

PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS

Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill $^1/_2$ to $^3/_4$ of the pillow block base with the same lubricant that was used to pack the bearing.

LUBRICATION PROCEDURE TO BE USED AT START-UP

A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

RE LUBRICATION

Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above			
Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.

2) National Lubricating Grease Institute Consistency Code.

3) Definition of speed categories:
Low: up to 1/4 of catalog speed limit for static oil lubrication.
Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication.
High: 1/2 to full catalog speed limit for static oil lubrication.

4) Consult SKF Engineering if temperature is below 0^{o} or above 200^{o}F.

5) Extremely slow speed will require special consideration if loads are high.

   * Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.

6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.

7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.

8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.

9) Never mix greases with unlike bases.

10) Remove old grease at least once a year.

10 - LIMITED WARRANTY

SEPROTECH SYSTEMS INCORPORATED warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

SEPROTECH SYSTEMS INCORPORATED shall fulfil this warranty by repairing or exchanging any component part, F.O.B. our factory, that in SEPROTECH SYSTEMS' judgement, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

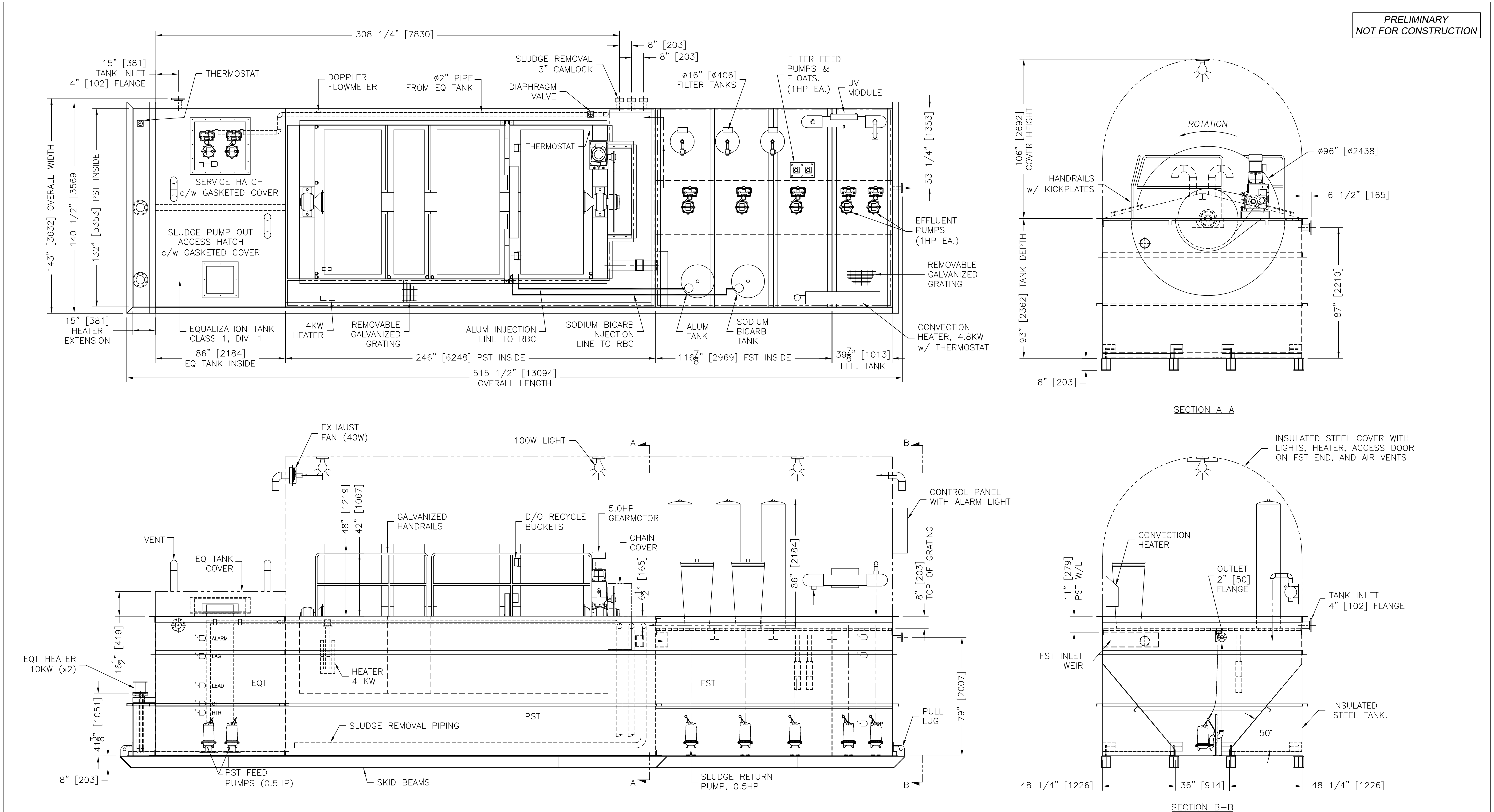
The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. SEPROTECH SYSTEMS INCORPORATED is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

SEPROTECH SYSTEMS INCORPORATED reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. SEPROTECH SYSTEMS INCORPORATED also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgement is equivalent to the Company part replaced.

Under no circumstance will SEPROTECH SYSTEMS INCORPORATED, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of SEPROTECH SYSTEMS INCORPORATED.



NOTES:
1. UNIT TO BE PLACED LEVEL ON CONCRETE OR WELL COMPACTED GRAVEL. (PAD DESIGN BY OTHERS)
2. ALL DIMENSIONS IN BRACKETS ARE IN MILLIMETERS.
3. TANKS, RBC TROUGH, & SHAFT SANDBLASTED AND PAINTED WITH DEVTAR 5A FINISH.
4. INLET/OUTLET ARE STD. 150# ANSI B16.5 RAISED FACE FLANGES.

NOTES:
5. WEIGHT SHOWN IS DRY WEIGHT ONLY.
6. TANKS ARE EQUIPPED WITH DRAIN PORTS FOR SHIPPING PURPOSES ONLY.
7. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION WITHOUT PRIOR APPROVAL OF SEPROTECH SYSTEMS INC.

REV	DESCRIPTION	YY/MM/DD	BY
XX	XXXXX	YY/MM/DD	XX

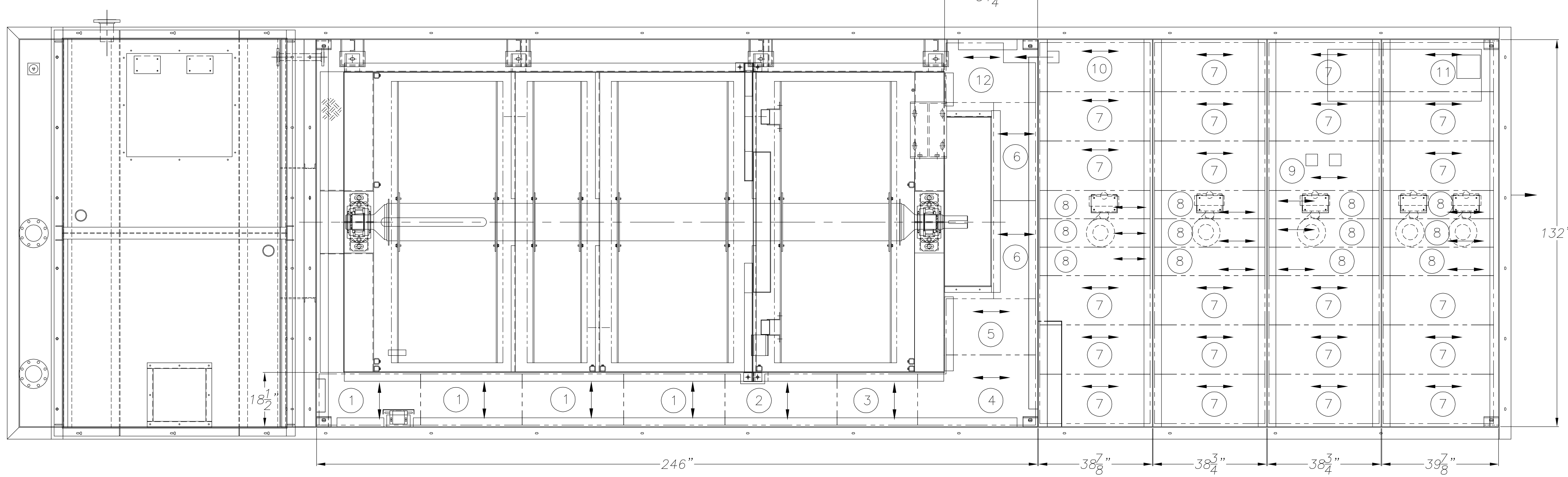
PROJECT:
BAFFINLAND IRON MINES
MARY RIVER, NUNAVUT

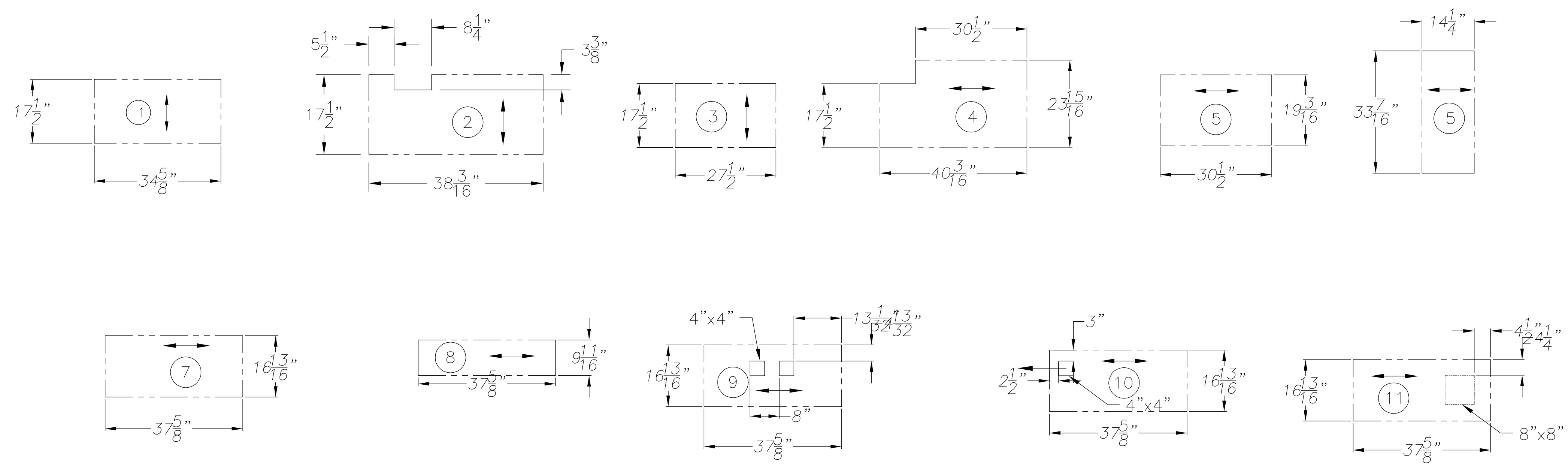
ALL TOLERANCES ARE +/- 1/32" UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES.

Seprotech Water. Pure and Simple
SEPROTECH SYSTEMS INC.
2378 HOLLY LANE OTTAWA, ONTARIO, CANADA K1V 7P1
TEL: (613) 523-1641 FAX: (613) 731-0851
Email: contact@seprotech.com Web: http://www.seprotech.com

DESCRIPTION
MODEL N70, GENERAL ARRANGEMENT
FULL STEEL, w/ FILTERS, EQT & EFFLUENT TANK

DRAWN	CHECKED						
AH							
DATE	SIZE	SCALE	WEIGHT	SHEET	DWG NO.	REV	
28-MAY-2007	B	1:60	50000 LB.	1 OF 1	60052-L01	0	





PANEL DETAILS
SCALE = 1:32

BANDED GALVANIZED GRATING

GRATINGS 1 – 6 & 12 = W/B-6
1 1/4" X 3/16" (8.9 LB/SQ FT)

GRATING 7 – 11 = W/B-8
1 1/2" X 3/16" (10.6 LB/SQ FT)

SADDLE CLIPS INCLUDED.
2 PER PANEL. 94 TOTAL.

GRATING	QTY
1	4
2	1
3	1
4	1
5	1
6	2
7	21
8	12
9	1
10	1
11	1
12	1

NOTES:
1. SADDLE CLIPS INCLUDED, 2 PER PANEL.

NOTES:

REV	DESCRIPTION	YY/MM/DD	BY
XX	XXXXX	YY/MM/DD	XX

ALL TOLERANCES ARE +/– 1/32" UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES.

Seprotech Water. Pure and Simple
SEPROTECH SYSTEMS INC.
2378 HOLLY LANE OTTAWA, ONTARIO, CANADA K1V 7P1
TEL: (613) 523-1641 FAX: (613) 731-0851
Email: contact@seprotech.com Web: http://www.seprotech.com

DESCRIPTION: GRATING, N70 – SPECIAL E70S/F70 w/ FILTERS & EFF. TANK

DRAWN	CHECKED	DATE	SIZE	SCALE	WEIGHT	SHEET	DWG NO.	REV
SA		30-MAY-2007	B	1:40	1980 LB.	1 OF 1	60052-S03	0

Seprotech
Water. Pure and Simple

DESIGN BRIEF

BAFFINLAND - N70

May 25 2007

1. HYDRAULIC DESIGN: (AVERAGE DAILY FLOW)

1 unit at	34	**m3/day =**	34	**m3/day = Q**	
Peak Flow (to EQ tank)	101				
design based on a	24	hour day.			

2. INFLUENT PARAMETERS:

BOD (biochemical oxygen demand) =	519	mg/l
SS (suspended solids) =	519	mg/l
TKN =	65	mg/l
Phosphorus =	10	mg/l

Ontario Application?	n	y/n
Designated Model?	y	y/n
What Model?	N	70

3. TREATED EFFLUENT QUALITY:

BOD (biochemical oxygen demand) =	10	mg/l
SS (suspended solids) =	10	mg/l
NH3-N =	2	mg/l
Phosphorus =	0.5	mg/l

4. R.B.C. SURFACE AREA REQUIRED (AO):

a) Removal in Primary Settling Tank (P.S.T.)

Primary BOD Removal = 10% (Ref.1)

Primary Tank. Eff. BOD = 519 mg/l x 90%

to RBC = 467.1 mg/l

b) RBC BOD Loading.

Applied Load = 467.1 mg/l 34 **m3/day**

15.76 kg BOD/day

c) Area required to reduce BOD to 10 mg/l (AO)

Applied Load = 15.76 kg BOD/day **15.76** **kg BOD/ day**

For 10 mg/l* use 1.93 kg/day/100m2

817 m2

(*in a nitrification application, reduce BOD to 30 mg/l, the nitrification

d) NH3-N to be removed

(Assume Organic Nitrogen is converted to Ammonia NH3)

Removed to	5	mg/l	=		65	less	5	times	**33,750** **litres/day**
=	2.03	kg/day	=		**4.46**	**lb/day**			
Area Required to reduce NH3-N to	5	mg/l							
=	2.03	kg/day		over	0.147	kg NH3-N/day/100 m2		**(Ref. 12)**	
=	1378	m2	=						
Residual NH3-N to be removed below 5 mg/l =	5	mg/l		less	2	mg/l times	**33,750**	**litres/day**	
=	0.101	kg/day							
Area Required to reduce NH3-N to	2								
=	0.101	kg/day		over	0.068	kg NH3-N/day/100 m2			
=	149	m2	=						
Total Nitrification Area Required =	1526	m2	=						

e) Total Surface Media Required

Total Surface Media Required = 2343 m2

f) Staging

Hydraulic Loading	0.15	L/d/m2
B.O.D.post primary	15.76	kg BOD/day
Media req'd(B.O.D)	817	m2
Media req'd(nitrfct'n)	1,526	m2
Total req'd	2,343	m2
Min req'd to prevent 1st st. overload	509	m2
Min req'd to prevent 2nd st. overload	509	m2

	ACTUAL AREA (m2)
First Stage	495
Second Stage	205
Third Stage	822
Fourth Stage	822
TOTAL	2,344

	ACTUAL AREA (ft2)	
First Stage	5,328	21%
Second Stage	2,207	9%
Third Stage	8,848	35%
Fourth Sytage	8,848	35%
TOTAL	25,230	

Minimum First Stage Media Area

Maximum loading to prevent first stage overload = 3.1 kg/day/100 m2

= 15.76 kg of post primary BOD/day divided by max. loading times 100 m2

= 509 m2

=

BOD remaining for 2nd Stage = 15.76 kg/day

Minimum Media 2nd Stage = 508.54 m2

Seprotech
Water. Pure and Simple

5. PRIMARY SETTLING TANK (P.S.T.) (per RBC unit):

a) Primary Settling Tank Influent Flows (per RBC unit)

Average Daily Flow =	**33,750**	**litres/day**		
Recycle at	203%	% =	68584	litres/day
Total Average Flow =	102,334	litres/day		
Peak Daily Flow =	101,250	litres/day		
Peak Flow including Recycle =	169,834	litres/day		

b) Loading Rates

Average Overflow Rate =	16,000	Litres/day/m2	max from	(Ref.5)
Peak Overflow Rate =	24,000	Litres/day/m2 (rounded)		(Ref.7)
Detention Time =	4	hours	use 4 hrs	(Ref.6)

c) Surface Area Required

i) by Average Overflow Rate = Total Average Flow divided by Average Overflow Rate
= 6.40 m2
ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate
= 7.08 m2
Therefore, use 7.08 m2 to compare with actual area of P.S.T.

P. S. T. Surface Area for Model N 6.25 m x 3.35 m = 20.9 m2

Safety factor of: 2.96 times supplied.
Therefore **Surface Area Acceptable**

d) Volume Required **=** Q x Detention Time / 24 hrs / day
= 5.6 m3
P.S.T. Tank Capacity for this N is 44 m3
(after allowance for sludge) 7.7 **safety factor**
Therefore **Volume Acceptable**

6. FINAL SETTLING TANK (F.S.T.):

a) Loading Rates

Average Overflow Rate =	24000	Litres/day/m2	[Ref. 10]
Peak Overflow Rate =	44822	Litres/day/m2	[Ref. 10]
Detention Time =	3	hours	

b) Surface Area Required

i) by Average Overflow Rate = Average Flow divided by Average Overflow Rate
= 1.41 m2
ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate
= 2.26 m2
Therefore, use 2.26 m2 to compare with actual area of F.S.T.

F. S. T. Surface Area for Model N 3.35 m x 3.0 m = **10** m2

Safety factor of 4.41 times supplied.
Therefore **Surface Area Acceptable**

c) Volume Required **=** Q x Detention Time / 1000 / 24 hrs / day
= 4.2 m3 =
F.S.T. Tank Capacity for this N is 10.9 m3
(after allowance for sludge) **2.6** safety factor
Therefore **Volume Acceptable**

Seprotech
Water. Pure and Simple

7. ALUM DOSING CALCULATIONS:

Alum Dosing

$Al_2(SO_4)_3 + 2\ PO_4^{3-} = 2\ AlPO_4 + 3\ SO_4^{2-}$

Assumptions

Conc. Al_2O_3 in comm. alum sol.: 8.1 %

Density comm. alum sol.: 1.328 kg/l

Data specific to site

Conc. P PST: 10 mg/l

Conc. P Out: 0.5 mg/l

Required P removal: 9.5 mg/l
95 %

Black and Veach suggested Al:P molar ratio: 2.3

ADF 33,750 l/day

Required tank autonomy: 28 days = 4 weeks

Dosing Calculations

Conc. Al_2O_3 needed = 37.8 mg/l

Conc. comm. alum sol. needed = 467.1 mg/l

Relative volume comm. alum sol. Needed = 0.000351765 l comm. alum/l wat.

Daily comm. alum consumption = 11.9 l/day

(dosing pump sizing): 0.49 l/h

Volume tank required = 332 l
73 imp. gal.
88 US gal.

Molecular Weights

Al	27 g/mol
P	31 g/mol
$AlPO_4$	122 g/mol
Al_2O_3	102 g/mol
$Al(OH)_3$	78 g/mol
$Al_2(SO_4)_3$	342 g/mol
$Al_2(SO_4)_3 \cdot 14H$	594 g/mol

mol Al per mol Al_2O_3:	2
mol AlPO4 per mol P:	1
mol Al per mol P in $AlPO_4$:	1
mol Al per mol $Al(OH)_3$:	1
mol Al per mol $AlPO_4$:	1

Black and Veach (with interpolations)			
P Reduction	Mole Ratio	Weight Ratio	Weight Ratio
Required (%)	Al:P	Al:P	Alum:P
75	1.38	1.2	13
76	1.41	1.23	13.3
77	1.45	1.26	13.6
78	1.48	1.29	13.9
79	1.52	1.32	14.2
80	1.55	1.35	14.5
81	1.58	1.38	14.8
82	1.62	1.41	15.1
83	1.65	1.44	15.4
84	1.69	1.47	15.7
85	1.72	1.5	16
86	1.78	1.55	16.6
87	1.84	1.6	17.2
88	1.89	1.65	17.8
89	1.95	1.7	18.4
90	2	1.75	19
91	2.05	1.79	19.5
92	2.1	1.83	19.9
93	2.17	1.89	20.6
94	2.24	1.94	21.3
95	2.3	2	22
96	2.38	2.05	22.6
97	2.45	2.1	23.2
98	2.47	2.15	23.8
99.7	2.57	2.235	24.82

7. SLUDGE CALCULATIONS:

<u>Assumptions Used for Calculation of Sludge Accumulation</u>

1. Inlet TSS:	519	mg/l
2. Outlet TSS:	10	mg/l
3. Inlet BOD5:	519	mg/l
4. Outlet BOD5:	10	mg/l
5. Average Daily Flow:	34	m3/day
6. Proportion of inlet BOD5 soluble:	70%	
7. Total incoming solids	17.52	kg/d
8. Inert portion of solids (30%)	5.25	kg/d
9. Remaining organic solids (70%)	12.26	kg/d
11. Assuming Aerobic digester removal efficiency 50%.	6.13	kg/d
12. BOD removed in secondary treatment	15.09	kg/d
13. Sludge produce due to BOD removal	4.53	kg/d
15. Aerobic digester removal efficiency 50%.	2.26	kg/d
16. Total sludge produced per day	13.65	kg/d

<u>Information Pertaining to the ROTORDISK Used in Calculation of Sludge Accumulation</u>

1. All sludge accumulates in the PST (sludge settled in the FST is pumped back to the PST).

2. PST Surface Area:	20.9	m2
3. PST Volume:	43.6	m3
4. PST Sludge Storage Capacity:	21.8	m3
TOTAL Mass of sludge produced that accumulates in the PST:	**13.6**	**kg/day**
Volume of Wet Sludge produced Daily:	0.2730	m3/day
Depth of Wet Sludge produced Daily:	0.0130	m/day
Frequency of Pump-Outs:	80	days

SUMMARY OF REFERENCES

Ref.1
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 475, which states, " Sedimentation with coagulation may remove 60 to 90% of the TSS, 40 to 70% of BOD5, 30 to 60% of COD, 70 to 90% of the Phosphorus, and 80 to 90% of the bacteria loadings. In comparison, sedimentation without coagulation, may remove only 40 to 70% of the TSS, 25 to 40% of the BOD5, 5 to 10% of the Phosphorus loadings, and 50 to 60% of the bacteria loadings."

Ref.2
excerpt from "Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems, Ontario Regulation 374/81 under part VII of the Environmental Protection Act", May 1982, ISBN 0-7743-7303-2, section 12.7.1, which states, "if it is a system operating on the rotating biological disc or similar principle involving contact of the biomass with air, provide a disc area so that the daily loading of sewage will not be in excess of 1.25 kg of BOD5 per 100 sq.m. of disc area, or a hydraulic loading in excess of 45 l/sq.m. of disc area".

Ref.3
excerpt from "Pilot Plant Studies of Rotating Biological Contactors treating municipal Wastewater", by: K.L. Murphy and R.W. Wilson, International Environmental Consultants Ltd., Toronto Ontario, prepared for Central Mortgage and Housing Corporation, Ottawa, Ontario.

Ref.4
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 776, which states, "...whenever the first stage loading limit exceeded 3.1 kg BOD5/100 sq.m.day(6.4 lbs. BOD5/d/1000 sq.ft.), the system was associated with the presence of sulfur-oxidizing organisms".

Ref.5
excerpt from "EPA Process Design Manual, On-site Wastewater Treatment and Disposal Systems", Oct 1980, EPA 625/1-80-012, section 6.4.2.4.e., p.149, which states, "...average flow design values normally range from 200 to 400 gpd/sq.ft.(8 to 16 cu.m./d/sq.m.)".

Ref.6
excerpt from " O&M of Trickling Filters, RBC's, and Related Processes, Manual of Practice OM-10, 1988, Water Pollution Control Federation, p. 105, which states, " Weir overflow rates typically range from 125 to 250 cu.m./m.d (10,000 to 20,000 USgpd/ft.)...The wastewater detention time in a settling basin is normally between 1 to 3 hours, but has been as high as 10 hours with excellent results". [use 4 hours]

Ref.7
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 6.4.2., which states, " the peak overflow rate may be 2,500 to 3,000 USgpd/sq.ft. (100 to 120 cu.m./sq.m.d) for primary clarifiers followed by biological treatment processess".
" Clarifiers handling chemical flocs, such as aluminum or iron coagulants, should be designed for peak overflow rates no longer than 600 and 800 USgpd/sq.ft.(24 and 32 cu.m./sq.m.d)".

Ref.8
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 484, which states, " TSS removal efficiencies in primary sedimentation tanks usually range between 50 and 65%. Many designers assume a removal efficiency of 60% for estimation purposes".

Ref.9
excerpt from "Wastewater Engineering Treatment, Disposal, and Reuse", 3rd ed., Metcalf and Eddy Inc., revised by George Tchobanoglous and Franklin L. Burton, p.808, table 12-14, which shows,"...typical concentrations of thickened sludge for a rotating biological contactor is 2 to 5%".

Ref.10
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.10, which states, " Murphy and Wilson recommend surface overflow rates less than 600 gpd/sq.ft. to maximize solids removal... DeCarlo recommends that peak hydraulic rates be limited to 1000 to 1200 gpd/sq.ft.".

Ref.11
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 9.2.4.6, p.9-43, which states, " Sludge produced by the RBC unit is similar to humus sludge from a trickling filter. The amount of sludge produced will depend on waste characteristics and loading rates. An RBC unit designed for 80% BOD5 removal would produce about 0.7 lb. of sludge per lb. of BOD5 removed; 95% percent removal would produce about 0.3 lb. of sludge."

Ref.12
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 5.5.2.2, which states, "Figure 5-19 represents data for one day for a given stage...The zero-order removal rate above bulk liquid ammonia nitrogen concentrations of 5 mg/l in Figure 5-19 is projected at 0.3 lb. NH3-N/day/1000 sq.ft., same as the Autotrol design". (Figure 5-19 attached)

Ref.13
excerpt from Ministry of Environment and Energy - Ahlberg & Kwong Report - "Winter Operation"
No process or operating problems were experienced throughout the winter. The minimum temperature encountered in the unit, with a raw sewage feed rate of 320 gpd, was 4 oC. Process performance remained good during the winter even under conditions of intermittent operation.

Ref.14
excerpt from the Forgie study
For the RBC unit and wastewater tested, the effect of temperature on removal efficiency over the 15 oC to 5 oC range was relatively low (theta = 1.001 to 1.02)

Ref.15
excerpt from Trinh - Environment Canada "Exploration Camp Wastewater Characterization and Treatment Plant Assessment"
It [the RBC] also operated at a low liquid temperature of 4 oC during one week without the effluent quality deteriorating.

Ref.15
WEF MOPNo. 8, p913 Oxygen recovery is 2.86 mg O2/mg NO3-N reduced."

Ref.16
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106,
section 2.9.3, which states, " The observed denitrification rate at 550F was approximately 0.85 lb NO3-N /day/1000sq. ft.."

Ref.17
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106,
section 2.9.2, which states, " The commonly used design value for the required methanol dosage is 3 mg/mg NO3-N reduced."

Ref.18
WEF MOPNo. 8, p913 states that "Oxygen recovery is 2.86 mg O2/mg NO3-N reduced." and that Heterotrophic biomass production is approximately 0.4 mg VSS/mg COD removed"

ROTORDISK®
Aerobic Wastewater
Treatment Plant

Model B30
Shanco Baffinland
Project #60069

ROTORDISK®
Aerobic Wastewater Treatment Plant
Model B30

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Shanco Baffinland
Project #60069

Seprotech
Water. Pure and Simple

ROTORDISK®

Wastewater Treatment Plant
Model B30

INSTALLATION, OPERATION & MAINTENANCE MANUAL

August 2007

SEPROTECH SYSTEMS INC.
2378 HOLLY LANE
OTTAWA, ONTARIO
K1V 7P1
CANADA
Tel: (613)-523-1641
Fax: (613)-731-0851

Seprotech Systems Incorporated
2378 Holly Lane, K1V 7P1
Ottawa, Ontario, Canada
Telephone (613) 523-1641
Fax (613) 731-0851

INSTALLATION, OPERATION AND MAINTENANCE

MANUAL

TABLE OF CONTENTS

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS:

1.1 (applies to Steel Tankage only)

When there is a complete ROTORDISK® unit supplied, site preparation is as follows:

A level concrete or well-compacted gravel base is to be supplied by Customer/Contractor.

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. Check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED GROUP INC. will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied.

<u>IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.</u>

1.2 - (applies to Concrete Tankage for ROTORDISK® only)

If the ROTORDISK® unit supplied is to be encased in concrete tankage, the site preparation is as follows:

The unit is lowered into the concrete tankage, the pipe at the end of the unit is placed into the opening of the intermediate wall between the primary and final settlement chambers and lowered onto the anchor bolts (contractors supply).

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchor bolts (contractors supply) should be correctly located in concrete in a vertical position. In addition, all bolts should include a levelling nut.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. When the unit is set onto the anchor bolts in the concrete tank, it must be levelled to a slope of no more than 3/4” in 20’ along the length. The unit is then centred in the tank and completely bolted down.

After the unit has been bolted down, check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied. (As shown)

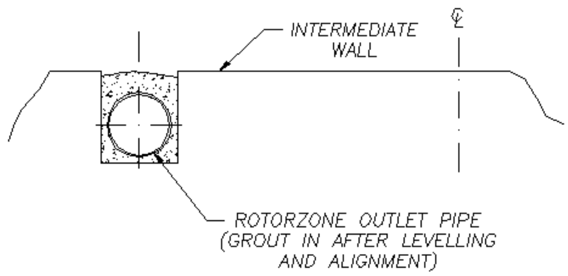


Figure a - **ROTORDISK®** tank outlet through intermediate wall between settlement tank chambers.

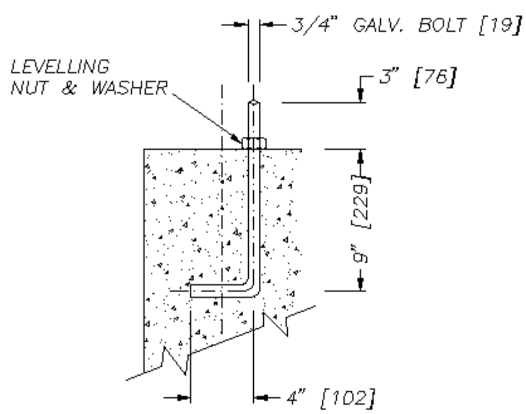
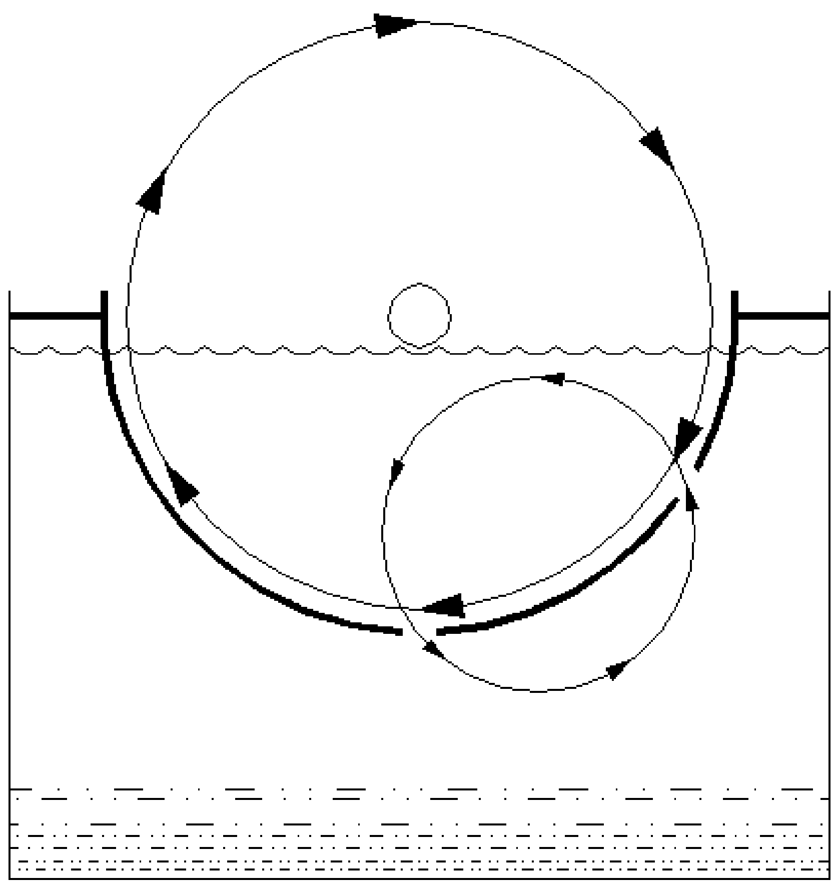


Figure b - anchor bolt detail for **ROTORDISK®** tank.

1.3 - DIRECTION OF SHAFT ROTATION



The direction of shaft rotation should be such that disks mounted on shaft will enter water on the side where inlet to "Rotorzone" is located. The electric motor driving the shaft should be wired accordingly.

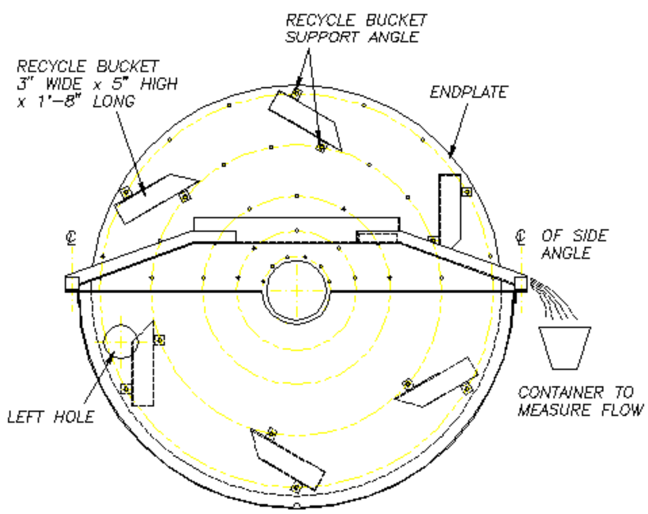
1.4 - DISSOLVED OXYGEN (D.O.) RECYCLE for ROTORDISK®

1.4.1 Recycle buckets are mounted on the last stage of the ROTORDISK®. These buckets rotate at the same speed as the disks. See the attached elevation view of the recycle buckets and trough on the Rotorzone tank.

1.4.2 As the disks rotate, the buckets scoop-up treated wastewater. As this wastewater falls into the recycle trough, it is exposed to the atmosphere, where it absorbs fresh oxygen. The wastewater then cascades on one side of the trough through a narrow steel channel and mixes back with the contents of the Primary Clarifier, thereby introducing fresh dissolved oxygen in the Primary Clarifier. See the section of diskbank assembly showing buckets and recycle trough.

1.4.3 The set-up described above is comprised of the recycle buckets and recycle trough, is what we term as our D.O. re-circulation device. This is especially advantageous to preventing septic conditions from occurring in the Primary Clarifier in small flow or low flow situations.

1.4.4 It is **important** to measure the **actual recycle rate** on the **ROTORDISK®**. This data is compared to our theoretical recycle rate designed. This is advantageous prior to connecting and setting-up for service. Using a container (5 gallon bucket is ideal) and a stopwatch, record the water flowing out of the effluent channel of the recycle trough. Make 3-5 readings, and report this data to SEPROTECH SYSTEMS INCORPORATED for future reference.



SECTION OF DISKBANK ASSEMBLY
SHOWING 6 BUCKETS
AND RECYCLE TROUGH

1.5 - SUMMARY OF OPERATION

(ROTORDISK® systems designed for BOD/SS/Ammonia/Nitrate removal)

A). The sewage plant (as supplied by SEPROTECH SYSTEMS INCORPORATED) is comprised of five (5) main components: the primary settling tank, the RBC tank, the denitrification tank, the secondary settling tank and the multi-media filters.

B). The RBC tank is the aerobic section of the treatment plant divided into four (4) stages.

Raw sewage is pumped and/or gravity flows into the primary settling tank (PST). When the sewage is pumped into the plant, pumping must simulate conditions encountered in gravity fed systems. Indeed, over a 24-hour period, the plant is designed to handle a flow rate corresponding to the Average Daily Flow (ADF) and can accommodate for two Peak Daily Flow (PDF) periods of two (2) hours per day. Each PDF event can be at a maximum of three times ADF.

In the PST, sedimentation separates heavy solids from the bulk of the liquid and the supernatant enters the aerobic section through the inlet slot located at the front section of the RBC tank.

The aerobic section is made up of four stages. The 1st stage is mounted on one common shaft. This 1st stage is comprised of one (1) to three (3) disk banks. The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD removal by biological oxidation occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the rest of the shaft or another common shaft. Each stage has one (1) to three (3) disk banks. It is in the 2nd stage that further BOD is removed, and nitrifying bacteria (those which convert ammonia (NH_3) in the form of ammonium ions (NH_4^+) into nitrite (NO_2^-) and, ultimately, nitrate (NO_3^-)) start to predominate in the 3rd and 4th stages. The 4th and last aerobic stage has recycle buckets that introduce both fresh dissolved oxygen into the primary settling tank and nitrifying bacteria present in the recycled water.

The rotation of the disks in and out of the water provides a mean of air and heat transfer from the ambient air to the water. The transfer of air to the water is important for aerobic bacteria to remove BOD and ammonia. The transfer of heat to the water is important to maintain the water at an optimum temperature of 15 °C and above such that BOD and ammonia removal rates by the bacteria are maximised (removal rates are a function of the water temperature). Because maintaining a temperature that provides acceptable removal rates is important to the process, RBC's are installed indoors and ambient air is maintained at 15 °C and above.

C). The media in the denitrification section is completely submerged since denitrifying bacteria convert nitrate (NO_3^-) to nitrogen gas (N_2) in an anoxic (i.e., in the absence of dissolved oxygen (DO)) environment.

(Text missing pending completion of patent application process.)

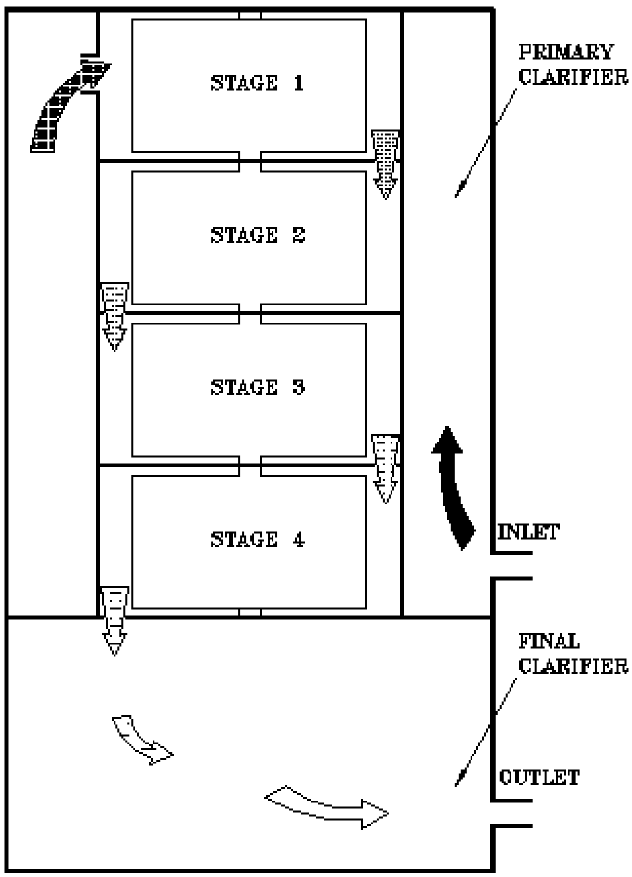
The denitrification section is comprised of two stages separated by a baffle. An equal amount of media is provided in both stages.

D). Partially treated water from the denitrification section then enters the secondary settling tank. Sloughed off biomass from the disks and media bundles and other suspended solids is further settled in this chamber.

E). The partially treated water is then fed to three (3) multi-media filters using one of two (2) submerged pumps. The purpose of these filters is to further reduce the concentration of suspended solids in the final effluent.

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS

ROTORDISK® sewage treatment plants have three major steps in the purification process. In the primary settling tank, gross solids separate from the flow by either sinking or floating. In the Rotorzone, dissolved pollutants are broken down to simple, non-pollutant compounds by the bacteria ("biomass") which grows on the rotating disks. The final settling tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Rotorzone preceding it.



2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settle-able solids at the bottom of the tank. Periodic (9-12 months) removal of sludge at the bottom of the tank is required for proper operation of the Unit.

If no sludge measuring device is available, the accumulation of 9"-12" depth of scum on the surface is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank(s).

2.2 - ROTORZONE

The Rotorzone is subdivided into four sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the denitrification zone.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the unit. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

2.2.1 - 'BATHTUB RING'

The wastewater flows by gravity within a ROTORDISK® Plant thus the water level is relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this suggests that partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction. Another condition which can lead to the level of water rising to greater levels than 1" – 2" is if the plant is fed by pumps that exceed the design limits of the plant (i.e., ADF over a period of 24 hours including a maximum of two (2) PDF events no longer than 2 hours each).

2.3 – ACETIC ACID INJECTION SYSTEM

One of the most important building blocks of life is carbon. The bacteria responsible for denitrification need carbon in an organic form to grow and thus convert nitrate to nitrogen gas. Most soluble organic carbon (often measured in terms of Biochemical Oxygen Demand or BOD) has been consumed in the aerobic section of the wastewater treatment plant and there is thus very little left for the denitrifiers by the time the wastewater reaches the denitrification section of the plant. It is for this reason that acetic acid (vinegar), an easily biodegradable organic carbon source, is injected at the inlet of the denitrification zone.

The system provided consists in a 125 imp. gal. storage tank (ϕ=30", H=49") equipped with a mixer and of a dosing pump of maximum capacity 12.3 l/h mounted on a skid.

The dosing pump can be controlled in either of two ways: by a 4-20 mA signal coming from the flowmeter located on the effluent outlet pipe (the system is programmed to be operated that way by default) or by a dry contact (by others) located outside SEPROTECH SYSTEMS INCORPORATED's main control panel. For example, that dry contact (by others) could be closed when the pumps (by others) feeding the wastewater treatment plant are running and opened when they are not.

The target dose of pure acetic acid (CH_3COOH) in the water is: 175 mg/litre. Assuming that commercial acetic acid is at a concentration of 12% by weight, this means that the target dose of commercial acetic acid at the inlet of the denitrification section would be 1460 mg of commercial acetic acid per liter of water. At ADF (i.e., 49,000 litres per day), this corresponds to a dosing rate of 2.9 litres of commercial acetic acid per hour. If the 4-20 mA signal from the flowmeter is used to control the dosing pump (again, this is the default mode), then the actual dosing rate will be $3 \times 2.9 = 8.7$ litres of commercial acetic acid per hour one third of the time since the flow exiting the plant (via the flowmeter) is pumped from the FST to the multi-media filters at a rate of $3 \times \text{ADF} = \text{PDF}$ (i.e., 147,000 litres per day).

The average daily quantity of commercial acetic acid necessary has been estimated at 70 l/day (15.4 imp. gal per day) based on an ADF of 49,000 litres/day.

2.4 – DENITRIFICATION ZONE

(Text missing pending completion of patent application process.)

In the denitrification zone, the media is completely submerged such that anoxic conditions (i.e., the absence of Dissolved Oxygen (DO) in the water) prevail and thus the denitrification process (i.e., the conversion of nitrate (NO_3^-) to nitrogen gas (N_2)) can take place. The denitrification zone includes two (2) stages that are separated by a baffle.

2.5 – FINAL SETTLING TANK (FST OR FINAL "CLARIFIER")

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. Clarity can best be judged by scooping a small volume of the final effluent into a clear glass container. This is particularly true of larger units where the depth and dark colour of the tank walls may make clarity hard to determine. (Note: Although the risk of infection is very small, the wearing of rubber gloves is a rational safety precaution when hand-scooping the effluent for a clarity check. This is particularly true if there are open cuts on the hands.)

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the accumulation of floating scum in the primary clarifier.

2.6 – FILTERS FEED PUMPS LOGIC AND LEVELS IN THE FST

The level in the FST is controlled in the following manner:

- Level Switch Low (LSL or float #1): both filter feed pumps (each of capacity = 3 × ADF) stop when this level is reached;
- Level Switch High (LSH or float #2): lead filter feed pump starts when this level is reached;
- Level Switch High High (LSHH or float #3): lag filter feed pump starts (lead filter feed pump is maintained in operation) and an alarm goes off when this level is reached (i.e., the alarm light is activated);
- Overflow: the FST is equipped with an outlet that can be connected directly to the storm sewer in the exceptional case that the plant is overflowed (piping between this outlet and the storm sewer is out of SEPROTECH SYSTEMS INCORPORATED' scope of supply).

2.7 – POST FILTRATION SYSTEM

The clarified water is pumped from the FST to three multi-media filters operating in parallel. The purpose of these multi-media filters is to reduce further the concentration of suspended solids in the treated wastewater.

The three filters operated in parallel are designed to treat peak low rates (PDF) of 3 times the design average daily flow (ADF) and are fed at this flow rate since each filter feed pump also has a capacity of PDF.

Each of the three filters is filled with anthracite, sand and garnet with gravel underbedding. The water is filtered from top to bottom of each filter with the coarser filtration media placed on top and the finer on the bottom of the filter. Each vessel is made of fibreglass. In normal operation (i.e., when all 3 filters operate in parallel), the filtration velocity is about 10 m/h on each filter.

A backwash of one of the three filters is performed approximately every 4 hours. The filters are backwashed alternately, i.e., filter no. 2 gets backwashed approximately 4 hour (exactly 4 hours + the time it takes to backwash and rinse a filter) after filter no. 1 gets backwashed and filter no. 3 gets backwashed approximately 4 hour after filter no. 2 gets backwashed. These operating parameters are adjustable on the plant's main control panel (see Section 2.9). When a backwash occurs, the water pumped at PDF from the FST is fed to two of the filters and the filtrate from these is used to backwash the third filter from bottom to top (inverse direction than in filtration mode). The two filters used to produce the filtrate operate at velocities of approximately 15 m/h while the third filter gets backwashed at a velocity of approximately 30 m/h.

The filtration system is controlled by the main control panel for the plant. The automatic diaphragm valves installed on the filtration unit are pneumatic and are thus opened and closed using compressed air. A compressor is provided with the plant. The compressed air transits through a filters solenoid valves panel.

2.8 – MONITORING OF DISCHARGE FLOW RATE

The plant is equipped with a magnetic flow meter located on the clean effluent's discharge pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant. As mentioned in paragraph 2.3, the flow meter is also used to control the injection rate of acetic acid. A thermal chart recorder was also provided in order to produce hardcopies of the flow measurements taken by the flowmeter.

2.9 – OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL

The following operating parameters were set as default in the Programmable Logic Control (PLC) panel provided with the plant but are adjustable within the ranges shown below. Making changes and adjustments to the default plant's operating parameters requires a good understanding of the wastewater treatment process and should therefore only be performed by qualified and trained staff. Please contact SEPROTECH SYSTEMS INCORPORATED if assistance is needed to optimise the operation of the plant.

	T1 Time between backwashes	T2 Time for a backwash	T3 Time for rinse	T4 Time between sludge pumping	T5 Time for sludge pumping
Factory Setting	4 h	10 min	5 min	1.0 h	0.25 min
Minimum	1 h	5 min	2 min	0.5 h	0.10 min
Maximum	18 h	30 min	30 min	12.0 h	1.00 min

2.10 - FREQUENCY OF INSPECTION

Visual checks every week should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through. A standard operator checklist should be prepared and used by the person responsible for periodic maintenance of the plant at every visit. SEPROTECH SYSTEMS INCORPORATED can assist in preparing such checklist upon request.

The acetic acid storage tank should be topped off every time the plant is being visited.

The pressure loss on every filter should also be controlled. Two pressure gauges were provided for this purpose, one on the inlet pipe and one on the outlet pipe of each filter. The pressure drop across a filter shouldn't exceed 15 PSI. If it does even after a filter has been backwashed, the frequency and/or duration of backwashes should be increased.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of ROTORDISK®, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

A more accurate procedure of determining sludge levels is to directly measure actual accumulations, and compare these to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the ROTORDISK® model in question.

A variety of sludge measuring devices is commercially available. The two most common are the weighted hollow tube type, and, the (electronic) turbidity-change detector type. The former is less costly, relatively easy to use, and more appropriate because of the low frequency with which measurements need to be made in a ROTORDISK® unit.

Whatever means of measuring the sludge may be selected, it must be kept in mind that the sludge is <u>not</u> a firm solids substance. Domestic wastewater sludge is mostly trapped water and other liquids. Only to determine sludge levels by "feeling" for a solid layer with a stick or pole. The settled sludge is far more liquid than the surface scum, which is perhaps 30-40% solids by volume.

Irrespective of the type of device used, sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone trough.

Once an average sludge height has been determined, multiply by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. For smaller ROTORDISK® units, the entire liquid contents of the treatment plant can be withdrawn. For larger installations, the haulage contractor should be instructed to get the suction hose directly to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible. Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank to expose the secondary sludge. The suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed. Haulage contractors should be given a brief description of the unit and its operation if they are not already familiar with it. A particular point to emphasise is that the biological growth on the disks should <u>not</u> be washed off, but should be left in place. The exception to this is if the disks have accumulated excess biomass due to sludge pump out being delayed past the indicated intervals.

Sludge removed from the unit is normally hauled away by the pumping truck and disposed of at municipal facilities, or, by controlled spreading on farmland. On-site disposal in shallow trenches and/or some form of on-site volume reduction (prior to export) may be feasible or desirable depending on the specific opportunities and limitations afforded by the site of a given installation.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Rotorzone at this time (and since start-up) will be in the range of 180-200 mg BOD/1 and 50-250 mg SS/1. The supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Rotorzone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/1 and 10,000 mg BOD/1, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Rotorzone. If, for example, the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the ROTORDISK® unit in question.

3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK®

UNIT OPERATING AT-, AND ABOVE-,
RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

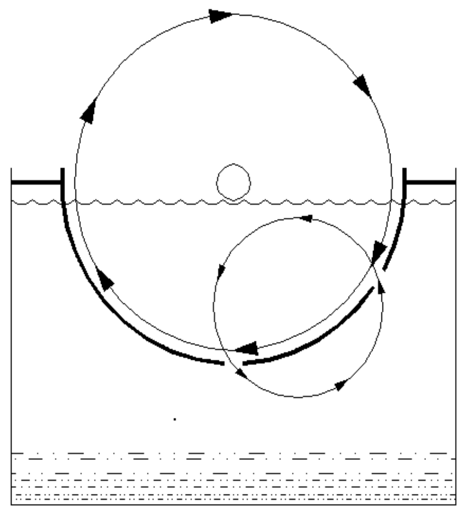


Figure c-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

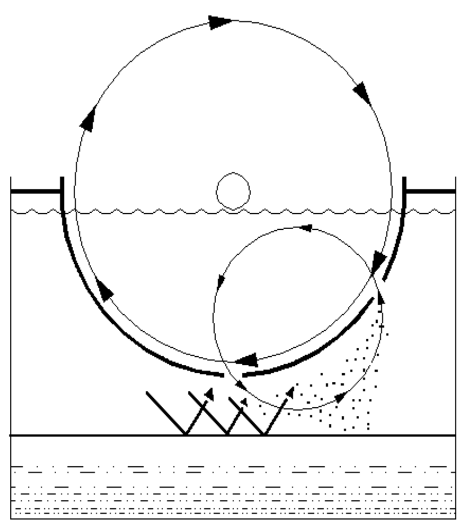


Figure d- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Rotorzone to levels above treatment design.

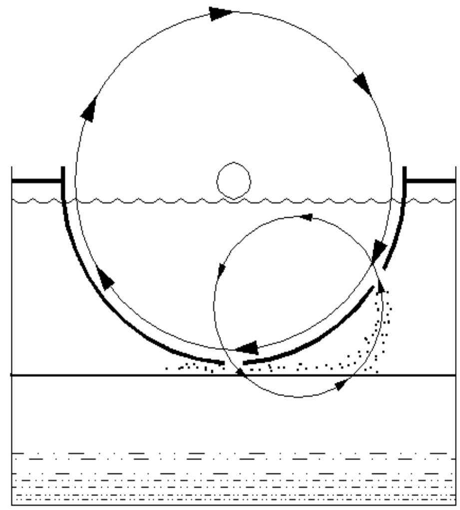


Figure e-Unit operating with excess sludge accumulated to base of Rotorzone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Rotorzone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF ROTORDISK®

WARNING: A VALVE LOCATED AT THE BOTTOM OF THE DENITRIFICATION TANK AND EQUIPPED WITH A REMOTE ACTUATION MECHANISM WAS PROVIDED WITH YOUR UNIT. THIS VALVE:

- Needs to be OPEN: when the plant is first filled with water, during draining if the plant ever requires such operation and during subsequent refilling operations. FAILURE TO OPEN THIS VALVE DURING FILLING AND DRAINING WILL RESULT IN SERIOUS DAMAGE TO THE PLANT. This is because, during a filling operation, the water rising in the PST would push the denitrification tank upwards while it is empty (this tank wouldn't have had a chance to fill with water until the water level reaches the inlet slot between the PST and the aerobic ROTORDISK®. Th open valves provide a mean of filling the PST and the through (denitrification tank included) at the same time.

- Needs to be CLOSED: during normal operation of the plant. Indeed, the denitrification section contains water already partly treatment thus this water and that contained in the PST shouldn't mix. FAILURE TO CLOSING THIS VALVE DURING NORMAL OPERATION OF THE PLANT WILL RESULT IN A POOR QUALITY EFFLUENT.

The ROTORDISK® sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a ROTORDISK® with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the ROTORDISK® with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

Alternately, seeding can be accomplished using dry bacteria and a source of organic carbon such as raw molasses or sugar. This can be done, for example, in situations where wastewater or activated sludge are not available and the plant needs to be ready to treat wastewater very shortly after it begins receiving it. By simulating the conditions encountered in wastewater (where large amounts of organic carbon and bacteria are present), biomass will establish on the ROTORDISK® and the plant can thus be prepared to work under actual conditions before these are actually encountered. SEPROTECH SYSTEMS INCORPORATED can help find appropriate supplies of both dry bacteria and raw molasses.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is <u>not</u> an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is <u>not</u> recommended. This is especially true of the ROTORDISK® process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a ROTORDISK® is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for “pre-starting” a ROTORDISK® unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.

The ROTORDISK® concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of ROTORDISK® is maintained.

4.0 - STORAGE OF **ROTORDISK®** SEWAGE TREATMENT EQUIPMENT

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

2. Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).

3. Support bearings on main ROTORDISK® shaft(s) should be re-lubricated prior to start-up.

4. The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. Water level in the primary settlement tank to be dropped to below the bottom of the Rotorzone tank level, if freezing of the tank contents is possible.

5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED

1. Upon receipt of mechanical components:

   a. Check packing list for any missing items on delivery.

   b. Motor/Reducer is shipped loose, for assembly on the reducer flange. The reducer is shipped completely filled with synthetic lubricant.

   c. Bearing components are shipped as a set. Open only when ready for assembly, to avoid moisture contamination.

   d. Chain and sprockets are shipped as a set. Check for the following:

      -Large sprocket bushing (O.D.) fits into the large sprocket bore.
      -Large sprocket bushing bore (I.D.) fits the Rotordisk® shaft drive end.
      -Small sprocket bore (I.D.) fits on the reducer output shaft.
      -Cottered chain fits or matches the teeth on the sprockets.

   e. Coupling (applicable only to split-shaft ROTORDISK® is shipped as a set. Check the coupling hubs if they fit the center stub ends of the ROTORDISK®shafts.

   f. Disk banks are shipped pre-assembled on the shaft by SEPROTECH SYSTEMS INCORPORATED and are shipped on A-frames. Handle with care, as the Fiberglass of the disk banks is brittle.

   g. Hardware (bolts, nuts, washers) for mounting the following items are provided:

      -Bearings
      -Reducer
      -Recycle trough

2. If, for any reason, the diskbanks must be removed from the shaft, the procedure for remounting them is as follows:

If disk banks are 5 ft. in diameter or larger (supplied in semicircular sections)

Mount them on shaft(s) as shown on Dwg.# GL-28D, with 1/2-20NFX1-1/2 Bolts. Connect two half sections with two connecting plates (see sketch of typical mounting details) Remove outer nuts on required tie rods, fit connecting plate on tie rods over the end plates, then fasten them together with nuts and washers.

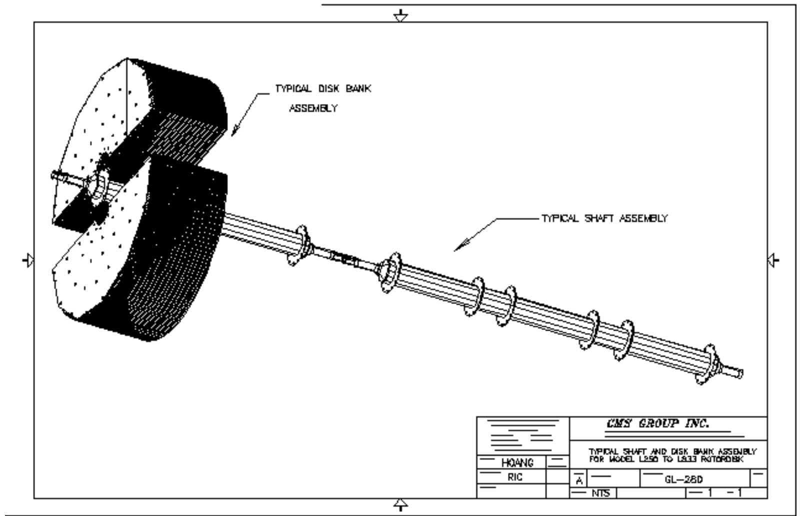


Figure f - typical mounting of disk banks on the shaft(s).

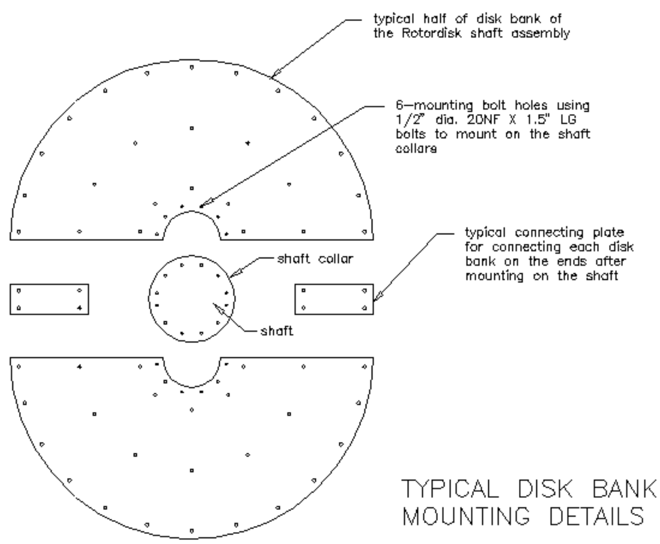


Figure g - exploded view of disk bank mounting parts.

3. Mount Bearings on Shaft(s).

   a) Bearing should be mounted at the centre of stub end. Follow bearing manufacturer's installation instructions.
   b) Use of the bearing fixing rings: one bearing of each pair is "fixed", the other "floating". Install the fixed bearing on the drive end of the shaft and the floating bearing on the non-drive end.

   FOR 'L'Rotordisk® models ONLY: On the shaft where the large sprocket will be mounted, fix the bearing into its housing closest to the sprocket. On the other shaft fix the bearing into its housing closest to the coupling (i.e. one bearing should be fixed on every shaft).

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in the manual, using a bearing locking tool or equal. See installation, operation and maintenance instructions section of this manual regarding bearings.

4. Mount coupling hubs on their respective shafts (if applicable) so that hub face is flush with the end of its shaft (for direct drive and 'L' models). See installation, operation and maintenance instructions section of this manual regarding couplings.

5. Install shaft(s) in ROTORDISK® tank.

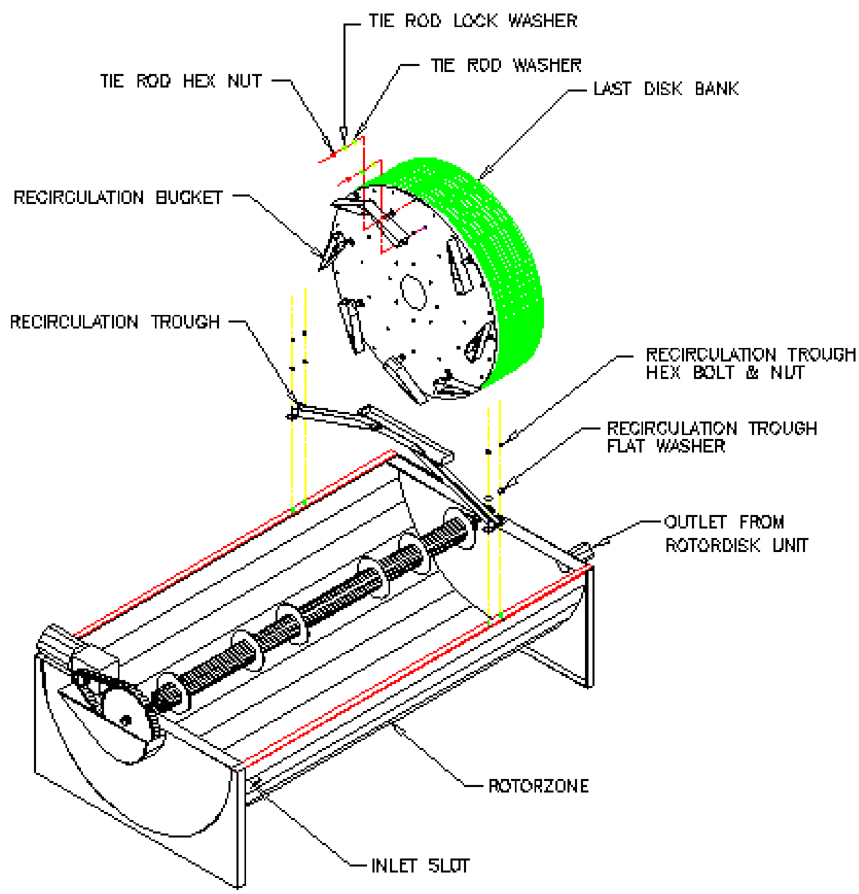
6. Mount small sprocket/coupling hubs on reducer output shaft (whichever is applicable).

7. Install Reducer-Motor Assembly in place. The reducer comes completely filled with synthetic lubricant. Ensure that the breather plug (mounted on top of one of the reducer oil intake ports) is installed on the reducer, after it is mounted on the ROTORDISK®. It is recommended that the motor be mounted into the reducer prior to assembly into the ROTORDISK® tank. Allow for some play in the reducer mounting bolt tightness so the chain tightness can be adjusted later.

8. Connect sprockets with chain. Check the axial alignment of the sprockets while tightening the chain. Tighten the previously loosened reducer mounting bolts after the sprockets are aligned and set in place. See installation, operation and maintenance instructions section of this manual regarding roller chain drives.

9. Connect two coupling hubs, grease, and fit coupling cover (if applicable). Before mounting, check bore on both hubs to match the shaft diameter. See installation, operation and maintenance instructions section of this manual regarding couplings.

10. Mount the stainless steel recycle trough on the ROTORDISK® tank with the bucket opening points to the proper rotation of the shaft.



NOTES:

1. Follow manufacturers instructions in the "Installation & Maintenance Manuals" included by SEPROTECH SYSTEMS INCORPORATED for mounting bearings, couplings (if applicable), reducer, sprockets and chain (if applicable).

2. Make sure all setscrews on sprockets and coupling hubs; bolts on reducer and bearings, are all well tightened before machine goes into operation.

6.0 - ROUTINE MECHANICAL MAINTENANCE OF **ROTORDISK®** SEWAGE TREATMENT PLANTS

6.1 - MOTOR:

If motor is equipped with grease fittings and relief plugs, it should be re-lubricated using a low-pressure gun once a year with Shell Alvenia R2" grease (DO NOT OVER-LUBRICATE). There is no lubrication required for motors without grease fittings and relief plugs

6.2 - REDUCER:

Reduction gear on ROTORDISK® units is filled with synthetic long life lubricant. No inspection or maintenance outside of periodic visual inspection is normally required. If there are no evidence of oil leaks on the seals, the synthetic lubricant must be changed every five (5) years for ROTORDISK® units running 24 hours a day.

Reduction Gear on medium and large ROTORDISK® size units are filled with Shell Tivela 75 oil and does not require oil changes (permanent lubrication). Periodic visual inspection is required. Check oil level and top up to required level with same oil, if necessary.

6.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

6.4 - SPROCKETS AND CHAIN:

(Applicable to non-direct drive ROTORDISK® units)

Chain drive should be inspected every six- (6) months for following points:
- If Chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated.
- Inspect oil for contamination, such as chips, dirt or grit. Replace oil if necessary (Oil with viscosity of SAE30 at ambient temperature 40^{o} to 100^{o} F is recommended).
- Milky white colour of the oil is indicative of flooding. Replace oil and determine the cause of the flood.
- Check Chain tension and adjust if required.

6.5 - COUPLING:

(Applicable for direct drive ROTORDISK® units and 'L' models)

Coupling should be checked for lubricant level. Lubricant is to be added if required. Re-lubrication with NLGI#2 or LTG Grease once a year is usually adequate.

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won’t start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and “fry” motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn’t turn	1. Power failure 2. Motor failure 3. Reducer failure 4. chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

7.2 - ROTORDISK® PROCESS

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	**a.** Pre-aerate RBC influent **b.** For severe organic overloads, increase recycle rate **c.** De-sludge unit **d.** Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or sulfate concentration	**e.** Determine the cause of the problem and correct it at source. For example, aerate equalization tank **f.** Pre-aerate influent wastewater **g.** Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	**a.** Check dissolved oxygen levels to confirm overload problem **b.** Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	▪ See Problem 2, solutions a and b above
	2. Grease on the disks	**a.** Remove grease at source **b.** Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances in influent, including abrupt pH changes	**a.** Eliminate source of toxic or inhibitory substances **b.** Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant **c.** Dilute influent using plant effluent or any other source of water **d.** See Problem 7.4
	2. Variation in flow or organic loading	**a.** - During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit **b.** - During high flow or loading conditions, attempt to throttle plant inflow during peak periods **c.** - For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
7. Decrease in process efficiency	1. Reduced wastewater temperature	**a.** Decrease air opening in RBC building **b.** Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	▪ See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	▪ Install additional treatment units
	4. High or low pH values	▪ Adjust pH to near neutral
	5. Improper rotation of media	▪ Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	**a.** Improve pre-treatment efficiencies **b.** Provide supplemental aeration to help prevent solids from settling **c.** De-sludge primary tank
9. Floating or rising sludge in the secondary clarifier	Removal of sludge from the clarifier is inadequate	**a.** Increase the duration of pumping sludge from the clarifier **b.** Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	▪ Decrease organic loading
	2. Stage loading too high	**a.** Increase number of recycle buckets
	3. Inorganic solids accumulation because of inadequate pre-treatment	▪ Check primary treatment and grit removal equipment for proper operation
	4. Accumulation of minerals	▪ Use chemical pre-treatment to eliminate minerals
	5. Digester supernatant adding excessive BOD or sulfides	▪ Modify supernatant pumping frequency
11. Shaft rotation non-uniform or “jerky”	1. Normal variations in balance	▪ Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	**a.** If severe, shut unit down and wash down disks **b.** Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting **c.** Decrease or stop flow of wastewater to affected units **d.** contact manufacturer for assistance

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
12. Effluent quality apparently below requirements	1. Organic loading too high	**a.** Add additional operating RBCs **b.** Identify cause of additional loading and eliminate at source **c.** Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	**a.** If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor **b.** Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	**a.** Clean and de-sludge clarifier **b.** Modify sludge removal procedures to eliminate BOD kickback **c.** Install filters after clarifier **d.** Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	▪ Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails ($^1/_8$" - $^1/_2$" in size)	**a.** Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily **b.** Contact manufacturer

Contact SEPROTECH SYSTEMS INCORPORATED for advice on how to resolve problems related to the process before making changes to the process or equipment.

Adapted from Water Pollution Control Federation "Manual of Practice OM-10", 1988.

8.0 - MAINTENANCE PROGRAM – Do’s and Don’ts

DO'S

1. Do use biodegradable soap if at all possible. The system will however handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.

2. Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

3. Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.

4. For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.

5. If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.

6. If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.

7. If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

DON'Ts

1. Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.

2. Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.

3. Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.

4. If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.

5. Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.

6. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLE-FREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE **ROTORDISK®** AND OTHER EQUIPMENT SUPPLIED

9.1 INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES

CHAIN TENSIONING:
The proper fit of a chain may be obtained by adjusting the sprocket centres. When a chain is correctly tensioned, the total mid-span movement (double amplitude) in the slack span should be 4-6% of the span length for normal drives.

Where there is no adjustment means, adjustment may be made by removing links to compensate for elongation due to wear (Drives with fixed centres). Proper lubrication and proper drive maintenance may minimize chain wear.

LUBRICATION:
Although many slow speed drives operate successfully with little or no lubrication beyond the initial factory lubrication, proper lubrication will greatly extend the useful life of every chain drive.

A good grade of clean petroleum oil without additives, free from flowing at the prevailing temperatures should be used.

Chain drives should be protected from abrasive and corrosive conditions, and the oil supply kept free of contamination. Periodic oil change is desirable. The lubricant viscosity recommended for ambient temperature 40^{o} - 100^{o}F is SAE 30.

OIL BATH:
With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest point while operating. Only a short length of chain should run through oil.

INSTALLATION RECOMMENDATIONS:

Shafting, bearings and foundations should be supported rigidly to maintain the initial alignment. Roller chain should be free of grit and dirt. Wash chain in kerosene when required. Re-lubricate!

Misalignment results in uneven loading across the width of the chain and may cause roller link-plate and sprocket tooth wear. Drive alignment involves two things:

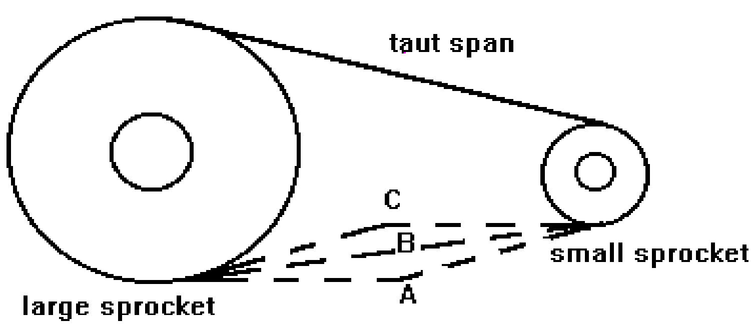
a) Parallel shaft alignment: Shafts should be parallel and level.
b) Axial sprocket alignment: Sprocket axial alignment can be checked with a straight edge, which will extend across the finished sides of the two sprockets.

Normally, it is good practice to align sprockets as close to the shaft bearings as possible.

Installing the Chain: Recheck all preceding adjustments for alignment and make sure all setscrews, bolts and nuts are tight. Fit chain around both sprockets and bring free ends together around one sprocket for connection.

Chain Tension: Check chain tension to be sure that the slack span has 4-6% mid-span movement in horizontal drives.

Recommended Possible Mid-Span Movement AC									
Drive	Tangent Length Between Sprockets								
Center-Line									
	5”	10”	15”	20”	30”	40”	60”	80”	100”
Horizontal to 45	.25”	.5”	.75”	1”	1.5”	2”	3”	4”	5”
Vertical to 45	.12”	.25”	.38”	.5”	.75”	1”	1.5”	2”	2.5”



AC = Total Possible Mid-Span Movement
Depth of Free Sag = .866 AB, approximately

MAINTENANCE RECOMMENDATIONS:

Regular maintenance schedules should be followed for all chain drives. Each drive should be inspected every six months. At each inspection period the following points should be checked:

a) Check Lubrication: If chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated before reinstalling. With bath lubrication, oil should be maintained at the proper level, as shown in lubrication instructions. Add oil if necessary. At each inspection, oil should be checked for contamination, such as chips, dirt or grit.

b) Check sprocket alignment: If the chain is properly aligned, no wear will show on the inner surfaces of the chain roller link-plates. If wear is apparent, this is evidence that sprockets are misalign and should be realigned as outlined in the installation instructions to prevent further chain and sprocket wear.

c) Check sprocket tooth wear: If sprocket shows evidence of wear high on the sprocket teeth, this is evidence of excessive wear in the chain, the chain should be replaced. If the sprocket teeth are severely worn, the sprocket should be replaced. Do not run new chain on worn sprockets.

d) Check chain tension: At each inspection period, the chain tension should be adjusted. If excessive slack has accumulated which cannot be removed by available shaft centre adjustment (i.e. by moving reducer away from large sprocket using chain tensioning bolts), two or more pitches of chain should be removed and chain reconnected.

9.2 PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation
Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip ‘G’ type seal

MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline. A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings
Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing
Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings
Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

PREPARATION OF PILLOW BLOCK HOUSING

Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

<u>FIXING RINGS</u>

On each shaft one bearing is generally "Held" and other bearings are "Free", to permit shaft expansion. For "Held" bearing housings, use two fixing rings. Place one on each side of bearing.

<u>CAPPING THE PILLOW BLOCK</u>

Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are <u>not</u> manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

<u>GREASE LUBRICATED BLOCKS</u>

Lubrication Notes

<u>Grease Lubrication</u>

If grease is used as a lubricant, it should be smeared between the rolling elements and worked in. The lower half of the housing should be packaged $^1/_2$ to $^3/_4$ full.

PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS

Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill $^1/_2$ to $^3/_4$ of the pillow block <u>base</u> with the same lubricant that was used to pack the bearing.

LUBRICATION PROCEDURE TO BE USED AT START-UP

A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

RE LUBRICATION

Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above			
Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.

2) National Lubricating Grease Institute Consistency Code.

3) Definition of speed categories:
Low: up to 1/4 of catalog speed limit for static oil lubrication.
Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication.
High: 1/2 to full catalog speed limit for static oil lubrication.

4) Consult SKF Engineering if temperature is below 0^{o} or above 200^{o}F.

5) Extremely slow speed will require special consideration if loads are high.

* Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.

6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.

7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.

8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.

9) Never mix greases with unlike bases.

10) Remove old grease at least once a year.

10 - LIMITED WARRANTY

SEPROTECH SYSTEMS INCORPORATED warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

SEPROTECH SYSTEMS INCORPORATED shall fulfil this warranty by repairing or exchanging any component part, F.O.B. our factory, that in SEPROTECH SYSTEMS' judgement, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. SEPROTECH SYSTEMS INCORPORATED is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

SEPROTECH SYSTEMS INCORPORATED reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. SEPROTECH SYSTEMS INCORPORATED also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgement is equivalent to the Company part replaced.

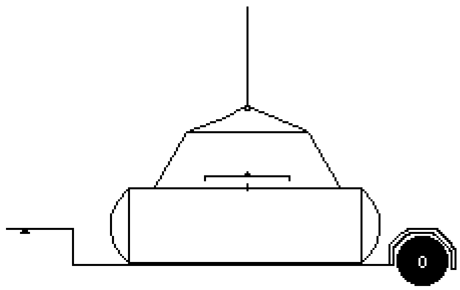
Under no circumstance will SEPROTECH SYSTEMS INCORPORATED, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

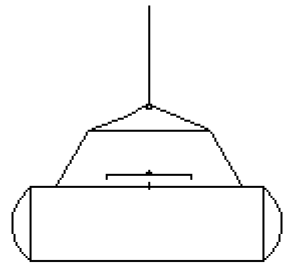
This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of SEPROTECH SYSTEMS INCORPORATED.

Seprotech Systems Incorporated
2378 Holly Lane, K1V 7P1
Ottawa, Ontario, Canada
Telephone (613) 523-1641
Fax (613) 731-0851

LIFTING

INSTRUCTIONS





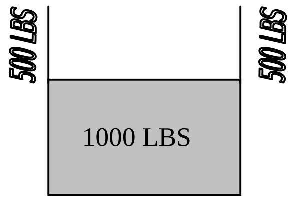
CENTER OF GRAVITY

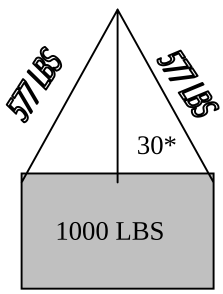
It is always important in rigging practice to rig the load so that it is stable. A stable load is one in which the center of gravity of the load is directly below the main hook and below the lowest point of attachment of the slings. The center of gravity of an object is that point at which the object will balance. The entire weight may be considered as concentrated at this point. A suspended object will always move so that the center of gravity is below the point of support. In order to make a level or stable lift, the crane or hook block must be directly above this point. Thus a load, which is slung above and through the center of gravity, will be stable and will not tend to topple or slide out of the slings.

Predicting the center of mass for an object to be lifted is not a trivial matter. It may require several attempts at rigging to find the appropriate balance point. Many objects are not rectangular such that predicting the center of mass is often difficult. In all crane lifts the center of mass must remain below the hook and below the point of attachment for any rigging. A center of mass above the hook is inherently unstable and will cause the load to flip. Similarly, loads that are not balanced in the horizontal plane may slip form the rigging. The overall stability of the load is a combination of balance with respect to the center of mass, weight distribution, and rigging tightness.

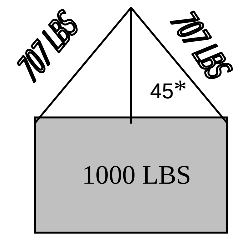
Crane operators should adjust the rigging and test for the actual center of gravity before the load is lifted.

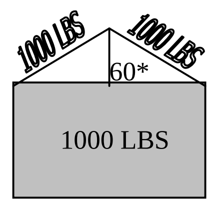
WEIGHT vs. ANGLE





Sling Angle With Vertical	Stresses per Sling Leg Per 1000 LBS Total Load
0	500
5	502
10	508
15	518
20	532
25	552
30	577
35	610
40	653
45	707
50	778
55	872
60	1000
80	2880





The angle at which a sling holds a given load influences the effective weight of the load. Stresses are minimal for loads with slings held perpendicular to the load, as shown in Figure A. For distributing the load vertically among more than a single leg of a sling, a spreader bar may be used. As shown in figures B-D, increasing the angle of the sling to the hook from 30 to 60 degrees increases the effective mass of the load from 1154 lbs. to 2000 lbs., essentially doubling the weight on each leg of the sling at 60 degrees. The chart in the middle offers a handy guide for assessing the effective angle of the sling to the relative weight. Thus, it is always better to limit the angle of the sling. Further, such changes in sling angle must be accounted for in lifts that are close to the sling weight limit and/or for critical lifts (greater than 90% of the crane limit). Crane operators should download a copy of this chart and carry it with them during crane operations.

RIGGING

- Loads should be well secured
- Slings should be adequate to the task
- Slings should be un-kinked and load balanced and secured
- No sudden stops
- No obstructions while lifting or traveling
- No loose items on load or crane before lift
- Bumping into runway stops is prohibited
- Hoist line must be vertical prior to the lift (remove slack in the hoist slowly)
- No crane load should pass overhead of personnel, clear the area before making the lift
- No one is to ride the crane without permission

The most important job of any crane operation is rigging of the load. Poor rigging may result in personnel injury, property damage, or other serious hazards. Rigging is the most time consuming of any crane operation and represents the single most hazardous potential of crane operation. In a multi-sling operation, each leg must be of the same length and must contribute equally to load distribution. Nylon slings are susceptible to damage by sharp corners on the item to be rigged. Caution must be taken to ensure that slings are not damaged by sharp corners or by excessive loading. Rigging requires years of practice to perfect. If in doubt about the security of your rigging, ask for help. Rigging should be checked by lifting the load a few inches off the ground to ensure that no swing develops and that the load is completely secure. Remember it is important to take the time to accomplish this task correctly. Not doing so may result in catastrophic consequences. One of the most important things to check before lifting a load is to look for loose items, such as screws or tools, which may have been used to secure the load. Such items can become projectiles during a lift. This is the reason why crane operators or especially tag line operators should wear hard hats when operating the crane and why it is essential to make sure the path of the crane does not pass over the head of any individual.

Spreader bars must be used when lifting the B30. Slings are to be attached at the lifting lugs located at the Four Inside Corners of the B30.

Overall Weight	34, 200 Lbs
- Weight Trough	3,650
- Weight Shaft	4,634
- Weight Hood	3,900
- Miscellaneous	22,000

Overall Dimensions	311 Inch Long x 143 Inch Wide x 186 Inch High

(Refer to the General Arrangement Drawing for exact dimensions)

The following handling and installation instructions are intended to help customers install the RBC properly and efficiently.

Handling and installation instructions are only recommendations. They do not relieve the purchaser from full responsibility for proper inspection, handling and installation. Improper handling or installation, which results in damage or tank failure, is the sole responsibility of the purchaser. Failure by the customer to comply with the handling or installation instructions will void the tank warranty. Unknown situations or conditions are also the burden of the purchaser.

The presence of SEPROTECH SYSTEMS personnel or an authorized representative at the installation site does not relieve the purchaser of their responsibilities.

DO NOT fully assemble RBC prior to lifting. First install the tank, and then assemble the shaft and other components onto installed tank.

INSPECTION

At the time of delivery, the customer shall be responsible for inspecting the tank for damage during transit. Both the inside and the outside of the tank must be inspected. If damage has occurred it should be noted on the delivery receipt prior to signing acceptance, whether it be a SEPROTECH SYSTEMS truck of common carrier. If a SEPROTECH SYSTEMS truck makes delivery, the factory should be immediately contacted prior to unloading or acceptance. The customer accepts all future responsibility for a damaged tank if the procedures set forth are not followed.

Minor damage can be repaired at the delivery site.

SEPROTECH SYSTEMS tanks are designed to withstand normal handling. Note the following handling precautions:

1. NEVER roll or slide a RBC. Lift the tank using a crane or other approved method.
2. Operators of hoist equipment should follow proper rigging procedures at all times. NEVER allow RBC to swing out of control.
3. Do not drop or allow hard impact from tools, spreader bars, etc.
4. Avoid the use of equipment inside the tank that could scratch or damage the inner corrosion barrier.
5. NEVER use cables or chains around tank.
6. NEVER lift tank by using fittings. Use designated lifting lugs.
7. If RBC is being stored prior to installation, be sure to lay on padded surface and tie down securely.

Seprotech
Water. Pure and Simple

DESIGN BRIEF
SHANCO NUNAVUT - RETRO-FIT
*Note that since this is a retro-fit that has not been tested in the field, effluent values are target values.

1. HYDRAULIC DESIGN: (AVERAGE DAILY FLOW)

1 unit at	14	**m3/day =**	14	**m3/day = Q**
Peak Flow	41			
design based on a	24	hour day.		

2. INFLUENT PARAMETERS:

BOD (biochemical oxygen demand) =	491	mg/l
SS (suspended solids) =	491	mg/l
TKN =	70	mg/l
Phosphorus =	n/a	mg/l

Ontario Application?	n	y/n
Designated Model?	y	y/n
What Model?	B30	**MODIFIED with extra media**
In concrete tank?	Full Steel	

3. TREATED EFFLUENT QUALITY:

BOD (biochemical oxygen demand) =	20	mg/l	
SS (suspended solids) =	20	mg/l	
NH3-N =	2	mg/l	this effluent concentration is expected after the retro-fit
Phosphorus =	n/a	mg/l	

4. R.B.C. SURFACE AREA REQUIRED (AO):

a) Removal in Primary Settling Tank (P.S.T.)

Primary BOD Removal =	10%			(Ref.1)
Primary Tank. Eff. BOD =	490.9090909	mg/l x	90%	
to RBC =	441.8181818	mg/l		

b) RBC BOD Loading.

Applied Load =	441.8181818	mg/l	**14**	**m3/day**
	5.96	kg BOD/day		

c) Area required to reduce BOD to 20 mg/l (AO)

Applied Load =	5.96	kg BOD/day	**5.96**	**kg BOD/ day**
For	20	mg/l* use	1.95	kg/day/100 m2
	306	m2		

(*in a nitrification application, reduce BOD to 30 mg/l, the nitrification process completes the BOD reduction)

TABLE #1
BOD REMOVAL RATES
Seprotech Curve

Req. effl.	**lbs/day/1000 ft2**	**kg/day/100 m2**
5	1.25	0.61
10	2.65	1.29
15	2.00	0.98
20	2.65	1.29
25	3.35	1.64
30	4.00	1.95
35	4.60	2.25
40	5.15	2.52
50	6.00	2.92
60	7.15	3.52
70	8.28	4.05
80	9.40	4.59
90	10.53	5.13
	USE	1.95

* For effluent strengths less than 20 mg/l, filtration is required. Filtration removes the sloughed biomass 50% of which is BOD. Therefore, to obtain effluent strengths of 5 and 10 mg/l BOD use the loading rates for 10 and 20 mg/l respectively with filtration.

No temperature correction required
Refs. 13,14,&15

d) NH3-N to be removed
(Assume Organic Nitrogen is converted to Ammonia NH3)

Removed to	5	mg/l	=	70	less	5	times	**13,500 litres/day**
=	0.88	kg/day	=	**1.93**	**lb/day**			
Area Required to reduce NH3-N to	5	mg/l						
=	0.88	kg/day	over	0.147	kg NH3-N/day/100 m2		**(Ref. 12)**	
=	597	m2	=					
Residual NH3-N to be removed below 5 mg/l =	5	mg/l	less	2	mg/l	times	13,500	**litres/day**
=	0.041	kg/day						
Area Required to reduce NH3-N to	0							
=	0.041	kg/day	over	0.089	kg NH3-N/day/100 m2		**(Ref. 12)**	
=	46	m2	=					
Total Nitrification Area Required =	642	m2	=		**(Ref. 12)**			

e) Total Surface Media Required
Total Surface Media Required = 948 m2

f) Staging

Hydraulic Loading	0.13	L/d/m2
B.O.D.post primary	5.96	kg BOD/day
Media req'd(B.O.D)	306	m2
Media req'd(nitrfct'n)	642	m2
Total req'd	948	m2
Min req'd to prevent 1st st. overload	192	m2
Min req'd to prevent 2nd st. overload	71	m2

TABLE # 2 - Brenner

Req'd NH3-N concentratio (mg/l)	**Removal Rate (kg/day/ 100m2)**
1	0.037
1.5	0.061
2	0.089
2.5	0.110
3	0.123
3.5	0.135
4	0.147
4.5	0.147
5	0.147

No temperature correction required
Refs. 13,14,&15

Media Distribution After Retro-fit

	ACTUAL AREA (m2)
First Stage	205
Second Stage	140
Third Stage	784
Fourth Stage	0
TOTAL	1,129

Minimum First Stage Media Area

Maximum loading to prevent first stage overload = 3.1 kg/day/100 m2

= 5.96 kg of post primary BOD/day divided by max. loading times 100 m2

= 192 m2

BOD remaining for 2nd Stage = 2.21 kg/day

Minimum Media 2nd Stage = 71.38 m2

5. PRIMARY SETTLING TANK (P.S.T.) (per RBC unit):

a) Primary Settling Tank Influent Flows (per RBC unit)

Average Daily Flow =	**13,500**	**litres/day**		
Recycle at	507%	% =	68472	litres/day
Total Average Flow =	81,972	litres/day		
Peak Daily Flow =	40,500	litres/day		
Peak Flow including Recycle =	108,972	litres/day		

The actual volume per bucket may change in the field depending on how much wastewater each bucket picks up

b) Loading Rates

Average Overflow Rate =	16,000	Litres/day/m2	max from	(Ref.5)
Peak Overflow Rate =	24,000	Litres/day/m2 (rounded)		(Ref.7)
Detention Time =	4	hours	use 4 hrs	(Ref.6)

c) Surface Area Required

i) by Average Overflow Rate = Total Average Flow divided by Average Overflow Rate

= 5.12 m2

ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate

= 4.54 m2

Therefore, use 5.12 m2 to compare with actual area of P.S.T.

P. S. T. Surface Area for Model B30 3.35 m x 4.19 m = 14.0 m2

Safety factor of: 2.74 times supplied.

Therefore **Surface Area Acceptable**

d) Volume Required = Q x Detention Time / 24 hrs / day

= 2.3 m3

P.S.T. Tank Capacity for this B30 is 27 m3

(after allowance for sludge) 12.0 **safety factor**

Therefore **Volume Acceptable**

6. FINAL SETTLING TANK (F.S.T.):

a) Loading Rates

Average Overflow Rate =	24000	Litres/day/m2	[Ref. 10]
Peak Overflow Rate =	44822	Litres/day/m2	[Ref. 10]
Detention Time =	3	hours	

b) Surface Area Required

i) by Average Overflow Rate = Average Flow divided by Average Overflow Rate

= 0.56 m2

ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate

= 0.30 m2

Therefore, use 0.56 m2 to compare with actual area of F.S.T.

F. S. T. Surface Area for Model B30 3.35 m x 1.0 m = **3** m2

Safety factor of 5.75 times supplied.

Therefore **Surface Area Acceptable**

c) Volume Required = Q x Detention Time / 1000 / 24 hrs / day

= 1.7 m3 =

F.S.T. Tank Capacity for this B30 is 4.0 m3

(after allowance for sludge) **2.4** safety factor

Therefore **Volume Acceptable**

Seprotech
Water. Pure and Simple

7. SLUDGE CALCULATIONS:

Assumptions Used for Calculation of Sludge Accumulation

1. Inlet TSS:	491	mg/l
2. Outlet TSS:	20	mg/l
3. Inlet BOD5:	491	mg/l
4. Outlet BOD5:	20	mg/l
5. Average Daily Flow:	34	m3/day
6. Proportion of inlet BOD5 soluble:	70%	
7. Total incoming solids	16.57	kg/d
8. Inert portion of solids (30%)	4.97	kg/d
9. Assuming Aerobic digester removal efficiency, 50%.	5.80	kg/d
10. BOD removed in secondary treatment	14.24	kg/d
11. Sludge produce due to BOD removal	4.27	kg/d
12. Aerobic digester removal efficiency 50%.	2.14	kg/d
13. Total sludge produced per day	12.90	kg/d

Information Pertaining to the ROTORDISK Used in Calculation of Sludge Accumulation

1. All sludge accumulates in the PST (sludge settled in the FST is pumped back to the PST).

2. PST Surface Area:	14.0	m2
3. PST Volume:	27.0	m3
4. PST Sludge Storage Capacity:	13.5	m3
TOTAL Mass of sludge produced that accumulates in the PST:	**12.9**	**kg/day**
Volume of Wet Sludge produced Daily:	0.2581	m3/day
Depth of Wet Sludge produced Daily:	0.0184	m/day
Frequency of Pump-Outs:	52	days

SUMMARY OF REFERENCES

Ref.1
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 475, which states, " Sedimentation with coagulation may remove 60 to 90% of the TSS, 40 to 70% of BOD5, 30 to 60% of COD, 70 to 90% of the Phosphorus, and 80 to 90% of the bacteria loadings. In comparison, sedimentation without coagulation, may remove only 40 to 70% of the TSS, 25 to 40% of the BOD5, 5 to 10% of the Phosphorus loadings, and 50 to 60% of the bacteria loadings."

Ref.2
excerpt from "Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems, Ontario Regulation 374/81 under part VII of the Environmental Protection Act", May 1982, ISBN 0-7743-7303-2, section 12.7.1, which states, "if it is a system operating on the rotating biological disc or similar principle involving contact of the biomass with air, provide a disc area so that the daily loading of sewage will not be in excess of 1.25 kg of BOD5 per 100 sq.m. of disc area, or a hydraulic loading in excess of 45 l/sq.m. of disc area".

Ref.3
excerpt from "Pilot Plant Studies of Rotating Biological Contactors treating municipal Wastewater", by: K.L. Murphy and R.W. Wilson, International Environmental Consultants Ltd., Toronto Ontario, prepared for Central Mortgage and Housing Corporation, Ottawa, Ontario.

Ref.4
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 776, which states, "...whenever the first stage loading limit exceeded 3.1 kg BOD5/100 sq.m.day(6.4 lbs. BOD5/d/1000 sq.ft.), the system was associated with the presence of sulfur-oxidizing organisms".

Ref.5
excerpt from "EPA Process Design Manual, On-site Wastewater Treatment and Disposal Systems", Oct 1980, EPA 625/1-80-012, section 6.4.2.4.e., p.149, which states, "...average flow design values normally range from 200 to 400 gpd/sq.ft.(8 to 16 cu.m./d/sq.m.)".

Ref.6
excerpt from " O&M of Trickling Filters, RBC's, and Related Processes, Manual of Practice OM-10, 1988, Water Pollution Control Federation, p. 105, which states, " Weir overflow rates typically range from 125 to 250 cu.m./m.d (10,000 to 20,000 USgpd/ft.)...The wastewater detention time in a settling basin is normally between 1 to 3 hours, but has been as high as 10 hours with excellent results". [use 4 hours]

Ref.7
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 6.4.2., which states, " the peak overflow rate may be 2,500 to 3,000 USgpd/sq.ft. (100 to 120 cu.m./sq.m.d) for primary clarifiers followed by biological treatment processess".
" Clarifiers handling chemical flocs, such as aluminum or iron coagulants, should be designed for peak overflow rates no longer than 600 and 800 USgpd/sq.ft.(24 and 32 cu.m./sq.m.d)".

Ref.8
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 484, which states, " TSS removal efficiencies in primary sedimentation tanks usually range between 50 and 65%. Many designers assume a removal efficiency of 60% for

Seprotech
Water. Pure and Simple

estimation purposes".

Ref.9
excerpt from "Wastewater Engineering Treatment, Disposal, and Reuse", 3rd ed., Metcalf and Eddy Inc., revised by George Tchobanoglous and Franklin L. Burton, p.808, table 12-14, which shows,"...typical concentrations of thickened sludge for a rotating biological contactor is 2 to 5%".

Ref.10
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.10, which states, " Murphy and Wilson recommend surface overflow rates less than 600 gpd/sq.ft. to maximize solids removal... DeCarlo recommends that peak hydraulic rates be limited to 1000 to 1200 gpd/sq.ft.".

Ref.11
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 9.2.4.6, p.9-43, which states, " Sludge produced by the RBC unit is similar to humus sludge from a trickling filter. The amount of sludge produced will depend on waste characteristics and loading rates. An RBC unit designed for 80% BOD5 removal would produce about 0.7 lb. of sludge per lb. of BOD5 removed; 95% percent removal would produce about 0.3 lb. of sludge."

Ref.12
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 5.5.2.2, which states, "Figure 5-19 represents data for one day for a given stage...The zero-order removal rate above bulk liquid ammonia nitrogen concentrations of 5 mg/l in Figure 5-19 is projected at 0.3 lb. NH3-N/day/1000 sq.ft., same as the Autotrol design". (Figure 5-19 attached)

Ref.13
excerpt from Ministry of Environment and Energy - Ahlberg & Kwong Report - "Winter Operation"
No process or operating problems were experienced throughout the winter. The minimum temperature encountered in the unit, with a raw sewage feed rate of 320 gpd, was 4 oC. Process performance remained good during the winter even under conditions of intermittent operation.

Ref.14
excerpt from the Forgie study
For the RBC unit and wastewater tested, the effect of temperature on removal efficiency over the 15 oC to 5 oC range was relatively low (theta = 1.001 to 1.02)

Ref.15
excerpt from Trinh - Environment Canada "Exploration Camp Wastewater Characterization and Treatment Plant Assessment"
It [the RBC] also operated at a low liquid temperature of 4 oC during one week without the effluent quality deteriorating.

Ref.15
WEF MOPNo. 8, p913
Oxygen recovery is 2.86 mg O2/mg NO3-N reduced."

Ref.16
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.9.3, which states, " The observed denitrification rate at 550F was approximately 0.85 lb NO3-N /day/1000sq. ft.."

Ref.17
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.9.2, which states, " The commonly used design value for the required methanol dosage is 3 mg/mg NO3-N reduced."

Ref.18
WEF MOPNo. 8, p913 states that "Oxygen recovery is 2.86 mg O2/mg NO3-N reduced." and that
Heterotrophic biomass production is approximately 0.4 mg VSS/mg COD removed"

APPENDIX “B”

- **Tables 10.1 to 10.4 from “Cold Regions Utilities Monograph, 3rd Edition**

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*	Water Demand 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))

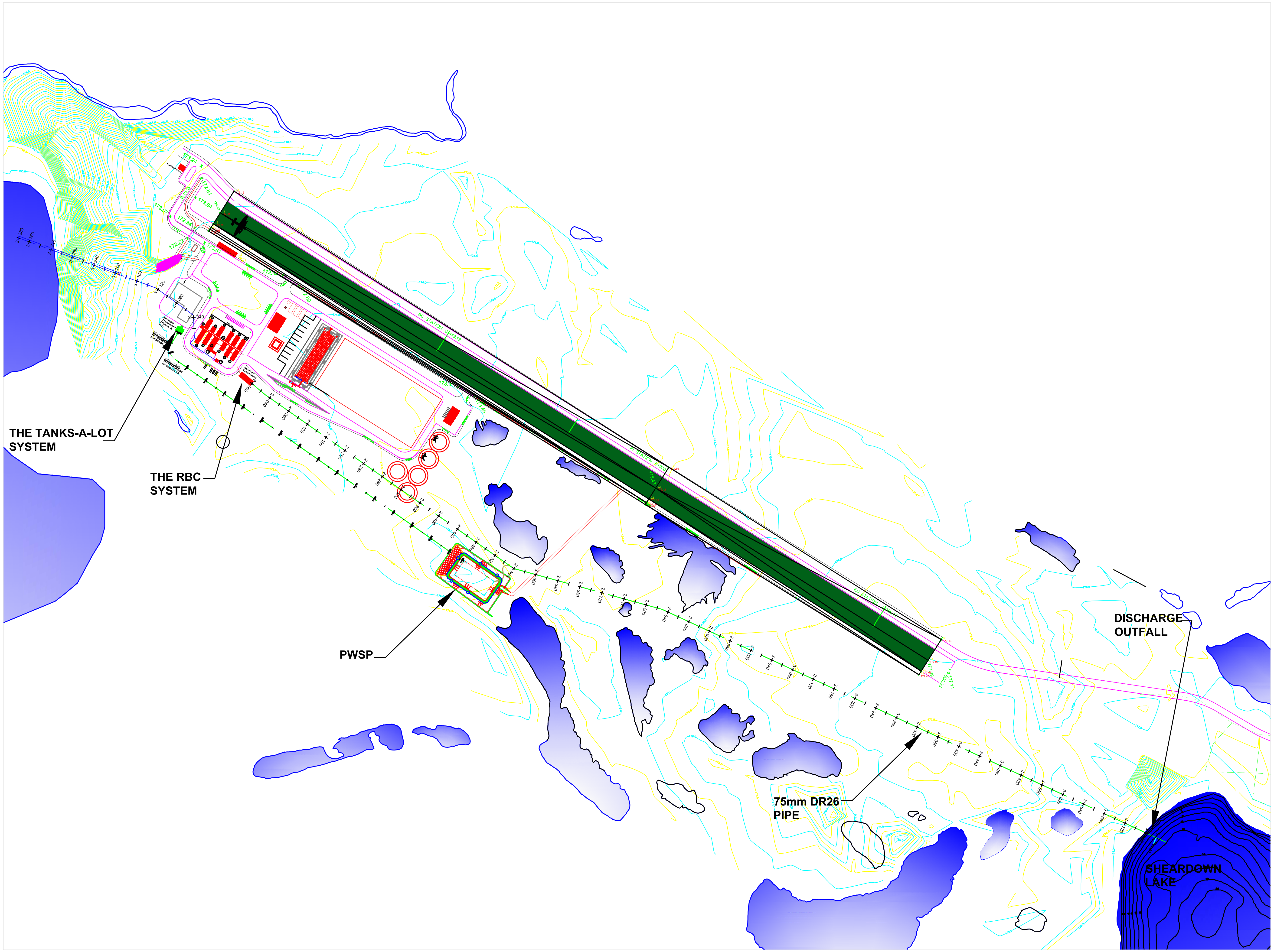
vary from 1.4 to 1.77 (Lufkin and Tobiasson, 1969; Murphy et al., 1977; Given, 1978). These values do not represent a drastic change from those found for the households in small communities.

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 "C"

➢ FIGURES



Description	Date	No.
Revisions and Issues		

NORTH | Date Printed

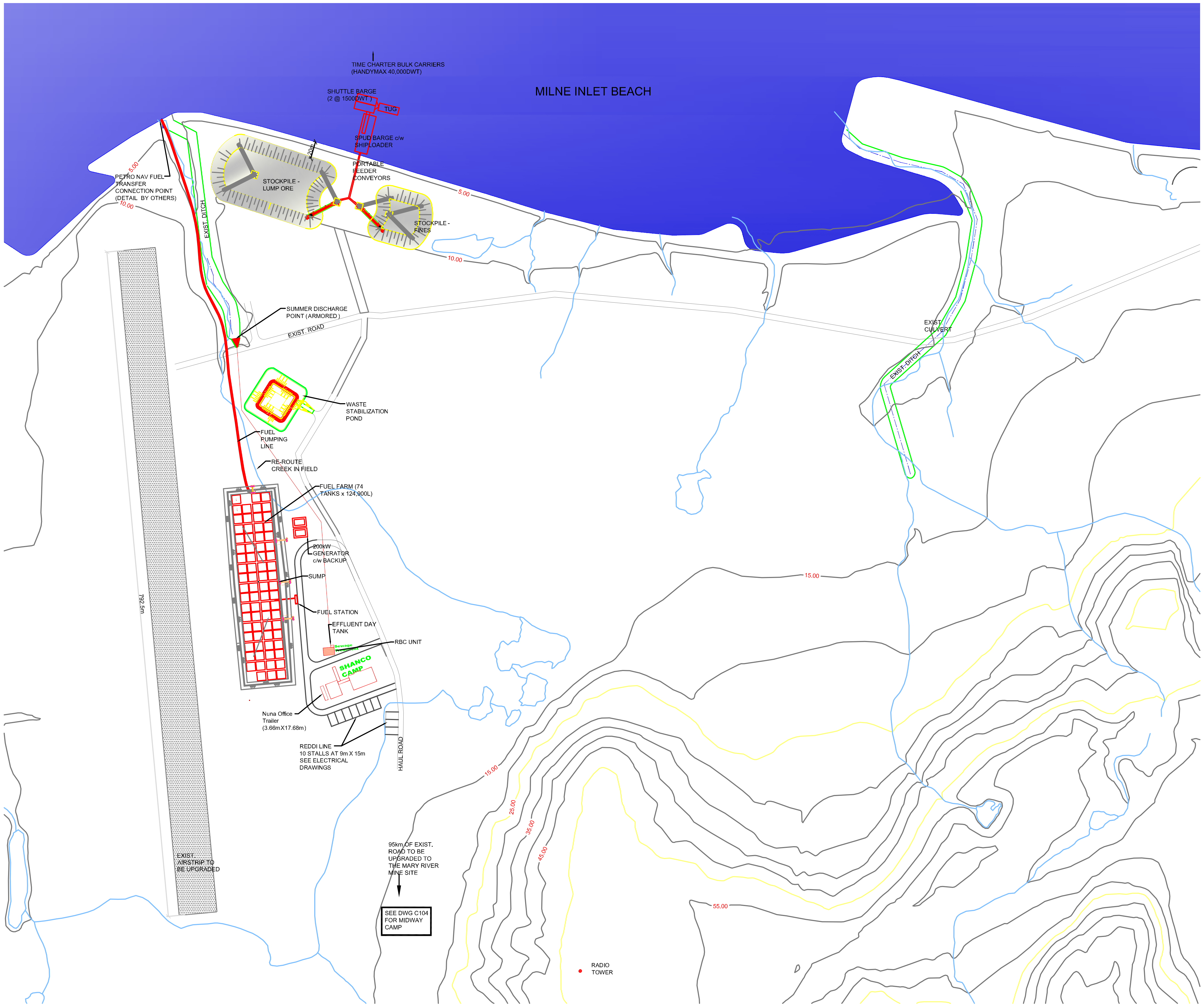
B.H. MARTIN CONSULTANTS LTD.
Consulting Engineers and Architect
Timmins Ontario
www.bhmartin.com

ARCHITECT | STRUCTURAL/CIVIL
MECHANICAL | ELECTRICAL

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

Drawing
MARY RIVER CAMP WASTEWATER TREATMENT SYSTEM

Date: AUGUST 2007	CADD File Number
Scale: AS NOTED	Job Number: 06-090
Drawn: rjr/SO	
Checked: BHM	Drawing Number: FIGURE 2
Approved	



SCALE

200m 0 200m

This drawing is an instrument of service and shall remain the property of B.H. Martin Consultants Ltd. It shall not be used for the construction, enlargement or alteration of a building other than the said project without the authorization of the ARCHITECT and / or ENGINEERS

PROJECT
MARY RIVER PROJECT
BAFFINLAND IRON MINES CORP.
NORTHERN BAFFINLAND, NT

DRAWING
SITE PLAN
MILNE INLET

B.H. MARTIN CONSULTANTS LIMITED
CONSULTING ENGINEERS – ARCHITECT
834 MOUNTJOY STREET SOUTH
P.O. BOX 120
TIMMINS, ONTARIO P4N 7C5

Date SEPT. 2007	Job Number 06–090
Scale 1:5000	
Drawn CM	Figure Number FIG. 3
Approved MK	

CADD File No. present\Fig.3

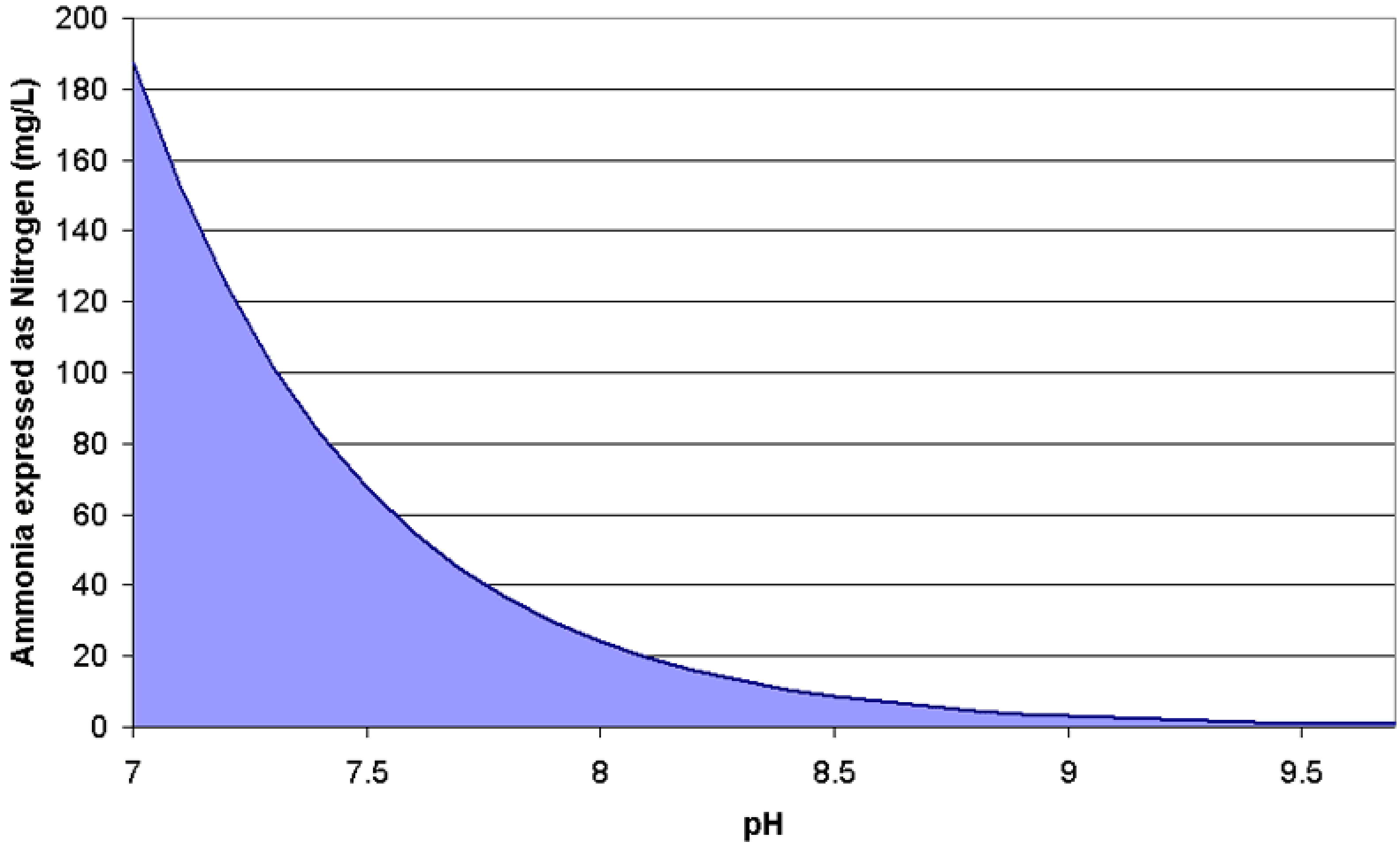


Figure 4. Acute Toxicity of Ammonia with pH.

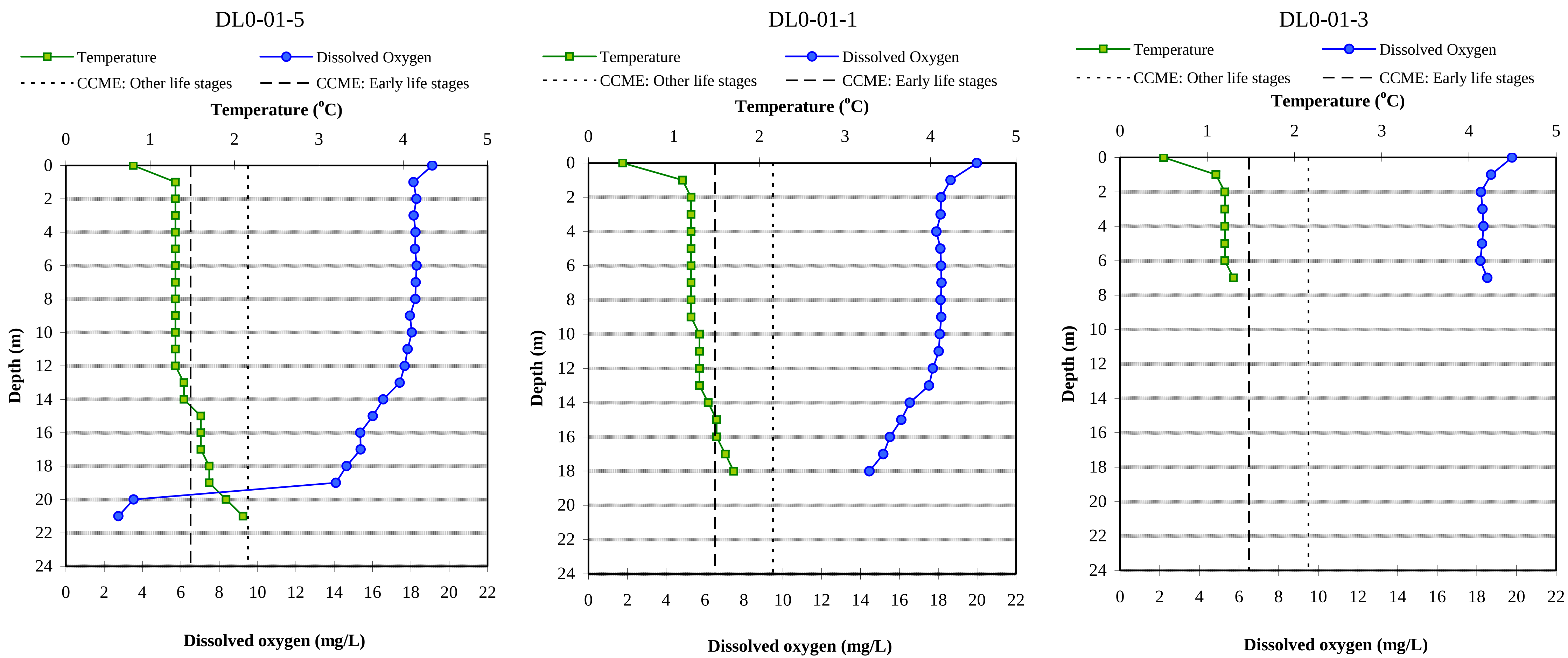


Figure 5. Temperature and dissolved oxygen depth profiles for the northwest basin of Sheardown Lake, May 2007.

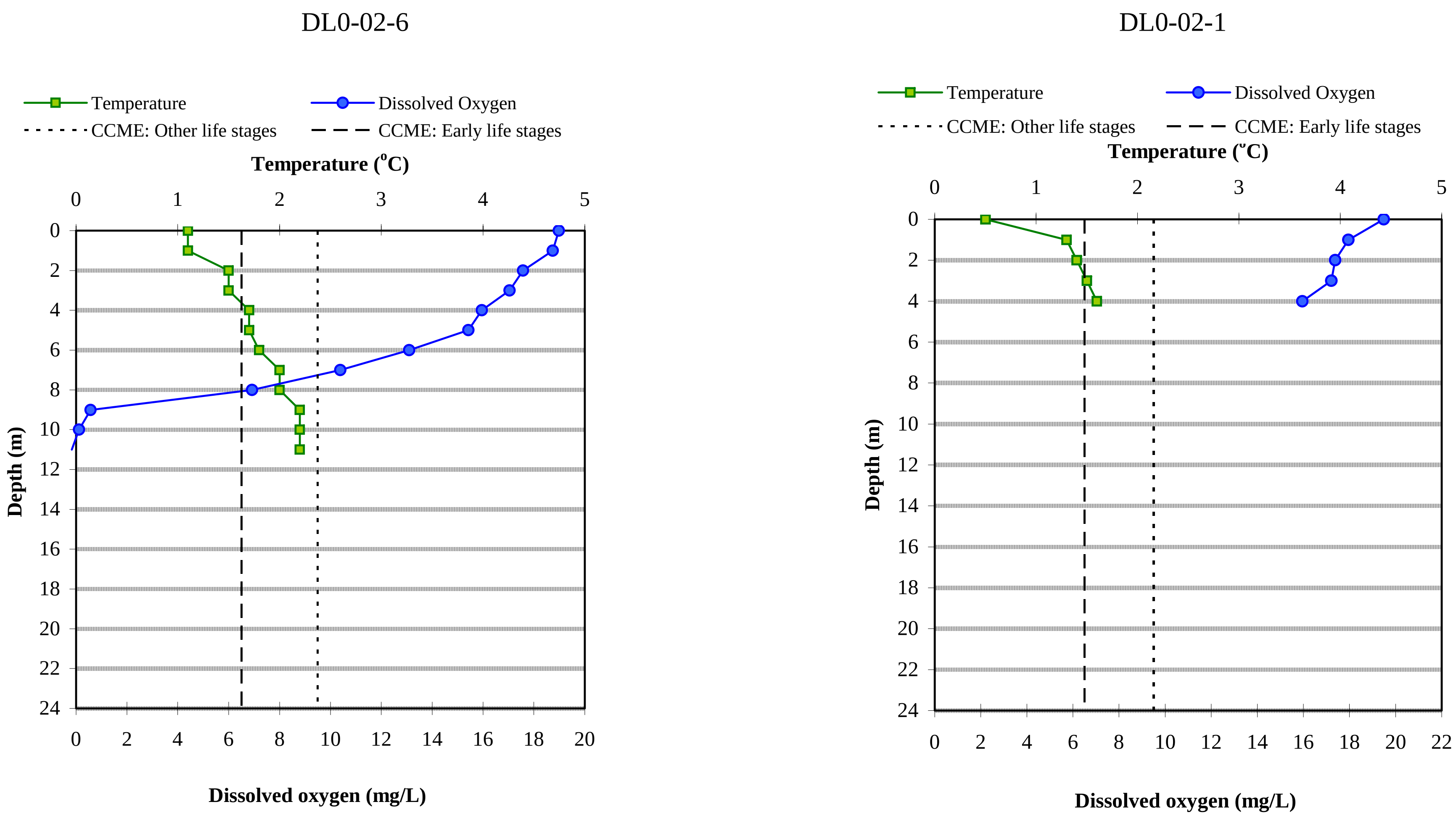
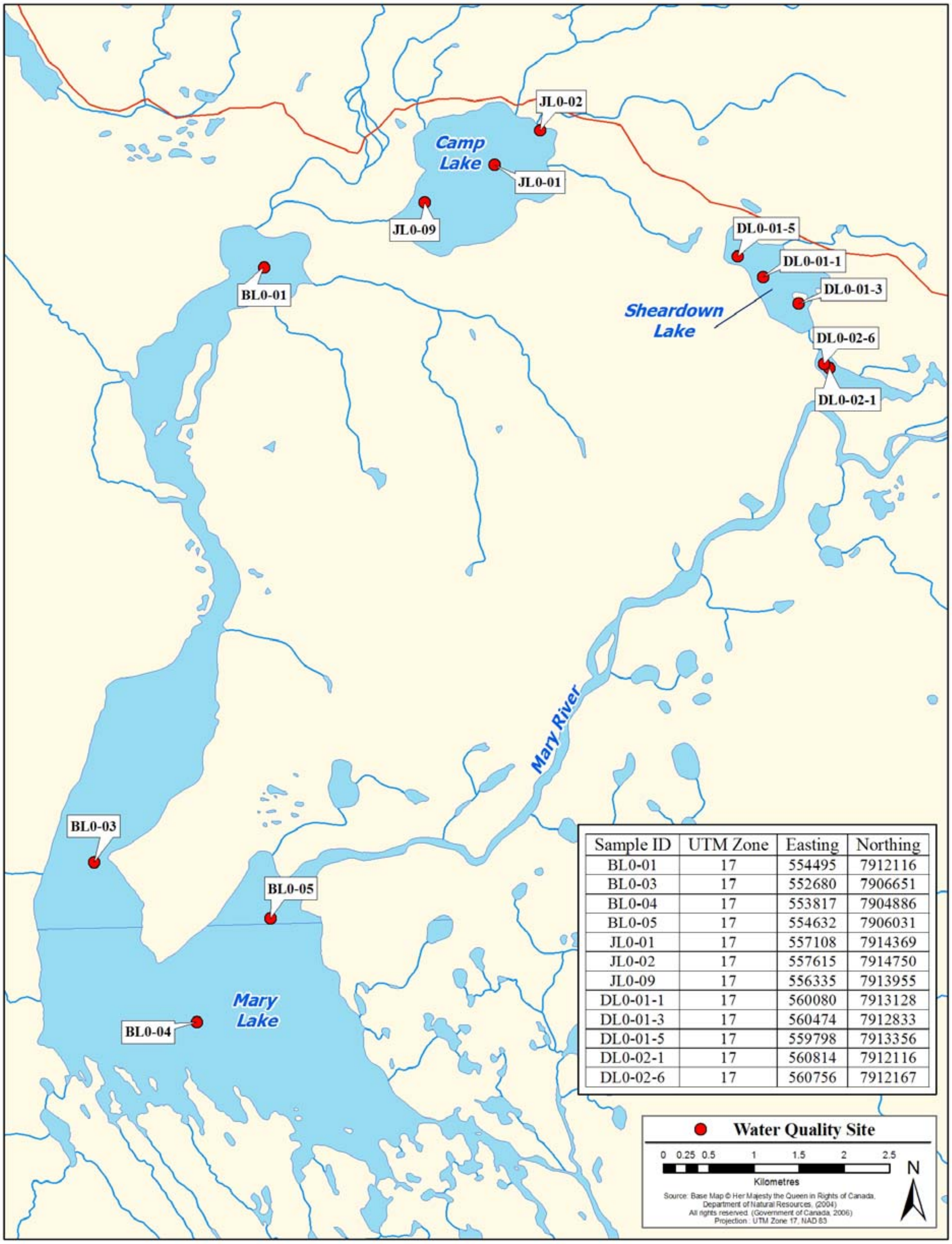
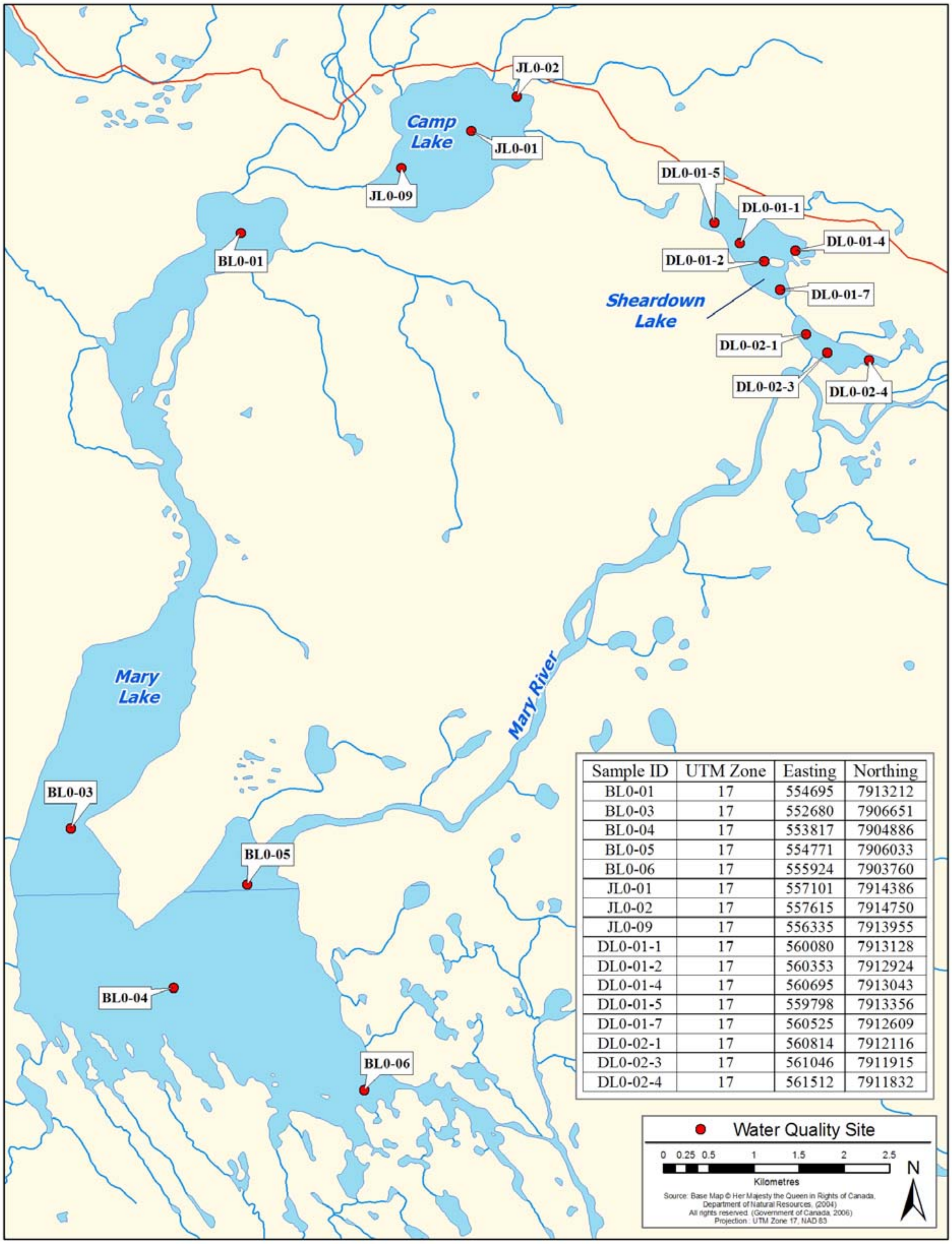


Figure 6. Temperature and dissolved oxygen depth profiles for the southeast basin of Sheardown Lake, May 2007.



Sample ID	UTM Zone	Easting	Northing
BL0-01	17	554495	7912116
BL0-03	17	552680	7906651
BL0-04	17	553817	7904886
BL0-05	17	554632	7906031
JL0-01	17	557108	7914369
JL0-02	17	557615	7914750
JL0-09	17	556335	7913955
DL0-01-1	17	560080	7913128
DL0-01-3	17	560474	7912833
DL0-01-5	17	559798	7913356
DL0-02-1	17	560814	7912116
DL0-02-6	17	560756	7912167

Figure 7. Water quality sampling sites: May 2007.



Sample ID	UTM Zone	Easting	Northing
BL0-01	17	554695	7913212
BL0-03	17	552680	7906651
BL0-04	17	553817	7904886
BL0-05	17	554771	7906033
BL0-06	17	555924	7903760
JL0-01	17	557101	7914386
JL0-02	17	557615	7914750
JL0-09	17	556335	7913955
DL0-01-1	17	560080	7913128
DL0-01-2	17	560353	7912924
DL0-01-4	17	560695	7913043
DL0-01-5	17	559798	7913356
DL0-01-7	17	560525	7912609
DL0-02-1	17	560814	7912116
DL0-02-3	17	561046	7911915
DL0-02-4	17	561512	7911832

Figure 8. Water quality sampling sites: August 2007.

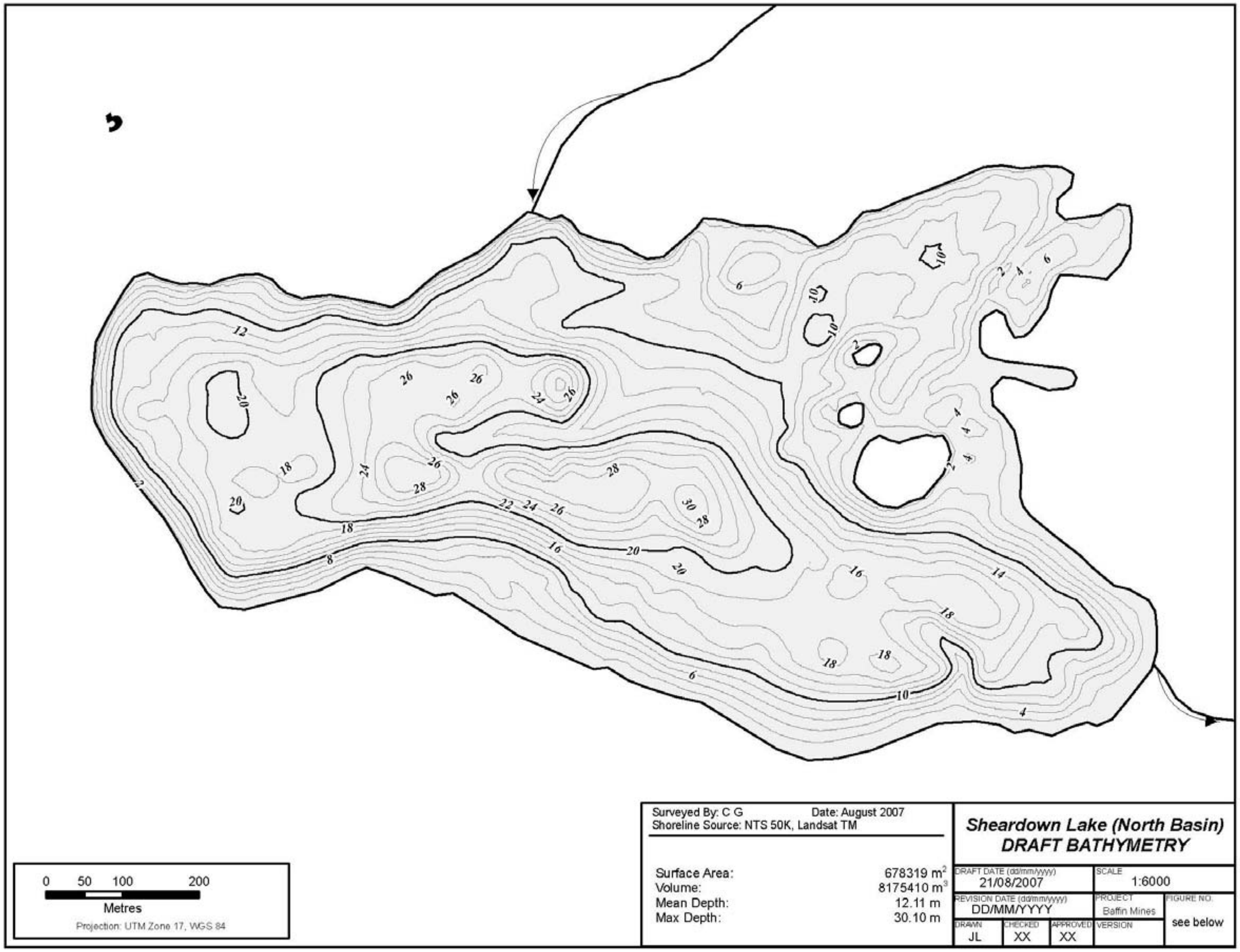
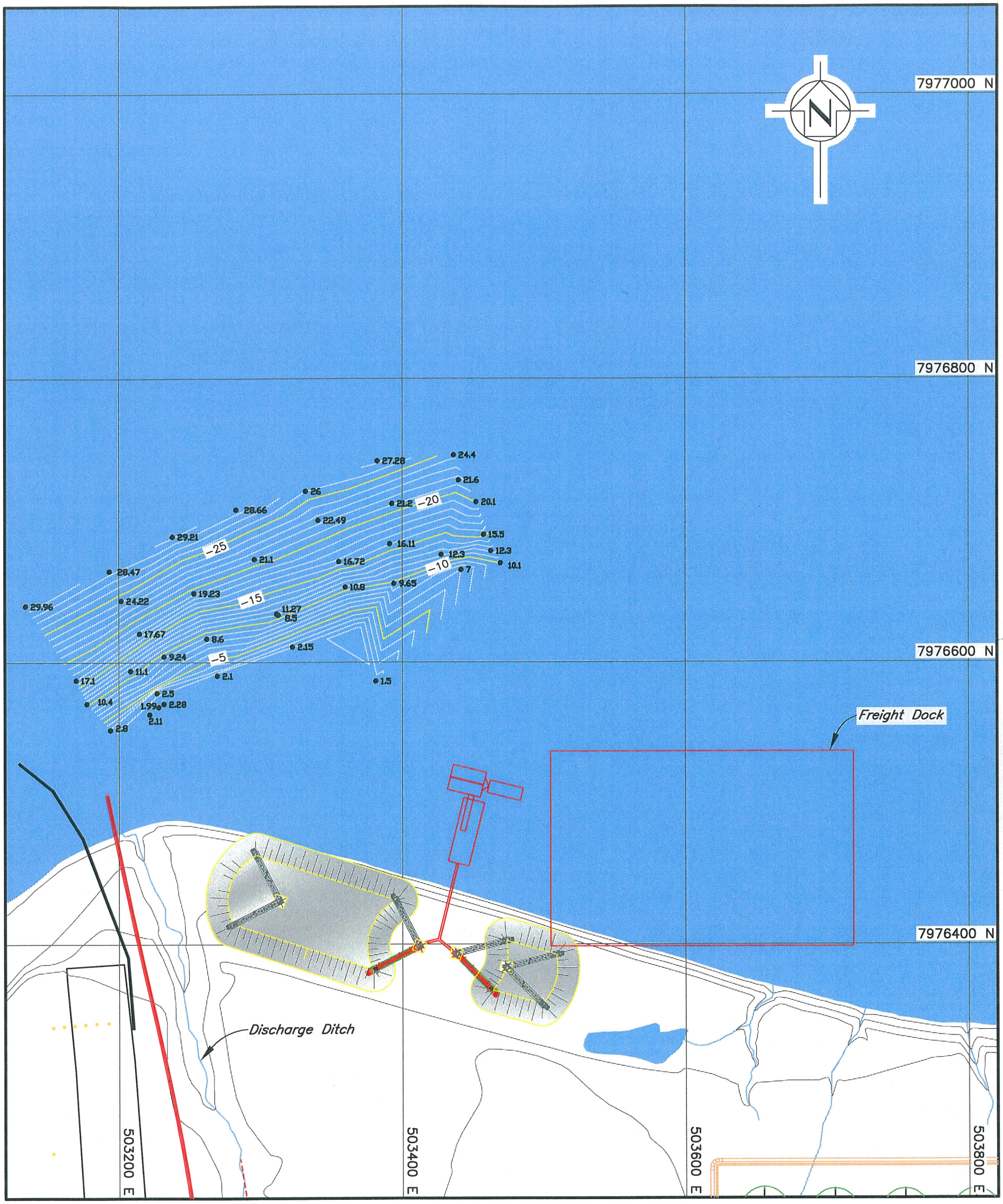


Figure 9. Bathymetric map of the northwest basin of Sheardown Lake.



LEGEND:

- Water
- River
- • Bathymetry locations (depth)

NOTES:

1. Mapping provided by Eagle Mapping.
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Depths are shown in metres and do not account for tidal fluctuations (i.e. +/- ~1.5 metres).

Scale 40 20 0 40 80 120 160 200 Metres

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY 2007 BATHYMETRY AT MILNE INLET FREIGHT DOCK LOCATION

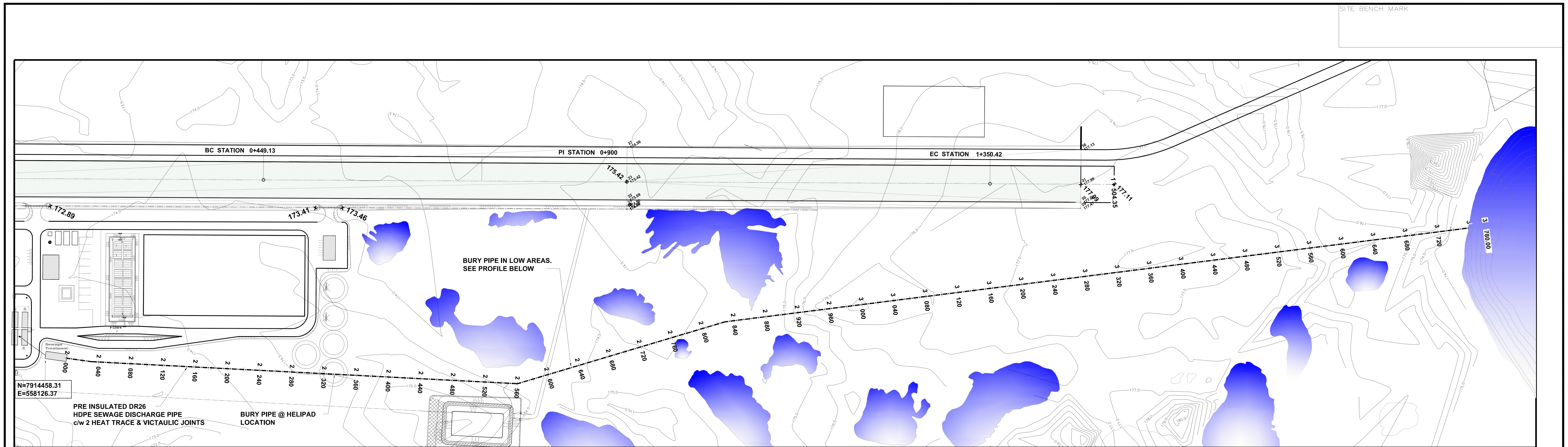
Knight Piésold CONSULTING

P/A NO.	REF.	REV.
NB102-00181/10	NB07-00750	0

FIGURE 10

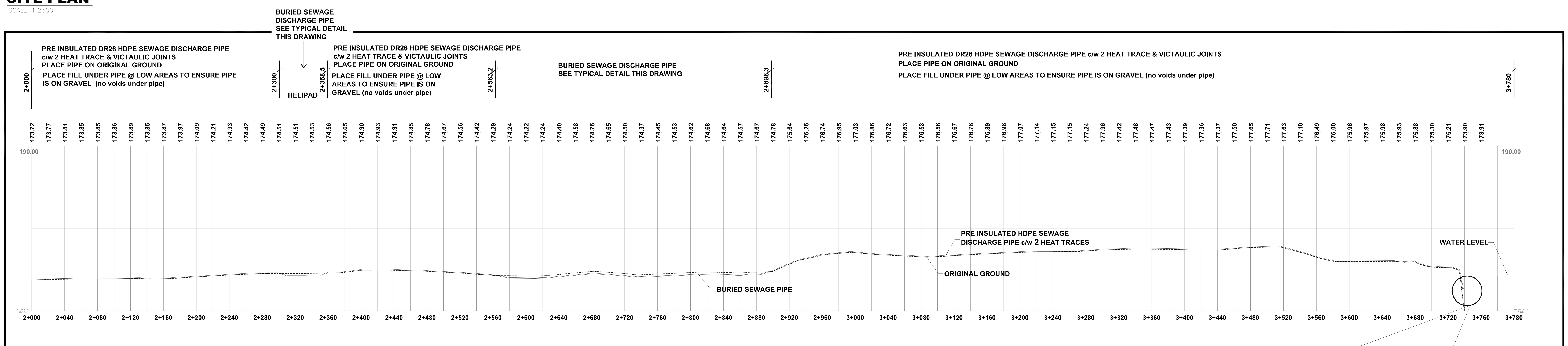
XREF FILE(S): Milne base; Milne Buildings IMAGE FILE(S): Baffinland logo-big corp

NORTH BAY ON. CREATED BY: rjohnson SAVED: I:\102-00181-10\Assignment\Acad\Fig\A54, 8/30/2007 11:01:47 AM PRINTED: 8/30/2007 11:02:28 AM, Layout1, mdemers



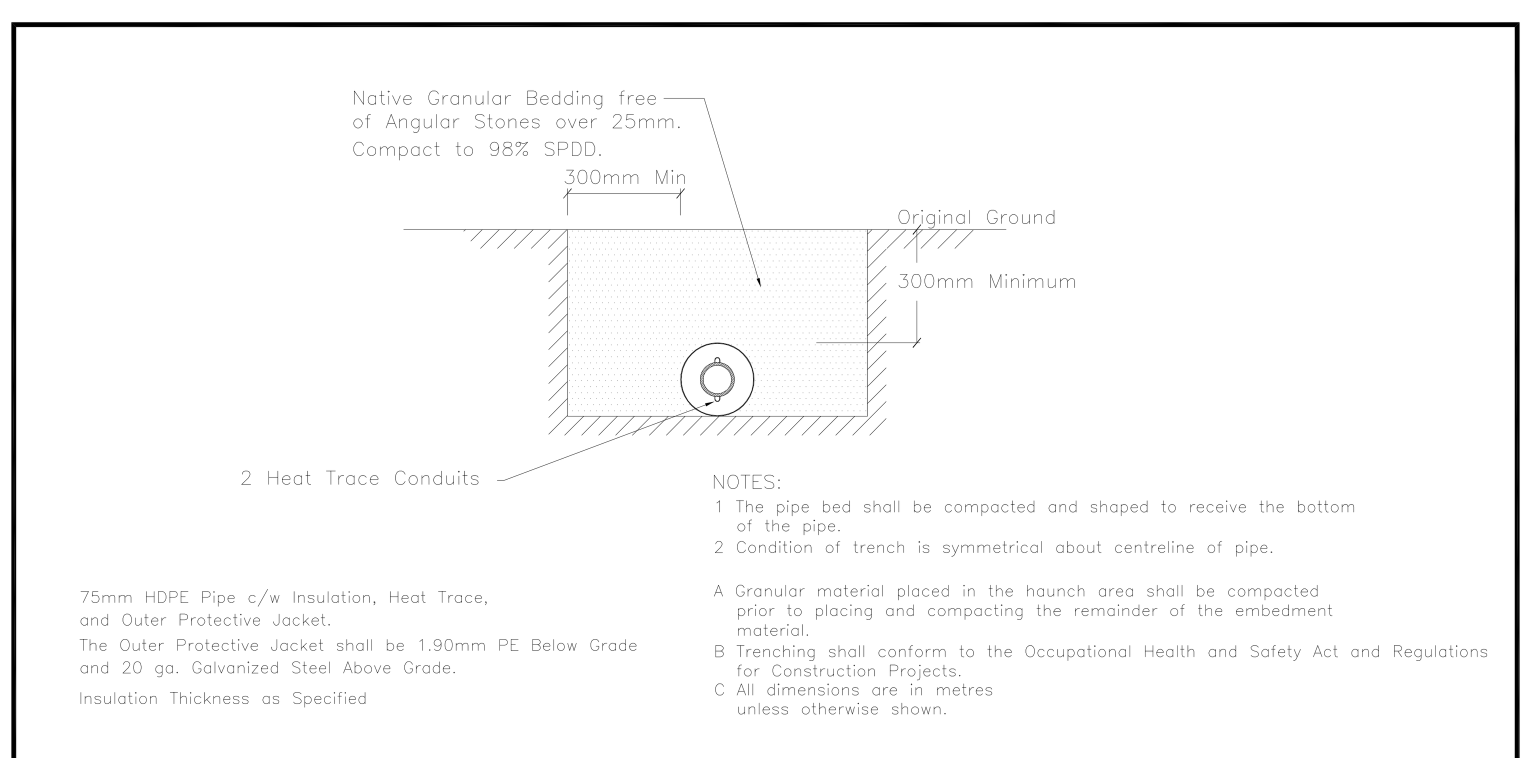
SITE PLAN

SCALE 1:2500

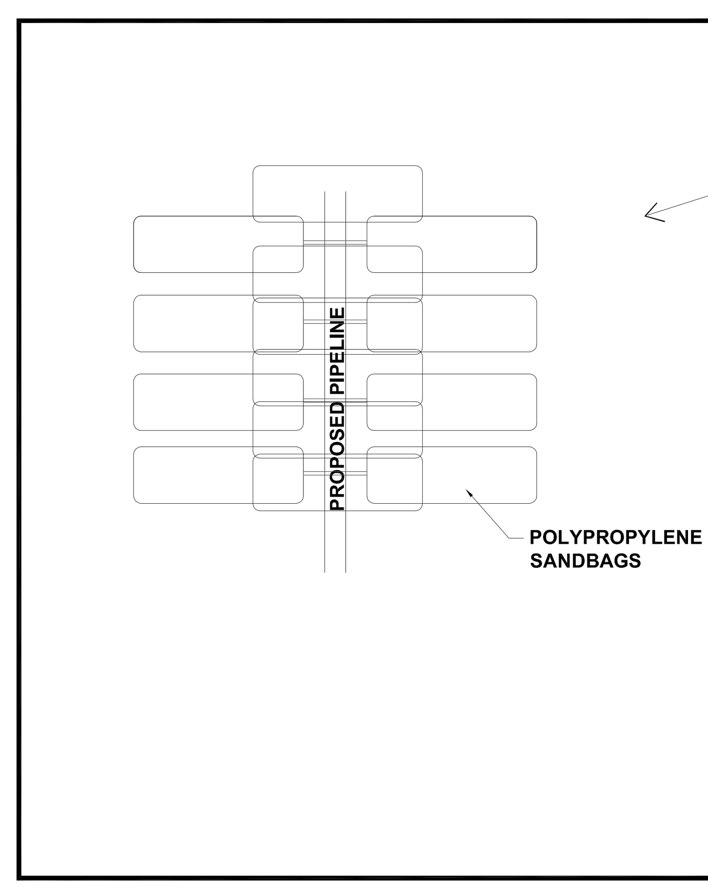


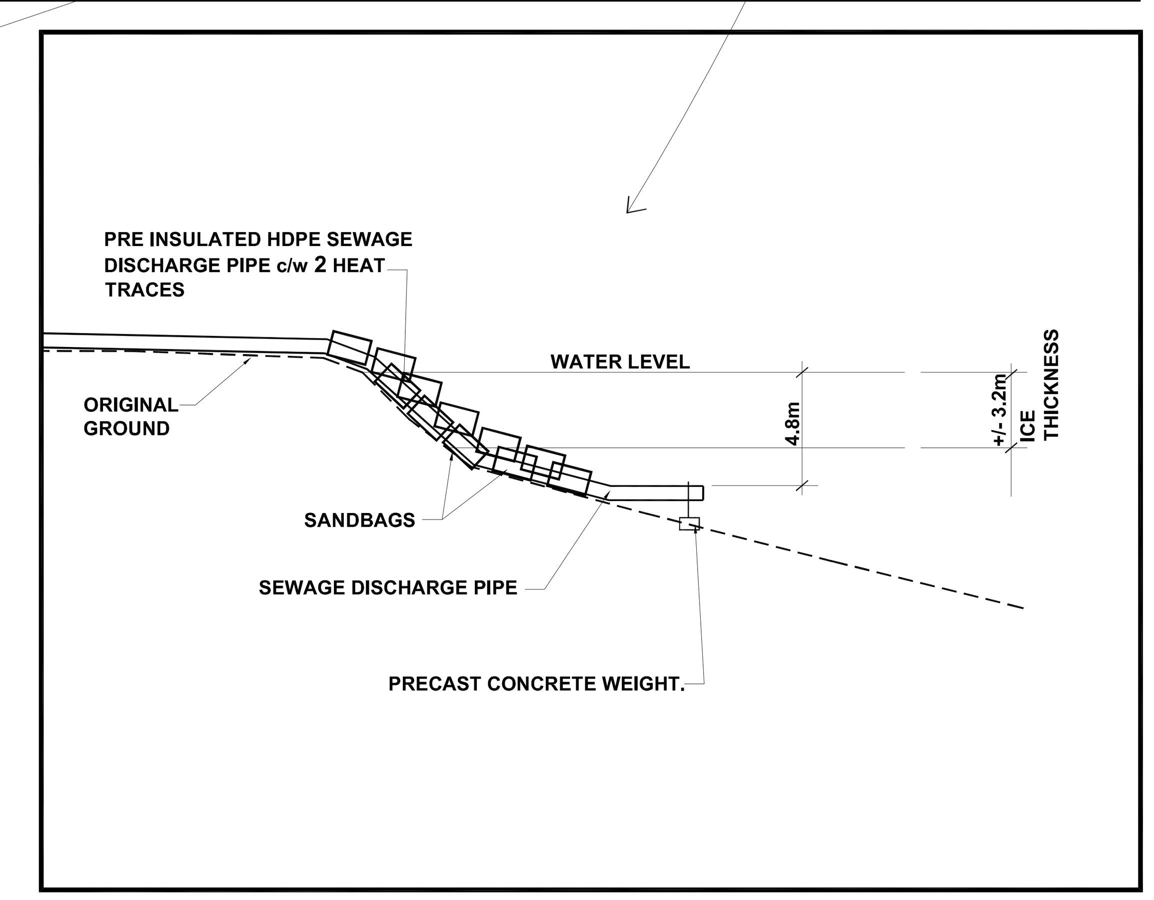
PROFILE THRU SEWAGE DISCHARGE PIPE

SCALE 1:2000 HORIZONTAL
SCALE 1:200 VERTICAL



EFFLUENT OUTFALL PIPE DETAIL





This Drawing is an instrument of service and shall remain the property of B.H. Martin Consultants Ltd. It may not be reproduced or copied in any form. It shall not be used for the construction, enlargement or alteration of a building other than the said project without the authorization of the ARCHITECT and/or ENGINEER.

Contractors shall verify and be responsible for all dimensions and conditions on the job and report any discrepancies to the Architect and/ or Engineer before proceeding with the work.

Drawings shall not be scaled.

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.
ISSUED FOR CONSTRUCTION	July 03,2007	1
ISSUED FOR TENDER/REVIEW	May 24,2007	0

Revisions and Issues

NORTH

Date Printed

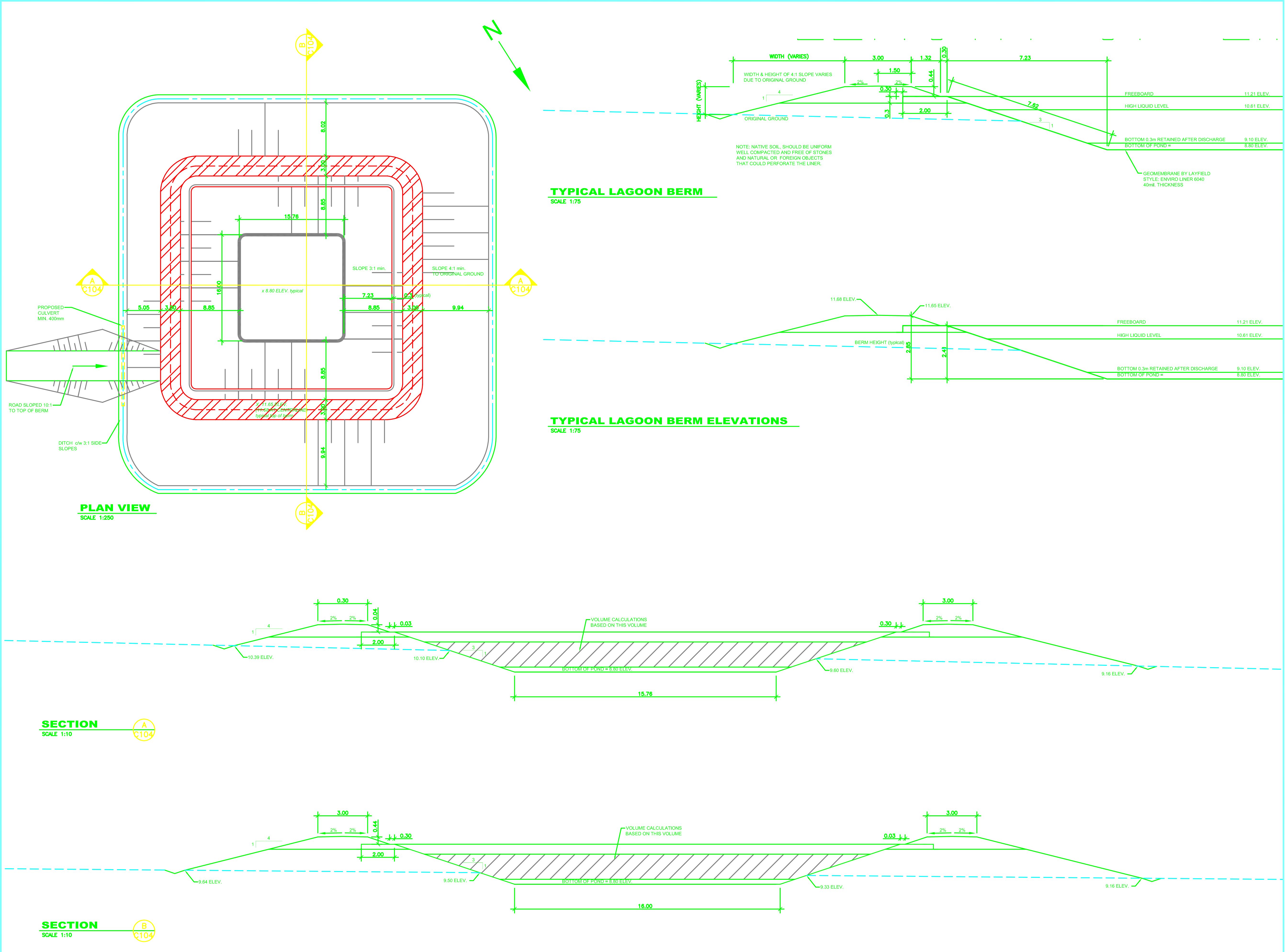
B.H. MARTIN CONSULTANTS LTD.
Consulting Engineers and Architect
Timmins Ontario
www.bhmartin.com

ARCHITECT | STRUCTURAL/CIVIL
MECHANICAL | ELECTRICAL

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

Drawing
MARY RIVER CAMP SEWAGE DISCHARGE PLAN/PROFILE & DETAILS

Date: JUNE 2007	CADD File Number: ../main_camp/dwg/issued.../C103-R1.dwg
Scale: AS NOTED	Job Number: 06-090
Drawn: rjr/SO	
Checked: BHM	Drawing Number: C103-R1
Approved:	



Description	Date	No.
ISSUED FOR CONSTRUCTION	JULY 24/07	0

Revisions and Issues

NORTH

Date Printed

B.H. MARTIN CONSULTANTS LTD.
Consulting Engineers and Architect
Timmins Ontario
www.bhmartin.com

ARCHITECT

STRUCTURAL/CIVIL

MECHANICAL

ELECTRICAL

Project

MILNE INLET PROJECT
BAFFINLAND IRON MINES CORPORATION
BAFFIN ISLAND, NUNAVUT

Drawing

WASTE STABILIZATION POND PLAN & SECTIONS

Date: JULY 2007	CADD File Number: milne\dwg\issued...\c104-r1
Scale: AS NOTED	Job Number: 06-090
Drawn: DL	
Checked:	Drawing Number: C104
Approved: BHM	

APPENDIX "D"

- **TABLES**

Table 1: Selected water quality data measured in the northwest basin of Sheardown Lake in May, 2007

Table 2: Selected water quality data measured in the northwest basin of Sheardown Lake in August, 2007

Table 3: Summary of selected trophic status classification schemes for lakes

Table 4: Results of mass-balance modeling to predict the effect of discharge of treated sewage effluent on water quality in the northwest basin of Sheardown Lake

Table 1: Selected water quality data measured in the northwest basin of Sheardown Lake in May, 2007

		Sample Date:	2007-05-06	2007-05-06	2007-05-06	2007-05-06	2007-05-06	2007-05-06	2007-05-08	2007-05-08	2007-05-08	2007-05-08		2007-05-08	2007-05-08	**Lake-Wide Mean**
		Sample ID:	DLO-01-5-S	DLO-01-5-B	DLO-01-1-S	DLO-01-1-B	DLO-01-3-S	DLO-01-3-B	DLO-02-1-S	DLO-02-1-BA	DLO-02-1-BB	DLO-02-1-BC	DLO-02-1-B	DLO-02-6-S	DLO-02-6-B	
		Descriptor:	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom: Rep 1	Bottom: Rep 2	Bottom: Rep 3	Bottom: Mean	Surface	Bottom	
PARAMETER	**UNITS**	**MDL**														
Alkalinity (as $CaCO_3$)	mg/L	5	64	60	62	61	67	63	77	77	78	77	77	77	78	**77**
pH			6.82	6.73	6.81	6.79	6.88	6.82	7.06	6.97	6.96	7.01	6.98	7.05	7.04	**7.03**
Conductivity	uS/cm	5	120	115	121	119	128	121	155	157	157	157	157	157	156	**156**
TDS (COND - CALC)	mg/L	5	78	75	79	77	83	79	101	102	102	102	102	102	101	**102**
Total Suspended Solids	mg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	**<2**
Turbidity	NTU	0.1	0.2	0.2	0.4	0.2	0.3	0.2	0.5	0.8	0.7	0.7	0.7	0.4	0.4	**1**
Total Organic Carbon	mg/L	0.5	1.7	1.7	1.9	1.8	2.0	2.0	2.1	1.8	2.0	1.9	1.9	2.1	2.1	**2.0**
Dissolved Organic Carbon	mg/L	0.5	2.0	1.8	1.8	1.8	2.0	1.9	2.0	1.9	2.0	1.9	1.9	2.0	2.0	**2.1**
Total Kjeldahl Nitrogen	mg/L N	0.05	0.07	<0.05	<0.05	<0.05	0.07	0.05	<0.05	0.13	0.11	<0.05	0.12	0.06	0.10	**0.08**
N-NH_3 (Ammonia)	mg/L N	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	**<0.02**
N-NO_2 (Nitrite)	mg/L N	0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**<0.002**
N-NO_3 (Nitrate)	mg/L N	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**<0.10**
NO_2 + NO_3 as N	mg/L N	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**<0.10**
Total Nitrogen	mg/L	Calculated	0.12	0.08	0.08	0.08	0.12	0.10	0.08	0.18	0.16	0.08	0.14	0.11	0.15	**0.13**
Total Phosphorus	mg/L	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	**<0.003**
Chlorophyll *a*	µg/L	0.2	0.4	-	0.6	-	0.4	-	<0.2	-	-	-		<0.2	-	**<0.2**
Pheophytin *a*	µg/L	0.2	<0.2	-	<0.2	-	<0.2	-	1.1	-	-	-		0.5	-	**1**
Total Chlorophyll *a*	µg/L	Calculated	0.5		0.7		0.5		1.2					0.6		**1**

Table 2: Selected water quality data measured in the northwest basin of Sheardown Lake in August, 2007

		Sample Date:	2007-08-05	2007-08-05	2007-08-05	2007-08-05	2007-08-05	2007-08-05	2007-08-07	2007-08-07	2007-08-07	2007-08-07	Lake-Wide Mean
		Sample ID:	DLO-01-1-S	DLO-01-1-B	DLO-01-2-S	DLO-01-2-B	DLO-01-4-S	DLO-01-4-B	DLO-01-5-S	DLO-01-5-B	DLO-01-7-S	DLO-01-7-B	
		Descriptor:	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	
PARAMETER	**UNITS**	**MRL**											
Alkalinity as $CaCO_3$	mg/L	5	51	52	50	50	51	50	50	50	51	53	***51***
pH			8.29	8.36	8.32	8.30	8.30	8.34	8.19	8.15	8.14	8.19	***8.26***
Conductivity	uS/cm	5	104	105	103	103	104	103	103	103	104	110	***104***
TDS (COND - CALC)	mg/L	5	68	68	67	67	68	67	67	67	68	72	***68***
Total Suspended Solids	mg/L	2	<2	<2	<2	3	<2	<2	<2	<2	<2	<2	***<2***
Turbidity	NTU	0.1	0.4	0.5	0.3	1.4	0.4	0.3	0.2	0.2	0.3	0.3	***0.4***
Bromide	mg/L	0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	***<0.25***
Chloride	mg/L	1	1	1	1	1	1	1	1	1	1	1	***1***
Sulphate	mg/L	1	1	1	1	1	1	1	3	3	3	3	***2***
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	***<0.001***
Total Organic Carbon	mg/L	0.5	2.1	2.0	2.0	2.0	2.0	2.2	1.6	1.5	1.7	1.6	***1.9***
Dissolved Organic Carbon	mg/L	0.5	2.1	2.3	2.0	2.0	1.9	2.0	1.7	1.8	1.8	1.7	***1.9***
Total Kjeldahl Nitrogen	mg/L	0.10	0.13	0.27	<0.10	0.18	0.14	<0.10	0.20	0.13	0.18	<0.10	***0.14***
N-NH3 (Ammonia)	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.06	0.03	<0.02	0.02	***<0.02***
N-NO2 (Nitrite)	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	***<0.002***
N-NO3 (Nitrate)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	***<0.10***
NO2 + NO3 as N	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	***<0.10***
Total Nitrogen	mg/L	Calculated	0.18	0.32	0.10	0.23	0.19	0.10	0.25	0.18	0.23	0.10	***0.19***
Total Phosphorus	mg/L	0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	***<0.003***
Chlorophyll-a	mg/m3	0.2	<0.2	<0.2	0.2	1.3	0.9	<0.2	<0.2	<0.2	0.2	0.2	***0.3***
Pheophytin-a	mg/m3	0.2	<0.2	<0.2	<0.2	<0.2	0.4	4.9	2.0	1.6	2.4	1.4	***1.3***
Total Chlorophyll a	mg/m3	Calculated	<0.2	<0.2	0.3	1.4	1.0	5.0	2.1	1.7	2.6	1.6	***1.6***

Table 3: Summary of selected trophic status classification schemes for lakes

Lake Trophic Status							Reference
Ultra-oligotrophic	Oligotrophic	Oligo-mesotrophic	Mesotrophic	Meso-eutrophic	Eutrophic	Hypereutrophic	
Total Phosphorus (µg/L)							
-	<10	-	10 - 35	-	35-100	> 100	OECD (1982)
<4	4 - 10	-	10 - 20	20 - 35	35 - 100	> 100	CCME (1999)
-	<5	-	10 – 30	-	-	> 100	Chambers et al. (2001)
<5	-	5 - 10	-	10 - 30	30 - 100	> 100	Wetzel (1983)
-	<10	-	10 - 30	-	-	> 100	Nürnberg (1996)
Chlorophyll *a* (µg/L)							
-	<2.5	-	2.5 - 8	-	8 - 25	> 25	OECD (1982)
0.01 - 0.5	0.3 - 3	-	2 - 15	-	10 - 500	-	Wetzel (1983)
-	<3.5	-	3.5 - 9	-	9.1 - 25	> 25	Nürnberg (1996)
Secchi Depth (m)							
-	> 6	-	3 - 6	-	<1.5	-	OECD (1982)
-	> 4	-	2 - 4	-	1 - 2.1	<1	Nürnberg (1996)
Total Nitrogen (µg/L)							
-	<350	-	350 - 650	-	651 - 1,200	> 1,200	Nürnberg (1996)
<1 - 250	-	250 - 600	-	500 - 1,100	-	500 - > 15,000	Wetzel (1983)
Inorganic Nitrogen (µg/L)							
<200	-	200 - 400	-	300 - 650	500 - 1,500	> 1,500	Wetzel (1983)

Table 4: Results of mass-balance modeling to predict the effect of discharge of treated sewage effluent on water quality in the northwest basin of Sheardown Lake

Parameter	Unit	Effluent Concentration	Initial Lake Concentration	Predicted Lake Concentration at the End of 1.5 Years		CCME Guideline for the Protection of Aquatic Life
BOD5	mg/L	10	0.5[1,2]	0.5		-
TSS	mg/L	10	1[2]	1		Maximum average increase of 25 mg/L above background for long-term exposures
Fecal Coliform Bacteria	CFU/100 mL	1	0[1]	0.02		
Nitrates	mg/L N	10	0.053[2]	0.07		2.93
TP	mg/L	0.5	0.0015[2]	0.0030		Remain within CCME trophic category and up to a 50% increase above the baseline level.
Total ammonia	mg/L N	2	0.01[2]	0.01		0.34-7.3[3]

[1]Estimated from data collected at Camp Lake.
[2]Value used represents one half of the analytical detection limit.
[3]Based on an ambient range of pH of 7.5-8.5 and a temperature of 0-10^{o}C

APPENDIX "E"

- **Photographs**

Photo looking north showing the local drainage ditch

REFERENCES

1. D.W. Smith, 1996, “Cold Regions Utilities Monograph, Third Edition”, 10.1 to 10.7, Wastewater treatment
2. Baffinland Iron Mines License 2BB-MRY0710, Nunavut Water Board, July 2007-09-04
3. Duong and Kent, 1996, “Guidelines for the preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in Northwest Territories”
4. Knight Piesold, 2006 and 2007, “Unpublished documents pertaining to Mary River Project”
5. Knight Piesold, 2006, “Environmental Screening Document”, submitted to NIRB on behalf of Baffinland Iron Mines Corporation
6. Canada Gazette, 2004, December 4, 2004, Part 1, Volume 138, Issue 49
7. Seprotech, 2007, “RBC system data and manuals, unpublished”
8. Canadian Environmental Protection Agency, The Act, 1999
9. Fisheries and Oceans Canada. Tides, Currents and Water Levels. 15 Oct. 2006. www.waterlevels.gc.ca/cgi-bin/tide-shc.cgi?queryType=showRegion&language=english&region=2>
10. Buckley, J.R., B.R. de Lange Boom and E.M. Reimer. “The physical oceanography of the Cape Hatt region, Eclipse Sound, N.W.T.” Arctic 40 (1987): 20-33.
11. Dickens, D., I. Bjerkelun, P. Vonk, S. Potter, K. Finley, R. Stephen, C. Holdsworth, D. Reimer, A. Gordon, W. Duval, I. Buist, and A. Sekerak. Lancaster Sound Region – A Coastal Atlas for Environmental Protection. Yellowknife: Environment Canada, Environmental Protection Division, 1990
12. Canadian Council of Ministers of the Environment (CCME). ed. “Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table.” Canadian Environmental Quality Guidelines, 1999.. Winnipeg: CCME, Update 6.0, July 2006a