Operation & Maintenance Manual
Construction Water Treatment Plant

Prepared by:
Agnico Eagle Mines Limited – Meadowbank/Amaruq Division

EXECUTIVE SUMMARY

Agnico Eagle has prepared the following document which summarizes the operational and maintenance procedures to be followed at the Construction Water Treatment Plant (CWTP).

This report documents the stand alone Operation & Maintenance Manual – Construction Water Treatment Plant, includes the following requirements:

- The manual was prepared in accordance with the "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996", and adapted for the use of a mechanical contact water treatment facility;
- The manual includes contingency measures in the event of a plant malfunction; and
- The manual includes sludge management procedures.

IMPLEMENTATION SCHEDULE

This Plan will be implemented upon Board approval and subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

Agnico Eagle Internal:

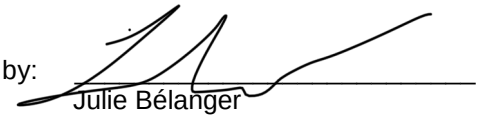
- Process Plant Superintendent
- Process Plant General Foreman
- Energy&Infrastructures Services Superintendent
- Energy&Infrastructures Services General Foreman
- Environmental Superintendent
- Senior Environmental Coordinator
- Environmental Compliance Counselor
- Water Treatment Plant Operator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	18/06/2018			Operation and Maintenance Manual
2	13/07/2018	2.1.2	13	Updated to reflect comments during review period

Prepared By: 

Manon Turmel
Environmental Compliance Counselor

Approved by: 

Julie Bélanger
Project Superintendent

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

1.1 PURPOSE

This Construction Water Treatment Plant (CWTP) Operation and Maintenance Manual (OMM) for the Whale Tail Gold Project (the Project) has been prepared based on the "*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996, prepared by the Department of Municipal and Community Affairs, NWT*". The OMM has been adapted for the use of a mechanical contact water treatment facility.

This manual is a component of the Whale Tail Environmental Management System. The objectives of this plan are summarized as follows:

1. To define the location, design and operating procedures to be used in the treatment of contact water generated at the Project; and
2. To provide monitoring requirements for the CWTP.

The CWTP purpose is to treat water during the dike construction of the Whale Tail Lake in summer 2018.

1.2 BRIEF DESCRIPTION OF THE PROJECT

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is developing Whale Tail Pit and Haul Road Project, a satellite deposit located on the Amaruq property, to extend mine operations and milling at Meadowbank Mine. The proposed open pit mine, mined by truck-and-shovel operation and will produce an ore grading at approximately 3.68 g/t from 2019 to 2025.

The Amaruq Mineral Deposit is considered to be an extension of the currently operating Meadowbank mine and most positions will be filled by Meadowbank employees. A conventional open pit mining operation is forecasted on the Whale Tail deposit. Access to the site is via a 64-kilometre road from Meadowbank mine. On-site facilities will include a power plant, maintenance facilities, tank farm for fuel storage, Construction water treatment plant (CWTP), sewage treatment plant, drinking water treatment plant, as well as accommodation and kitchen facilities for approximately 400 people.

In order to start the open pit development, a dike is required to be built in the Whale Tail Lake and water pumped from the north section of the lake to the south section of the lake.

During dike construction, lake sediment will likely be re-suspended. In order to contain the re-suspended sediments within the work area, before initiating construction, two rows of turbidity barriers will be installed on each side of the dewatering dike. Turbidity barriers are floating devices used in lakes or rivers. They are made of geotextile preventing sediment migration in water.

According to the Water Quality Monitoring and Management Plan for Dike Construction Dewatering, (Version 1 January 2017 Prepared by Agnico-Eagle Mines Limited – Meadowbank Division), during dike construction on Whale Tail Lake, contact water originating from affected areas in the lake will be pumped and treated by the Construction water treatment plant (CWTP) prior to discharge to the receiving environment. Figures 1 and 2 illustrate the location and general arrangement of the CWTP.

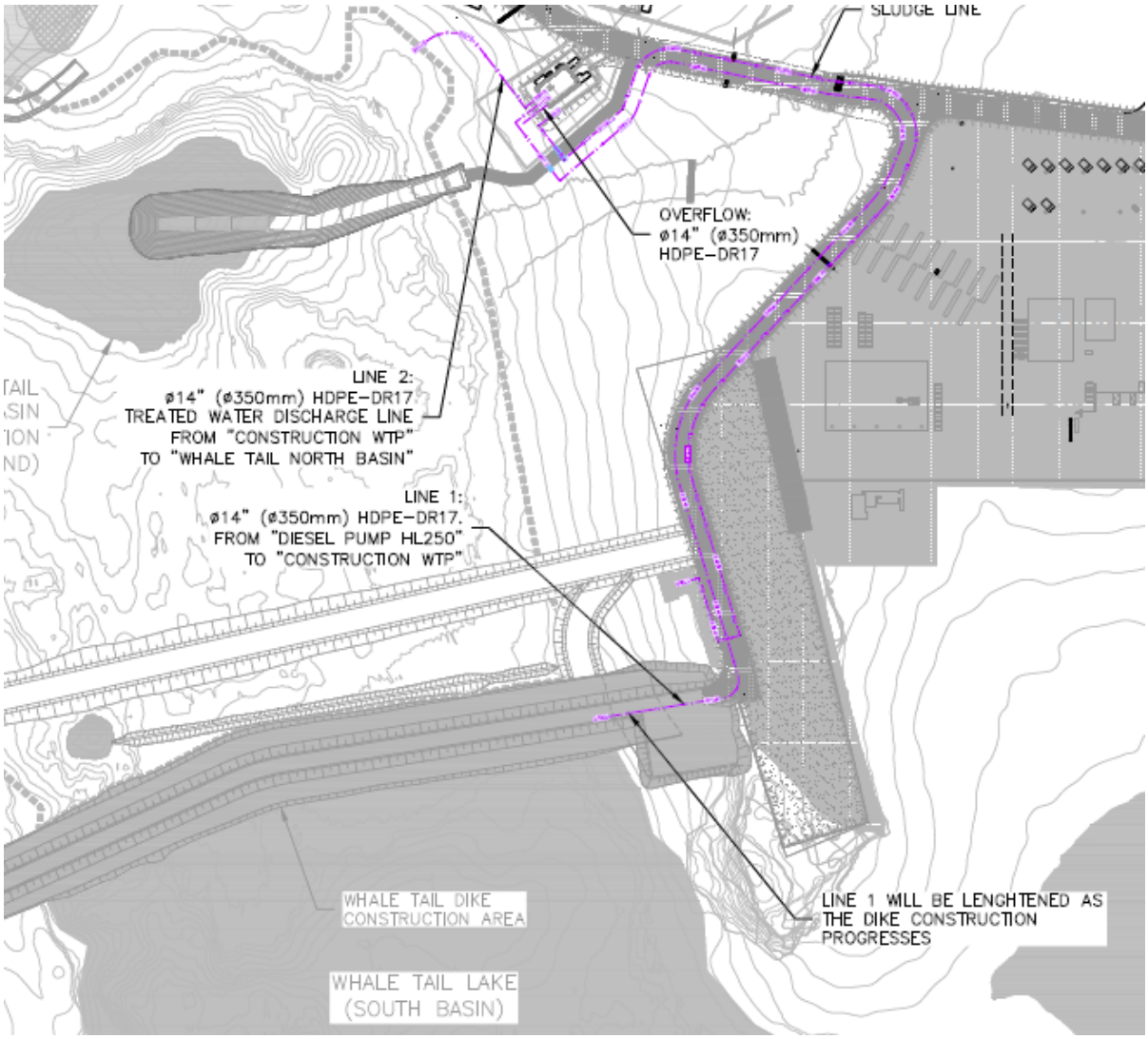


Figure 1 – Location of CWTP

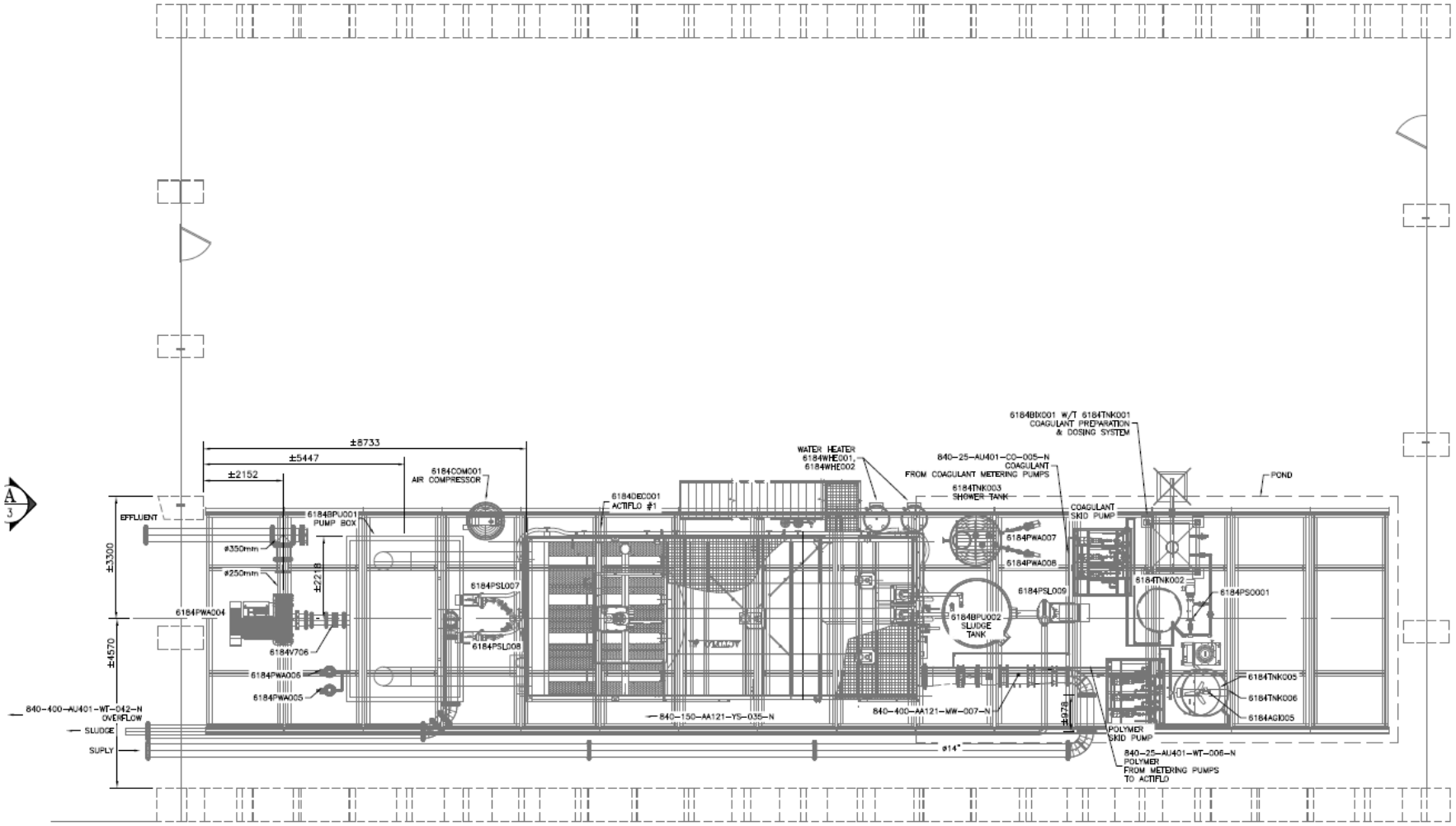


Figure 2 – General Arrangement of CWTP

1.3 CONTACT INFORMATION

The individuals responsible for the operation of the construction water treatment plant for the Project are the following:

Mill Superintendent	819-759-3555
Site Services Superintendent	819-759-3555
Site Services General Foreman	819-759-3555

2 DESCRIPTION

2.1 CONSTRUCTION WATER TREATMENT PLANT (CWTP)

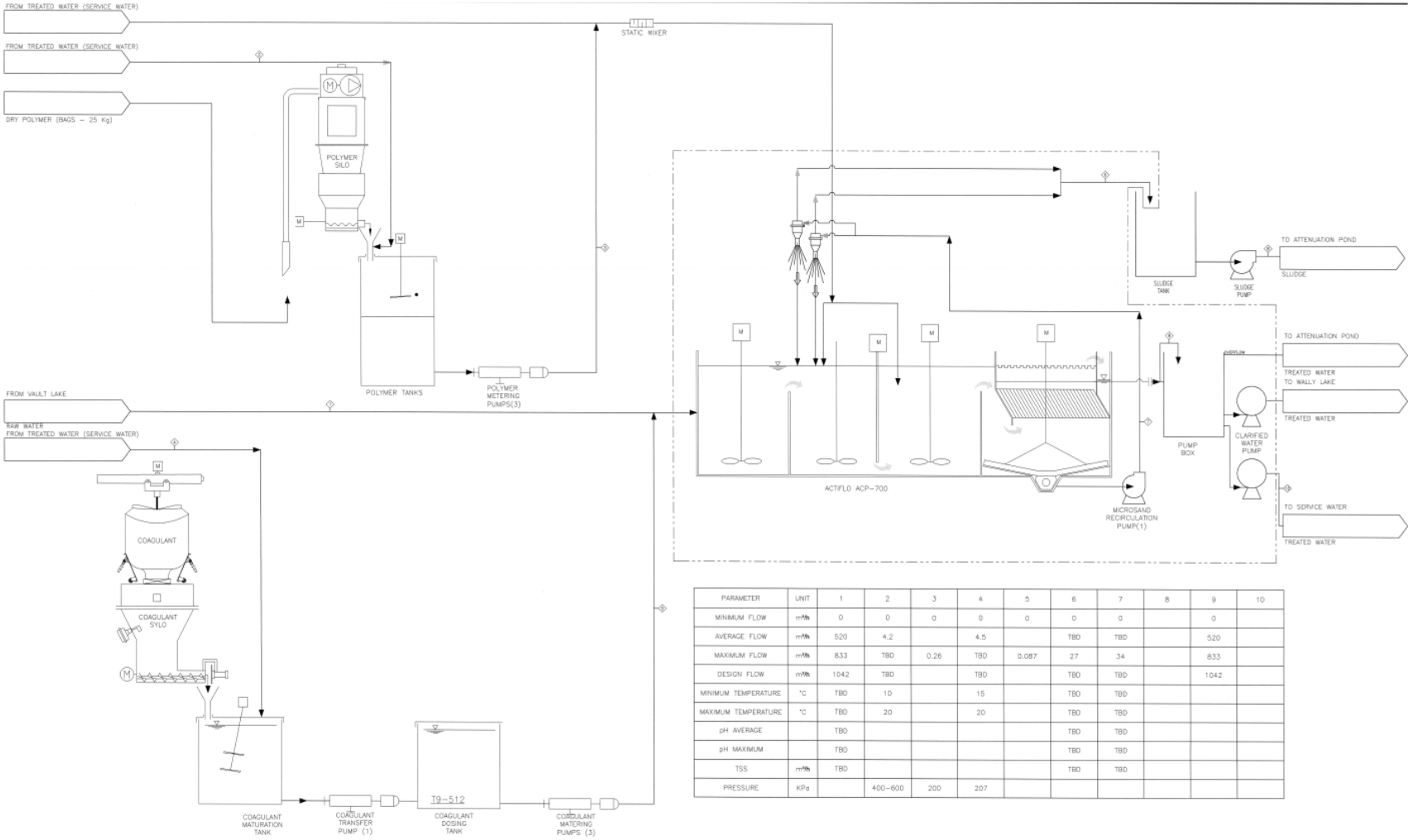
2.1.1 Process summary

The purpose of the CWTP (ACP-700R) is to remove Total Suspended Solids (TSS) from the influent water pumped from Whale Tail Lake, close to the dike construction. The equipment has an operational range of 6,250 to 28,000 m^3/d. It is expected that the CWTP will be in use only during the dike construction, approximately two (2) months in 2018 (July and August).

The equipment chosen for the CWTP was the current Actiflo® used in the past at Meadowbank mine. The plant was disassembled and would be reassembled at Amaruq site. The Actiflo® ACP 700 R as an operational range in the same order of magnitude than what is required for this project (max capacity of approximately 800 m^3/h).

The main treatment component consists of one Actiflo® clarifier with two (2) recirculation lines and two (2) hydrocyclones. The Actiflo® can be operated with one (1) or two (2) lines, depending on the influent flow rate and TSS content. The hydrocyclone overflow is sent into the rock fill structure located in the energy dispenser at a minimum 31 m of the Whale Tail Lake shore. The TSS is passively removed from the water by percolating onto the rock fill structure located in the energy dispenser and water will flow by gravity back into Whale Tail Lake. The Actiflo® overflow is designed to meet the Type A License final effluent discharge criteria for TSS concentrations. The final effluent will be monitored on a continuous basis for pH and turbidity. Flow rate is measured continuously in the feed pipe of the Actiflo®.

The CWTP general flow diagram is illustrated in Figure 3. The following sections describe the CWTP components. Note that the flowsheet represents the water treatment plant that had been installed in the past at Vault open pit, close to Meadowbank mine. This plant will be transported to Amaruq project and will be built according to the plan from Meadowbank.



PARAMETER	UNIT	1	2	3	4	5	6	7	8	9	10
MINIMUM FLOW	m³/h	0	0	0	0	0	0	0		0	
AVERAGE FLOW	m³/h	520	4.2		4.5		TBD	TBD		520	
MAXIMUM FLOW	m³/h	833	TBD	0.26	TBD	0.087	27	34		833	
DESIGN FLOW	m³/h	1042	TBD		TBD		TBD	TBD		1042	
MINIMUM TEMPERATURE	°C	TBD	10		15		TBD	TBD			
MAXIMUM TEMPERATURE	°C	TBD	20		20		TBD	TBD			
pH AVERAGE		TBD					TBD	TBD			
pH MAXIMUM		TBD					TBD	TBD			
TSS	m³/h	TBD					TBD	TBD			
PRESSURE	KPa		400-600	200	207						

Figure 3 – Flowsheet of CWTP (adapted from Meadowbank water treatment plant)

2.1.2 Actiflo®

The Actiflo® clarifier uses sand ballasted settling, a high rate coagulation-flocculation-sedimentation process. In the coagulation basin, TSS are destabilized under the action of the coagulant and start to form small aggregates (also called flocs). The coagulant is a trivalent soluble metal compound, usually iron or aluminum, which will cause coagulation when it reaches a certain concentration. Once the coagulant has performed the destabilizing effect, it will precipitate as a metal hydroxide and will participate in the formation of the aggregates. Water then flows into a second tank called the injection tank. There, micro-sand and polymer are added. The polymer acts as a flocculant aid, binding the destabilized solids together with the micro-sand particles by forming polymer bridges. The micro-sand provides a large contact area for floc attachment and acts as a ballast, thereby accelerating the settling of the flocs. From the injection tank, water flows into the maturation tank where flocs formed in the previous stage agglomerate and grow into high density flocs known as micro-sand ballasted flocs. Water then overflows to the settling section of the tank, and with the help of the lamella system, a solid-liquid separation is achieved resulting in clarified water exiting from the system via a collection trough or weirs. The clarified water is monitored for pH and turbidity prior to final discharge. The flow rate signal is also connected to a flow totalizer.

The flocs settle in a portion of the system where they are collected by a rake mechanism. A proportion of the unit's design raw water flow is continuously withdrawn from the clarifier and pumped to a hydrocyclone system which separates the micro-sand from the sludge. The recovered micro-sand is reused in the process. A small quantity of the micro-sand is not recovered by the hydrocyclones and remains within the sludge. The lost micro-sand needs to be replaced periodically by adding more to the process. After micro-sand separation, the sludge is sent to the rock fill structure located in the energy dispenser (expected solid at 0.5% solid depending on TSS feed water quality at a rate of approximately 54m^3/h). Regular inspections of the sludge discharge location will be completed to ensure that particulate materials do not migrate to surface waters.

2.1.3 Service Water System

The service water system consists of two (2) multimedia filters, two (2) heaters, one (1) filtered water tank and two (2) service water pumps. Service water is used in the preparation of dry chemicals and for polymer makeup systems. Coagulant and polymer require filtered heated water. Treated water from the Actiflo® is used to produce service water.

2.1.4 Reagents

One (1) polymers as well as a coagulant are used to treat the water that flows through the Actiflo®, each is supplied by a dosing system that is adjusted according to the influent flow rate. Treated water from the Actiflo® is used for the mixing of the reagents. The MSDS sheets are provided at Appendix A.

2.1.5 Controls

The Actiflo® Feed Pump a diesel pump working on an ON/OFF mode that allows the flow to be constant during ON mode at 444 m^3/h. The flow is monitored on the feed pipe of Actiflo®

The raw water TSS analyzer (turbidity sensor) is used to monitor the water quality. An alarm is triggered when a high-high turbidity is reached. The high-high turbidity alarm value is a setting that will be determined during the commissioning phase and will depend on the quality of the water to be treated.

The effluent water TSS concentration (turbidity) and pH values are monitored continuously with in-line instrumentation. If effluent concentrations reach a set point indicating that final effluent discharge criteria may be exceeded, an alarm is sent to the Operator, who will manage the system to meet effluent criteria. A second alarm is sent to the Operator if effluent concentrations reach a second set point that is just below the final effluent discharge criteria.

Addition of the two (2) required reagents is proportional to the influent water flow. Since this flow is constantly maintained, no manual adjustment is required. If the operator has to modify the influent water flow, adjustment of the reagent dosing system will be required to maintain the target dosage rate. The reagent dosing systems are equipped with pumps that maintain a constant flow rate when running at a constant frequency. The flow can be modified by changing the electric motor frequency.

The reagent dosing system is equipped with valves and graduated cylinders allowing the Operator to measure the addition rate of the reagent using a stop watch. The Operator will determine the required flow of a specific reagent by a formula based on influent flow rate. Based on this calculation, a manual adjustment to the reagent pump will be done in order to obtain the required dosage. Initially, the formula will be based on laboratory testing and will be adjusted accordingly to the treatment plant performance. With time and experience, operation performance may be improved based on the results obtained and sharing practices with other sites such as at Meliadine.

3 OPERATION AND MAINTENANCE

3.1 PUMPING

The system includes mainly pumps for the operation of the CWTP. Some of these pumps are equipped with a VFD that could be adjusted by the Operator or by an automatic system. In all cases the pumps can only be started by the Operator.

All pumps are regularly inspected by the Operator who will ensure the pumps continue to operate efficiently and will address any deficiencies. If the pumps require maintenance, the Operator will report the situation and take appropriate action. Some of the pumps are installed with a standby unit that allows the Operator to switch from one pump to the other if necessary. In some situations, it may be necessary to temporarily shutdown the CWTP for servicing of the equipment.

A preventative maintenance program, as recommended by the pump supplier, will be followed by the Maintenance Crew to ensure the pumps are always kept in good working order.

3.2 REAGENT MIXING

The reagent mixing system is fully automated system. The only requirement is to change the reagent bag when it is empty. Since one bag will last for many days, daily verification of the dry reagent level is sufficient to ensure stable operation of the process.

During the daily inspection, the Operator will monitor the different reagent systems and prepare additional reagent, as required, according to the reagent preparation procedures in place. The water levels in the mixing and distribution tanks are connected to the control system, which will ensure sufficient water is supplied to the reagent preparation systems. In the event of a lack of water supply, a low level alarm will occur to notify the Operator.

Preventive maintenance of the mechanical equipment will be performed according to the supplier operating manual specifications. With time and experience, the maintenance program may be improved based on results obtained and sharing practices with Meliadine.

3.3 EFFLUENT QUALITY CONTROL

The Operator will conduct regular inspections of the entire operating system to ensure it operates as intended. Any upset condition will be reported and corrective actions will be applied accordingly. The operator will also record process key values that will allow the process to be optimized and any discrepancies between the process and expected performances to be detected.

The quality of the final effluent is monitored on a continuous basis by pH and turbidity (Nephelometric Turbidity Unit (NTU)) probes. The turbidity measurement is an indirect indication of the TSS in the water, and will be used to infer the effluent TSS. The output of these instruments will send an alarm indicating that the levels are higher than the set point, but lower than the maximum discharge criteria. This allows the operator to act on the process before the limit is exceeded. In the event that the discharge limit is about to be reached, a second alarm will send a signal to the operator. The system will be equipped with an uninterruptable power supply for instrumentation and controls.

The final effluent will be sampled for water quality following the frequency and parameters stipulated in the MDMER and sent to a certified laboratory for analysis. The results generated by the laboratory will be compared with those obtained with the plant instrumentation to detect any deviations. All the probes and instrumentation within the plant will be calibrated and serviced as per the preventative maintenance program.

As stipulated in the Type A License and the Metal Mining Effluent Regulations (MMER), the final effluent discharged shall not exceed a pH range between 6.0 and 9.5 or a maximum average concentration for TSS of 15 mg/L, and a maximum of 30 mg/L for a grab sample.

3.4 TROUBLESHOOTING AND MAINTENANCE PROCEDURES

The sections below outline the general operational and maintenance procedures at the plant; further details are available in the manufacturer' operating manuals in Appendix B.

The operation of the Actiflo® process is relatively simple and a visual inspection will determine whether the process is performing as expected. A critical component of the process for monitoring is the maturation tank. The agitator of this tank is equipped with a VFD and the speed is adjusted to obtain a gentle mixing in this tank. When the process is operated correctly, big flocs of about 5 mm are visible in the tank and moving slowly. The agitation must be adjusted in a way that the flocs are maintained in suspension and not broken down. The water between the flocs should look clear. If flocs are visible but the water is cloudy, it is an indication that the coagulant dosage is insufficient. If the water is clear but the flocs are small, it is an indication that the flocculant addition is insufficient.

The system must also contain enough micro-sand to obtain flocs that are heavy enough to sink in the clarifier section. If large flocs are visible but are present at the top of the clarifier, this is an indication of insufficient micro-sand. Usually, the micro-sand load is maintained by adding one bag at a time. The frequency of the addition of micro-sand is determined by trial and error. There is no environmental issue with an excessive addition since it would be compensated by an increased loss within the sludge.

The hydrocyclone is also an important part of the system since it allows the micro-sand to be recycled in the system. The underflow of the cyclone should never be blocked and the flow should have an umbrella shape.

3.5 RECORD KEEPING

Records of the operational and maintenance and sampling procedures will be accessible to assist in the evaluation of the CWTP performance. Details of any maintenance undertaken at the CWTP will also be recorded.

The volume, pH, turbidity and temperature of effluent discharged to environment will be recorded on a continuous basis. The data will be saved on a network data base.

3.6 SAFETY PROCEDURES FOR OPERATORS

Operators working in the CWTP facility must be trained prior to work so that they are aware of the health and safety risks as well as the operational procedures associated with the CWTP. The following are important safety considerations:

- Working within the plant, especially with chemicals, requires adequate personal protective equipment (PPE) for Operators. This includes wearing steel toed boots, hard hat, rubber aprons, safety glasses with side shields and gloves.
- Operators are required to conduct good housekeeping of the working area to minimize the risk of incidents.

- Lock-out/tag-out procedures must applied when servicing equipment.
- The MSDS for reagents used in the CWTP will be readily available for the Operator at all times.
- Eyewash stations are located within proximity of reagent systems in the CWTP.

3.7 CONTROLLING ACCESS TO THE CWTP

Access to the CWTP will be restricted to authorized personnel only. Signs will be posted at the CWTP entrance.

4 EMERGENCY RESPONSE

4.1 FIRE

In case of fire at the CWTP, the on-site emergency response team (ERT) will be notified as per Agnico Eagle's protocol. Instructions from the on-site emergency response team will be followed by all personnel at the CWTP. Further details of fire response are provided in the "*Risk Management & Emergency Response Plan*". The CWTP will include the necessary fire safety protection measures in accordance with the Nunavut and North West Territories Mine Act.

4.2 SPILL

Spill kits and the necessary secondary containment will be provided within the building of the CWTP. In the event of a spill at the CWTP, the Environment Department will be notified immediately and provide support, as required. In the event of a large spill, the on-site ERT will be notified as per Agnico Eagle's protocol. Instructions from the ERT will be followed by all personnel at the CWTP. A spill kit will be available at the CWTP. In accordance with the "*Spill Contingency Plan",* all spills into a waterbody or onto ice are reported immediately to the Nunavut Spill Line among others. For spills occurring away from a waterbody, a report is provided to the Nunavut Spill Line if quantities are above the threshold as specified in the "Nunavut Environmental Protection Act. Consolidation of Spill Contingency Planning and Reporting Regulations R-068-93*".* Further details regarding the site spill response procedure are provided in the "*Spill Contingency Plan"*.

4.3 PLANT MALFUNCTION

If there is a major problem or failure in the CWTP, it will be likely due to a problem with the reagent addition systems caused by the malfunction of the pump or due to a cyclone blockage on the sludge reclaim system.

In the case of an operational upset, the most likely consequence will be an increase of TSS in the effluent. This would be managed by adjusting the feed flow rate, dosage of chemical. Once the problem is resolved and the water quality returns to concentrations within discharge criteria, the valves will be re-opened to allow discharge to environment.

In the case of a cyclone underflow blockage, the micro-sand will be completely lost to the rejected sludge. New sand will then need to be added.

Appendix A: Reagent MSDS Sheets

Appendix B: Veolia Operation and Maintenance Manual