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Tahera Diamond Corporation

Waste Water Treatment Plant Operations Plan
Jericho Diamond Mine
Nunavut

Submitted to:

Tahera Diamond Corporation
Toronto, Ontario

Submitted by:

AMEC Earth & Environmental
Burnaby, BC

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VE51295

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1.0 INTRODUCTION

1.1 Location

A waste water treatment package system will be installed at the mine site, housed in a stand alone building next to the plant. The building will be founded in a manner similar to the accommodation building and will be supplied heat from the plant. The waste water treatment plant (WWTP) will be installed and operated by the camp services contractor (currently likely to be Nuna Logistics). The WWTP will be sized to service 100 people. This plan assumes a rotating biological contactor plant, but is specifically not meant to limit the choice of treatment system chosen by the contractor to optimize both environmental and economic benefits.

The waste water treatment plant will be installed at the same time as the camp in the early construction phase. Initially effluent will be pumped directly to the PKCA through a dedicated pipeline. Once the diamond plant is constructed and operational sewage will be pumped to the tailings box in the diamond plant where it will mix with fine PK prior to discharge to the PKCA.

1.2 Operation of The Rotating Biological Contactor Waste Water Treatment Plant

The following information was provided by a potential waste water treatment plant supplier:

The waste water treatment plant (WWTP) employs aerobic digestion of raw sewage to reduce the biochemical oxygen demand (BOD) and total suspended solids (TSS) in the treated effluent concentration.

In addition to aerobic digestion, the clarified plant effluent stream is subjected to UV light ensuring the complete destruction of any pathogens and bacteria prior to its discharge to the environment.

Raw camp effluent is gravity fed through piping to a small volume aluminum lift station placed below the camp outfall height. The effluent collects within the lift station and is transferred to the RBC system via a level activated submersible solids grinding pump. The lift station tank is also equipped with a submersible heating element for winter operations.

The raw effluent enters the plant through the primary treatment chamber. This chamber is designed to provide an adequate volume storage buffer so the treatment system is not shocked with a sudden volume of influent quality change. Air is blown into the primary chamber to initiate the biological destruction process using a small regenerative blower.

An overflow line from the primary tank feeds into a small volume biozone feed tank leaving the collected inlet solids within the primary tank. A bucket wheel assembly, connected to the end of the biorotor drive shaft rotates through the feed tank delivering a measured volume of influent to the biozone tank.

The biorotor sitting within the biozone tank rotates continuously through the delivered influent. Through this rotating action, the naturally occurring bacteria within the influent, are alternately exposed to the air and the wastewater. This alternating sequence provides the environment required for the biological digestion of the wastewater, resulting in the formation of a biological mat formed on the rotor itself.

A direct correlation exists between treatment efficiency, retention time within the biozone, and surface area available to the biological digestion. To maximize surface area, decrease the overall size and retention capacity of the system, the biorotor media is comprised of several 3.8 cm solvent-welded PVC tubes. To further reduce the overall outside dimension of the entire treatment process the biozone tank is placed on stilts within the primary tank.

Waste water flows through the biozone tank in an equilibrated pattern. This simply means that a gallon of influent flow to the biozone equals a gallon of treated effluent out. The treated effluent from the biozone tank flows into a conical clarifier tank where the contained biomass particles settle out of suspension. On a timed basis a return pump within the clarifier delivers the collected biomass particles to the primary tank. This ensures an adequate supply of bacteria in the primary tank to initiate the digestion process.

Clarified liquid overflows into the discharge tank. As the fluid enters the discharge chamber it flows over a chlorine element that destroys all entrained bacteria and pathogens. On a discharge tank level signal the digested, clarified and UV-treated effluent is discharged to the environment (at Jericho, the PKCA).

A single 5 cm drain line runs the length of the system. Each tank segment of the system is isolated from the drain line by a ball valve. This allows for each segment to be drained individually when required. The drain line is completed with a 5 cm camlock connection allowing a vacuum truck to connect and drain the system. This is required each time the system is to be moved to a new location or at the end of a specific project. Sludge from the plant will be periodically removed as required and placed in a fenced berm a minimum of 30 m from the accommodation building. If odor or other issues become problematic the treatment plant can be equipped to dewater the sludge and the sludge can be incinerated.

Off-the-shelf package plants are readily available with proven performance under Arctic conditions.

1.3 Effluent Discharge

Water from the WWTP will be discharged from the plant through a heat-traced HDPE pipe of sufficient diameter to carry peak discharge loads to the PKCA. Surface discharge will be the base case because, as the sewage water is heated it will not likely freeze until exited from the outfall pipe. Should winter freezing be problematic, the discharge will be modified to be subaqueous.

2.0 CHARACTERIZATION OF TREATMENT PLANT EFFLUENT

Information was obtained from a supplier of rotating biological contactor (RBC) waste water treatment plants. The manufacturer quotes the following for a typical 100-man camp unit similar in configuration (but smaller) than that installed at Diavik:

BOD_5	<10 mg/L
TSS	<10 mg/L
NO_3	<10 mg/L
Total N	<20 mg/L

P	<1.0 mg/L
Faecal coliform	<2.2 MPN
UV disinfection	

Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories (1992), for lakes are:

BOD	360 mg/L
Suspended Solids	100 mg/L
Phosphorus	Site specific
Fecal Coliform	100 CFU/.dL
pH	6 – 9
Oil and Grease	< 5 mg/L

mg/L: milligrams per litre CFU/dL: coliform units per 10 litres

Technical specifications for a RBC plant of similar design to that for Diavik and drawing are attached as Appendix 1. Note that UV sterilization is used in this design. The final plant will be chosen as part of detailed construction engineering. We note that all plant designs presented here and in the Final EIS exceed NWT guidelines for discharge to **receiving water bodies**, whereas the plant at Jericho will be discharged to the PKCA.

3.0 PHOSPHORUS ADSORPTION IN THE PKCA

The issue of phosphorus adsorption was addressed at EKATI™ in a study by Karen Patricia Graham of the University of Alberta (master's thesis available through University Microfilms™ *Investigation of the Fate of Wastewater Phosphorus Within the Processed Kimberlite Containment Area at BHP's EKATI™ Diamond Mine*. 2002). Her study showed that phosphorus was adsorbed by fine PK in the impoundment area. Further, if phosphorus is remobilized under anoxic conditions, it will be readsorbed near the surface of the PKCA where oxic conditions are again found. Very little, if any pore water, where anoxic conditions will occur, will be released during operations or closure.

Graham found the removal rate of phosphorus by Ekati Diamond Mine™ kimberlite (average 25% clays) was 0.56 to 2.5 mg/g kimberlite and was independent of temperature and pH. Additionally, the addition of coagulant and flocculant (Magnafloc 156 and 368, respectively) had no effect on phosphorus adsorption. Graham's work indicated 0.4 kg dry weight of kimberlite is required to reduce phosphorus concentrations two orders of magnitude (10 mg P/L to 0.1 mg P/L).

REFERENCES

Graham, K.P. 2002. Investigation of the Fate of Wastewater Phosphorus Within the Processed Kimberlite Containment Area at BHP's EKATI™ Diamond Mine. Thesis submitted to the Faculty of Graduate Studies and Research, Dept. of Civil and Environmental Engineering, Edmonton, AB.

P.J. Hannah Equipment Sales Corp. 2003. Technical specifications for a rotating biological contactor water treatment plant.

APPENDIX 1

SEWAGE TREATMENT PLANT TECHNICAL SPECIFICATIONS

Item 1 **< 10 mg/l BOD_5, < 10 mg/l TSS, < 1.0 mg/l Phosphorous, UV Disinfection**

ITEM	QTY	DESCRIPTION	UNIT PRICE
1	1	**P.J. HANNAH BIODISC®** sewage treatment plant model BS9F-BFP. Rated for a daily flow of 22.7 m^3 of camp strength sewage, to produce an effluent quality of < 10 mg/l BOD_5 , <10 mg/l TSS,and less than 1.0 mg/l Phosphorous average. Drive motor 1/2 hp, 110/1/60 TEFC. Media area 1098 m^2. This is a complete corrosion protected steel package plant complete with primary clarifier, rotor treatment zone, final clarifier, filter feed and backwash chambers and effluent pumping chamber. Also includes the following if √ √ Internal flow balancing system. √ 25 mm spray foam insulation on all external walls and bottom. √ 25 mm spray foam insulation on underside of cover. √ UV disinfection system. √ Tertiary filter. √ Control panel. √ Phosphorus removal system. √ Effluent pumps √ Intrinsically safe heaters and lights within treatment plant. √ Flow meter. √ Grating and handrailing within treatment plant. BUDGET PRICE Canadian Funds, F.O.B. Minesite, NWT	**$ 200,000.00**

Item 2 **< 20 mg/l BOD_5, < 20 mg/l TSS, < 1.0 mg/l Phosphorous, UV Disinfection**

ITEM	QTY	DESCRIPTION	UNIT PRICE
2	1	**P.J. HANNAH BIODISC®** sewage treatment plant model BS9F-BFP. Rated for a daily flow of 22.7 m^3 of camp strength sewage, to produce an effluent quality of < 20 mg/l BOD_5 , <20 mg/l TSS,and less than 1.0 mg/l Phosphorous average. Drive motor 1/2 hp, 110/1/60 TEFC. Media area 1098 m^2. This is a complete corrosion protected steel package plant complete with primary clarifier, rotor treatment zone, final clarifier, and effluent pumping chamber. Also includes the following if √ √ Internal flow balancing system. √ 25 mm spray foam insulation on all external walls and bottom. √ 25 mm spray foam insulation on underside of cover. √ UV disinfection system. √ Control panel. √ Phosphorus removal system. √ Effluent pumps √ Intrinsically safe heaters and lights within treatment plant. √ Flow meter. √ Grating and handrailing within treatment plant. BUDGET PRICE Canadian Funds, F.O.B. Minesite, NWT	**$ 175,000.00**

Client Ref#: AMEC Earth and Environmental **P.J. HANNAH REF#: K 17550- ITEM 1**

Job Name **Tahera Corp.** **DATE June 13, 2003**

	DESIGN CRITERIA	SUMMER	WINTER
INFLUENT CONDITIONS	Design Flow m^3/day (avg)	**22.7**	**22.7**
	Design Flow m^3/hr (peak)		
	To be flow balanced to m^3/hr (design)		
	Anticipated Flow m^3/day (avg)		
	Anticipated Flow m^3/ (peak)		
	To be flow balanced to m^3/hr (Anticipated)		
	PH	Assumed 6.5 to 8.5 all year round	
	BOD_5 mg/ℓ (total)	**375**	**375**
	SS mg/ℓ (total)	**450**	**450**
	Fats, oils & grease mg/ℓ	**50 (max)**	**50 (max)**
	NH_3-N mg/ℓ		
	T.K.N. mg/ℓ		
	Phosphorous mg/ℓ	**13**	**13**
	Sewage temperature °C	**>12.5**	**> 9**
EFFLUENT REQUIREMENTS (**All Average Values**)	BOD_5 mg/ℓ (total)	**< 10**	**< 10**
	SS mg/ℓ (total)	**< 10**	**< 10**
Nitrification	NH_3-N mg/ℓ		
	NO_3-N mg/ℓ		
Dentrification	T.K.N. mg/ℓ		
	Total Nitrogen mg/ℓ		
	Phosphorous mg/ℓ	**< 1.0**	**< 1.0**
Disinfection	Fecal Coliform M.P.N./100 mℓ	**< 10 CFU**	**< 10 CFU**
	SOURCE OF WASTEWATER:	**Mine Camp**	

Client Ref#: AMEC Earth and Environmental **P.J. HANNAH REF#: K 17550- ITEM 2**

Job Name **Tahera Corp.** **DATE June 13, 2003**

	DESIGN CRITERIA	SUMMER	WINTER
INFLUENT CONDITIONS	Design Flow m^3/day (avg)	**22.7**	**22.7**
	Design Flow m^3/hr (peak)		
	To be flow balanced to m^3/hr (design)		
	Anticipated Flow m^3/day (avg)		
	Anticipated Flow m^3/ (peak)		
	To be flow balanced to m^3/hr (Anticipated)		
	PH	Assumed 6.5 to 8.5 all year round	
	BOD_5 mg/ℓ (total)	**375**	**375**
	SS mg/ℓ (total)	**450**	**450**
	Fats, oils & grease mg/ℓ	**50 (max)**	**50 (max)**
	NH_3-N mg/ℓ		
	T.K.N. mg/ℓ		
	Phosphorous mg/ℓ	**13**	**13**
	Sewage temperature °C	**>12.5**	**> 9**
EFFLUENT REQUIREMENTS (**All Average Values)**	BOD_5 mg/ℓ (total)	**< 20**	**< 20**
	SS mg/ℓ (total)	**< 20**	**< 20**
Nitrification	NH_3-N mg/ℓ		
	NO_3-N mg/ℓ		
Dentrification	T.K.N. mg/ℓ		
	Total Nitrogen mg/ℓ		
	Phosphorous mg/ℓ	**< 1.0**	**< 1.0**
Disinfection	Fecal Coliform M.P.N./100 mℓ	**< 10 CFU**	**< 10 CFU**
	SOURCE OF WASTEWATER:	**Mine Camp**	

Reference Installations:

North American Palladium – Lac Des Iles, Ontario

Rob Normore – Tel: 807-448-2005, Fax: 807 448 2001, email rnormore@napalladium.com

Darryl Boyd – Environmental Coordinator – Tel: 807-448-2005 ext 16

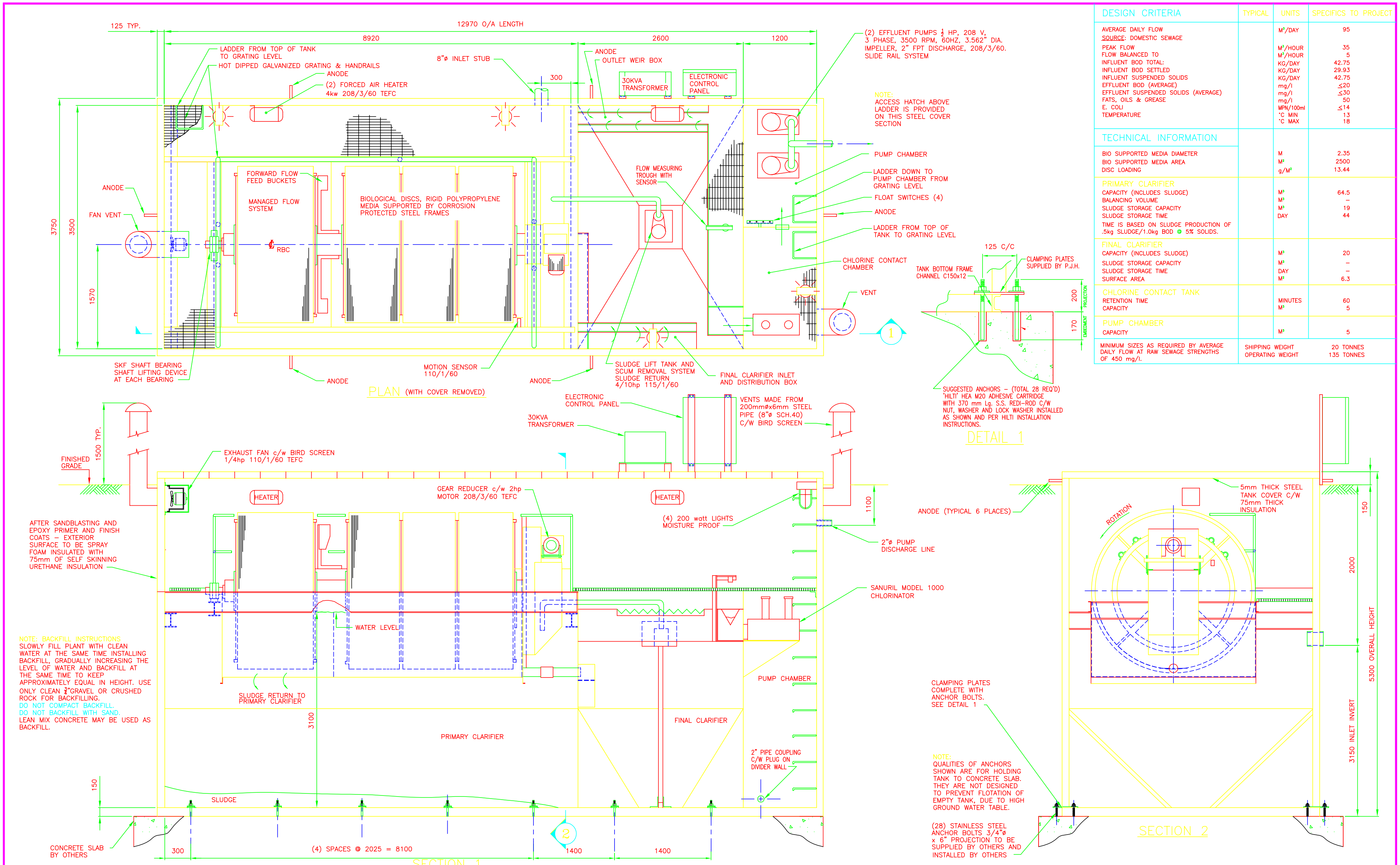
350 man camp - ~ 95 m^3/day

Hydro Quebec – Various sites through-out Northern Quebec

Yves Barabe – Tel: 514-289-6318

AutoCAD Drawings:

The attached AutoCAD drawing shows the treatment plant we supplied for North American Palladium several years back. While this is a good example of our factory-built packaged camp plants, it is considerably larger than your application (350 men vs. 100 men). At your request, we would be pleased to provide a basic lay-out drawing for a system suitable for your application.



DESIGN CRITERIA	TYPICAL	UNITS	SPECIFICS TO PROJECT
AVERAGE DAILY FLOW		M^3/DAY	95
SOURCE: DOMESTIC SEWAGE			
PEAK FLOW		M^3/HOUR	35
FLOW BALANCED TO		M^3/HOUR	5
INFLUENT BOD TOTAL:		KG/DAY	42.75
INFLUENT BOD SETTLED		KG/DAY	29.93
INFLUENT SUSPENDED SOLIDS		KG/DAY	42.75
EFFLUENT BOD (AVERAGE)		mg/l	≤20
EFFLUENT SUSPENDED SOLIDS (AVERAGE)		mg/l	≤30
FATS, OILS & GREASE		mg/l	50
E. COLI		MPN/100ml	≤14
TEMPERATURE		°C MIN	13
		°C MAX	18
TECHNICAL INFORMATION			
BIO SUPPORTED MEDIA DIAMETER		M	2.35
BIO SUPPORTED MEDIA AREA		M^2	2500
DISC LOADING		g/M^2	13.44
PRIMARY CLARIFIER			
CAPACITY (INCLUDES SLUDGE)		M^3	64.5
BALANCING VOLUME		M^3	–
SLUDGE STORAGE CAPACITY		M^3	19
SLUDGE STORAGE TIME		DAY	44
TIME IS BASED ON SLUDGE PRODUCTION OF .5kg SLUDGE/1.0kg BOD @ 5% SOLIDS.			
FINAL CLARIFIER			
CAPACITY (INCLUDES SLUDGE)		M^3	20
SLUDGE STORAGE CAPACITY		M^3	–
SLUDGE STORAGE TIME		DAY	–
SURFACE AREA		M^2	6.3
CHLORINE CONTACT TANK			
RETENTION TIME		MINUTES	60
CAPACITY		M^3	5
PUMP CHAMBER			
CAPACITY		M^3	5

MINIMUM SIZES AS REQUIRED BY AVERAGE DAILY FLOW AT RAW SEWAGE STRENGTHS OF 450 mg/l.	SHIPPING WEIGHT 20 TONNES OPERATING WEIGHT 135 TONNES

PROTECTED BY CANADIAN PATENT #2,097,917, U.S. PATENT #5,407,578 AND OTHER NORTH AMERICAN AND WORLD WIDE PATENTS.
PROTEGER PAR UN BREVET CANADIAN N° 2,097,917 ET PAR D'AUTRES BREVETS NORD AMERICAIN ET INTERNATIONAUX.

THIS REVISED DRAWING SUPERSEDES ALL PREVIOUS ISSUES

DO NOT SCALE THIS DRAWING

TOUS LES DIMENSIONS EN mm SINON SPÉCIFIER AUTREMONT / ALL DIMENSIONS IN mm UNLESS OTHERWISE NOTED

CONSULTANT
PROJECT / PROJET: NORTH AMERICAN PALLADIUM
OUR REF. # / NOTRE RÉF #: K17296
YOUR REF. # / VOTRE RÉF #:

GENERAL ARRANGEMENT
KLARGESTER BIODISC MODEL BSF-18-BFP

DRAWN / DESSINÉE	RP/SDW
DATE	00/06/08
SCALE / LÉCHELLE	NTS
CHECKED / VÉRIFIÉ	
APPROVED / APPROVÉE	
PLOT	1:20

DESCRIPTION	REV.	DATE

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