MELIADINE GOLD PROJECT

Used Water Management Plan

Prepared by:

Agnico-Eagle Mines Limited, Exploration Division

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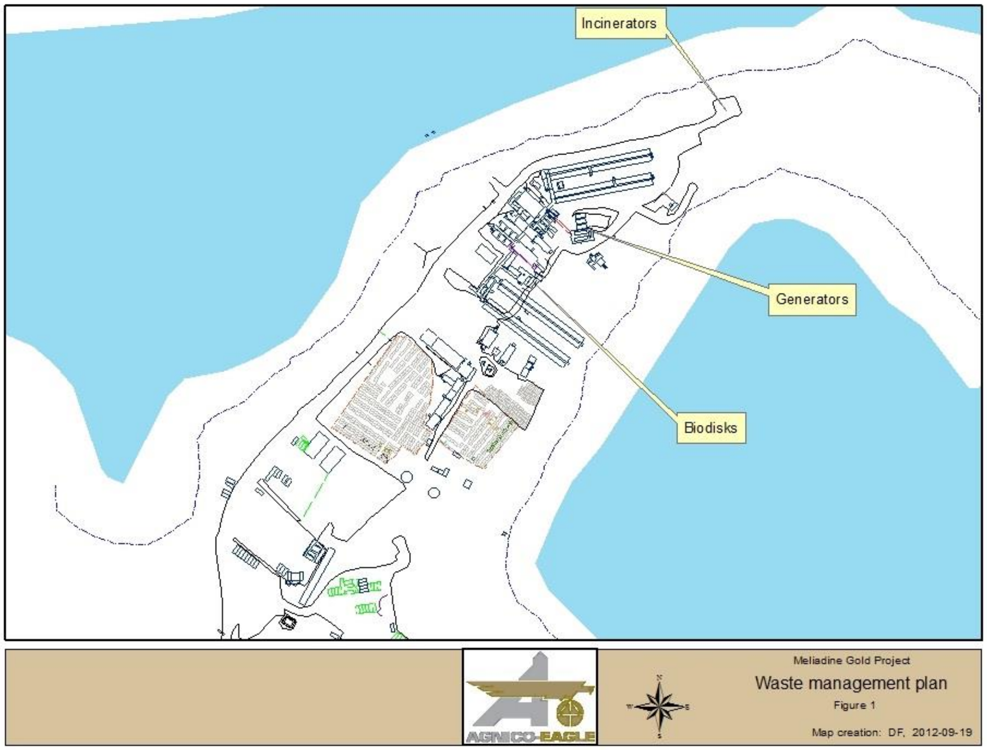
1.0 Introduction

This Used Water Management Plan is designed to reduce adverse impacts on the environment at the Agnico-Eagle Mines Limited (AEM), Meliadine Gold Project's exploration camp on Meliadine Lake, Nunavut. It is designed to comply with the terms and conditions for water use and waste management outlined in Nunavut Water Board License 2BB-MEL0914.

A site plan showing the general layout of the Meliadine Gold Project's exploration camp and associated infrastructure is given in Figure 1 (page 4)

Figure 1: camp and related infrastructures



2.0 BIODISKS Rotating Biological Contactors

2.1 Introduction

AEM is presently using two BIODISKS rotating biological contactors wastewater treatment system designed to handle both black and grey water and produce effluent in compliance with NWB water license 2BB-MEL0914. Sewage wastes at the Meliadine Gold Project advanced exploration camp were at first incinerated but this practice ended with the BIODISKS coming on line in 2010. The grey water from the laundry and kitchen facilities passed through a sump and wetland system before reaching Meliadine Lake. This grey water is now being redirected to the BIODISKS.

2.2 Location

The 2 BIODISKS have been positioned on the southeast side of the camp in a position amenable to the plumbing of influent piping from the kitchen, the dry, the showers and toilets.

Discharge plumbing delivers used water from these facilities to storage tanks (lift station) adjacent to the BIODISKS treatment plant. A grinder pump within the lift station delivers a sewage/grey water slurry to the BIODISKS and is operated by a system of floats.

2.3 BIODISKS Operation and Maintenance

2.3.1 General Description of Operation (BIODISK Operations Manual)

The following information is inspired from the manual provided by BIODISK Corporation.

The waste water treatment facility at the Meliadine Lake exploration camp is a tertiary treatment aerobic sewage treatment plant. The unit is designed to remove phosphorus, and destroy nitrogenous products and organic material. It is comprised of the primary clarifier, the BIODISK tank and the final clarifier (figure 3).

Raw sewage and grey water is pumped from the lift station into the primary clarifier. A grease trap will remove most fats, oils and greases (**FOG**) before any waste water reaches the primary clarifier. The Bio-zone location concentrates the scum in the area along the side walls of the tank. Settling separates the heavy solids. The clarified water enters the aeration section through the inlet slot located at the bottom of the non-drive end section of the bio-zone. This is the first section of three equal stages in the BIODISK aeration process. This process utilizes a fixed growth bacteria process, whereby bacteria are grown on a disc shaped media surface mounted on a shaft that is rotating into and out of the wastewater. The treated wastewater flows through three zones, each with a progressively higher standard of treatment. The first section is where most of the biological oxygen demand (BOD) reduction occurs. The third section has recycle buckets allowing recycling of the clarified water back into the primary clarifier.

Normally, it is unnecessary to add anything to the process. The biomass is naturally occurring and attaches itself to the discs which are 40% submerged in the waste water and have 60% exposure to air. As the discs rotate, the biomass is exposed to oxygen in the air, and consumes pollutants when submerged. The discs revolve 3 times per minute. Two basic classes of organisms are represented. The early stages of the process are dominated by *carbonaceous consuming microbes* that eat organic material. Later stages are dominated by *nitrification bacteria* that convert ammonia to nitrate. The early stage *carbonaceous consuming microbes* are typically dark brown and coat the disc to a thickness of about 1/16th of an inch. *Nitrificiation bacteria* is lighter in color and creates a thinner coating on the discs. Experienced operators can monitor the condition of the system by monitoring the color and odor of the biomass.

Partially treated water from the BIODISK now enters the final clarifier. Spent biomass settles in this chamber and no sludge is returned to the primary clarifier. Water levels in the final clarifier are controlled by a system of floats and pumps.

2.3.2 General Process Inspection Guideline

The process efficiency of the BIODISK system can be checked by monitoring common elements of the process. The **amount of scum** in the primary clarifier is proportional to the sludge on the bottom. Fats, oils and greases (**FOG**) need to be removed from the wastewater before it enters the BIODISKS. At Meliadine, a grease removal trap is installed after the kitchen drain. Some Rhino filters have also been added under some kitchen sinks in 2012 to improve grease recuperation.

The **thickness and distribution of the biomass** is an indicator of plant capacity. When the flow is close to design maximum, the biomass will be approximately 32 mm in the first stage and progressively less in the following stages. When the treatment is at capacity, biomass will be evident on the last stage. As flow is reduced, the amount of biomass on the disks will be proportional to the loading. At 50% of design, the organic removal biomass will occupy 50% of the length of the shaft. Light brown nitrification bacteria in the last stages is a good sign. This does not occur until the BOD is less than 30 mg/L. If the last stage is without biomass, this is a good indication that complete nitrification has been accomplished.

Biomass color is a good process indicator. In the lead stages, the biomass color should be medium brown. In the latter stages, the disks will be lighter brown when the system is lightly loaded. The appearance of black or grey patches of biomass is not good. **Black and grey biomass** is an indicator of organic overload and/or excessive FOG. This will appear first on the lead stage and may indicate the need to pump the system out.

Odor is evident when the dissolved oxygen (DO) levels are low in the BIODISK. Low DO in the first stage is an indicator of organic overload. If the problem causes black, grey and gelatinous biomass and if not addressed, it will lead to more odor and process break down. The problem will appear first in the first stage and will progress down the shaft as it gets worse. Generally, the BIODISK produces a rich loamy odor that is not offensive when operating correctly. If it is producing abnormal odor it is an indication of poor effluent, organic overload or excessive FOG.

Small amounts of **scum in the final clarifier** are an indication that nitrogen gas is being released. Nitrogen gas is released in an anoxic environment when a carbon source and nitrates are present. This indicates that de-nitrification is taking place. When the final clarifier is more than 50% covered with scum, the BIODISK may need to have the bio-solids and scum removed.

2.3.3 Electrical Controls

A control panel connects all electrical circuits within the control room of the BIODISKS units. Pumps and heaters are normally left in the auto position and the BIODISKS run 24 hours per day, 365 days per year. The effluent pumps are controlled with switches for manual or auto operation and are also hooked up to a high water alarm. The floats in the final clarifier provide the switches for the pumps. At very high flows, a float is rigged to start both pumps and also the backup pump if the primary pump fails.

There is an exterior red light outside of the control room. An **exterior flashing red** light is activated by one of the following conditions:

- Drive motor amps too high or too low
- High water
- Effluent pump malfunction

The exact problem will be indicated by control panel lights within the control room

2.3.4 Biosolids Removal

It is not necessary to empty the tank to remove all the sludge and scum if the BIODISKS are to be run continuously. There will be instances when sludge has to be removed. Generally, the first step is to remove the scum blanket and then remove the sludge. Sludge is distributed all over the primary clarified tank bottom. Solids will also be found near the inlet and under the first stage. The primary clarifier has a sludge storage capacity of about 15 cubic meters and the final clarifier has a capacity of about 0.6 cubic meters. When the primary settlement tank needs to be emptied, the supernatant is pumped into section one of the BIODISKS. The pumping of supernatant is then halted. The sludge is then pumped into 205 literss drums. The sludge pumping suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Once the primary settlement tank is emptied, the pumping of sludge is halted. The liquid content of section one of the BIODISKS is withdrawn by pumping out the liquid to expose the sludge. The supernatant from section 1 is pumped into section 2 of the BIODISK until the sludge is exposed. The pumping of supernatant is then halted. The sludge is then pumped from section 1 into 205 liters drums. Once the section 1 tank is emptied, the pumping of sludge is halted. The process is then repeated for sections 2, 3 and 4 and for the final settlement chamber.

The water treatment consultant Nordikeau has suggested removal of part of the sludge every month to improve the treatment.

2.3.5 General Operating Considerations

Good kitchen techniques can help keep the BIODISKS units operating correctly. A grease trap has been installed after the drain in the kitchen at the Meliadine Camp and Rhino filters under some kitchen sinks. There is also a bigger grease trap in a building. **The largest source of problem fats, oils and greases (FOG) is the kitchen sink.** Poor kitchen techniques can double the BOD loading. All plates and pots should have food scraps removed before rinsing.

Antibacterial soaps are designed to kill bacteria and should be avoided. The use of harsh cleaners and strong detergents will be limited and controlled in order to protect the growth of bacteria within the sewage treatment plant. When possible, biodegradable cleaners and detergents will be used.

Specific components of the unit require some routine maintenance. **The bearings of the BIODISKS shaft should be lubricated every 3 months.** Look for lubricant leaks around the gear box and motor. The **UV light has an alarm** that indicates low transmission and may indicate that it requires cleaning.

2.4 Water disinfection

UV disinfection

The treated water produced by the Biodisk must be disinfected before being released in the environment. Two UV systems TROJAN PTP 3000 are installed in series to have the longer contact time possible between the UV light and the water. This system destroys bacteria living in water.

To continue improving disinfection, a system of recirculation was designed by the AEM used water consultant and planned to be in place in May 2013.This system will recirculate 75% of the water in the UV system increasing the contact time between the water and the UV light, increasing the disinfection.

Factors Affecting UV Disinfection

The UV dose delivered by a disinfection system is a product of UV intensity (milliwatts per square centimeter) and retention (exposure) time in seconds: **UV Dose = Intensity X Time**

The units of dose are milliwatt seconds per square centimeter (mW.s/cm2) or millijoules per square centimeter (mJ/cm2). “UV intensity” is affected by:

- waste water quality,
- microbial inactivation kinetics,
- equipment/lamp configuration, and
- lamp age and sleeve fouling.

Figure 2: 2 UV water disinfection systems

__2nd water disinfection__

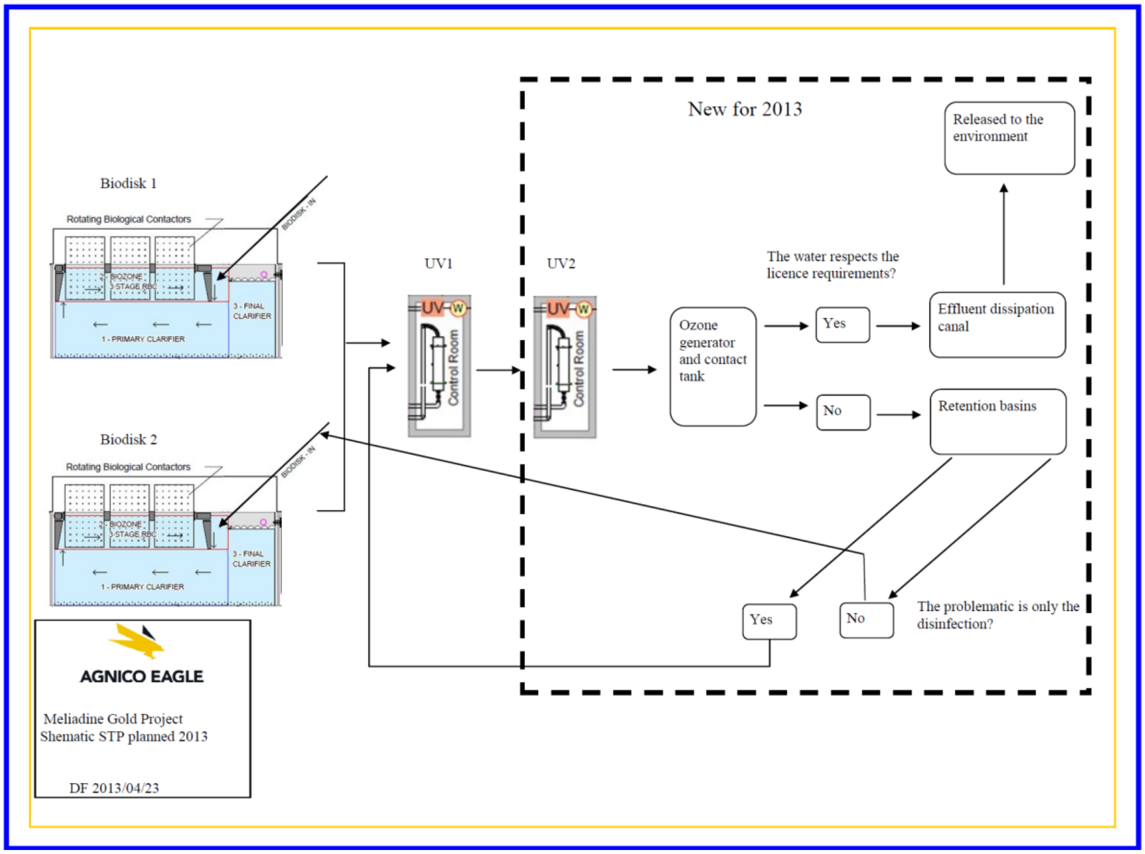
During 2012, with the improvement done at the biological treatment, the water quality of the effluent released has been improved, but a problematic with the fecal coliforms was present many times over the year. To resolve this problematic, many systems were studied and AEM chose to test an ozone treatment, an environmentally safe disinfection treatment. The ozone system that would be installed should resolve the problematic of the fecal coliforms, but also improve the quality of the treated water on many other parameters as oil and grease, TSS, NH3-NH4, DCO, etc.

The system designed for the Meliadine utilization is an OZOMAX system, able to produce 10 grams Ozone per hour. The ozone is 50 times more powerful than chlorine and will kill bacteria 3000 times more rapidly.

Some advantages of using Ozone Water disinfection:

- Ozone is primarily a disinfectant that effectively kills biological contaminants.
- Ozone also oxidizes and precipitates iron, sulfur, and manganese so they can be filtered out.
- Ozone is made of oxygen and reverts to pure oxygen; it will vanish without a trace once it has been used.

Figure 3: Meliadine STP shematic planning

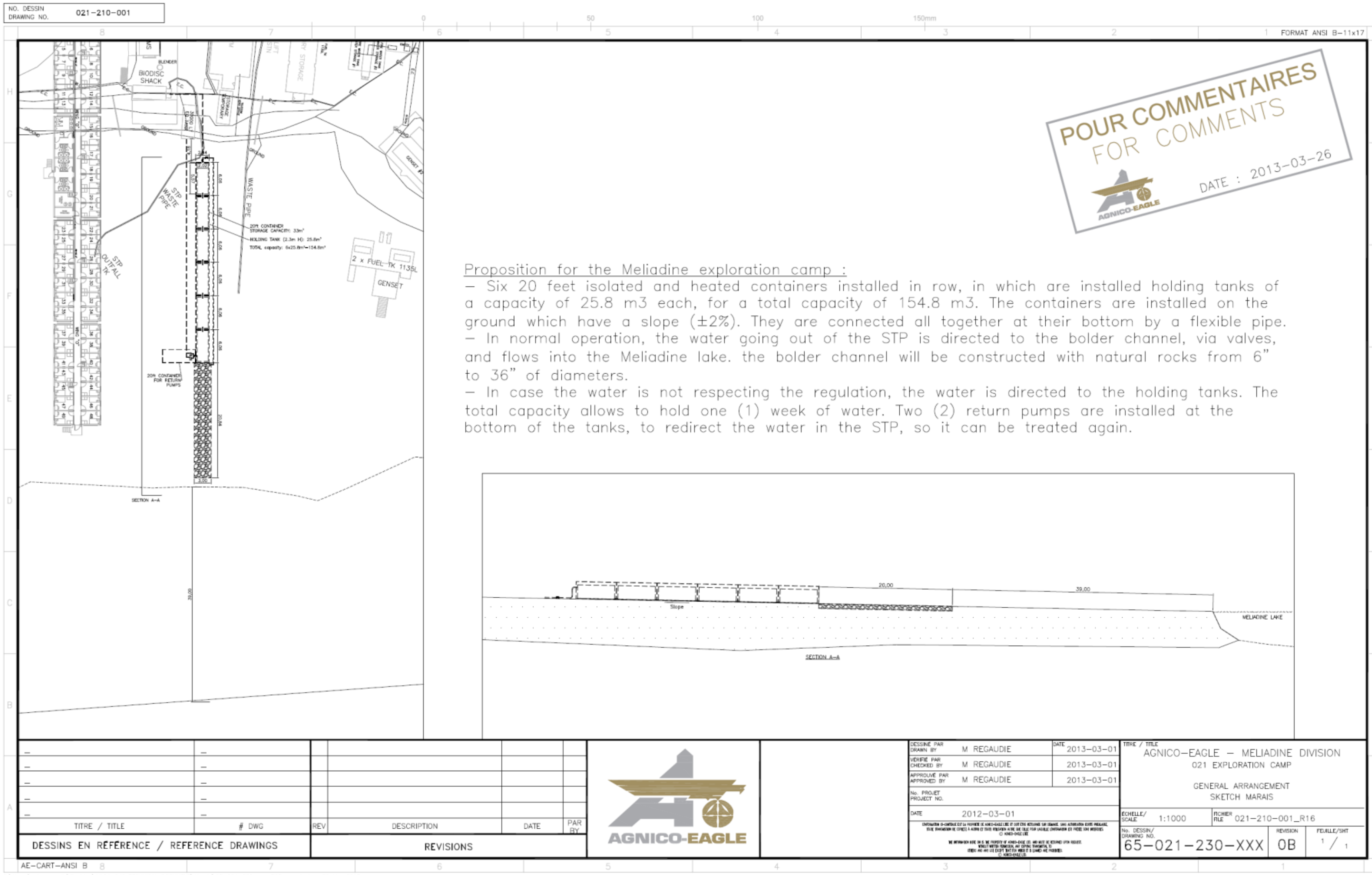


2.5 Retention basins and effluent dissipation canal

By January 2013, the Kivalliq Inuit Association required Agnico-Eagle Mines (AEM), to install a system to stop the Sewage Treatment Plan (STP) effluent if the sampling results did not meet the license 2BB-MEL0914 requirements (Part D, 13) during two consecutive weeks. The system AEM plans to install is shown in the attached figures and will be used as a “retention sump” if the water doesn’t respect the quality required by the license. In such cases, the water retained in this system will be retreated before being released in the environment. The system planned will have a total capacity of 154,8m³. Two pumps will be installed at the bottom of the tanks to return the water to the treatment line.

A dissipation effluent canal will be constructed between the last retention basins and the 31 meters protection line from the lake. This installation will maintain the soil in place and avoid sedimentation in the lake. The rock that will be used to construct the canal will be taken in the quarry authorized in the all-weather-road area. This rock is sampled for potential acidity.

Figure 4: retention basins and effluent dissipation canal



2.6 Sludge Disposal

The sludge management system is currently in development. Before 2013 the sludge pumped from the Biodisk was temporarily stocked in 205 liters drums. To improve this method, AEM works to a sludge dehydration system. The solid dehydrated material obtained is removed and incinerated or applied to land as a soil amendment material. If the material is incinerated, the ash obtained will be sampled and disposed as prescribed in the "Incinerator waste management plan".

The sludge will be removed from the BIODISKS treatment plant as required during its operation. The quantity of sludge removed will be dependent on the number of persons in camp over the year, the estimate of the solid sludge treated per year is 20m^3.

2.7 Performance and Monitoring

The final point of control is the end of the pipe from the BIODISKS and is noted in the water license as MEL-7. This station was established to monitor the performance of the BIODISKS treatment plant. The parameters monitored include BOD_5, fecal coliforms, TSS, pH, and oil and grease. Weekly samples will be collected at the end of the pipe to document the performance of the plant vs the effluent requirements set in the water license, with the results submitted to the Water Board in the monthly reports.

Table 1: License 2BB-MEL0914 requirement

Parameter	Maximum Concentration of any Grab Sample
pH	6.0 to 9.5
BOD_5	80 mg/L
TSS	100 mg/L
Faecal Coliforms	1000 CFU/100mL
Oil and Grease	5 mg/L & No visible sheen