APPENDIX 4-R
KSM HIGH DENSITY SLUDGE WATER TREATMENT PLANT FEASIBILITY REPORT

KSM High Density Sludge Feasibility Report
Water Treatment Plant

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EXECUTIVE SUMMARY

SGS-CEMI was tasked to provide feasibility level engineering designs, complete with process flowsheet, mass balances, general plant layout, major equipment sizing and a capital cost estimate for a High Density Sludge Process Water Treatment plant to treat mine drainage from the KSM Project. The scope of the study was to:

- Develop process design criteria for the treatment plant,
- Develop a process flowsheet;
- Develop preliminary plant general arrangement drawings;
- Provide other similar plant effluent quality;
- Size major equipment, provide equipment specification sheets and data based major equipment quotations;
- and develop a mass and water balance
- develop capital and operating budgets

Water flow rates for design, were provided by Klohn Crippen Berger Ltd. (KCBL) and water chemistry was provided by Rescan Environmental. This information was used to develop a treatment plant process design criteria and flowsheet to treat acid mine drainage at a flowrate capacity of 3,350 L/s while average flow during operations is expected to be 2,200 L/s. The additional capacity provided for the water treatment plant allows it to handle the 200-year return wet year and/or periods of degraded diversion performance. The peak annual treatment rate during the 200 year wet year event is 3,000 L/s.

The effluent water chemistry was confirmed by bench-scale testing, where seven samples from various seeps were sent for testing. Based on the test results, metals of concern can be treated to below reasonable discharge criteria using the HDS process at an operating pH of 9.5 or higher.

Due to the mine plan, the water treatment plant is designed for various flows as the overall water treat plant can handle flows greater than 3,350 L/s; however, the plant has four sections which are identical to handle the varying flow. During the first ten years of mine operations the plant can handle the entire flow of 2,400 L/s

in the first three sections and as the flows increase the 4th unit will come online to handle the additional flow and meet the increased expected peak flowrate of 3,350 L/s from Year 10 to Year 30.

The plant design for 3,350 L/s includes eight lime reactors for neutralization, a lime slurry stock tank, a lime/sludge mix tank, one lime silo with lime slakers, and four conventional clarifiers sized for 833 L/s each. Only four neutralization tanks will be needed for Year 0 – 10 and the plant is designed so that individual lime reactors can be bypassed for a short period of time without having a negative effect on the effluent quality. In summary, there is sufficient redundancy built into the process design within the four identical units such that during upsets or shutdowns water treatment can continue and maintenance can occur without any increased risk to the environment. Within each treatment train all of the equipment that is likely to fail has a standby backup. All pumps for sludge recycle, lime loop, sludge wasting have a back up system in the event the pump under duty fails for any reason. As well all of the lime loop line and the sludge recycle lines are installed in duplicate in case of line failure due to plugging or blockage.

It is not recommended to use the clarifier overflow water for lime slaking or flocculent preparation or dilution. However, if necessary, this water can be used to dilute lime slurry after slaking. A mass and water balance for the treatment plant is provided in the report details. Process flowsheet has been developed to provide major equipment sizes and reagent consumption estimates. The equipment sizes and reagent consumptions for the different scenarios are estimated at +/- 25%; and the equipment quotations from our data base are provided with 25% accuracy. The air requirements are calculated based upon the assumption that 100 percent of the ARD dissolved iron will be present in the ferrous form, and the oxygen transfer efficiency from air was assumed to be 20%.

The effluent water quality is expected to be as presented in Table 3 based on the bench-scale testing results. Operating a plant at pH 10.0 should produce an effluent that would meet reasonable discharge limits for all metals of concern.

Capital cost to treat the average flowrate of 2,200 L/s is estimated at **$59.0 Million** with a +/- 25% accuracy, while to treat the peak flow of 3,350 L/s is expected to cost **$73.6 Million**. All external requirements of water treatment, such as surge ponds, sludge ponds, polishing ponds, power supply to the plant, feed lines, and discharge lines from the plant, etc. are not part of this costing study and were costed by others. In addition to obtaining vendor's quotation for major equipment, the equipment sizing was compared to another project in Colorado with similar flowrate, in order to establish a basis for estimating several costs for this cost estimate.

The operating cost for the plant is expected to be $6.30 Million per year ($0.09 per m^3) for 2,200 L/s and $10.02 Million per year ($0.10 per m^3) for the higher flow of 3,350 L/s. The operating cost is based on the base case scenario water quality predictions.

Durability is planned into the plant design to maximize the equipment life. Components such as clarifier tanks will be constructed of concrete to extend the life of the most costly equipment within the treatment plant. Expected life of steel works can range from 30 years to 40 years with maintenance and protection. The mechanical equipment life for agitators is in excess of 25 years while pumps may have to be replaced sooner.

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1.0 INTRODUCTION

The KSM Project is located approximately 65 km northwest of Stewart, British Columbia at latitude 56°30' North and longitude 130° West. The property is owned by Seabridge Gold Inc. The project requires dewatering and treatment during the construction phase and during life-of-mine prior to discharge into the environment. The treatment requires a process to neutralize the acidity and precipitate metal hydroxides as high density sludge to minimize the sludge storage and sludge management.

1.1 The HDS Process

The effective removal of base metals in a chemically stable form in the HDS process is primarily the result of the formation of co-precipitates with iron on the surfaces of the recycled sludge particles. The stability of the precipitates is favourably influenced by a total iron to total metals ratio in the plant feed. This process is implemented at numerous sites around the world treating far worse water than expected at this site. A simple recycle is not sufficient to change metal ratios and, in extreme examples, iron may have to be added. Otherwise, the storage site for the sludge produced must allow for the possibility of longer-term instability. In all cases, the oxidation of ferrous to ferric iron is the principal oxygen-consuming reaction. However, if air is sparged into the reactor for oxidation, the oxygen transfer may well be controlling the reaction and hence the reactor tank sizing. Oxygen transfer will be the dominant factor in agitator design.

The near-complete precipitation of the metals as hydroxides in the neutralization process proceeds according to the following reactions:

$$M^{++} + SO_4^{=} + Ca^{++} + 2(OH)^{-} + H_2O \rightarrow M(OH)_2 + CaSO_4 \bullet H_2O$$

$$2M^{+++} + 3(SO_4)^{=} + 3Ca^{++} + 6(OH)^{-} + 6H_2O \rightarrow 2M(OH)_3 + 3CaSO_4 \bullet H_2O$$

As implied by the equations above, the products of these reactions are metal hydroxide precipitates and calcium sulfate (gypsum). If the sulfate concentration of the wastewater is high enough, there will be sufficient gypsum produced to exceed its solubility and it will precipitate with the sludge. The presence of the gypsum

increases the buffering capacity of the sludge and is partially responsible for the sludge's improved chemical stability. In fact, treated solutions are often supersaturated in gypsum. This High Density Sludge technology is especially beneficial to operations which produce high sulfate from pressure oxidation and bio-oxidation processes.

The main features of the HDS process can be summarized as follows: Lime and recycled sludge are added to the lime-sludge mix tank at the head of the process and this becomes the main neutralization agent. This mixture is discharged to the rapid mix tank where it is mixed with influent, thereby achieving neutralization. This mixture is fed to the main lime reactor where a combination of aggressive aeration and high shear agitation ensures optimum process chemistry and clarifier performance. The discharge from the lime reactor is treated with flocculent in the flocculation tank. The clarifier separates the treated effluent from the sludge, a portion of which is recycled to the head of the process.

The HDS process is normally run at a pH between 8.5 and 9.5, as most metals encountered precipitate at or below this concentration of hydroxide ions. Oxidation of ferrous to ferric iron takes place quite rapidly at this pH and oxygen from air is the most common oxidizing agent. There is no reason why other agents cannot be used for oxidation, although all the plants built by the authors so far have used air for oxidation.

The process itself depends upon sludge recycle from the treated effluent and in most plants this has been achieved in a thickener style clarifier which offers a pumpable sludge as the separated solids product. Clearly, recycle from a settling pond presents some material handling problems, as do filter-style clarifiers, but either procedure could be used.
Some general comments on the construction materials and design parameters are as follows:

Untreated water supply - All pumps in contact with this water should be 316 SS because of the acid pH of the water. Any surge tanks should also be 316 SS.

Pipelines are best in high density polyethylene. The process water flow rates and contaminant levels must be fully known in order to develop a proper design.

Lime-sludge mix tank - This vessel is normally made of carbon steel since the vessel contents are at a high pH. The agitator must be able to supply adequate mixing power to the vessel as the sludge can be quite thick.

Lime reactor - This tank can be either concrete or mild steel. In very large tanks concrete may be preferred because of the high power input requirements of the agitator. The final selection is dependent on an economic analysis and whether or not the possibility of freezing exists in the plant. The agitator gear reducer must be of a very heavy duty design to handle the difficult process requirements of keeping solids in suspension, dispersing the air into small bubbles, and contacting the air, water and solids. Designing for a low maintenance requirement is also an important factor.

Clarifier - This vessel will be constructed of concrete. Rake arms will be fitted with thixo-posts to minimize disturbance of the sludge bed. The introduction of the flocculated feed into the clarifier must be gentle to avoid breaking up the flocs and the clarifier overflow must be properly collected to reduce the problems of freezing where low temperature is a concern.

Sludge disposal - This will be pumped to the Ore Processing Complex area for incorporation into the Ore Slurry Pipeline. The line loss characteristics of the sludge must be known to properly size the pumps required. Proper start-up and shut-down of this batch pumping operation are important to avoid plugging. The sludge lines can be HDPE or steel.

Process control - The pH in the rapid mix tank is the primary parameter used to control lime addition to the sludge-lime mix tank. Optimum operation is achieved through time-proportional control of a pinch valve, which taps a small proportion of the slurry circulating in a loop from the lime slurry storage tank. The pH in the lime reactor is monitored and may be used to adjust the set-point of the primary pH control loop based on operating parameters such as feed rate, metals loading, and sludge recycle rate.

Flocculent - Flocculent may be added at various locations prior to the feed well to the clarifier. Flocculent flow is measured prior to dilution and controlled to an operator determined set-point. An on-line settling rate analyzer is commercially available and can be used to determine the settling characteristics of the clarifier feed and thus speed up the establishment of optimum flocculent requirements in addition to monitoring the effects on clarifier overflow turbidity. Monitoring of clarifier underflow density is essential. This parameter combined with sludge recycle flow rate determines recycle mass flow, the control of which is paramount in achieving optimum process performance. Duplication of the sludge recycle circuit with the use of variable-speed pump controllers and automatic line-flush sequencing has been found to provide good operating flexibility.

Clarifier overflow turbidity and pH are monitored and can be used to shut down plant feed or redirect clarifier overflow in the event that they exceed operational limits. Final discharge flow is monitored and grab samples are taken automatically for analysis and reporting. Fresh water consumption can be reduced through the use of treated water (from clarifier overflow) for lime slurry dilution, flocculent dilution and line flushing.

In order to minimize labour costs, various automatic sequences for equipment operation can be included with the use of programmable logic controllers. For example, operation of lime slakers can be automated based on the draw down of slurry from the lime slurry storage tank and flocculent preparation can be similarly controlled. At remote sites where the plant is mainly unattended, an automatic power on-restart sequence (which can restart the plant in the event of a brief power interruption) has been found to be beneficial.

1.2 Advantages of the HDS Process

The HDS process has many advantages over other lime precipitation systems. The most important of these is a substantial reduction in sludge volume resulting from an increase in sludge density. An increase from 5% solids to 40% solids is typical of HDS systems; this reduces the volume of sludge produced by over 95%. The resulting reduction in sludge disposal costs increases the cost effectiveness of the process. In addition to reduced sludge volume and superior sludge density,

there is an increase in sludge stability, both chemically and physically. Within a few days of deposition, the sludge can drain to in excess of 65% solids and possesses enough physical stability to support the heavy equipment on the surface of the impoundment area. Chemically the sludge has shown excellent stability characteristics at mining sites in BC, Canada and at numerous other sites. Following twenty-five years of impoundment at one facility, there has been no contamination of the surrounding groundwater or any other evidence of metal reversion.

Other advantages of the HDS process include:

- A high quality effluent is produced,
- The process is easily automated,
- HDS is a proven technology, and
- Operating plants consist of standard equipment available from many competitive manufactures, which reduces the need for large spare parts inventories,
- Lower neutralization costs than conventional lime treatment.

2.0 PROCESS OBJECTIVES & ASSUMPTIONS

2.1 Basis of Design

SGS Canada Inc. was requested to prepare a feasibility level design for a High Density Sludge (HDS) Process Water Treatment Plant for the KSM Project. Key elements of the study are to:

- prepare a descriptive Process Design Criteria document to form the basis of design and selection of equipment;
- develop a process flowsheet;
- develop major equipment sizing based on treatment flow and chemistry;
- develop preliminary plant general arrangement drawings;
- develop a preliminary mass and water balance;
- and develop a preliminary capital cost estimate.

The water treatment plant is designed to treat contaminated water with lime, and discharge the treated water to the receiving environment. The process flowsheet is based on previous HDS water treatment plants designed by SGS-CEMI with similar water chemistry. The equipment sizing and reagent criteria are based for a flowrate of 3,350 L/s as provided by Klohn Crippen Berger Ltd with a 45 minute retention time in eight neutralization reactors. Due to the mine plan, the flowrate for the initial 10 years is expected to be 2,200 L/s while the higher flowrate of 3,350 L/s is expected after Year 10 under a major wet event. A key consideration in using 45 minute retention time is that it allows the ability to treat higher flows than the nominal 3,350 L/s plant capacity for three to four weeks and still provide sufficient retention time (35-40 minutes) to obtain desired effluent quality that meets the applicable water Quality Standards as indicated by the bench scale test work conducted in November 2010 on simulated site water.

2.2 Design Chemistry

The design chemistry and flowrate for the treatment plant were provided by Klohn Crippen Berger Ltd. and were developed by Rescan Environmental. In order to design for the worst case scenario, highest dissolved chemical concentration was selected for each element. The flowrate to the treatment plant was estimated at an average of 2,200 L/s and a peak of 3,350 L/s in a wet year.

The plant is sized such that six reactors will be needed for average flow while additional reactors can be installed for the expected peak flows. The plant design is based on the concept to treat the ARD with lime in 8 reactors providing a total retention time of approximately 40 minutes at the peak flow rate. The design chemistry is summarized in Table 1 below and the material balance is provided in Appendix A.

Table 1. Design Chemistry*

Elements	Bench-Scale Tests**	Design Chemistry***
Aluminium	8.77	14.2
Arsenic	0.001	0.04
Cadmium	0.02	0.01
Copper	4.17	22.9
Iron	16.2	16.3
Manganese	0.05	3.3
Molybdenum	0.005	0.16
Selenium	0.002	0.04
Zinc	1.06	4.0
Sulphate	442.2	817

* All concentrations in mg/L
** Actual solution obtained from the site
*** Design Chemistry Source, Rescan 2011

The bench-scale water sample quality is somewhat lower than the predicted water quality. For the sizing of equipment specifically lime preparation system, the predicted water chemistry was used to determine the theoretical lime requirements. The effluent quality however would be similar as the bench-scale test results since most metals of concern can be easily treated using the proposed chemical precipitation process with the exception of sulphate which is below the

saturation limit of approximately 1600-1700 mg/L. For metals such as molybdenum, selenium and sulphate, a secondary process involving either ion exchange columns or another reagent addition may be needed to meet the discharge targets if required.

2.2.1 Operating Conditions

Results of bench-scale testing of the treatment process on site water samples with chemistry adjusted to simulate water quality estimates, as well as data from other HDS water treatment plants designed by SGS-CEMI were used to develop the treatment plant design. The retention times, sludge recycle ratio and clarifier underflow density were estimated using a model developed by SGS-CEMI based on past experience with similar water treatment plants.

For a typical HDS system, hydraulic retention time of 50 to 55 minutes (total retention time in 2 reactors) is preferable because of the slow reaction for complete oxidation of dissolved metals, particularly in this case iron and manganese. High retention time also yields higher lime efficiencies (lower operating cost) since lime is a slow reactant, and it provides extra risk management during high flows.

Operating pH of 9.5 or higher was chosen based on the bench-scale results. The quantity of sludge generated was calculated based on the chemistry of the feed water. The calculated sludge based on the hydroxide precipitate indicated that approximately 0.50 kilograms of sludge would be produced for each cubic meter of treated water while the bench-scale results indicate that the sludge generation can be expected to be as high as 1.04 kilograms per cubic meter. The sludge production shown in Table 2 below includes 8% of lime as inerts and 5% as unreacted lime. It should be noted that the sludge production does not include any total suspended solids that may be entrapped in the sludge.

Table 2. Sludge Production

Flow (m^3/hr)	Basis	Sludge Production	
		(kg/m^3)	(tph)
2999	Bench-Scale Testing Data	1.04	3.12
11880	Bench-Scale Testing Data	1.04	12.54

Recycled thickened sludge is a fundamental aspect of the HDS process. The amount of sludge that can be recycled has practical limits in terms of the volume of recycled sludge versus incoming ARD volumes, and these volumes have a significant impact on the vessel sizes, reactor residence times, as well as flocculent consumption. It is critical to maintain the recycle ratio at an appropriate level. The sludge recycle rate was based on past experience and data collected from other pilot studies with similar feed chemistry in order to provide sufficient sludge recycle to produce good quality effluent and maximize lime utilization.

2.2.2 Air Requirement

In order to produce chemically stable high density sludge, it is important to oxidize ferrous to ferric iron. Oxygen from air acts as an oxidizing agent to convert ferrous to ferric and the oxidation of ferrous to ferric is the principal oxygen consuming reaction.

In this case, it was assumed that 100% of the iron present would be in the ferrous form and the air requirement was calculated to be 682 m^3/hr (401 SCFM) primarily required for iron oxidation. It should be noted that oxygen transfer efficiency of 20% was assumed for the calculation as indicated in Appendix A.

2.2.3 Reagent Consumption

Lime consumption for this study was determined from the stoichiometric hydroxide requirement. The hydrated lime consumption was determined to be 0.34 g/L or 97.9 tons per day for the peak treatment rate of 3,350 L/s. The lime consumption rate was based on the bench-scale results for treatment to pH 10.0. The lime slaking system is design with sufficient flexibility and back up that if any one of the units is not operational then the other is sized so that the treatment would continue.

Flocculent addition affects the overflow Total Suspended Solids (TSS) and clarifier underflow density. High flocculation interferes with the formation of high density sludge; however, insufficient flocculent could lead to high TSS in the effluent. The consumption is typically between 0.5-2.0 mg/L based on other operating HDS plants.

2.2.4 Clarifier Design

Clarifier size is mainly dependant on the total suspended solids (TSS) concentration in the clarifier overflow. Therefore, in order to obtain low TSS, a larger clarifier is necessary. For this preliminary design, a clarifier rise rate of 1.2 was used to determine the clarifier size. Due to the low flowrate expected during the initial stage and limited available space to install two big clarifiers, it was decided to install four smaller 56m clarifiers able to handle up to 833 L/s each.

2.3 Effluent Quality

The HDS lime treatment system is a very reliable process which is used at numerous mining sites around the world and is a robust system. In an HDS system, where excess of iron, arsenic, nickel, manganese, copper etc is present, contaminated water can be treated successfully to meet discharge criteria as experienced at number of sites in around the world.

In an HDS system, several metals, such as arsenic, are removed utilizing chemical coagulant, such as iron and aluminum. Iron precipitates are found to be particularly effective in adsorbing and co-precipitating arsenic and other metals. Many studies have repeatedly confirmed effective removal by precipitation using iron. As a result, where arsenic removal is practiced, it is generally removed along with the removal of iron. Table 2 below shows typical effluent quality from other HDS plant operations.

Table 3. Comparison of Effluent Quality from Different HDS Processes*

Elements	KSM Design Chemistry	KSM Effluent Chemistry *(Bench-Scale Tests)*	Chile		Dominican Republic		BC Canada		Northern BC Canada	
			Feed	Effluent	Feed	Effluent	Feed	Effluent	Feed	Effluent pH ~8.0
Aluminium	**14.2**	**0.479**	**2090**	**1.6**	**1210**	**8.24**	**48.9**	**0.37**	**586.7**	**6.9**
Arsenic	**0.044**	**0.004**	**0.76**	**<0.04**	**43.6**	**0.0113**	**<0.05**	**<0.05**	**1.9**	**<0.2**
Barium	0.025	0.027	<0.2	<0.2	<0.10	0.0033	0.009	0.007	<0.01	<0.01
Beryllium	0.015	0.0002	0.24	<0.01	<0.050	<0.0050	-	-	-	-
Boron	0.46	0.41	0.5	<0.1	<1.0	<0.10	-	-	-	-
Cadmium	0.014	0.00007	0.43	<0.01	8.44	0.00068	-	-	0.58	<0.01
Cobalt	0.083	<0.0005	10.5	<0.01	0.98	<0.0050	0.063	-	3.36	<0.01
Copper	**22.9**	**0.0032**	**286**	**<0.01**	**2.51**	**<0.0010**	**44.3**	**-**	**54.42**	**<0.01**
Chromium	0.038	<0.001	0.53	<0.01	162	<0.0010	-	-	-	-
Iron	**16.3**	**<0.005**	**864**	**<0.05**	**7030**	**<0.030**	**58.2**	**0.037**	**729.19**	**<0.03**
Magnesium	16.5	9.46	-	-	-	-	-	-		
Manganese	**3.3**	**0.003**	**297**	**0.07**	**7.34**	**0.00165**	**3.98**	**0.082**	**115.41**	**4.01**[1]
Mercury	-	-			0.0018	<0.000050	-	-	<0.05	<0.05
Molybdenum	0.159	-	0.5	0.24	<0.30	0.0117	<0.005	<0.005	0.05	0.08
Nickel	0.0204	0.003	5.93	<0.01	1.29	<0.0050	0.13	<0.008	7.09	<0.02
Lead	0.089	0.008	<0.02	<0.02	<0.50	<0.00050	0.06	<0.03	0.13	<0.05
Selenium	0.04	0.03	0.11	<0.05	<2.0	0.021	<0.03	<0.03	-	-
Silver	-	-	<0.004	<0.004	<0.10	<0.00010	<0.01	<0.01	<0.02	<0.02
TSS	-	-	-	-	-	-	-	-	-	-
Sulphates	817	859	26100	2160	24470	1748	-	-	-	-
Sulphide	-	-	-	-	-	-	-	-	-	-
Zinc	**4.0**	**<0.005**	**103**	**<0.01**	**1230**	**0.011**	**48.8**	**0.021**	**107.16**	**0.02**

* Concentrations are shown in mg/L.

[1] The Manganese concentration in the effluent is higher than normal because the operating pH is 8.0, typically most of the HDS plants are operated at pH 9.3-9.5.

The saturation concentration for sulphate for typical HDS effluent ranges from 1,600-1,800 mg/L. If the sulphate concentration in the effluent is above the discharge standard then it may become necessary to either add barium hydroxide to the process to lower the sulphate concentration or utilize IX process for sulphate removal, although this may be cost prohibitive. Sulphate is removed from the solution with barium as barium sulphate [$Ba(SO_4)$].

Based on other similar projects designed/engineered by SGS-CEMI, it is expected that similar effluent quality, as shown in Table 3, can be achieved for the KSM Project in full scale treatment. It is recommended that effluent quality be confirmed by onsite pilot testing which will also confirm design parameters on a continuous 24 hour operation.

3.0 PRELIMINARY DESIGN

The contaminated water will be treated in an HDS process using lime for the precipitation of heavy metals. After treatment of the influent, the resulting sludge produced will be separated with a clarifier and the sludge will be discharged to the sludge ponds and the overflow (effluent) will be discharged to the receiving environment. Detailed design parameters are provided in Appendix A. Preliminary Process Flow Diagrams are provided in Appendix C, and Preliminary Plant General Arrangement Drawings are in Appendix D.

3.1 Water Management

The Water Treatment Plant will operate most effectively if the quantity and quality of the feed water is maintained at relatively constant levels. Relatively constant annual flow rates are expected as a result of the large storage volume present in the WSF. The solution thus undergoes treatment to pH 9.0 at a controlled flowrate.

3.2 Process Description

3.2.1 Acid Water Feed System

It is anticipated, based on information provided by Klohn-Crippen that the maximum flow will be 11,880 m^3/hr (3,350 L/s).

The equipment sizing provided in the following sections for a flow of 11,880 m^3/hr will provide a reaction time of 45 minutes based on other similar plants for reasonable scale control and good quality effluent. The reactor tanks are sized such that six reactors are needed during the design flowrate of 2,200 L/s while additional two reactors can be brought on line to meet the expected increase peak flowrate of 3,350 L/s. The treatment plant is also being designed with the flexibility to service either reactor while operating by diverting all of the flow into either of the reactors for a short period of time during maintenance without having a significant impact on the effluent quality. The attached GA illustrates the flexibility of having four identical treatment trains in which any one of the four treatment trains can be shut down for maintenance while treating the peak flows. The peak flow is only anticipated for peak events such as the 1 in 200 year wet year event, therefore for majority of the time there will be one to two treatment trains that will be available as

back up. Additional redundancy is provided by having excess storage capacity in the collection pond.

3.2.2 Lime System

It is assumed that lime will be utilized for neutralization; the lime preparation system will be located in the center of the four treatment trains to minimize the lime loop piping runs. Lime slaking units and a slurry stock tank is included in the center of the water treatment plants designed and sized to hold lime slurry for over 30 hours for peak events. Lime slurry will be pumped from the slurry storage tank (11.5 in diameter by 12.0 meters high) into a two independent duplicate circulating loops with primary take-offs to the sludge/lime mix tank and, optionally, to the reactor tanks in the event of line plugging. There will be two 3 ton/hr pebble lime slakers located in the building at the foot of a 250 tonne lime silo. At the peak flowrate, the lime demand is expected to be 95 tonnes per day. The discharge from the paste slakers will be diluted to approximately 18% solids slurry and pumped to the slime stock tank. On either side of the lime stock tank there will be two lime slurry pumps on each side piped into a duplicate lime slurry circulating loop.

3.2.3 Neutralization

The HDS Neutralization plant uses well-proven technology to produce clean treated water and chemically stable high density sludge containing precipitated metals and gypsum. The high sludge density is achieved by using recycled sludge mixed with lime slurry as the neutralization agent.

The treatment train is equipped with two lime reactors, a lime sludge mix tank, clarifier, floc addition system, sludge recycle system, sludge disposal system and a common lime preparation system. The ARD solution entering the plant is directed into Reactor 1, and then gravity fed to reactor 2, then to the clarifier. All eight reactors will provide a total retention time of 45 minutes at design flow and will also receive limed sludge from the sludge/lime mix tank. The Reactor tanks are 11.5m diameter by 12.0m high with 0.5m freeboard. All reactor tanks are mechanically agitated and have provision for air sparging to ensure that metals are fully oxidized for the desired precipitation reaction.

The second reactor tank in each treatment train (Reactor 2, 4, 6, 8) discharges (via up-comer) the slurry with gravity flow via an open feed launder to the adjacent clarifier center well.

Flocculent will be added to the feed launder, with provision made for alternative addition points. From the clarifier, the particles will settle into solids rich sludge (25-30% solids assumed for the design) while clarified solution will report to the overflow launder and into the common discharge collection culvert. The treated water solution will be diverted to the polishing ponds as a last resort for additional risk management and gravity discharged to the receiving environment. This solution will be monitored for pH and turbidity. The clarifier underflow, a sludge containing approximately 25% solids, will be continuously recycled back to the Sludge Mix Tank where the recycled sludge is mixed with lime slurry. This mixture of sludge and lime is used to neutralize the acidic solution entering the plant. Periodically, as the sludge bed builds up in the clarifier, sludge will be purged from the system and trucked to the tailings storage area or pumped to the sludge impoundment pond. The cost provision has not been allowed for the sludge management ponds or pumping a long distance.

The sludge lime mix tank receives sludge from the clarifier continuously. The rate at which sludge is recycled depends on the solution treatment rate, and the solids generation potential of the water to be treated. The sludge/lime mix tank receives lime slurry from the lime loop. The rate of lime addition is controlled by the pH in Reactor 1 (or Reactor 2). The sludge/lime mix tank overflows via a launder into Reactor 1.

The importance of the recycled sludge and the ratio of recycled sludge is that this sludge acts as nucleation sites for fresh precipitates. The benefit of these nucleation sites is twofold; firstly, the precipitation onto the recycled sludge increases the density of the sludge and thus generates a much-reduced volume of sludge for disposal. Secondly, the high amount of recycled sludge provides a large available surface area for precipitation sites for sludge. This results in much reduced scale formation on the mechanical components of the plant.

A critical minimum volume of recycled sludge may be required but by increasing sludge recycle beyond this critical minimum, little benefit may be experienced but there is no downside in terms of process risk. Similarly, a minimum size of clarifier is required; a larger unit may enable a reduction of flocculant to be realized but does not generate any adverse risks.

3.3 Note on Material Balance

The material balance is included on the flowsheet drawings and provided in Appendix A.

Lime consumption was based on the theoretical sulphate loadings. 0.78 gram of $Ca(OH)_2$ is required to neutralize one gram of sulphate, based on the theoretical calculation. The $Ca(OH)_2$ consumption was adjusted to CaO consumption using stoichiometric relationships.

Sludge recycle is dependent on the theoretical solids generations and data from other pilot studies with similar feed chemistry. A graph was generated based on the previous pilot plant data to estimate the required recycle ratios for different solids generation. This relationship was used to confirm the required sludge recycle ratios of 10:1.

3.4 Note on Scaling

The HDS pilot plant tested for other projects with similar feed chemistry have indicated that over 95% of scale formation can be controlled by recycled sludge. With sufficient reaction time, recycled sludge provides surface area for newly formed gypsum. Under controlled and normal operating parameters, scale may form to a small extent in Reactor #1 (in most cases) with minimal scale formation in Reactor #2, as determined in several pilot plant studies. However with insufficient retention time in the lime reactors, small amounts of scale formation may occur in Reactor 2 and the clarifier feed launder. Therefore, scheduled maintenance planning and operating philosophy will be important to maintain scale on the mechanical equipment to a minimum. It is important to note that normally a thin layer of gypsum forms on the walls of the tanks, and this should be monitored and

inspected regularly. It is more common to have gypsum build up on the agitator impeller due to tip speeds and typically requires more attention.

4.0 PROCESS TREATMENT DEVELOPMENT

4.1 Infrastructure

This study does not address site infrastructure except as to comment upon the needs for the purpose of the Treatment Plant.

4.1.1 Fresh Water System

Fresh water will have to be supplied to the Water Treatment Plant. The design and cost of this system lies outside the scope of this study. Fresh water will be supplied to:

- Flocculent Preparation System
- Gland Water System
- Emergency Showers
- Lime slaking

The water will have to be non-corrosive in nature and with a minimum of suspended solids.

4.1.2 Power

Power for the treatment plant will be supplied to the MCC from the proposed grid connection, from the KSM hydro plants and from the onsite Water Treatment Plant Energy Recovery facility. Additional emergency power will be provided from diesel generators to keep the critical equipment operational. The provision of power, and the engineering associated with it, lies outside the scope of this study.

4.2 Plant Feed System

The feed box located downstream of the hydro plant will collect the discharge from the energy recover hydro plant and will have four outlets stacked 1.5 meters apart on top of each other. Each outlet is designed to delivery approximately 833 L/s with a head pressure of 1.5 meters. Once the bottom outlet overcomes with flow, the second outlet will start feeding the second treatment train and the third and the fourth. The piping leading from the mix box will have a shutoff valve adjacent to the mix box in case the first treatment train needs to be taken off line. The discharge from the feed box is designed to gravity feed the treatment trains with

the piping installed on the ground with a light cover of sand and gravel for freeze protection.

4.3 Main Process Building

The Main Process Building will have to be of 12m x 12m to enclose the area indicated in the General Arrangement Drawings. The Main Process Building will be composed of the following areas:

4.3.1 Containment Area

A concrete floor is required in the Main Process Plant Area to control spillage. The slope will be sufficient to direct the flow of water with solids to the sump trench. In addition, the flocculent preparation area will have a separate sump and curbed (15 cm high) area. The main sump curb will be a minimum of 30 cm. The containment area will be sufficient to allow for controlled cleanup. To assist in clean up, there will be a trench located down the middle of the containment area. Discharge from the sump area will be via the Plant Area Sump Pump located in a sump hole, which will be part of the trench.

4.3.2 Flocculent Area

Flocculent will be prepared and mixed in the Main Process Building.

4.3.3 MCC Area

The MCC will be a room located in the Main Process Building. One end of this room will have a double door allowing for equipment installation and removal. There will also be a main door.

4.3.4 Lab and Office Area

Office will be located in the Main Process Building.

4.3.5 Fire Suppression

The building will require a fire suppression system. Recycle water can be used for fire suppression. Hydrants should be located at least at two points in the

Treatment Plant area. The appropriate fire extinguishers should be provided at the MCC, the Control Room, the Reactor Tank platform, the Clarifier bridge, and at the Clarifier discharge cone.

4.4 Reagent Systems

4.4.1 Lime System

The lime slurry storage tank (11.5m diameter and 12.0m high) will be a baffled carbon steel tank and will be placed on a concrete base. Discharge from the tank will be via the Circulating Pumps located on opposite sides for the double lime loop.

The tank will have a drain valve, a main access door (located near the bottom of the tank), and an overflow line (directed down to the floor trench, ending 30 cm. above the floor).

4.4.1.1 Lime Circulating Loop

The Lime Circulating Pumps will feed a circulating loop at a rate approximately 3-4 times the withdrawal rate. Takeoffs will be located at the Sludge/Lime Mix Tank and Reactor tanks. A centrifugal slurry pump will be in operation during normal operation, and will continuously circulate slurry through a HDPE piping system back to the Slurry Storage Tanks, with take-offs controlled by pinch valves to the Sludge/Lime Mix Tank and Reactor tanks. A second slurry pump will be the standby backup on both lime loops. One lime loop will service two treatment systems one side of the lime preparation system while the second lime loop will service the opposite side treatment systems (see the plant GA for details).

4.4.2 Flocculent System

The flocculent system will be based on a vendor supplied equipment package which will include mix agitator, tanks, pumps, wetting head, etc. The flocculant system will be in the Main Process Plant Building.

4.4.2.1 Flocculent Preparation

Dry flocculent will be supplied in bags and mixed with fresh water to a concentration of 0.5% (by weight) using an automated polymer feed and mixing

system. Suitably aged flocculent will be transferred from the Flocculent Mixing System to the Flocculent Holding Tank using a transfer pump. The flocculent solution will be discharged from the Flocculent Holding Tank by a variable speed dosing pump. The 0.5% strength flocculent solution will be further diluted with fresh water at a ratio of a minimum 10:1 in a static mixer before delivery to the Clarifier. Each of the four treatment systems will have a dedicated floc addition delivery system.

It is highly recommended that fresh water be used for both flocculant mixing and dilution.

4.4.2.2 Flocculent Distribution

The process destinations for the flocculent will include the contact mix box prior to the Clarifier feed pipe and the Clarifier feed well. Flocculent distribution will be by carbon steel lines with valves for isolation. The rate of dosage will be controlled by a variable speed dosing pumps. All lines will have to be heated and insulated.

4.5 Process Equipment (Tanks & Mechanical)

4.5.1 Tank Support Structures

The Lime Reactor Tanks, the Lime Slurry Storage Tank, and the Clarifier should all be located on concrete foundations. The top of the Sludge/Lime Mix Tank will be at a level above the first Lime Reactor tank. These tanks can all be situated outside the Main Process Building depending on the site conditions. In extreme weather conditions, the tanks should be located inside the building. The current design is to install al of the process equipment outdoors with sections covered on top of the tanks to access instrumentation in the winter months.

4.5.2 Sludge/Lime Mix Tank

This tank will be a baffled carbon steel tank sitting on structural steel. It will include an agitator to provide a high level of agitation for the viscous lime/sludge material. The tank will have a drain valve directed into the reactor tank.

4.5.3 Reactor Tanks

The Reactor tanks will be baffled carbon steel tanks (concrete based on cost analysis) and they will be sand blasted and primed. They will have an agitator running a 45-degree pitched blade propeller. Discharge from the last tank will be via an up-comer. The open top up-comers will allow visible confirmation of process conditions.

The tanks will have a drain valve, a man access door (located near the bottom of the tank), and an overflow line (directed down to the floor).

Sufficient opportunities should exist during periods of average flow to shut down and perform the required maintenance on the agitator. Certain spares will have to be maintained including; spare motors, etc.

4.5.4 Clarifier

In this study, the Clarifier design will be a standard capacity conventional unit, installed in as a concrete vessel with a discharge cone. There will be a bridge which will include a walkway, with grating for access to the drive mechanism but the unit will be a center drive support on concrete column. The rake drive system will have continuous torque sensing devices and be equipped with an automatic lifting device and a high torque alarm. Automatic shutdown will occur at extremely high torque to protect the rake mechanism.

4.5.5 Clarifier Overflow Discharge Pipelines to Treated Water Pond

The Clarifier overflow launder will flow into the Clarifier Overflow discharge ditch. From here, the treated water will be gravity fed to the Treated Water Pond or to the receiving environment. The clarifier overflow weir may have to be covered to minimize freezing in the winter.

4.5.5 Recycle Water System

Recycle water will be provided by a takeoff from the Treated Water pump discharges. The water produced in the overflow of the clarifier will be of sufficient quality to be used for a number of tasks around the plant including:

- Fire Suppression

- Flush Water (Clarifier Sludge Discharge and Recycle Lines)

It is not recommended to use the clarifier overflow water for lime slaking. Research has shown that processes where water containing high sulphates was used, the quality of the resulting slaked lime slurry was impaired. When process water is used, the lime precipitates as calcium sulphate which coats the unreacted quicklime particles, thus preventing complete hydration. However, if necessary, the recycled water can be used after slaking to dilute the lime slurry.

4.5.6 Fresh Water System

The Fresh Water System will provide fresh water sufficient for pump gland service, flocculent mixing, and flocculent dilution. These two pumps and a fresh water tank will be located inside the Main Process Building. This system will also provide minor water for washing within the plant. Others are to provide the supply of the fresh water to within 2 meters of the Main Process Building.

4.5.7 Sludge Recycle System

The sludge recycle system will consist of two variable speed centrifugal pumps for each treatment system, one of which will normally be the standby unit. All of these units will be located under the Clarifier. The pumps will discharge to the Sludge/Lime Mix Tank.

Treated water will be piped directly into the feed lines of these pumps to provide flush capability. All piping outside of the clarifier tunnel will have to be heat traced and insulated.

4.5.8 Sludge Discharge System

The sludge discharge system could be operated on a continuous or periodic basis. Initiation may be either by the process control system or by manual means. Similar to the recycle, the sludge discharge will have one pump under duty while one pump will be a backup. Further these pumps can be the same capacity as the sludge recycle and piped in a configuration that any one of the four pumps can be used as sludge recycle or sludge disposal. It is important to note that potentially there are three back up pumps for either service for redundancy.

It is understood that sludge will be pumped to the Ore Processing Complex site via a pipeline that connects to the slurry pipeline. The sludge will be combined with the slurry at the slurry tank and become part of the process stream.

4.5.9 Launders and Walkways

Carbon steel pipes will provide gravity flow between the process tanks. Standard guard railings and kick plates need to be provided for all walkways above ground level, as well as stairways and all tank platforms and bridges.

4.6 Process Control Philosophy

The field instruments and the communications systems are described below.

4.6.1 Control Hardware

The control system will consist of a PLC and associated I/O modules to make the plant(s) fully automatic with minimal operator intervention. The proposed level of instrumentation facilitates an efficient and reliable process.

The control equipment will be mounted in two MCC sections and stacked with the rest of the MCC line-up. This configuration ensures reliable and cost effective installation. The control panels are divided between an analog and a discrete panel.

4.6.2 HMI Operator Graphical Interface

The operator interface can run on a single desktop type computer with backup provided by a standby computer. The computer running the interface will communicate to the process via a plant control network (Ethernet). This network will be separate from any office networks running at site. Included with the HMI software is a historical database that will store analog and discrete data for reporting purposes. The operator can leave the plant running in automatic, or switch it to manual and control all the equipment by starting and stopping it individually. The HMI software also generates process alarms that will be displayed in graphical format on the interface computer.

A hardware dialler that will initiate phone/radio calls when certain process parameters are outside allowable tolerances will be included in the plant. The remote operator will have the capability to acknowledge alarms as well as giving some basic commands to correct the problem if possible.

4.6.3 Instrumentation

Field instrumentation is summarized below for the plant.

Screw Conveyor Start-up System	4 units
Magnetic Flowmeters	4 units
Process pH Meter	9 units
Density Gauges and Transmitters	4 units
Turbidity Transmitter	4 units
Level Transmitter	4 units
On/Off Valve (Knife Gate)	27 units
On/Off Valve (Ball)	35 units
On/Off Solenoids	4 units
Variable Valve (Pinch)	4 units
Level – Float Switch	2 units
Torque Indicator	4 units
Rotameter	8 units
Variable Frequency Drives	16 units
High Level Alarms	4 units

Despite the relative complexity of the process control system, instrumentation failure is not seen as a major threat to the operation of the plant. It should be possible to maintain sufficient plant performance if there are problems with the control system, although the situation will require more labour. Spare parts should be maintained on-site to provide immediate replacement.

5.0 BASIS OF COST ESTIMATE

5.1 Yards & Services

5.1.1 Roads

Costing of access ways is excluded from the scope of this work. No allowance has been provided for any type of roadwork.

5.1.2 Site Preparation

The site will be cleared, grubbed and stripped of topsoil. Site preparation and site wide earthworks (except for individual plant equipment foundations) are not the responsibility of SGS-CEMI and have been prepared by others. The site is composed of a moraine covered slope that will benched primarily into overburden. The clarifiers are expected to be set into the slope to minimize backfill and site excavation requirements.

The Owner is to provide a prepared site plan with control survey points on both the plan and on the ground.

5.1.3 Containment

The plant area floor will be sloped to provide the collection of all solution and sludge in a sump supplied with a vertical sump pump. These sumps will be located at the lime plant, lime stock tank and the 4 reactors, at the 2 reactors on the west side and 2 reactor tanks on the east side.

5.1.4 Relocations

No allowance has been provided to relocate any structures. Indications are that the site is clear of obstructions.

5.1.5 Fencing & Security

This design and costing falls within the scope of the Consultant performing the site preparation and infrastructure cost study.

5.1.6 Water Supply System

Clean process water will be supplied up to the boundary of the HDS WTP area. The design and cost of this system lies outside the scope of this study. At peak usage, approximately 36 m^3/hour of process water will be required. The majority of this water is required for lime preparation. This water can be sourced from local creeks and supplemented in the winter if required from well points in wells near the WTP site.

Water will be supplied to:

Lime Tank
Flocculent Preparation System
Emergency Showers
Hose Stations

Process water will also be used for gland water service

5.1.7 Fire Suppression

Process water will be provided for fire suppression use at 6 points in the HDS WTP area, one of which will be located in the grinding area. The appropriate fire extinguishers will be provided at the MCC room, the Control Room, the main tank platform, the Sludge Storage Tank platform, the Clarifier bridge, and at the Clarifier discharge cone.

5.1.8 Septic System

The sanitary system falls outside the scope of this study.

5.1.9 Yards Electrical

HDS WTP area lighting and primary power are included in this section. The Owner is to provide power to the MCC area. Connection hardware for the HDS WTP area and associated equipment are included in this section. No allowance for roadway lighting is included.

5.2 Electrical

This study includes all electrical services on the HDS WTP plant site including power distribution from the WTP feeder. It does not include the design or cost of bringing the power to the plant site. The cost of motors is included with the equipment.

5.2.1 Lighting/Receptacles

Lighting and receptacles for the MCC Building, the Reagent area and underneath the Clarifier have been costed. The principal lighting system will consist of high pressure sodium (HPS) fixtures in the plant area and fluorescent fixtures in the electrical room and Control Room. Lighting will be controlled in the electrical room and Control Room by local switching in each room. Plant areas and stairs have un-switched lighting circuits for 24 hour operation. The exterior lighting will be controlled by photocells. Lighting levels will be in accordance to the recommendations of the Illumination Engineering Society (IES) Lighting Handbook.

Battery powered emergency lighting will be provided. Lighting levels will be sufficient to allow personnel to egress safely. Exit lights shall be part of the emergency lighting system.

Exterior lighting will be provided at each exterior door in the MCC to provide visibility and security for personnel approaching or leaving the building.

5.2.2 Grounding

A bare copper conductor will be buried outside the perimeter of the treatment area, with compression connection to ground rods at each corner of the building and at intermediate locations as required to provide maximum contact with the earth. This will provide the main earth grounding reference point for all other grounding systems. The system will be bonded to each structural steel column and all connections will be via post connectors.

5.2.3 Motor Control Centers, VFDs

Power to all process motors and equipment, will be provided from the motor control center located in the electrical room in the MCC Building. Variable frequency controllers will also be located in the MCC Building area but controlled from the Control Room.

5.2.4 Standby Generator

There will be a standby diesel generator, which will provide sufficient power for emergency lighting and the provision of power to critical equipment. It is assumed that a single emergency power generator will be available and provided by Seabridge Gold Inc. for the HDS WTP and the other critical.

5.2.5 Transformers/Panel Boards

Control voltage within the MCC and a suitable transformer will be determined during detailed engineering.

Distribution transformers will supply power for lighting, and various electrical services. A separate panel will supply power for process control and instrumentation.

5.3 Process Control

The field instruments and the communications systems are described below. No allowance has been included for wiring or communications to a remote control system outside the confines of the HDS WTP area.

5.3.1 Communications

For process control and safety reasons, it is recommended that a radio system be installed in the plant. One channel can be used for normal plant control purposes, while another channel is to be set aside and connected to whatever emergency system is available in the area.

5.4 Facilities Outside Scope of Provision But Within Scope of Definition

5.4.1 Service Facilities

The provision of all service facilities is beyond the scope of the SGS-CEMI study for the
HDS WTP; however, the HDS WTP requires the following services to be supplied to the HDS WTP:

1) Emergency Power
2) Analytical facilities capable of sample preparation, pH determinations, specific gravity determinations, metal analysis (Cu, Zn, Fe, Fe^{2+}, Fe^{3+}), alkalinity, etc.
3) Washroom and change room with showers sufficient for upto 2 personnel/shift.
4) Mechanical service area, 10m x 10m, with access by double wide doors to a forklift, complete with an overhead crane.

5.5 Construction Indirects

5.5.1 Construction Management

An allowance has been made in the study for construction management services, including Construction Manager, Construction Inspectors, vehicles, and related items.

5.5.2 Temporary Facilities

This includes provision of temporary buildings, power, lighting, water, weather protection, scaffolding, on-going site clean-up, and related items provided by Contractors for their crews (normally part of labour rate).

5.5.3 Construction Services

This includes materials handling and warehousing, pre-commissioning testing; site security and fire watch.

5.5.4 Construction Equipment

This includes factored allowances for Contractor-supplied construction equipment, small tools, consumable supplies, and medical/first aid supplies.

5.5.5 Construction Allowances

This includes factored allowances for Contractor expenses.

5.6 Engineering Indirects

5.6.1 Project Management

Project management cost is included in the design. This study includes an allowance for project management, scheduling, cost management, accounting and procurement.

5.6.2 Detailed Engineering Study

A detailed engineering design will be executed by others, but SGS-CEMI can provide guidance to the engineering company. SGS-CEMI will provide process and engineering management to direct the detailed design, and to perform site inspections to ensure that the work is being performed according to the specifications.

5.6.3 Specialist Consultants

Does not include allowance for Specialist Consultants that may be required to provide special control surveying, geotechnical, or other services.

5.7 Contractor's Fees

5.7.1 Contractor's Profit

In this study, 10% Contractor's profit has been added to the Estimate.

5.7.2 Contractor's Contingency

A contingency of 25% has been applied to the capital cost estimate to cover changes likely to be encountered in detailed design, particularly firmed up costs and sub-assemblies inadequately defined at this level of study.

5.7.3 Owner's Indirects

The Owner's Indirects budgets provide for a number of cost items which will be provided and capitalized from the Owner's organization.

5.7.4 Owner's Team

No budget has been provided for an Owner's Team beyond that included for Project Management. The Owner will have to make provision for this cost.

5.7.5 Insurance, Bonds, Taxes

No budget has been allocated for those items within the Project Budget as this lies outside the scope of this study.

5.7.6 Land and Easements

No budget has been provided for these items within the Project Budget as this lies outside the scope of this study. The Owner is assumed to be responsible.

5.7.7 Spare Parts

An allowance of $1,000,000 has been provided within the capital cost budget for spare parts.

5.7.8 Reagents

An allowance of $70,000 has been provided for start up reagents.

5.7.9 Permitting and Public Relations

No budget has been provided for these items within the Project Budget as this lies outside the scope of this study. The Owner is assumed to be responsible.

5.7.10 Escalation

The estimated cost is presented in 2011 Cdn dollars. No allowance has been provided for escalation.

5.8 Cost Estimate Summary

As mentioned in previous sections, this preliminary study only addresses the capital cost of the major process equipment within the Water Treatment Plant.

Table 4 summarizes the capital and the operating costs. The capital and operating costs for treatment plant is estimated at +/- 25%. The capital cost for this plant is estimated to be $75.4 million for the expected flowrate is 3,350 L/s. The costs are based on major equipment quotations, pipe sizing and estimate/assumptions based on three other plants designed by SGS-CEMI with similar flowrates which was constructed in 2001, 2005, 2007. Details of the capital cost estimate are provided in Appendix E. All external requirements of water treatment, such as surge ponds, sludge ponds, etc. are not part of this costing study.

Table 4. Cost Estimate Summary

Flow rate (L/s)	**Capital** (CDN $)	**Operating Costs**	
		Annual (CDN $)	**Normalized** (CDN $/ m^3)
3350	$75,473,118	$10,024,016	$0.12

Table 5. Capital Cost Estimate for the Peak flowrate of 3,350 L/s

1	General Excavation	$	436,000.00
2	Buildings - General	$	-
3	Structures	$	1,696,000.00
4	Equipment	$	51,548,843.00
5	Electrical Services - General	$	3,415,000.00
6	Piping Systems	$	2,942,000.00
7	Site Construction Management & Services	$	1,873,500.00
8	Construction Equipment & Services	$	1,369,000.00
9	Engineering	$	6,100,000.00
10	Start Up	$	540,000.00
Subtotal		$	69,920,343.00
10% General Contractor's Profit		$	5,552,775.80
TOTAL		$	75,473,118.80

Table 6. Operating Cost Estimate for the Peak flowrate of 3,350 L/s

Reagent	Dose Rate (mg/L plant feed)	Average Plant Flow Rate (L/min)	Reagent Consumption (tonnes/year)	Reagent Unit Cost ($/tonne)	Reagent Cost ($/year)
Quicklime	260	199,920	27320.3	250	6,830,067
Flocculant	1.5	199,920	157.6	5500	866,893
				Sub-total:	**$8,466,656**

Item	Annual Consumption	Unit Cost ($)	Annual Cost ($/year)
Electric Power per plant	375 kW-hr (Installed motor load x 0.8 + Lighting)	$0.08/kW-hr	1,051,200
O & M Maintenance	15 hr/wk for Mechanical, 15 hr/wk for Instrument	$50/hr	78,000
O & M Labour	2 Operators, 12 hr/day, 7 days/week, 12 months/yr	$40/hr	322,560
O & M Labour	1 Supervisor, 8 hr/day, 5 days/week, 12 months/yr	$55/hr	105,600
		Sub-total:	**$1,557,360**

Total Annual Operating Cost:	**$10,024,016**	**per year**
Normalized:	**$0.10**	**per m^3**

APPENDIX A.

Construction Design Memo

Seabridge Gold – KSM Project
Construction Treatment

Date:	April 11, 2011
To:	Graham Parkinson, Harvey McLeod
From:	Sohan Basra, Prab Bhatia (SGS Canada Inc.)
Subject:	Construction Period Temporary ARD Treatment and Sediment Control

1.0 PURPOSE AND OBJECTIVE

The purpose of this memorandum is to summarize temporary water treatment required during the construction phase of this project. There are 12 sites that would require treatment during the construction, with treatment ranging from simple TSS (Total Suspended Solids) removal to ARD metal precipitation. A total of three temporary ARD treatment plants and twelve sediment control facilities are needed to treat water at twelve sites:

1. McTagg Diversion Tunnel North, Site S1
    - Water pumped from one half of the McTagg tunnel (approximate length of 4.3km) in N-PAG rock
    - Treatment for TSS from tunnel and muck stockpile
2. McTagg Diversion Tunnel South, Site S2
    - Water will be gravity fed from one half of the McTagg tunnel (approximate length of 4.3km) in N-PAG rock.
    - Treatment for TSS from tunnel and muck stockpile.
3. TMF Portal Site S3, (Teigen - Saddle Portal Tunnel Section)
    - A 6.3 km section of the Mitchell-Teigen tunnel consisting entirely of N-PAG rock. Drainage from one half of this tunnel will be pumped to the site and will require TSS removal.
    - Control of sediment in runoff from N-PAG muck pile created from driving the tunnel

4. Saddle Decline Portal Site S4, ARD2 (Mitchell-Teigen Tunnel)
    - Water pumped from one half of 16.5 km tunnel to west, with about 65% PAG rock and 35% N-PAG rock and water drained from one half of the 6.3km tunnel to the east (100% N-PAG rock)
    - Treatment needed for TSS removal (Phase I Year 0-1) and then metals removal for PAG rock affected water (Phase II, Year 1-4).
    - Sediment pond to store and treat by flocculent dosing water drained from both tunnels in NAG rock sections, as well as from the N-PAG muck stockpile.
    - ARD treatment plant and pond to treat water affected by PAG rock in Phase II only.
5. Mitchell Valley and Portal Site S5, ARD1 (OPC Pad, FOS Pad, Crusher Pad, Tunnel Muck Pad and MTT and MDT tunnel drainages)
    - Treat ARD and sediment in water drained from one half of 16.5 km tunnel to west, with about 65% PAG rock and 35% N-PAG rock
    - Treat ARD in water pumped from the Mitchell Glacier half of the Mitchell Diversion Tunnel (approximately 65% PAG rock)
    - Treat ARD from tunnel muck stockpile (PAG rock) from one half of the 16.5km tunnel to west.
    - Treat ARD from tunnel muck stockpile (PAG rock) from the Mitchell Glacier half of the Mitchell Diversion Tunnel.
    - Treat ARD from PAG rock cuts in Mitchell Plantsite Area
    - Control TSS from N-PAG fills in Mitchell Plantsite Area, and N-PAG tunnel muck
6. Mitchell Diversion Tunnel (Mitchell Glacier), Site S6
    - Treat sediment in water pumped from one half of Mitchell Diversion Tunnel. (ARD is to be pumped to Mitchell Plantsite for treatment - Site ARD1).
7. Mitchell Diversion Tunnel South, Site S7, ARD3
    - Treat ARD and sediment in water drained from one half of 5.6 km tunnel with about 50% PAG rock

- Treat ARD and sediment in water run-off from PAG and N-PAG muck storage pads at south end.

8. TMF East Catchment Diversion Tunnel West end, Site S8
    - Treatment for TSS from tunnel and muckpile
9. TMF East Catchment Diversion Tunnel West end, Site S9
    - Treatment for TSS from tunnel and muckpile
10. Water Treatment Plant / Water Storage Dam Area, Site S10
    - Treatment for TSS during construction of WTP and WSD
11. TMF North Seepage Dam, Site S11
    - Treatment for TSS during TMF North Dam construction
12. TMF North Seepage Dam, Site S12
    - Treatment for TSS during TMF South Dam construction

Table 1 below presents the expected average treatment rates required for the ARD treatment plants. Storm events are handled by pond storage so capacities of the treatment facilities are sized to the average flow rates.

Table 1: Table of Estimated Treatment Requirements at Temporary KSM Construction Period Sites

Site	Location	Stage I Avg Treatment Rate (L/s)	Stage II Avg Treatment Rate (L/s)	Stage II Retention Volume (m3)	Treatment
S1	McTagg Stage 1 Inlets (East and West)	30	30	1,965	TSS, Floc Dosing, Settling Pond
S2	McTagg Gingrass Creek Portal	30	30	1,777	TSS, Floc Dosing, Settling Pond
S3	Teigen Plant Site (TMF North Dam)	15	30	1,833	TSS, Floc Dosing, Settling Pond
S4	Saddle Decline Portal	30	122	5,747	TSS, Floc Dosing, Settling Pond
S5	Mitchell Plantsite (OPC, FOS, Crusher, Tunnel Muck)	60	149	45,085	TSS, Floc Dosing, Settling Pond
S6	Mitchel Diversion Tunnel Inlet (Mitchell Glacier)	30	30	1,526	TSS, Floc Dosing, Settling Pond
S7	Mitchel Diversion Tunnnel Outlet (Sulphurets Lake)	26	26	1,471	TSS, Floc Dosing, Settling Pond
S8	East Catchment (TMF) Inlet	25	25	1,346	TSS, Floc Dosing, Settling Pond
S9	East Catchment (TMF) Outlet	25	25	1,346	TSS, Floc Dosing, Settling Pond
S10	Water Treatment Plant/Water Storage Dam	45	45	14,192	TSS, Floc Dosing, Settling Pond
S11	North TMF Sediment Control (Seepage Dam Pond)	78	78	48,600	TSS, Floc Dosing, Settling Pond
S12	South TMF Sediment Control (Seepage Dam Pond)	79	79	49,320	TSS, Floc Dosing, Settling Pond
ARD1	Mitchell Plantsite (OPC, FOS, Crusher, Tunnel Muck)	25	92	66,355	Metals removal: Lime, Floc Addition, Settling
ARD2	Saddle Decline Portal	-	60	23,256	Metals removal: Lime, Floc Addition, Settling
ARD3	Mitchell Diversion Tunnel Outlet (Sulphurets Lake)	30	30	10,986	Metals removal: Lime, Floc Addition, Settling

Note: Treatment Rates consist of estimated Tunnel drainages, plus calculated runoff from Pad and Pond Areas.

2.0 Selected Treatment Plant Capacities

Based on the table above it is recommended that treatment systems be provided in the following capacities.

TSS Removal: 30 L/s, 60 L/s and 150 L/s

ARD Removal: 30 L/s, and 100 L/s

2.1 TSS Removal Treatment Plants

The treatment for TSS will be done in situ with polymer added in line and settling in a settling pond. Polymer comes in two main forms, referred to as 'dry' and 'neat'. Dry polymer is delivered to the site in a powder form, typically in 25kg bags, and utilized in a "batch" setup. The powder is transferred into a mixing tank where it is mixed with water to the desired feed solution concentration, and can be added into the feed pipe using a small metering pump. Neat polymer comes as a viscous fluid with approximately 35% concentration. Typically, neat polymer is diluted down to a 0.5% concentration prior to injection into the process. Neat polymer is delivered to a site in a drum or tote and is then pumped into a dilution system where it is mixed with water to obtain the 0.5% concentration. Adding neat polymers directly is not common practice and is not recommended by polymer suppliers, as this leads to high polymer consumption.

Table 2 below shows the advantages and disadvantages of each type of polymer.

Table 2: Polymer Comparison

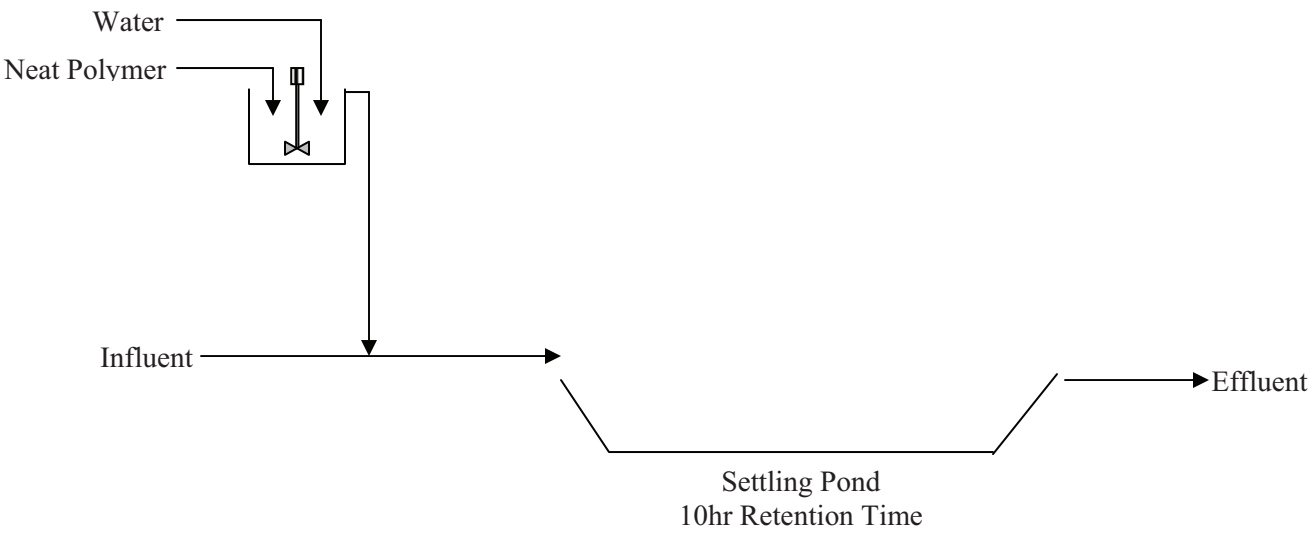
Dry Polymer		Neat Polymer (w/ dilution)		Neat Polymer (w/o dilution)	
Advantage	**Disadvantage**	**Advantage**	**Disadvantage**	**Advantage**	**Disadvantage**
Low Product Cost	High System Cost	Low System Cost	High Product Cost	Low System Cost	High Product Cost
-	Requires Mixing Water	-	Requires Mixing Water	No Mixing Water Needed	-
-	Higher O&M	Lower O&M	-	Lowe O&M	Requires up to 5x more polymer
-	More mechanical equipment	Less Mechanical Equipment	-	Less Mechanical Equipment	-

Both dry and neat polymer would require water for either mixing or dilution. However, if acquiring the required mixing water to properly utilize the system is an issue, then neat polymer can be fed directly to the system, but polymer consumption would be much higher and an in line mixer would be needed. For the purpose of this study, it is assumed that water will be provided for polymer mixing or dilution.

2.1.1 Settling Pond

The settling pond will provide a clarification zone for the flocs to settle. The settling pond will be designed to provide a minimum 10hr retention time. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids, particle size, etc. This should be confirmed with bench scale test work.

Figure 1: TMF Treatment Plant Process Flowsheet\



2.1.2 Polymer Cost Comparison

Table 3 and Table 4 below compare the equipment cost and reagent cost for two alternative polymers feed systems. The system capital cost is much greater for the dry polymer system, which does not include cost for the settling pond. A polymer feed system utilizing a neat polymer system with mixing water is recommended (Option 2).

Table 3: Capital Cost Options for Polymer Dosing System

Option 1	Dry Polymer System (Vendor Package)	$75,000
Option 2	Neat Polymer System (Metering Pump, Dilution Tank ~ 1m dia.) (Recommended Option)	$18,000

Since minimal data for the TSS concentration is unavailable, a conservative dose of 4 mg/L is used as the basis for feed system design and reagent cost estimation.

Table 4: Reagent Cost for TSS Treatment Plants

	Flowrate (L/s)	Dose (mg/L)	Polymer Required (Kg/hr)	Polymer Required (Lph)	$/Kg	$/L	Polymer Cost ($/year)
Dry	30	4	0.43		6.5		$ 24,598
Neat	30	4		1.23		3.5	$ 37,843
Dry	60	4	0.86		6.5		$ 49,196
Neat	60	4		2.47		3.5	$ 75,686
Dry	150	4	2.16		6.5		$ 122,990
Neat	150	4		6.17		3.5	$ 189,296

2.2 ARD Treatment Plants

The treatment of ARD will be done in a standard lime neutralization plant consisting of lime make-up and delivery system, two reactor tanks with 20 minutes retention time each, polymer system and a settling pond with a 72 hr retention time for solid/liquid separation. Given that there is minimal water quality information available, it is assumed that the water quality would be similar to the bench-scale water chemistry summarized in Table 6 on page 16.

Since the plant will be temporarily needed during the construction phase only (expected 2-3 years), hydrated lime will be used for neutralization and prepared as 15% solids slurry. Lime slurry will be pumped from the slurry storage tank into a circulating loop with take-off to the first reactor tank. The lime requirement based on the bench-scale testing is estimated to be 0.13 g/L.

2.2.1 Neutralization Tanks

The plant will consist of two reactors with a total retention time of 40 minutes, which is sufficient to remove heavy metals to below the discharge limit. The reactor tanks are will be mechanically agitated and pH maintained using a pH controller. Since iron and manganese concentration in the feed are relatively low, no provision for air sparging is made; however, sparjets can be installed if needed to ensure proper oxidation of metals.

2.2.2 Polymer Addition

Flocculent will be added to the second reactor tank overflow prior to entering the settling pond. Similar system used in the TSS removal plants can be used for this treatment.

2.2.3 Settling Ponds

The settling ponds will provide a clarification zone for the flocs to settle. The settling pond is designed to provide 72 hr retention time. However, further test work is recommended on actual samples to determine the settling rate and sludge characteristics.

2.2.4 Cost Estimate

The capital and operating cost for the 30 L/s and 100 L/s ARD treatment plant is estimated at +/- 30% based on equipment cost from SGS-CEMI database. The capital and operating costs are outlined in Table 5 below. The plant is designed with minimal automation (pH controller for automatic lime addition only) and will require one operator, part-time for reagent makeup.

Table 5: Capital & Operating Costs for ARD Treatment Plants

Flowrate (L/s)	Reactor Tanks Diameter (m)	Capital Cost (Excluding ponds)	Reagent Cost ($/year)
30	3.5	$455,339	$56,633
100	5.0	$763,894	$188,777

3.0 SITE SPECIFIC DESIGN CRITERIA

Due to the project layout and pumping requirements, it was decided that three temporary ARD treatment facilities to treat water will be needed during the construction period. Since the ARD load will grow as the tunnels reach ARD zones and as the tunnel muck accumulates and PAG cuts are made, two of the ARD treatment systems are planned as Phase I and Phase II.

Settlement ponds and TSS treatment facilities will be required at all twelve sites.

- ***McTagg North TSS Treatment Pond, Site S1***

  Water from the North McTagg tunnel portals and the NAG muck pad will be pumped to a temporary treatment pond. The flow from McTagg north portal will only require TSS removal with the average flow expected to be 30 L/s.

- ***McTagg South TSS Treatment Pond, Site S2***

  A similar treatment pond will be constructed at the McTagg South Portal to treat an average flow of 30 L/s to remove TSS.

- ***TMF Treatment Plant, Site S3***

  The treatment plant would be located near the Tailing Management Facility with water being pumped from the Teigen-Saddle portal tunnel section to the treatment plant, as well as runoff from the NAG muck pad. The plant will be designed to primarily remove TSS and sized to treat 30 L/s.

- ***Saddle Treatment Plant, Site S4 and ARD2***

  The treatment plant will be located in between the Mitchell Teigen Tunnel sections and would receive water from the Teigen – Saddle section (gravity flow to the plant) and Saddle-Mitchell Tunnel section (pumped up to the plant). For

the first year, there will be heli-support only with no access road and the water is expected to contain only TSS with no metals (Phase I). After Year 1, the water quality from the tunnel to the west is expected to worsen with high metal concentration requiring chemical precipitation for metals removal (Phase II).

Phase I

The Sediment Pond would be sized to store a maximum flow rate of 70 L/s (10 L/s from Saddle-Mitchell section, 20 L/s from Teigen-Saddle section and 40 L/s runoff from the NAG muck pad) expected during Phase-I for TSS removal. In addition, an ARD Pond would be required to store up to 60 L/s: (30 L/s from the tunnel sections and approximately 30 L/s runoff from the PAG muck pad). The Saddle ARD treatment plant will be required to treat an average flow of 30 L/s.

Phase II

For Phase II, the maximum flow is expected to be 160 L/s for TSS removal from NAG sections of the tunnels and the NAG muck pad (average yearly flow is 122 L/s). Water corrupted by PAG rock is expected to average 60 L/s from the PAG sections of the tunnel and the PAG muck pad. TSS removal during both phases will not require a treatment plant, and can be accomplished with a settling pond and flocculent dosing.

- ***Mitchell Treatment Plant, Site S5 and ARD1***

  The ARD treatment plant will be located below the west end of the Mitchell Teigen tunnel near the Mitchell Plantsite pad area, and will receive water from the Saddle-Mitchell Tunnel Section (by gravity flow), runoff collected from PAG cuts and PAG muck pads in the Ore Processing Complex site and also water pumped from the north portal of the Mitchell Diversion Tunnel. The plant is designed to remove metals and is sized for 92 L/s during Phase I and Phase II.

  TSS from the NAG muck pads will be removed separately with flocculent dosing in settling pond S5, located further to the west of the OPC. This pond will be

designed to contain high TSS flows of up to a peak flow of 1,252 L/s in Phase II. Average flow from the pond will be up to 149 L/s.

- ***Mitchell Diversion Tunnel, Mitchell Glacier Portal Site S6***
  A Sediment pond to remove TSS from tunnel flows, as well as the runoff from the NAG muck pad is to be constructed near the Mitchell Glacier Portal to the Mitchell Diversion Tunnel. The pond and flocculent treatment is to be designed for an average flow of 31 L/s.

- ***South Mitchell Diversion Tunnel Portal Site S7 and ARD3***
  A treatment plant will be required above Sulphurets lake for removal of potential ARD water from the south portal as the tunnel will be driven from both ends. This plant will be sized for an average flow of 31 L/s.

  A settling pond will be designed to remove TSS from the tunnel flows, as well as the NAG muck pad runoff, at an average rate of 26 L/s.

- ***East Catchment (TMF) Inlet Treatment Pond, Site S8***
  Water from the East Catchment Diversion tunnel portal and the NAG muck pad will be pumped to a temporary treatment pond. The flow from the East Catchment Inlet portal will only require TSS removal with an average flow of 25 L/s.

- ***East Catchment (TMF) Outlet Treatment Pond, Site S9***
  A similar treatment pond will be constructed at the East Catchment diversion tunnel outlet portal to treat an average flow of 25 L/s to remove TSS.

- ***Water Storage Dam/Water Treatment Plant Construction Sediment Pond, Site S10***
  Runoff from the footprints of the WSD and WTP whilst under construction will require treatment for sediment control. A sediment pond with flocculent dosing capabilities is to be designed downstream of both construction sites. The

maximum flow into the pond will be 394 L/s, with an average flow of 45 L/s to be treated.

- ***North TMF Seepage Dam, Site S11***

  A temporary treatment plant downstream of the North TMF Dam will need to be operational prior to beginning construction on the dam structure. The North TMF Seepage Dam will be constructed and flocculent dosing will be carried out on water that has been affected by North TMF Dam construction activities. Flow into the dam is expected to reach 1350 L/s, with an average rate of 78 L/s.

- ***South TMF Seepage Dam, Site S12***

  A similar treatment pond will be constructed downstream of the South TMF Dam tunnel outlet portal to treat an average flow of 79 L/s to remove TSS.

3.1 McTagg North Treatment Plant, Site S1

The water from the north portals of McTagg will be pumped to the temporary construction treatment plant at the site of the permanent treatment facility. The McTagg North Treatment Plant will be sized to treat 30 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment will consist of polymer addition and a large settling pond with a 10hr retention time as recommended by the BC mine guidelines to remove solids. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids, particle size, etc. However, further test work is recommended on actual samples to determine the settling rate and sludge characteristics, retention time and total volume of 1965 m^3 to remove solids. The treatment will be done in situ with polymer added in line and settling in a settling pond. The capital and operating cost is outlined in Table 2 and Table 3. As before, polymer feed system utilizing a neat polymer system with mixing water is recommended.

3.2 McTagg South Treatment Plant, Site S2

The McTagg South Treatment Plant is similar to the McTagg North Treatment Plant with design treatment flow of 30 L/s and require treatment for TSS removal. The treatment

plant will consist of polymer addition and a large settling pond with 10hr retention time to remove solids. The treatment will be done in situ with polymer added in line and settling in a settling pond with a volume of 1,777 m^3. The capital and operating cost is outlined in Table 3 and Table 4 above on page 8. As before, polymer feed system utilizing a neat polymer system with mixing water is recommended.

3.3 Teigen Portal TSS Treatment Plant, Site S3

This treatment facility is designed to treat flow pumped from Teigen-Saddle portal tunnel section for TSS. Since metals concentrations are expected to be below discharge targets, the Teigen treatment plant consists of polymer addition and a settling pond with 10 hr retention time as recommended by the BC mine guidelines to remove solids. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids, particle size, etc. However, further testwork is recommended on actual samples to determine the settling rate and sludge characteristics. The treatment plant is to be sized to treat up to 30 L/s. Based on our experience at other sites, the treatment can be done in situ with polymer added in line and settling in a settling pond with retention time. Since minimal data for the TSS concentration is unavailable, a conservative dose of 4 mg/L is used as the basis for feed system design.

3.4 Saddle Decline Portal Treatment Plant, Site S4 and ARD 2

For the first year of construction (Phase I), water from the Mitchell Teigen section and Teigen – Saddle section is expected to contain no metal contamination and would require treatment for TSS only.

After Year 1 (Phase II), water quality is expected to worsen with high metal concentration, requiring chemical precipitation for metals removal. The treatment facility would be sized to treat and average flow of 30 L/s (consisting of flow from Saddle-Mitchell section and runoff from the NAG muck pad) expected for TSS removal. For Phase II, the average flow is expected to be 122 L/s for TSS removal from NAG sections of the tunnels and the NAG muck pad, and 60 L/s requiring chemical precipitation for metals removal.

3.4.1 Saddle TSS Treatment Plant S4 - Phase I

Similar to the TMF treatment plant discussed earlier, the Phase I Saddle treatment plant will consist of a polymer dosing system and a settling pond to remove solids. The plant is to be design to treat an average flow of 30 L/s. The treatment plant is designed using neat polymer diluted to 0.5% concentration and added in line at 4 mg/L dosage using a variable speed dosing pump, followed by solid/liquid separation in a settling pond with 10hr retention time. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids, particle size, etc.

The capital cost for Phase I would be $18,000, which includes an agitated tank for polymer dilution, metering pump and associated instrumentation and piping. The reagent cost for Phase I based on 30 L/s flowrate and 4 mg/L neat polymer dosage is estimated to be $37,843 per year.

3.4.2 Saddle Treatment Plant - Phase II

After Year 1, water is expected to contain higher concentration of heavy metals requiring treatment. In addition, the flow for sediment laden water is also expected to increase from 30 L/s to 122 L/s. The corresponding treatment facility for TSS water is to be upgraded from a 30L/s capacity to 150L/s. Water requiring chemical precipitation for metals removal is expected to enter the ARD pond at an average rate of 60 L/s. The treatment plant is to be designed to treat an average of 100L/s. Since there is minimal water quality information available, it is assumed that the water quality during Phase II would be similar to the bench-scale water chemistry summarized in Table 6 below.

Table 6: Assumed Water Quality for Phase II of Saddle Treatment Plant

	Units	Feed
pH		**2.4**
Aluminium (Al)	mg/L	**8.77**
Antimony (Sb)	mg/L	<0.0005
Arsenic (As)	mg/L	0.001
Barium (Ba)	mg/L	0.017
Beryllium (Be)	mg/L	0.0018
Boron (B)	mg/L	<0.05
Cadmium (Cd)	mg/L	**0.0166**
Calcium (Ca)	mg/L	84.5
Chromium (Cr)	mg/L	0.001
Cobalt (Co)	mg/L	0.0239
Copper (Cu)	mg/L	**4.17**
Iron (Fe)	mg/L	**16.2**
Lead (Pb)	mg/L	0.0399
Lithium (Li)	mg/L	9.63
Manganese (Mn)	mg/L	0.05
Molybdenum (Mo)	mg/L	0.005
Nickel (Ni)	mg/L	0.023
Phosphorous (P)	mg/L	0.087
Potassium (K)	mg/L	1.66
Selenium (Se)	mg/L	0.002
Silicon (Si)	mg/L	12.6
Silver (Ag)	mg/L	0.00009
Sodium (Na)	mg/L	6.47
Strontium (Sr)	mg/L	0.606
Sulphur (S)	mg/L	134
Thallium (Tl)	mg/L	0.00016
Tin (Sb)	mg/L	<0.005
Titanium (Ti)	mg/L	<0.005
Uranium (U)	mg/L	0.0028
Zinc (Zn)	mg/L	**1.06**
Sulphate (SO_4)	mg/L	442.2

As indicated, the primary metals of concern are aluminium, cadmium, copper, iron and zinc. All metals of concern can be removed using chemical precipitation with lime at pH 9.1, as demonstrated in the bench-scale study conducted in January 2010.

Phase II Saddle treatment plant will be set up as a standard lime neutralization plant consisting of lime make-up and delivery system, two reactor tanks with 20 minutes retention time each, polymer system and a settling pond with 72 hr retention time for solid/liquid separation.

Table 7: Phase II Saddle Treatment Plant Capital Cost Estimate

Process equipment supply	$	246,100
Piping	$	54,142
Platform and Supports	$	59,064
Electrical	$	68,908
Instrumentation	$	49,220
Sub total equipment supply	**$**	**477,434**
Settling Pond		Not Included
Civil & Site Preparation (To Be Determined by Others)		Not Included
Equipment installation	$	286,460
Total direct costs	**$**	**763,894**

Table 8: Phase II Saddle Treatment Plant Reagent Cost Estimate

Reagent	Dose Rate (mg/L plant feed)	Annual Average Plant Flow Rate (L/min)	Annual Reagent Consumption (tonnes/year)	Reagent Unit Cost ($/tonne)	Annual Reagent Cost ($/year)
Hydrated Lime	130	6,000	410.7	260	106,784
Flocculant	4.0	6,000	12.6	6500	81,994
				Total	**$188,777**

3.5 Mitchell Treatment Plant, Site S5, ARD1

Mitchell treatment plant would require TSS removal for the first year of construction receiving water from the Saddle-Mitchell Tunnel section (gravity flow) and north portals of the Kerr Tunnel and Mitchell Diversion Tunnel. The flow of sediment laden water is expected to average 60L/s. The Mitchell Treatment Plant will also accept water with a high metals concentration, averaging 25 L/s during Phase 1 construction.

3.5.1 Mitchell Treatment Plant - Phase I

Similar to the Saddle treatment plant discussed earlier, the Phase I Mitchell treatment plant will consist of a polymer dosing system and a settling pond to remove solids sized to treat peak flow of 60 L/s. The treatment plant is designed using neat polymer diluted

to 0.5% concentration, and added in line at 4 mg/L dosage using a variable speed dosing pump, followed by solid/liquid separation in a settling pond with 10hr retention time.

The treatment plant for high metal concentrated water will require to treat an average flow of 30 L/s.

The capital cost for Phase I TSS would be $18,000 which includes an agitated tank for polymer dilution, metering pump and associated instrumentation and piping. The reagent cost for Phase I based on 60 L/s flowrate and 4 mg/L neat polymer dosage is estimated to be $75,686 per year.

3.5.2 Mitchell Treatment Plant - Phase II

After Year 1, the water average flow requiring polymer treatment is expected to increase to 149 L/s. The treatment plant for TSS is to be upgraded to treat 150L/s.

Water affected by acid generating agents is expected to flow at an average rate of 92 L/s. Again it is assumed that the water quality during Phase II would be similar to the bench-scale water chemistry summarized in Table 4 with primary metals of concern being aluminium, cadmium, copper, iron and zinc. All metals of concern can be removed using chemical precipitation with lime at pH 9.1 as demonstrated in the bench-scale study conducted in January 2010.

Phase II Mitchell treatment plant for sediment laden water will consist of a polymer dosing system and a settling pond to remove solids sized to treat an average flow of 150 L/s. The treatment plant is designed using neat polymer diluted to 0.5% concentration, and added in line at 4 mg/L dosage using a variable speed dosing pump, followed by solid/liquid separation in a settling pond with 10hr retention time. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The costs for the above treatment system are shown in Table 3 and Table 4 above.

Phase II Mitchell treatment plant for PAG affected water will be set up as a standard lime neutralization plant consisting of lime make-up and delivery system, two reactor tanks with 20 minutes retention time each, polymer system and a settling pond with 72 hr retention time for solid/liquid separation. The plant will be sized to treat an average flow of 100 L/s.

The capital and operating cost for the Phase II Mitchell treatment plant is estimated at +/- 30% based on equipment cost from SGS-CEMI database. The capital cost is estimated to be $763,894 which does not include site preparation and settling pond as summarized in Table 9 below. The plant is designed with minimal automation (pH controller for automatic lime addition only) and will require one operator part-time.

Table 9: Phase II Mitchell Treatment Plant Capital Cost Estimate

Process equipment supply	$	246,100
Piping	$	54,142
Platform and Supports	$	59,064
Electrical	$	68,908
Instrumentation	$	49,220
Sub total equipment supply	**$**	**477,434**
Settling Pond		Not Included
Civil & Site Preparation (To Be Determined by Others)		Not Included
Equipment installation	$	286,460
Total direct costs	**$**	**763,894**

Table 10: Phase II Mitchell Treatment Plant Reagent Cost Estimate

Reagent	Dose Rate (mg/L plant feed)	Annual Average Plant Flow Rate (L/min)	Annual Reagent Consumption (tonnes/year)	Reagent Unit Cost ($/tonne)	Annual Reagent Cost ($/year)
Hydrated Lime	130	6,000	410.7	260	106,784
Flocculant	4.0	6,000	12.6	6500	81,994
				Total	**$188,777**

3.6 Mitchell Diversion Tunnel, Mitchell Glacier Portal Treatment Plant, Site S6

Similar to the TMF Treatment Plant, the treatment plant will be sized to treat 30 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment plant will consist of polymers addition and a large settling pond with 10hr retention time to remove solids. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The settling characteristics should be tested to confirm the required settling time and pond size.

The treatment can be done in situ with polymer added inline and settling in a settling pond. The capital and operating cost will be similar to TMF treatment plant as outlined in Table 3 and Table 4. A neat polymer system is recommended.

3.7 South Mitchell Diversion Portal Plant, Site S7, ARD3

The South Mitchell plant would require TSS removal for the first three years of construction receiving water from the Saddle-Mitchell Tunnel section (gravity flow). The flow of sediment laden water is expected to average 26L/s. The Mitchell Treatment Plant will also accept water with a high metals concentration, averaging 30 L/s during Phase I and Phase II construction.

3.7.1 South Mitchell Treatment Plant - Phase I and II

Similar to the Saddle treatment plant discussed earlier, the Phase I and Phase II Mitchell treatment plant will consist of a polymer dosing system and a settling pond to remove solids sized to treat peak flow of 30 L/s. The treatment plant is designed using neat polymer diluted to 0.5% concentration, and added in line at 4 mg/L dosage using a variable speed dosing pump, followed by solid/liquid separation in a settling pond with 10hr retention time. Please see Table 3 and Table 4 for system costs. Once again, a neat polymer system is recommended.

The treatment plant for high metal concentrated water will require to treat an average flow of 30 L/s. The capital and operating cost for the South Mitchell treatment plant is estimated at +/- 30% based on equipment cost from SGS-CEMI database. The capital

cost is estimated to be $453,339 which does not include site preparation and settling pond as summarized in Table 11 below. The plant is designed with minimal automation (pH controller for automatic lime addition only) and will require one operator part-time.

Table 11: South Mitchell Treatment Plant Capital Cost Estimate

Process equipment supply	$	146,050
Piping	$	32,131
Platform and Supports	$	35,052
Electrical	$	40,894
Instrumentation	$	29,210
Sub total equipment supply	**$**	**283,337**
Settling Pond		Not Included
Civil & Site Preparation (To Be Determined by Others)		Not Included
Equipment installation	$	170,002
Total direct costs	**$**	**453,339**

Table 12: South Mitchell Treatment Plant Reagent Cost Estimate

Reagent	Dose Rate (mg/L plant feed)	Annual Average Plant Flow Rate (L/min)	Annual Reagent Consumption (tonnes/year)	Reagent Unit Cost ($/tonne)	Annual Reagent Cost ($/year)
Hydrated Lime	130	1,800	123.2	260	32,035
Flocculant	4.0	1,800	3.8	6500	24,598
				Total	**$56,633**

3.8 East Catchment Diversion Tunnel Inlet Treatment Plant, Site S8

The East Catchment Diversion Tunnel Inlet treatment plant will be sized to treat 30 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment plant will consist of polymers addition and a large settling pond with 10hr retention time to remove solids. The treatment can be done in situ with polymer added in line and settling in a settling pond. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The settling characteristics should be tested to confirm the required settling time and pond size.

The capital and operating cost will be similar to TMF treatment plant as outlined in Table 3 and Table 4 above. A neat polymer system is recommended.

3.9 East Catchment Diversion Tunnel Outlet Treatment Plant, Site S9

Similar to the East Catchment Diversion Tunnel Inlet Treatment Plant, the treatment plant will be sized to treat 30 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment plant will consist of polymers addition and a large settling pond with 10hr retention time to remove solids. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The settling characteristics should be tested to confirm the required settling time and pond size.

The treatment can be done in situ with polymer added in line and settling in a settling pond. The capital and operating cost will be similar to TMF treatment plant as outlined in Table 3 and Table 4 above. A neat polymer system is recommended.

3.10 WSD/WTP Construction Sediment Treatment Plant, Site S10

The WSD/WTP construction Sediment treatment plant will be sized to treat 60 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment plant will consist of polymers addition and a large settling pond with 10hr retention time to remove solids. The treatment can be done in situ with polymer added in line and settling in a settling pond. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The settling characteristics should be tested to confirm the required settling time and pond size.

The capital and operating cost will be similar to TMF treatment plant as outlined in Table 3 and Table 4 above. A neat polymer system is recommended.

3.11 North TMF Seepage Dam Treatment Plant, Site S11

The North TMF Seepage Dam treatment plant will be sized to treat 150 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment plant will consist of polymers addition and a large settling pond with 10hr retention time to remove solids. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The settling characteristics should be tested to confirm the required settling time and pond size.

The treatment can be done in situ with polymer added in line and settling in a settling pond. The capital and operating cost will be similar to TMF treatment plant as outlined in Table 3 and Table 4 above. A neat polymer system is recommended.

3.12 South TMF Seepage Dam Treatment Plant, Site S12

Similar to the North TMF Seepage Dam treatment plant, the south TMF plant will be sized to treat 150 L/s and require treatment for TSS removal since metals concentration are expected to be below the discharge targets. The treatment plant will consist of polymers addition and a large settling pond with 10hr retention time to remove solids. The 10 hour retention time may not be sufficient as it will depend on the settling characteristics of the soils, suspended solids as well as the particle size. The settling characteristics should be tested to confirm the required settling time and pond size.

The treatment can be done in situ with polymer added in line and settling in a settling pond. The capital and operating cost will be similar to TMF treatment plant as outlined in Table 3 and Table 4 above. A neat polymer system is recommended.

APPENDIX B.

Process Design Criteria
Mass Balance
Air Requirement
Equipment Sizing

Seabridge Gold - KSM Project
HIGH DENSITY SLUDGE WATER TREATMENT

Design: 833 L/s

Flowrate		
Normal Flowrate	71971	m^3/day
Normal Flowrate	**2999**	m^3/hr
Normal Flowrate	**833**	L/s
Max. Flowrate	71971	m^3/day
Max. Flowrate	**2999**	m^3/hr
Max. Flowrate	**833**	L/s

Solids		
Solids Genrations	**1.04**	g/L
Solids Generations-Max	**1.04**	g/L
Normal Solids Generations	3.12	ton/hr
Max. Solids Generations	3.12	ton/hr
Normal Sludge Recycle Ratio	**10**	:1
Max. Sludge Recycle Ratio	**10**	:1
Percent Solids in Sludge	**25.0**	%
Sludge Pulp Density	**1.18**	
Clarifier Feed S.G	**1.01**	

Vessels - Residence Times		
Reactor Vessels	**42**	minutes
Lime Sludge Mix Tank	**3**	minutes
Recycle Water Tank	**10**	minutes
Clarifier Upflow Ratio	**1.25**	

Lime		
Lime Require (CaO)	**0.26**	kg/m^3
Lime Requirements ($Ca(OH)_2$)	0.34	kg/m^3
Lime Concentration	**18**	%
Lime Solid S.G	**2.40**	
Lime Requirement ($Ca(OH)_2$)	1.020	ton/hr
Lime Requirement (CaO)	0.771	ton/hr
Lime Recycle IN Ratio	**3**	
Lime Recycle RETURN Ratio	**2**	
Lime to TANKS Ratio	1	
Lime Slurry Tanks Holding Time	59	hrs.

Flocculent		
Flocculent Addition	**1.5**	mg/L
Flocculent Addition	4.5	kg/hr
Flocculent Concentration	**0.05**	%
Flocculent Make Up Water pH	5-7	

Seabridge Gold - KSM Project
HIGH DENSITY SLUDGE WATER TREATMENT

Design: 3350 L/s

Flowrate		
Normal Flowrate	289440	m^3/day
Normal Flowrate	**12060**	m^3/hr
Normal Flowrate	**3350**	L/s
Max. Flowrate	289440	m^3/day
Max. Flowrate	**12060**	m^3/hr
Max. Flowrate	**3350**	L/s

Solids		
Solids Genrations	**1.04**	g/L
Solids Generations-Max	**1.04**	g/L
Normal Solids Generations	12.54	ton/hr
Max. Solids Generations	12.54	ton/hr
Normal Sludge Recycle Ratio	**10**	:1
Max. Sludge Recycle Ratio	**10**	:1
Percent Solids in Sludge	**25.0**	%
Sludge Pulp Density	**1.18**	
Clarifier Feed S.G	**1.01**	

Vessels - Residence Times		
Reactor Vessels	**42**	minutes
Lime Sludge Mix Tank	**3**	minutes
Recycle Water Tank	**10**	minutes
Clarifier Upflow Ratio	**1.25**	

Lime		
Lime Require (CaO)	**0.26**	kg/m^3
Lime Requirements ($Ca(OH)_2$)	0.34	kg/m^3
Lime Concentration	**18**	%
Lime Solid S.G	**2.40**	
Lime Requirement ($Ca(OH)_2$)	4.100	ton/hr
Lime Requirement (CaO)	3.100	ton/hr
Lime Recycle IN Ratio	**3**	
Lime Recycle RETURN Ratio	**2**	
Lime to TANKS Ratio	1	
Lime Slurry Tanks Holding Time	59	hrs.

Flocculent		
Flocculent Addition	**1.5**	mg/L
Flocculent Addition	18.1	kg/hr
Flocculent Concentration	**0.05**	%
Flocculent Make Up Water pH	5-7	

Water Quality and Sludge Generation Prediction

HIGH DENSITY SLUDGE WATER TREATMENT

Ion	Ion Wt. (g/mol)	Hydroxide Formula	Hydroxide Weight (g/mol)	Mass of Ion Present (mg/L)	Mass of OH^- (mg/L)	Mass of Precip. (mg/L)
Al	26.98	$Al(OH)_3$	78.01	14.20	26.86	41.06
Ag	107.87	AgOH	124.88	0.00	0.00	0.00
As	74.92	$As(OH)_3$	125.95	0.04	0.03	0.07
Cr	52.00	$Cr(OH)_3$	103.03	0.04	0.04	0.08
Co	58.93	$Co(OH)_2$	92.95	0.02	0.01	0.04
Cd	112.41	$Cd(OH)_2$	146.43	0.01	0.00	0.02
Cu	63.55	$Cu(OH)_2$	97.57	22.90	20.00	35.16
Fe	55.85	$Fe(OH)_3$	106.88	16.30	14.89	31.19
Pb	207.2	$Pb(OH)_2$	241.22	0.09	13.21	0.10
Mg*	24.31	$Mg(OH)_2$	58.33	16.50	4.62	7.92
Mn	54.94	MnO_2	86.94	3.30	1.92	5.22
Ni	58.71	$Ni(OH)_2$	92.73	0.02	0.01	0.03
S*	32.06	$CaSO_4.2H_2O$	172.18	0.00	0.00	0.00
Sb	121.75	$Sb(OH)_3$	172.78	0.02	0.01	0.03
Se	78.96	$Se(OH)_4$	147	0.04	0.03	0.07
Si	28.09	$Si(OH)_2$	62.11	0.00	0.00	0.00
Zn	65.38	$Zn(OH)_2$	99.4	4.00	2.08	6.08
F	19.00	CaF_2	78.08		0.00	0.00
SO_4^{2-}*	96.06	$CaSO_4.2H_2O$	172.18	817.00	0.00	0.00
CO_3^{2-}	59.98	$CaCO_3$	100.06		0.00	0.00
TSS	n/a	n/a	n/a		n/a	0.00
Total					**83.73**	**127.08**

Residual SO_4^{2-} concentration 817 mg/L

Residual Mg Concentrations 13.2 mg/L

1.04 g/L Bench-Scale

* **Use either (S) or (SO_4).**

Solids Generation = 0.15 g/L

(includes 8.0 % lime enerts)

(includes 5.0 % unreacted lime solids)

Lime Requirements

Based on calcium requirements 0.00 g $Ca(OH)_2$/L effluent **OR** (SO_4^{2-} based)

Based on hydroxide requirements 0.18 g $Ca(OH)_2$/L effluent

Lime Utilization = 95.0 %

Available CaO = 92.0 %

Lime use = 0.19 g $Ca(OH)_2$/L

Lime use = 0.16 g lime (CaO)/L

Lime use = 0.34 g $Ca(OH)_2$/L Bench-Scale

MASS BALANCE (BC): Seabridge Gold - KSM Project

HIGH DENSITY SLUDGE WATER TREATMENT

FEED **2999 m^3/hr Design Flow**

Streams		HDS FEED 1	Lime Slurry 2	Lime Recycle 3A	Lime Recycle 3B	Lime Slurry 4	Sludge Recycle 5	Lime/Sludge Mixture 6	Floc. Feed 7	Clarifier Feed 8	Clarifier U/F 9	Sludge Purge 10	Clarifier O/F 11	Fresh Water 12
Slurry														
Vol. flow rate	m^3/hr	2999	5.07	15.21	10.14	5.07	105.7	110.8	9.00	3118.6	116.3	10.57	3001.0	35.99
Mass flow rate	ton/hr	2999	5.66	16.99	11.33	5.66	124.8	130.4	9.00	3138.2	137.2	12.48	3001.0	35.99
S.G		1.00	1.12	1.12	1.12	1.12	1.18	1.18	1.00	1.01	1.18	1.18	1.00	1.00
pH		0.0	<12	<12	<12	<12	8.5	<12	5-7	8.5	8.5	8.5	8.5	5-7
Solids														
Vol. Flow rate	m^3/hr	0.00	0.42	1.27	0.85	0.42	12.16	12.58	0.00	13.8	13.37	1.22	0.00	0
Mass Flow rate	ton/hr	0.00	1.02	3.06	2.04	1.02	31.2	32.2	0.00	35.3	34.3	3.12	0.00	0.00
S.G		0.00	2.40	2.40	2.40	2.40	2.57	2.56	0.00	2.57	2.57	2.57	0.00	0.00
% Solids of Total Wt		0	18	18	18	18	25	24.7	0	1.13	25	25	0	0
Liquid														
Vol. Flow rate	m^3/hr	2999	4.64	13.93	9.29	4.64	93.6	98.2	9.00	3103	102.9	9.36	3001.0	35.99
Mass Flowrate	ton/hr	2999	4.64	13.93	9.29	4.64	93.6	98.2	9.00	3103	102.9	9.36	3001.0	35.99
S.G		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
% Liquid of Total Wt		100	82	82	82	82	75	75	100	98.9	75	75	100	100

MASS BALANCE (BC): Seabridge Gold - KSM Project

HIGH DENSITY SLUDGE WATER TREATMENT

FEED 12060 m^3/hr Design Flow

Streams		HDS FEED 1	Lime Slurry 2	Lime Recycle 3A	Lime Recycle 3B	Lime Slurry 4	Sludge Recycle 5	Lime/Sludge Mixture 6	Floc. Feed 7	Clarifier Feed 8	Clarifier U/F 9	Sludge Purge 10	Clarifier O/F 11	Fresh Water 12
Slurry														
Vol. flow rate	m^3/hr	12060	20.39	61.16	40.78	20.39	425.2	445.6	36.18	12541.7	467.7	42.52	12068.8	144.72
Mass flow rate	ton/hr	12060	22.78	68.34	45.56	22.78	501.7	524.5	36.18	12620.7	551.9	50.17	12068.8	144.72
S.G		1.00	1.12	1.12	1.12	1.12	1.18	1.18	1.00	1.01	1.18	1.18	1.00	1.00
pH		0.0	<12	<12	<12	<12	8.5	<12	5-7	8.5	8.5	8.5	8.5	5-7
Solids														
Vol. Flow rate	m^3/hr	0.00	1.71	5.13	3.42	1.71	48.89	50.60	0.00	55.4	53.78	4.89	0.00	0
Mass Flow rate	ton/hr	0.00	4.10	12.30	8.20	4.10	125.4	129.5	0.00	142.1	138.0	12.54	0.00	0.00
S.G		0.00	2.40	2.40	2.40	2.40	2.57	2.56	0.00	2.57	2.57	2.57	0.00	0.00
% Solids of Total Wt		0	18	18	18	18	25	24.7	0	1.13	25	25	0	0
Liquid														
Vol. Flow rate	m^3/hr	12060	18.68	56.04	37.36	18.68	376.3	395.0	36.18	12479	413.9	37.63	12068.8	144.72
Mass Flowrate	ton/hr	12060	18.68	56.04	37.36	18.68	376.3	395.0	36.18	12479	413.9	37.63	12068.8	144.72
S.G		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
% Liquid of Total Wt		100	82	82	82	82	75	75	100	98.9	75	75	100	100

Aeration Requirements

Seabridge Gold - KSM Project

HIGH DENSITY SLUDGE WATER TREATMENT

Total Flow In =	11995	m^3/hr
Total Iron Content =	16.3	mg/L
Total Ferrous Iron =	3.50	kmol/hr
Percent Ferrous Iron =	**100**	%
O_2 Required for Ferrous =	28.03	kg/hr
Total Manganese Content =	3.3	mg/L
Total Manganese =	0.720	kmol/hr
O_2 Required for Manganese =	11.5	kg/hr
Total O_2 Required =	39.6	kg/hr
Oxygen Transfer Efficiency =	**20**	%
Aeration required =	**682.1**	**m^3/hour**
=	**401.4**	**SCFM**

VESSEL SIZES

Seabridge Gold - KSM Project

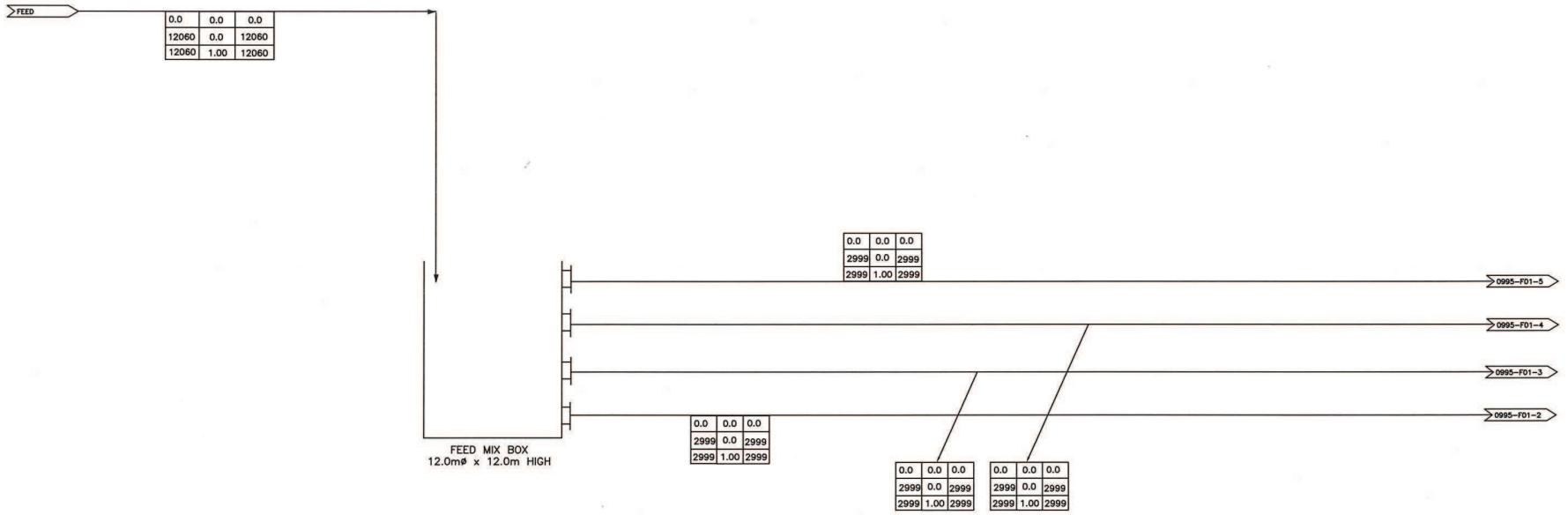
HIGH DENSITY SLUDGE WATER TREATMENT

	Volume Req'd	Diameter	Height	Freeboard	Height	D:H Ratio
	(m^3)	(m)	(m)	(m)	with Freeboard	
Sludge/Mix Tank	5.4	1.9	1.9	0.5	2.4	**1.0**
Reactor 1	1194	11.5	11.5	1.0	12.5	**1.0**
Reactor 2	1194	11.5	11.5	1.0	12.5	**1.0**
Lime Slurry Tank	1194	11.5	11.5	1.0	12.5	**1.0**
Fresh Water Tank	6.0	2.0	2.0	0.5	2.5	**1.0**
Clarifier-1 Dia. (m)						56

APPENDIX C

Process Flow Diagrams
Plant General Arrangement Drawings
Process & Instrumentation Drawings

Drawing No. 0995-F01-1



LEGEND

SOLIDS t/h	SOLIDS S.G	SOLIDS m³/hr
LIQUID t/h	SOLIDS %	LIQUID m³/hr
SLURRY t/h	SLURRY S.G	SLURRY m³/hr

CAD FILE NAME: 0995-F01-1 LAST UPDATE: 10/03/24

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CLIENT: SEABRIDGE GOLD KSM PROJECT
PO No.

— FEASIBILITY —

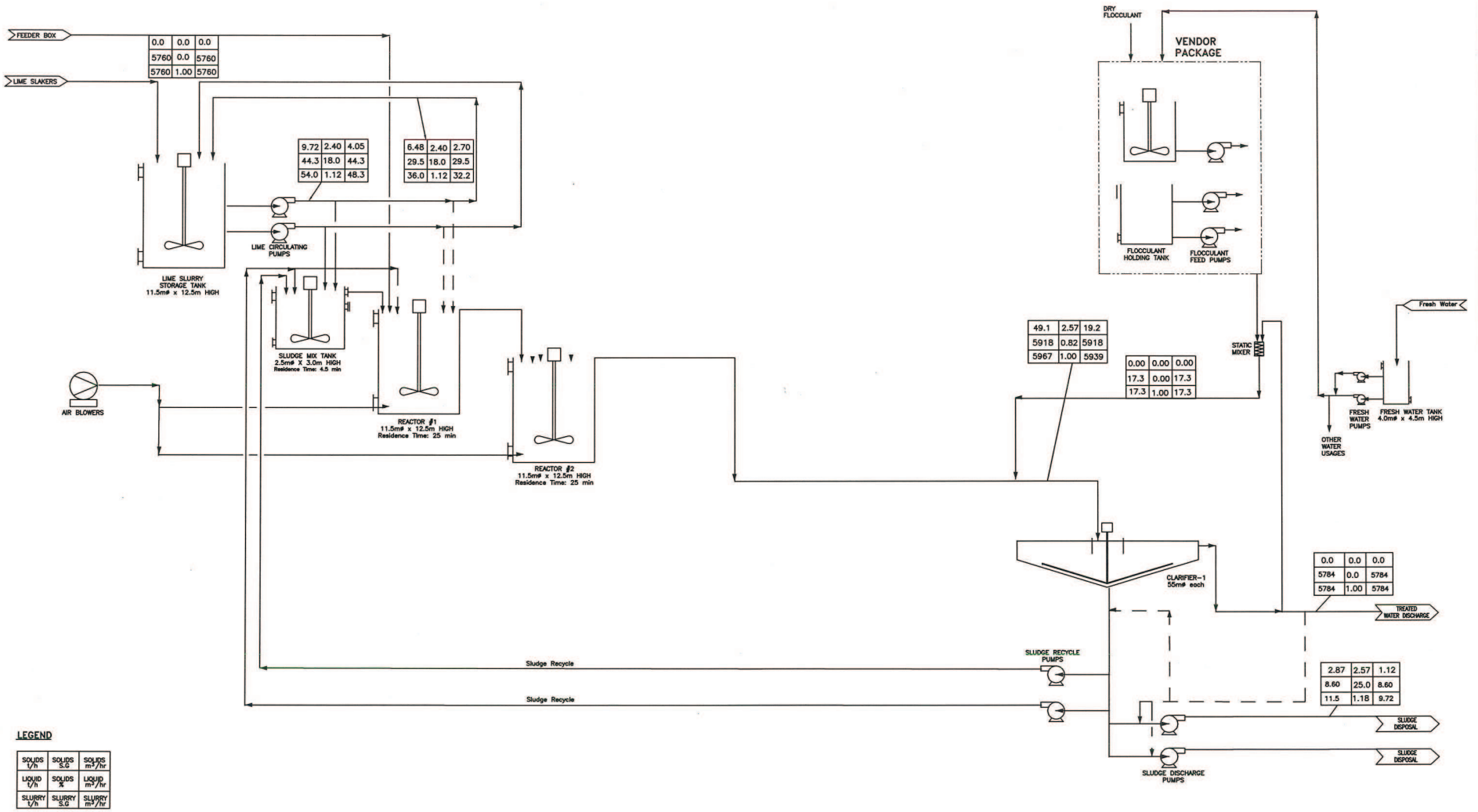
CLIENT APPROVAL By Date

Client No. CEMI-0995
Job. No. 0995-F01-1
Scale N/A

CANADIAN ENVIRONMENTAL & METALLURGICAL Inc.

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
FEASIBILITY ENGINEERING
PROCESS FLOWSHEET – FEED MIX BOX

Drawing No. 0995-F01-1 Rev. A



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CAD FILE NAME: 0995-F01-1 LAST UPDATE: 11/03/14

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Client No. CEMI-0995

CLIENT APPROVAL By Date

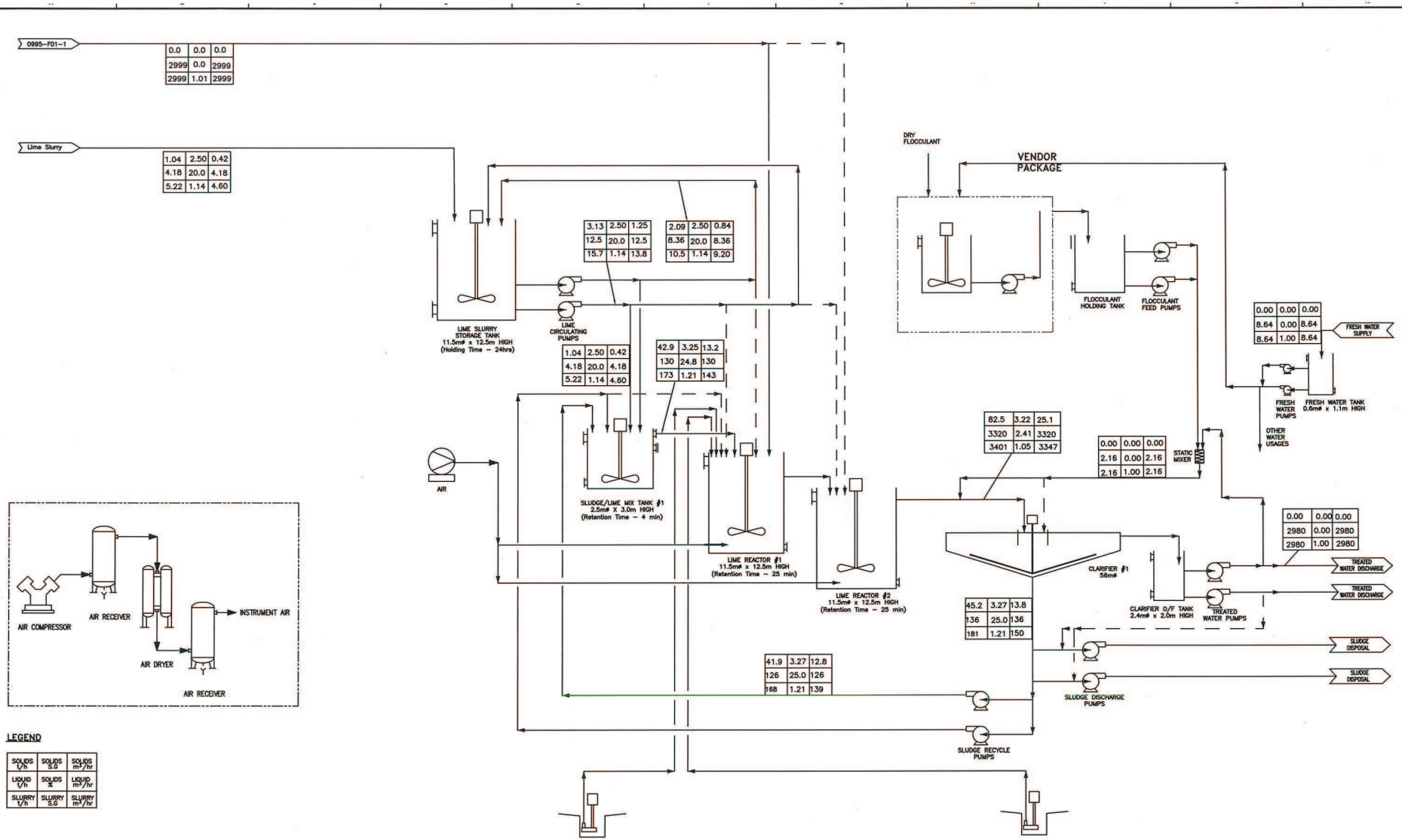
Job. No. 0995-F01-1

Scale N/A

CANADIAN ENVIRONMENTAL & METALLURGICAL Inc.

Title: SEABRIDGE GOLD – KSM PROJECT HDS WATER TREATMENT PLANT PREFEASIBILITY ENGINEERING PROCESS FLOWSHEET (CIRCUIT 1)

Drawing No. 0995-F01-1 Rev. A



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CAD FILE NAME: 0995-F01-1 LAST UPDATE: 11/03/14

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SEABRIDGE GOLD
KSM PROJECT

PO No.

– FEASIBILITY –

CLIENT APPROVAL By Date

Client No. CEMI-0995

Job. No. 0995-F01-1

Scale N/A

CANADIAN ENVIRONMENTAL & METALLURGICAL Inc.

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
FEASIBILITY ENGINEERING
PROCESS FLOWSHEET (CIRCUIT 2)

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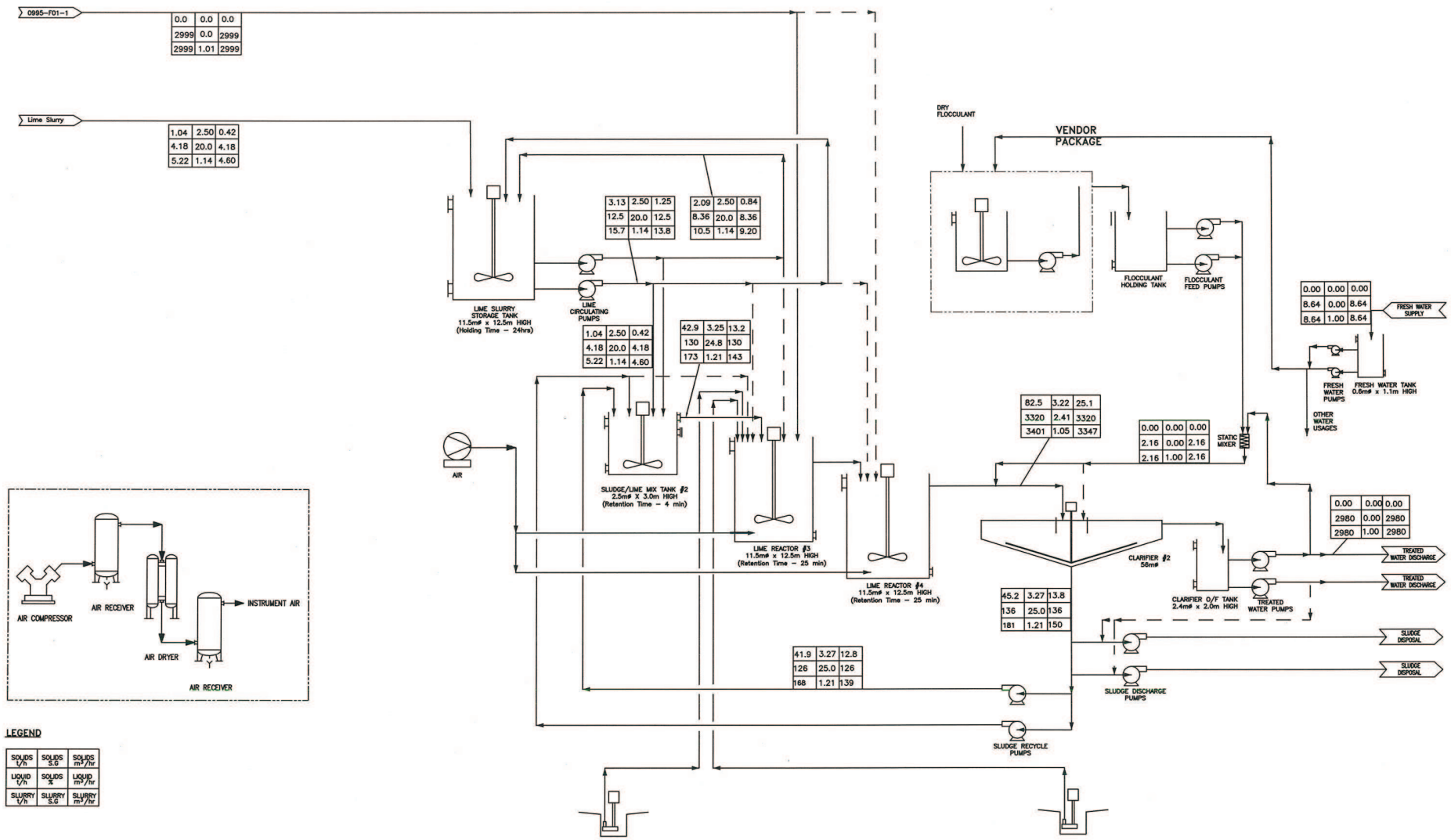

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LAST UPDATE: 11/03/14

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Designed By		

CLIENT

SEABRIDGE GOLD
KSM PROJECT

PO No.

– FEASIBILITY –

CLIENT APPROVAL By Date

Client No. CEMI-0995

Job. No. 0995-F01-1

Scale N/A

CANADIAN ENVIRONMENTAL & METALLURGICAL Inc.

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
FEASIBILITY ENGINEERING
PROCESS FLOWSHEET (CIRCUIT 3)

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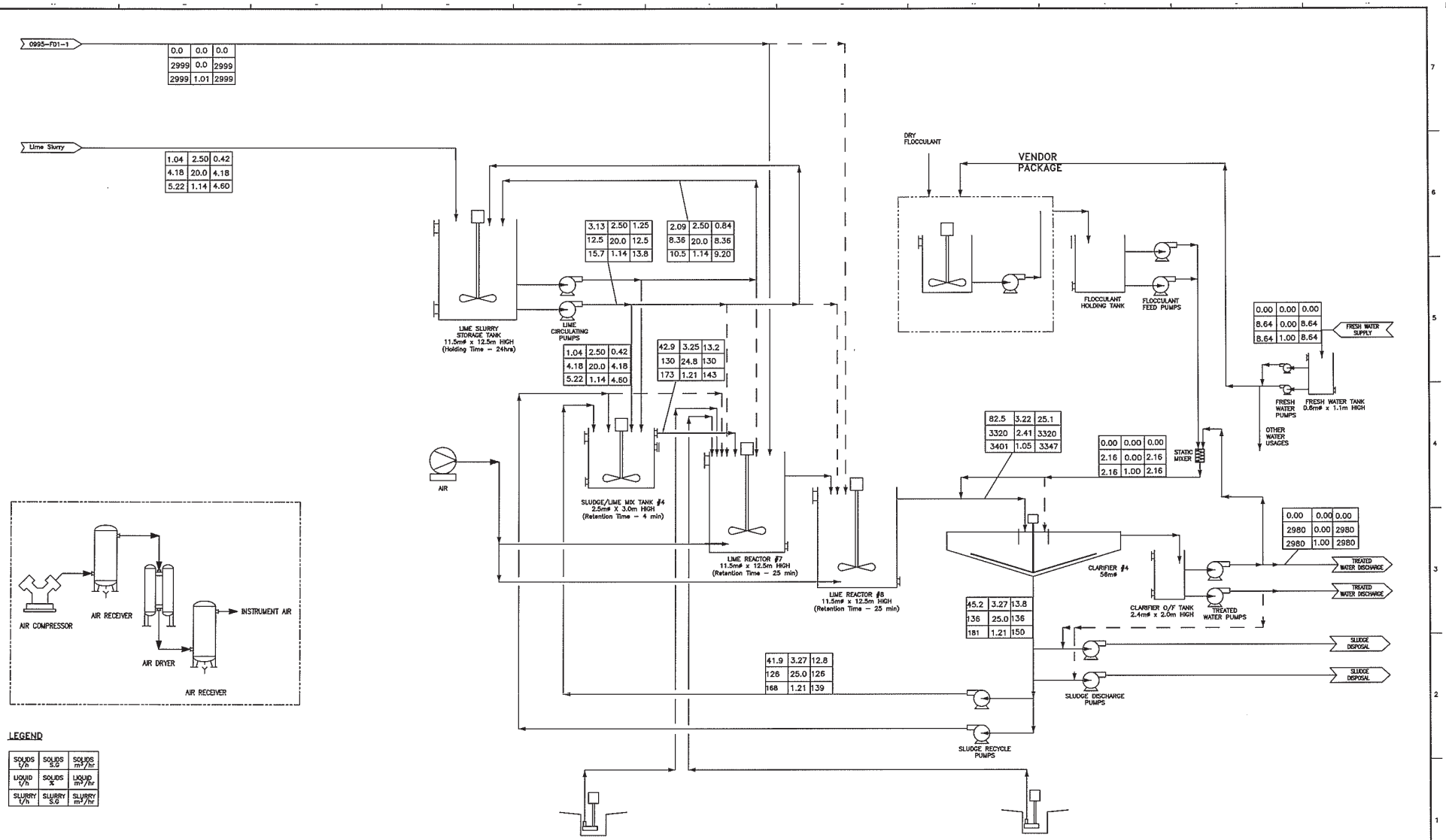

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LAST UPDATE: 11/03/14

CAD FILE NAME 0995-F01-5

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CLIENT: SEABRIDGE GOLD KSM PROJECT

PO No.

– FEASIBILITY –

Client No. CEMI-0995

CLIENT APPROVAL By Date

Job. No. 0995-F01

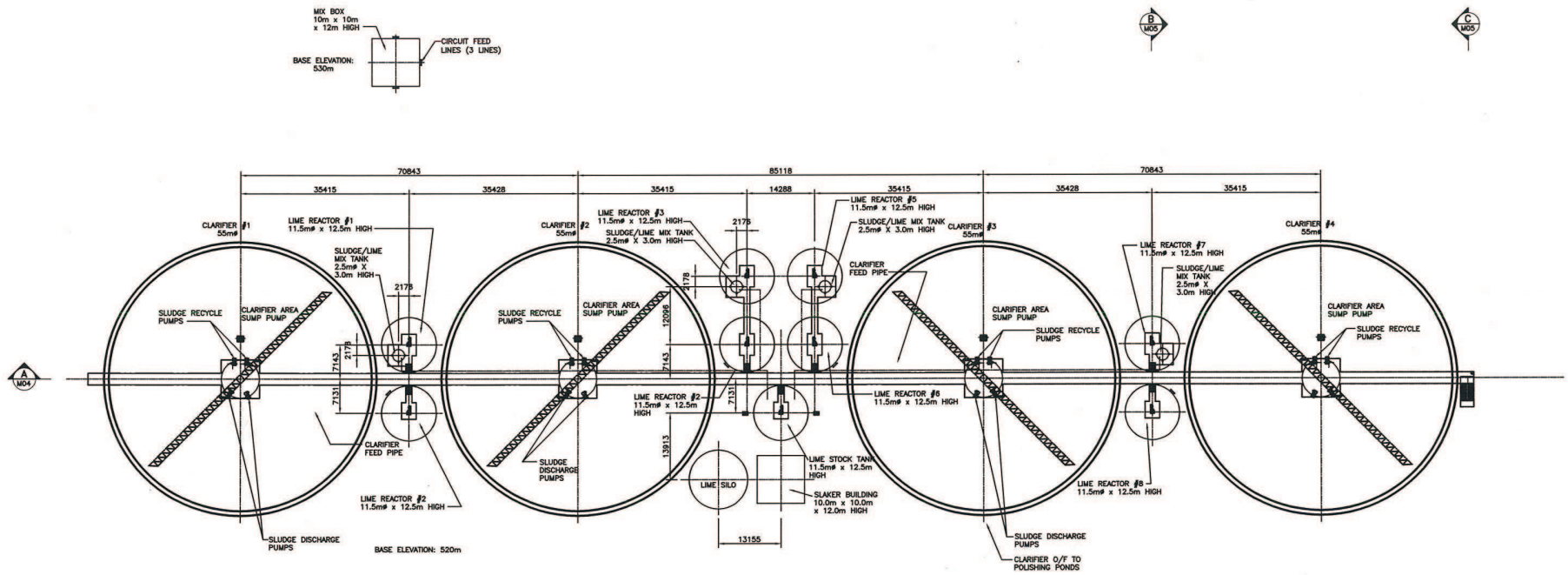
Scale N/A

CANADIAN ENVIRONMENTAL & METALLURGICAL Inc.

Title: SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
FEASIBILITY ENGINEERING
PROCESS FLOWSHEET (CIRCUIT 4)

Drawing No. 0995-F01-5 Rev. A

Drawing No. 0995-M01-01



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Checked By	
Drawn By	– –
Designed By	

Client Dwg. No.

CLIENT APPROVAL
By Date

Job. No. 0995

Scale 1:400

SGS CANADA INC
(FORMERLY CEMI)

Title
SEABRIDGE_GOLD
KSM_PROJECT
CONCEPTUAL_DESIGN
PLANT_G.A.

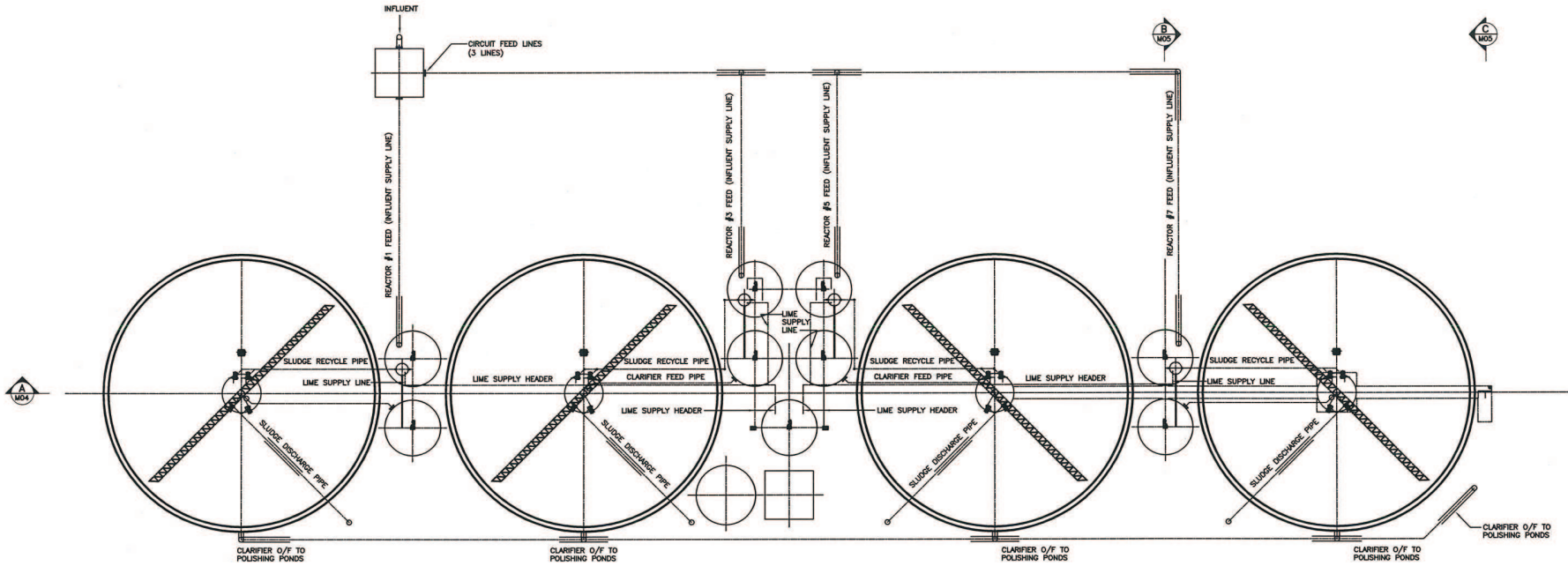
Drawing No. 0995-M01-01 Rev. –

CAD FILE NAME: – LAST UPDATE: –

Drawing No. 0995-M01-02

CAD FILE NAME: –

LAST UPDATE: –



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						4		
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						2		
						1		

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Approved By	
Checked By	
Drawn By	– –
Designed By	

CLIENT APPROVAL
By Date

Client Dwg. No.

Job. No. 0995

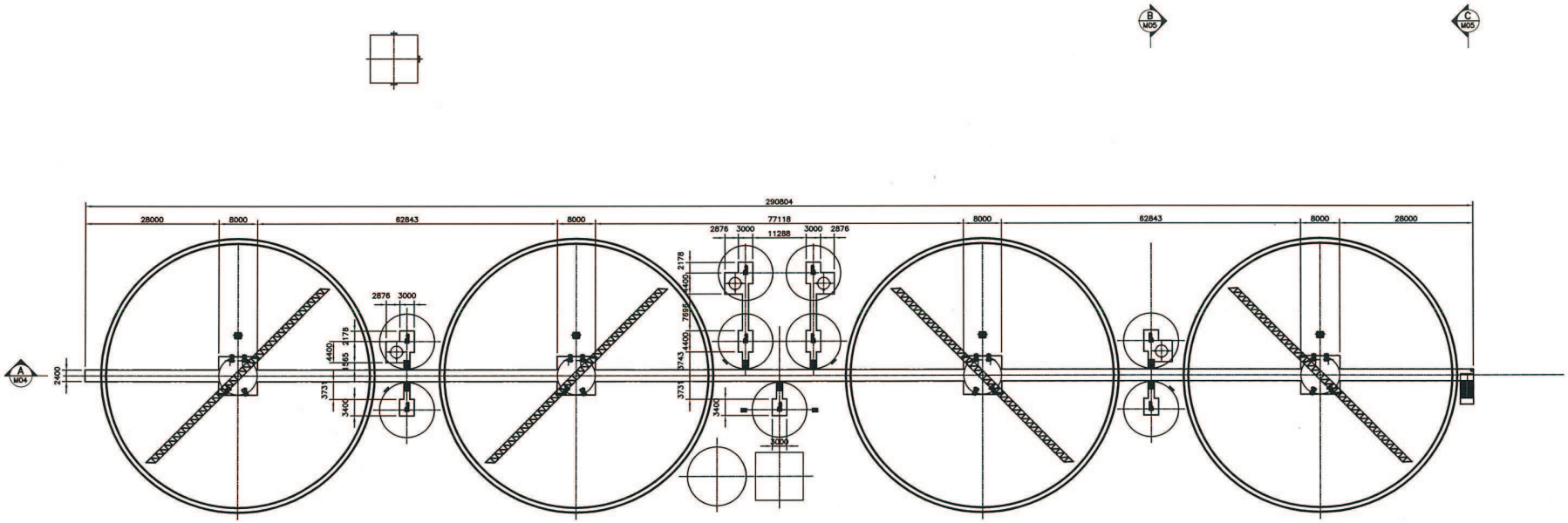
Scale 1:400

SGS CANADA INC
(FORMERLY CEMI)

Title
SEABRIDGE_GOLD
KSM_PROJECT
CONCEPTUAL_DESIGN
PIPING LAYOUT

Drawing No. 0995-M01-02 Rev. –

Drawing No. 0995-M01-03



CAD FILE NAME: –

LAST UPDATE: –

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Checked By		
Drawn By	–	–
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CLIENT APPROVAL

By Date

Client Dwg. No.

Job. No. 0995

Scale 1:400

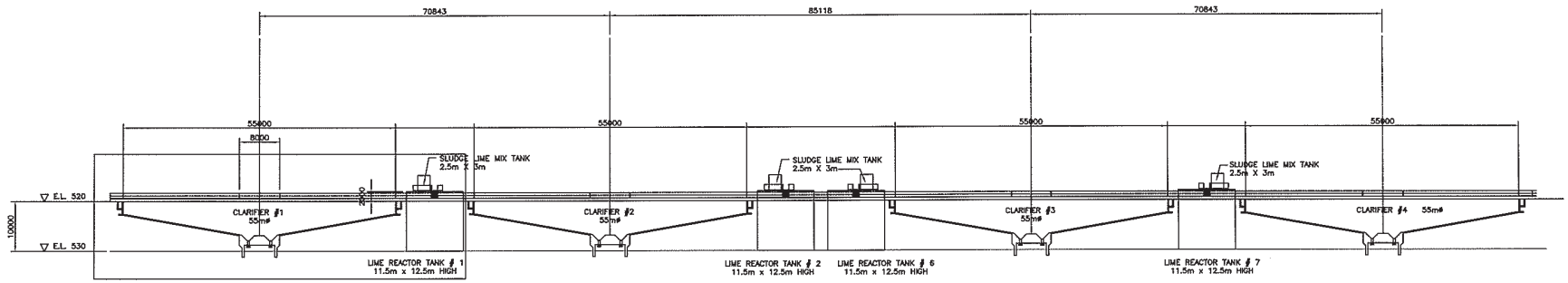
SGS CANADA INC
(FORMERLY CEMI)

Title
SEABRIDGE_GOLD
KSM_PROJECT
CONCEPTUAL_DESIGN
PLATFORM LAYOUT

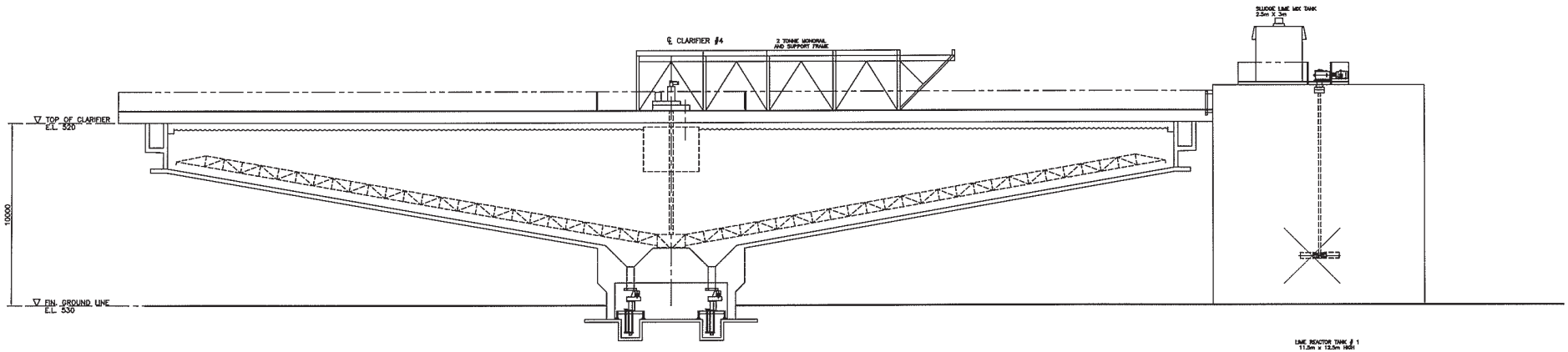
Drawing No. 0995-M01-03

Rev. –

Drawing No. 0995-M01-04



SECTION A / M01



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	For Approval
	For Checking

ENGINEERING REVIEW

Approved By	
Checked By	
Drawn By	-- --
Designed By	

CLIENT APPROVAL
By Date

Client Dwg. No.

Job. No. 0995

Scale 1:400; 1:200

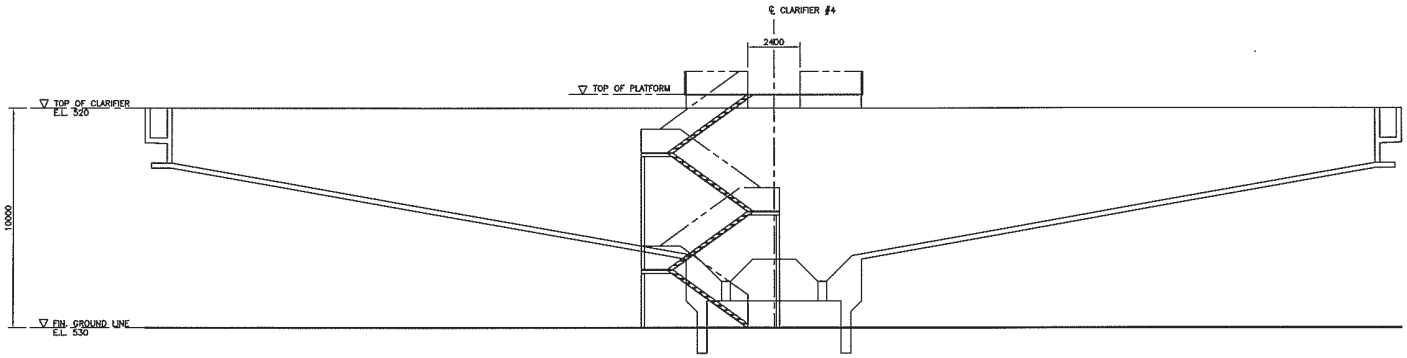
SGS CANADA INC
(FORMERLY CEMI)

Title
SEABRIDGE_GOLD
KSM_PROJECT
CONCEPTUAL_DESIGN
SECTIONS

Drawing No. 0995-M01-04 Rev. -

CAD FILE NAME: - LAST UPDATE: -

Drawing No. 0995-M01-05



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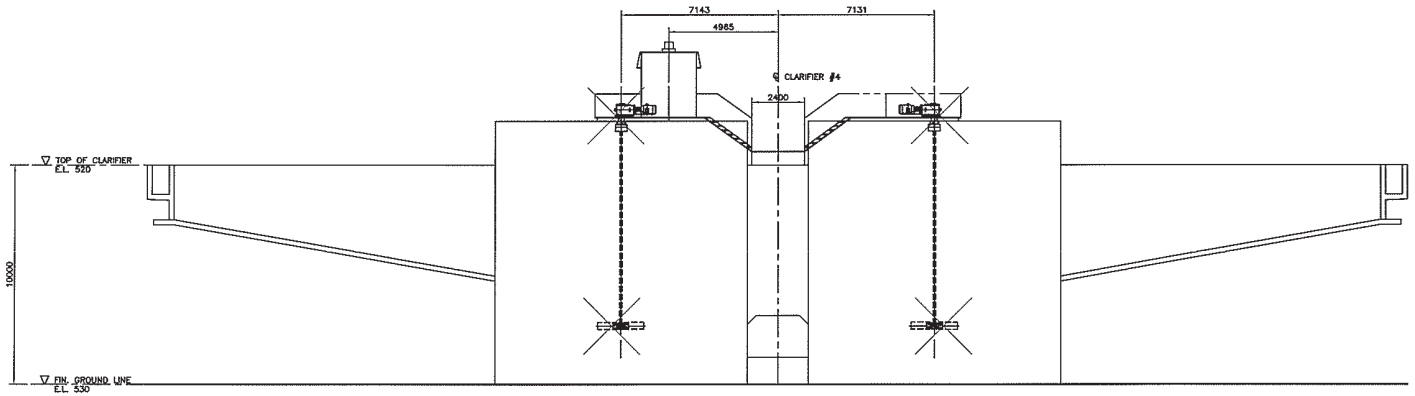
M01



SECTION B
M01

Rev.	REVISION DESCRIPTION	Date	By	Chk'd	App'd	No.	Dwg. No.	REFERENCE DRAWINGS
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PRINT RECORD

Date	Issue To
	For Tender
	For Approval
	For Checking

ENGINEERING REVIEW

Approved By	
Checked By	
Drawn By	-- --
Designed By	

CLIENT APPROVAL
By Date

Client Dwg. No.

Job. No. 0995 | Scale 1:100

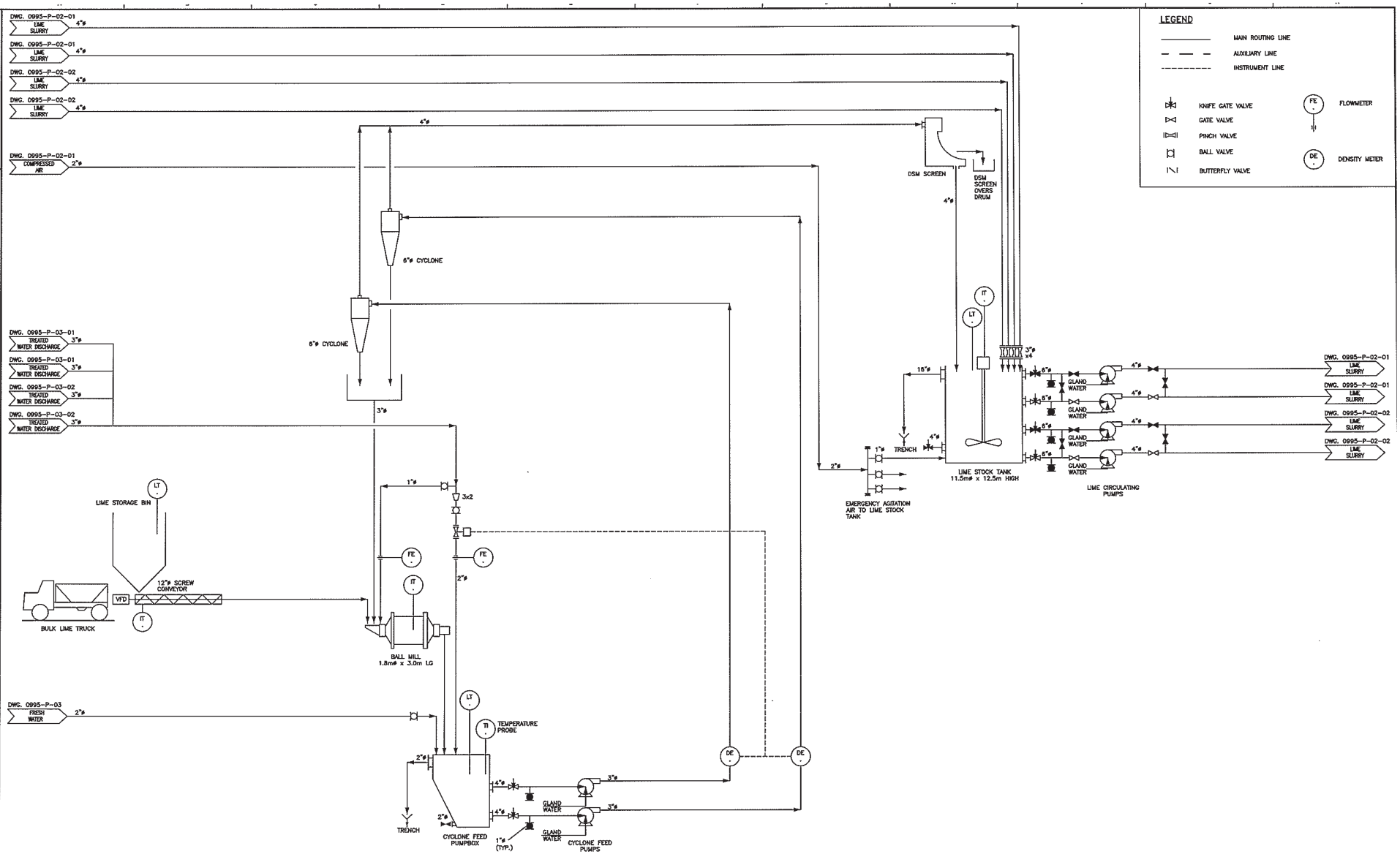
SGS CANADA INC
(FORMERLY CEMI)

Title
SEABRIDGE_GOLD
KSM_PROJECT
CONCEPTUAL_DESIGN
SECTIONS

Drawing No. 0995-M01-05 | Rev. -

LAST UPDATE: -

CAD FILE NAME: -



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A	ISSUED FOR PREFEASIBILITY ENGINEERING	11/03/25	RJF			1		

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Date	Issue To	
	For Tender	
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	For Checking	

Engineering Review		
Approved By		
Checked By		
Drawn By	RJF	11/03/25
Designed By		

– PRELIMINARY –
NOT FOR CONSTRUCTION

CLIENT APPROVAL
By Date

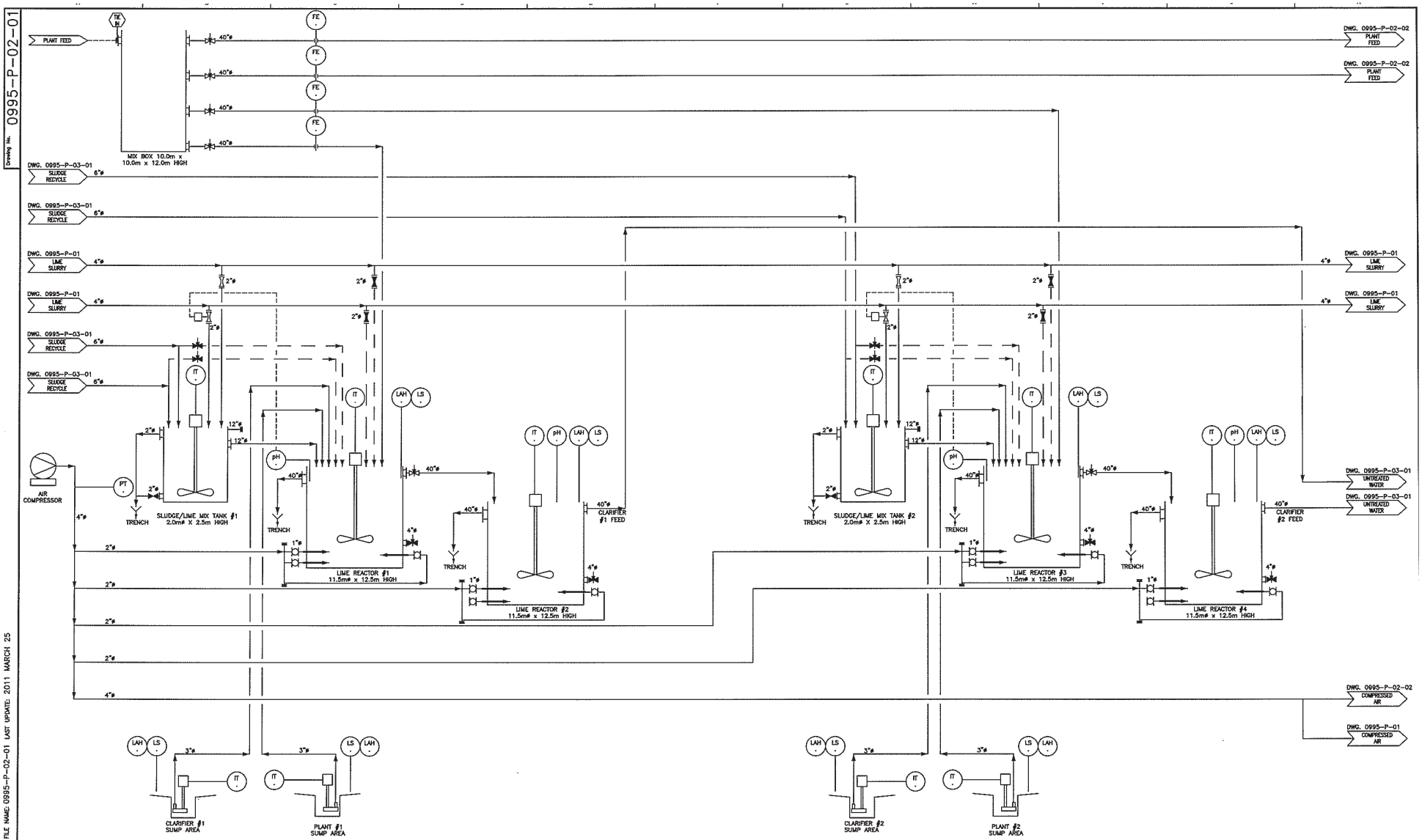
Client Dwg. No.

Job. No. 0995 | Scale NTS

SGS CANADA INC. (FORMERLY CEMI)

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
PIPING & INSTRUMENTATION DIAGRAM
LIME FEED CIRCUIT

Drawing No. 0995-P-01 Rev. A



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Date	Issue To
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Approved By		
Checked By		
Drawn By	RJF	11/03/25
Designed By		

– PRELIMINARY –
NOT FOR CONSTRUCTION

CLIENT APPROVAL
By Date

Client Dwg. No.

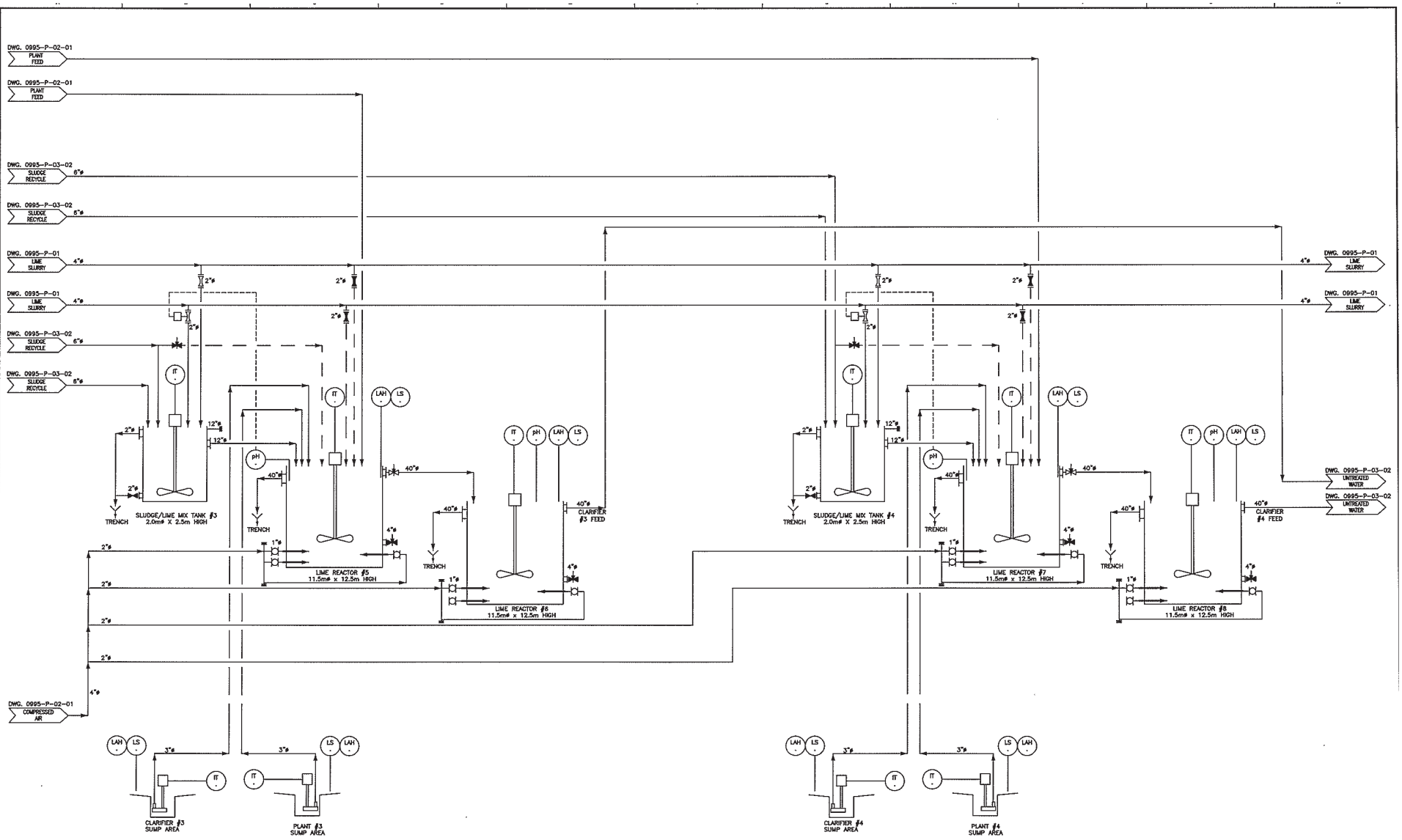
Job. No. 0995

Scale NTS

SGS CANADA INC. (FORMERLY CEMI)

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
PIPING & INSTRUMENTATION DIAGRAM
LIME REACTOR CIRCUIT (#1–4)

Drawing No. 0995-P-02-01 Rev. A



Rev.	REVISION DESCRIPTION	Date	By	Chk'd	App'd	No.
A	ISSUED FOR BUDGETARY PLANNING	02/12/02	SES	JAM	WL	1

Dwg. No.	REFERENCE DRAWINGS

Date	Issue To
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	For Approval
	For Checking

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Checked By		
Drawn By	RJF	11/03/25
Designed By		

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CLIENT APPROVAL
By Date

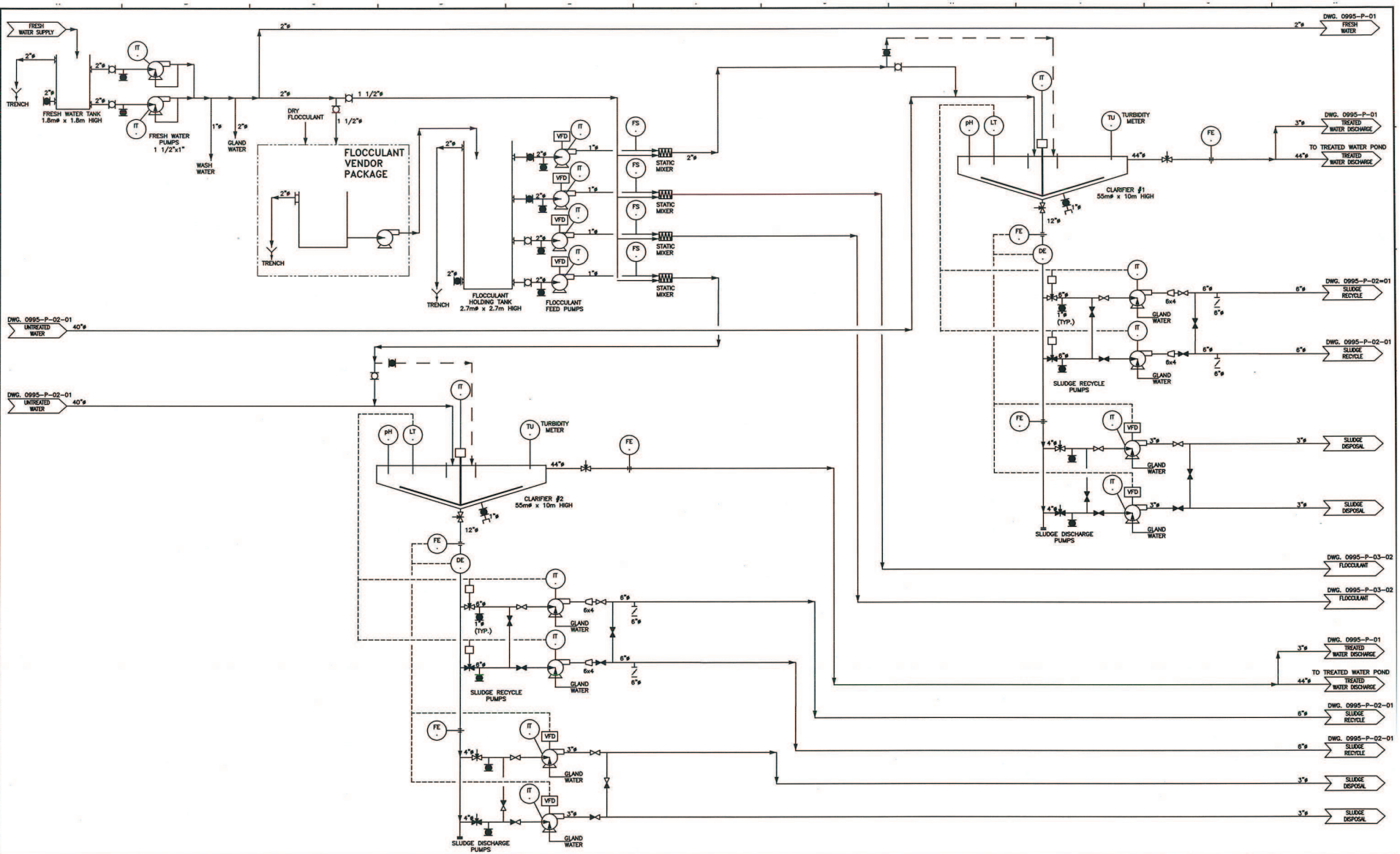
Client Drg. No.

Job. No. 0995 | Scale NTS

SGS CANADA INC. (FORMERLY CEMI)

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
PIPING & INSTRUMENTATION DIAGRAM
LIME REACTOR CIRCUIT (#5–8)

Drawing No. 0995-P-02-02 Rev. A



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	For Approval		Drawn By	RJF	11/03/25
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Client Dwg. No.

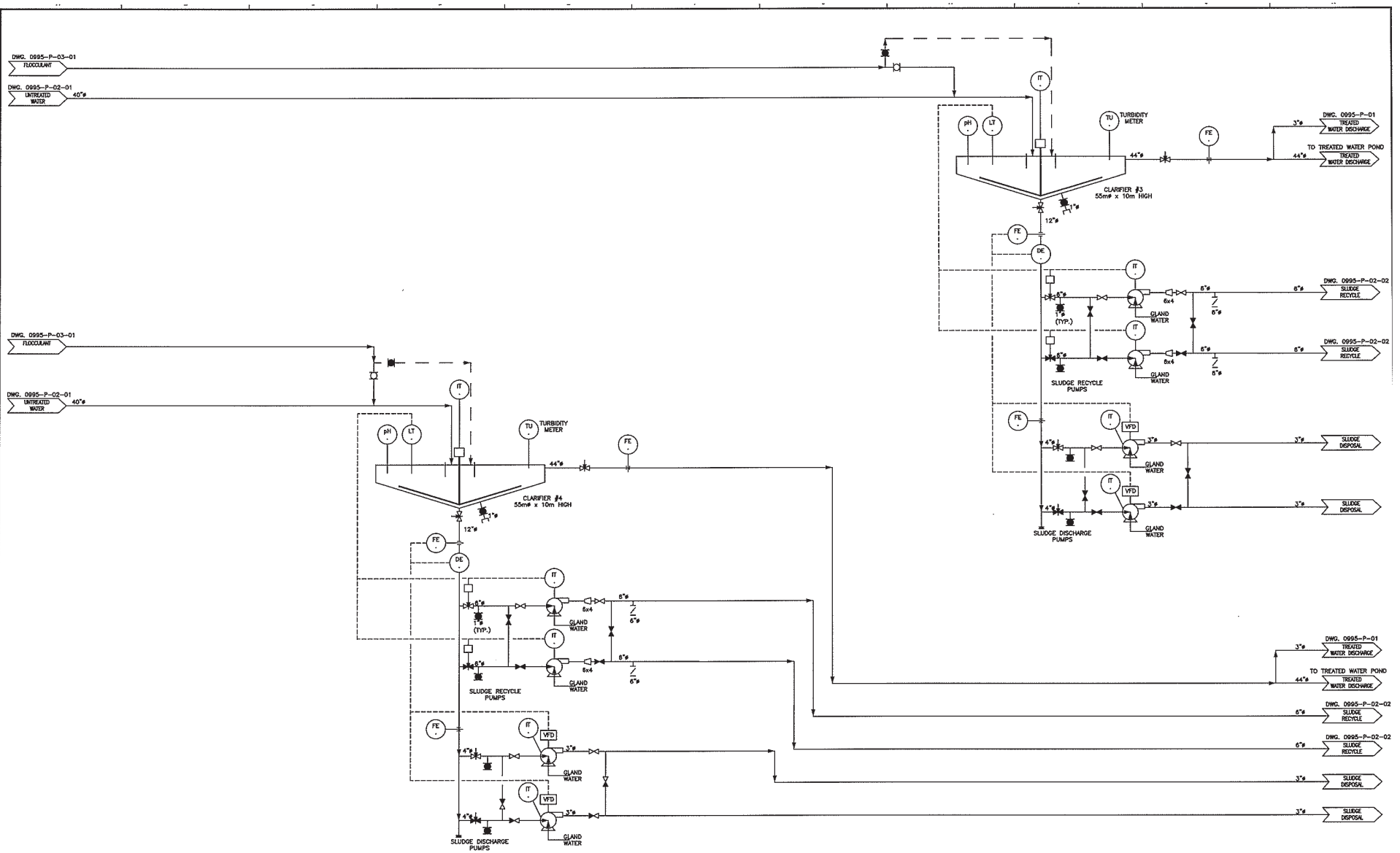
CLIENT APPROVAL By Date

Job. No. 0995 | Scale NTS

SGS CANADA INC. (FORMERLY CEMI)

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
PIPING & INSTRUMENTATION DIAGRAM
CLARIFIER #1 AND #2

Drawing No. 0995-P-03-01 Rev. A



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Approved By		
Checked By		
Drawn By	RJF	11/03/25
Designed By		

– PRELIMINARY –
NOT FOR CONSTRUCTION

CLIENT APPROVAL
By Date

Client Dwg. No.

Job. No. 0995

Scale NTS

SGS CANADA INC. (FORMERLY CEMI)

Title
SEABRIDGE GOLD – KSM PROJECT
HDS WATER TREATMENT PLANT
PIPING & INSTRUMENTATION DIAGRAM
CLARIFIER #3 AND #4

Drawing No. 0995-P-03-02 Rev. A

APPENDIX D

Capital Cost Estimate
Operating Cost Estimate
Major Equipment Quotations

Capital Cost Spreadsheet - Seabridge KSM Project

Item Name	Unit	Qty	Labour Hours	Labour Rate	Labour Cost	**Section Total Labour**	Material	**Section Material**	Equipment	**Section Equipment**	Total	**Section Total**
1 General Excavation						**420000**		**0**		**16000**		**436000**
General Excavation	m^3	1500	4200	100	420000				16000		436000	
2 Buildings - General						**0**		**0**		**0**		**0**
MCC Building	Each	1									0	
Office Building	Each	1									0	
Mechanical Structure	Each	1									0	
Floc Mixing Structure	Each	1									0	
3 Structures						**627500**		**1068500**		**0**		**1696000**
Concrete												
Concrete - General												
Concrete - General	m^3	400	3500	100	350000		195000		0		545000	
Equipment Grout	m^3	15	550	100	55000		7500		0		62500	
Steel												
Primary Steel Structures - General												
Beams and Columns for Platform	tonne	8	460	100	46000		145000		0		191000	
Steel Acessories												
Handrail (15 kg/m)	linear m	100	280	100	28000		95000		0		123000	
Floor Grating (53 kg/m^2)	m^2	60	320	100	32000		132000		0		164000	
Stairs	tonne	3	320	100	32000		245000		0		277000	
Ladders c/w cages	linear m	20	95	100	9500		122000		0		131500	
Painting	Lot	1	750	100	75000		127000		0		202000	

SGS

Capital Cost Spreadsheet - Seabridge KSM Project

Item Name	Unit	Qty	Labour Hours	Labour Rate	Labour Cost	Section Total Labour	Material	Section Material	Equipment	Section Equipment	Total	Section Total
4 Equipment						**7517533.182**		**42721210**		**45000**		**50266426.18**
Lime Prep System												
Lime Storage Silo/Slakers	Each	1	3800	100	380000		2820000		0		3200000	
Blowers												
High Pressure Air Blower	Each	3	320	100	96000		270000		0		366000	
Compressors												
Compressor for Instrument Air	Each	4	120	100	48000		78000		0		126000	
Grinding Mills												
Lime Slaking Unit	Each	1	400	100	40000		605000		0		645000	
Mixers and Agitators												
Lime/Sludge Mixing Agitator	Each	4	210	100	84000		154800		0		238800	
Lime Reactor No.1 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.2 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.3 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.4 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.5 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.6 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.7 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Reactor No.8 Agitator	Each	1	350	100	35000		123000		0		158000	
Lime Slurry Storage Agitator	Each	1	350	100	35000		59800		0		94800	
Lime Slurry Storage Agitator	Each	1	350	100	35000		59800		0		94800	
Pumps												
Lime Circulating Pump	Each	4	160	100	64000		93576		0		157576	
Lime Slaker Discharge Pump	Each	1	180	100	18000		14000				32000	
Plant Feed Pump	Each	3	180	100	54000		105000		0		159000	
Sludge Recycle Pump	Each	8	120	100	96000		311728		0		407728	
Sludge Discharge Pump	Each	8	120	100	96000		107152		0		203152	
Recycle Water Pump	Each	4	70	100	28000		20519		0		48519	
Plant Sump Pump	Each	4	60	100	24000		45268		0		69268	
Lime Area Sump Pump	Each	1	60	100	6000		11317					
Tanks												
Lime Reactor No.1 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.2 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.3 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.4 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.5 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.6 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.7 Tank	Each	1	450	100	45000		155000		0		200000	
Lime Reactor No.8 Tank	Each	1	450	100	45000		155000		0		200000	
Sludge/Lime Attrition Mixing Tank	Each	4	160	100	64000		300000		0		364000	
Lime Slurry Storage Tank	Each	2	230	100	46000		280000		0		326000	
Thickener												
Clarifier	Each	4	8400	100	3360000		33200000		0		36560000	
Earthworks	m3	36000	5509	100	2203533.182		1461250		45000		3709783.182	
Flocculant Package	Each	4	250	100	100000		500000		0		600000	
5 Electrical Services - General						**356000**		**3059000**		**0**		**3415000**
Electrical Light												
Exterior Lighting	m^2	640	430	100	43000		152000		0		195000	
Power Equipment - General												
Process Power for equipment	Lot	4	2300	100	230000		580000		0		810000	
Variable Frequency Drives	Each	12	90	100	9000		1176000		0		1185000	
Grounding Systems												
Allowance for Grounding Systems	Lot	1	90	100	9000		31000		0		40000	

Capital Cost Spreadsheet - Seabridge KSM Project

Item Name	Unit	Qty	Labour Hours	Labour Rate	Labour Cost	**Section Total Labour**	Material	**Section Material**	Equipment	**Section Equipment**	Total	**Section Total**
Control Systems - General												
Process Instrumentation c/w PLC Control	Lot	4	650	100	65000		1120000		0		1185000	
6 Piping Systems						**380000**		**2541000**		**21000**		**2942000**
Carbon Steel Piping												
Carbon Steel, 1", 2" and 3"	linear m	2800	750	100	75000		415000		0		490000	
PVC Piping Systems												
PVC Piping Systems	linear m	1600	750	100	75000		286000		0		361000	
HDPE Piping Systems												
HDPE Pipe - Plant - Estimated	linear m	2600	1500	100	150000		1080000		15000		1245000	
HDPE Pipe - Sludge Dispoal Pond - Estimated	linear m	3400	800	100	80000		760000		6000		846000	
Piping allowance is only made for 1000 meters to get the sludge to the tailings pond Additional piping will be extra for a sludge line that may be longer than 1000 meters												
7 Site Construction Management & Services						**1701000**		**171000**		**0**		**1847500**
Construction Manager												
Construction Manager	hours		10000	100	1000000		0		0		1000000	
1st Line Supervisors												
Civil	hours		800	100	80000		0		0		80000	
Mechanical	hours		900	100	90000		0		0		90000	
Electrical	hours		600	100	60000		0		0		60000	
Construction Management												
Planning & Scheduling	hours		250	100	25000		0		0		25000	
Cost Control	hours		400	100	40000		0		0		40000	
Field Accountant												
Site Accountant	hours		250	100	25000		0		0		25000	
Field Purchasing Agent												
Field Purchasing Agent	hours		300	100	30000		0		0		30000	
Secretarial & Clerical												
Secretarial & Clerical	hours		600	100	60000		0		0		60000	
Site Engineering												
Site Engineering	hours		300	100	30000		0		0		30000	
Surveying	hours		400	100	40000		0		0		40000	
Site Adiminstration												
Safety and First Aid	hours		350	100	35000		0		0		35000	
Material Testing Services												
Material Testing Services	Lot						15000				15000	
Field Expense Items												
Field Expense Items	Lot						20000				20000	
Subsitence												
Expenses	Lot						40000				40000	
Reproduction												
Reproduction	Lot						12000				12000	
Communications (Phone & Fax)												
Communications (Phone & Fax)	Month	8					8000				8000	
Temporary Facilities - General												
Temporary Facilities - General	Month	9					8000				8000	
Construction Offices & Trailers												
Construction Offices & Trailers	Month	12	250	100	25000		12000		0		37000	
Change & Lunch Room												
Change & Lunch Room	Month	9	80	100	8000		8000		0		16000	
First Aid												
First Aid	Month	9	80	100	8000		8000		0		16000	

Capital Cost Spreadsheet - Seabridge KSM Project

Item Name	Unit	Qty	Labour Hours	Labour Rate	Labour Cost	**Section Total Labour**	Material	**Section Material**	Equipment	**Section Equipment**	Total	**Section Total**
Toilets & Sanitary Facilities												
Toilets & Sanitary Facilities	Month	6	80	100	8000		2500		0		10500	
Furnishings												
Furnishings	Lot						2500				1000	
Temporary Utilities												
Temporary Utilities	Lot	9					15000				1000	
Water Supplies												
Water Supplies	Month	8					10000				1000	
Construction Support Services - General												
Scaffolding	Lot	1	620	100	62000		10000		0		72000	
Site Clean-up	hours	1	570	100	57000		0		0		57000	
Janitorial Services												
Janitorial Services	Month	12	450	40	18000		0		0		18000	

Capital Cost Spreadsheet - Seabridge KSM Project

Item Name	Unit	Qty	Labour Hours	Labour Rate	Labour Cost	Section Total Labour	Material	Section Material	Equipment	Section Equipment	Total	Section Total
8 Construction Equipment & Services						**630500**		**515000**		**223500**		**1369000**
Cranes, Lifting Equipment												
Manlift	hours	2600	250	90	22500		0		12500		35000	
Forklift	hours	2800	250	90	22500		0		15000		37500	
Hiab Truck	hours	4000	350	90	31500		0		35000		66500	
35 Ton Grove	hours	5000	350	90	31500		0		50000		81500	
60 Ton Grove	hours	5680	250	90	22500		0		56000		78500	
Welding Equipment, Compressor												
300A Gas Welder	hours	7200							20000		20000	
400A Gas Welder	hours	8000							35000		35000	
Small Tools												
Small Tools							75000				75000	
Overtime Allowance			5000	100	500000						500000	
Overtime Premium												
Construction Freight							440000				440000	
9 Engineering						**0**		**6100000**		**0**		**6100000**
Detailed Engineering including pilot plant study							6100000				6100000	
10 Start Up						**60000**		**480000**		**0**		**540000**
Commissioning												
Commissioning			500	120	60000						60000	
Safety Equipment												
Safety Equipment							30000				30000	
Chemicals												
Chemicals							200000				200000	
Spare Parts												
Spare Parts							250000				250000	

Sub-Total **68,611,926.18**

10% General Contractor's Profit **6861193**

Total **$US 75,473,119**

Reagent	Dose Rate (mg/L plant feed)	Average Plant Flow Rate (L/min)	Reagent Consumption (tonnes/year)	Reagent Unit Cost ($/tonne)	Reagent Cost ($/year)
Quicklime	260	199,920	27320.3	250	6,830,067
Flocculant	1.5	199,920	157.6	5500	866,893
				Sub-total:	**$8,466,656**

Item	Annual Consumption	Unit Cost ($)	Annual Cost ($/year)
Electric Power per plant	375 kW-hr (Installed motor load x 0.8 + Lighting)	$0.08/kW-hr	1,051,200
O & M Maintenance	15 hr/wk for Mechanical, 15 hr/wk for Instrument	$50/hr	78,000
O & M Labour	2 Operators, 12 hr/day, 7 days/week, 12 months/yr	$40/hr	322,560
O & M Labour	1 Supervisor, 8 hr/day, 5 days/week, 12 months/yr	$55/hr	105,600
		Sub-total:	**$1,557,360**

Total Annual Operating Cost: **$10,024,016** **per year**

Normalized: **$0.10** **per m^3**

February 09, 2010

Our reference: EQ Budget

Seabridge KSM Project c/o **SGS CEMI**
69 Antrim Avenue, Burnaby
BC V5J 4M5 Canada

Attention: Mr. Prab Bhatia (Prab.Bhatia@sgs.com)

REF: SEABRIDGE KSM TAILINGS FEASIBILITY STUDY
REQUEST FOR BUDGET QUOTATION - THICKENER

Dear Sirs,

Thank you for the above enquiry, we have reviewed the proposal for this project and submit our Budgetary Price Proposal (+/- 15%) as indicated below:

Item	Qty	Diameter (m)	Description	Tag No.
1	1	60	Tailings	Thickener: Rake Mechanism:

PROPOSAL DOCUMENTS

Our proposal has been divided into the following sections:

Section 1 : Financial Proposal
Section 2 : General Arrangement Drawings & Spare Parts List

REFERENCES

Delkor has won contracts totalling US$ 20 million for large thickeners in this region. The largest being for 2 x 100m Diameter High Rate Thickeners. These are the largest High Rate thickeners in South America, each rated to treat 65 000 tons per day.

Delkor has supplied a number of large thickeners, as shown in the attached reference list. Some of these references are:

Ambatovy - Madagascar	3 x 80m High Rate Grinding 2 x 80m + 4 x 55m High Rate CCD – Ni Leach (in fabrication)
Cerro de Maimon – Rep. Dominicana	1x18m Paste – Cu, Zn Tails 1x23m High Rate & 4 x 10,7m High Rate CCD – Cu, Zn leach
Volcan - Peru	4 x 27m High Rate CCD – Au, Ag leach (in fabrication)
Tiberon – Vietnam	1x55m Grinding, 3x6 & 24m Concentrate – 1x6m Neutralization
Seppon – Thailand	28 and 34m High Rate Thickeners – Cu Acid Leach
MVC - Rancagua – Chile	2x100m High Rate on Cu Float Tails
Carmen de Andacollo - Chile	1 x 70m High Rate – Cu Float Tails (in fabrication)
SPCC - Toquepala – Peru	99m High Density Thickener - 64% solids on Cu Tails 43m High Density - 63% solids on Cu Tails
Chelopech - Bulgaria	7x Thickeners – Concentrate and Acid Leach CCD – Cu, Zn
San Bartolomé – Bolivia	3x23 m CCD Thickeners – Leach Residue Ag
Kittila – Finland	1x12 m, 2x21m CCD Thickeners – Au (in fabrication) 2x12 m Acidulation & Concentrate, 1 x 16 m Tail Thk Au
BHP - Antamina – Peru	18, 23, 25 & 35m Clarifier & High Rate Thickeners Float Conc.
CMP – Chile	1x62m High Rate – Iron Ore Tailings
Buzwagi – Tanzania	1x10.7m Concentrate – 1 x 39m Pre-Leach – 1 x 39 Tailings
Cerro Verde – Perú	12, 15, 20 & 30m Clarifier, Cu, Cu Mo Concentrate
BHP – Escondida - Chile	2x43m Conventional Thickeners - Cu Conc
Cerro Vanguardia - Argentina	3 x 35m + 2 x 25m High Rate - Gold Leach CCD
Manantial Espejo - Argentina	1x 8m Concentrate, 4 x 16m CCD, 1 x 16m Cyanide Recovery
Shougang - Peru	1x65m High Rate – Iron Ore Tailings

DELKOR HIGH RATE THICKENERS

Delkor has perhaps the longest track record of any supplier of High Rate Thickeners, with its first units being supplied in 1975. At this stage patents belonging to the Amstar Corporation covered the High Rate design and Delkor was one of the licensees of this technology. In the late 1980's the patents expired and many other suppliers entered the markets.

Delkor has a large data base of design information and has been successful in introducing it's technological innovation to the industry. Examples of this are

- World's first High Rate Auto-dilution systems installed in 1983.
- Design of Box frame drive head that allows overhung gearbox mounting without flexing of the frame to ensure good pinion / main gear tooth contact to occur.
- Installation of Delkor Auto-dilution combined with a Froth Recovery system, in 2000, for float concentrates.

- Supply of Hydraulic drives with variable speed, soft start and reverse direction facilities.

All tanks are designed in accordance with UBC and API codes and consider the specific seismic conditions of the region. Modern design techniques include modelling and finite element analysis of all components including the tank design.

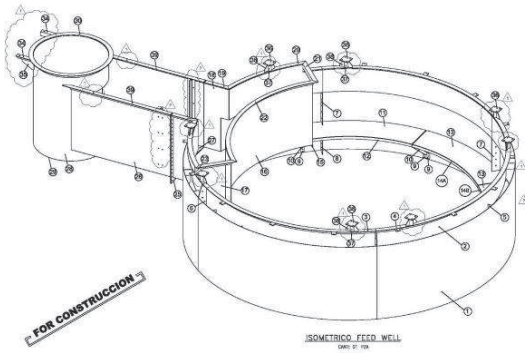
Designs include

- Free-standing Thickener tanks up to 43m for UBC Zone 4 conditions.
- Low Profile, truss and Thixotropic Rake Arms. The Thixo rake arm ensures that the main arm is kept at a distance from the rake blades and high viscosity compaction zone.
- Drive systems up to 8 000 000 Nm. These can be Electric or Hydraulic, although Hydraulic is preferred for the larger drive systems.
- Rakes and Torque Cages up to 100m Diameter

GENERAL ASPECTS OF DELKOR THICKENERS DESIGN

Delkor South America has a wealth of experience in all type of thickeners designs and has supplied more than 50 thickeners in the last years. In this aspect Delkor is perhaps the largest company in the region to specialize in solid-liquid separation. We are considering the followings design aspects for all applications.

MECHANISM: The design is a Delkor High Rate Mechanism including a Feedpipe, drop box, stilling launder to maximize air release, feedwell with autodilution, horizontal baffles to aid mixing and deflector plate to ensure the correct horizontal slurry velocities into the thickener tank. Flocculant dosing manifold and pipes are included to allow dosing along the feed pipe, at the feed well surface and also at the autodilution / feed interface. The schematic of the Drop Box / Feedwell showed in the picture to the right illustrates the special considerations Delkor considers necessary for optimum thickener performance. The rakes and blades are a truss design with a low profile. Raking capacity is designed to minimize torque during normal operation.



DELKOR COLUMN JACK DRIVE HEAD

The principle behind this design is that the Ring Gear & Raceway bearings should never have to be serviced. The Main service component is the gearbox, which weight 500 kg and can be replaced in a matter of hours. Key design considerations in Delkor drives are: -

- Stiffened Drive Frame prevents gearboxes rotating away from gear tooth maintaining maximum tooth on tooth contact, which is an important feature in ensuring > 25 year component life.
- 2.8m and 3.1m PCD Ring Gears to minimise forces transferred to the Pinion tooth. This is designed for an infinite fatigue life and a 35 years service life.
- Pinion gearbox with DOUBLE BEARINGS on the output. This caters for the High Radial loads (pushing the gearbox away from the gear teeth) when operating at near maximum

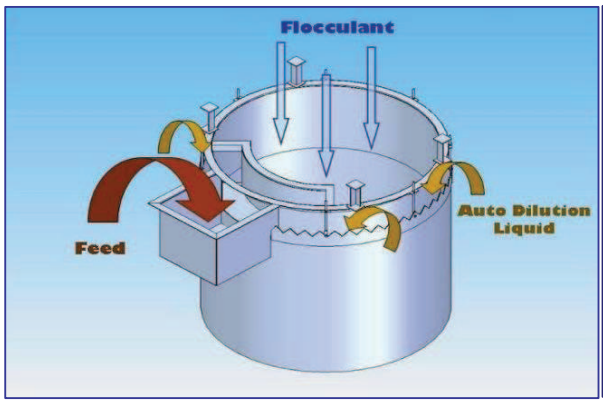
torque or starting bogged rakes. Gearboxes can be made smaller and lighter, and still comply with the Maximum Operating Torque requirements, but bearings would fail prematurely and service life would reduce to <60 000hrs.

Delkor standard is for Hydraulic drives, as they provide the best feedback on torque loads.

DELKOR AUTO DILUTION SYSTEM & FLOCC SAVINGS

The original Delkor Autodilution system first installed in 1984 operated on the bases of density differential in the Feedwell and tank. Since that data Delkor has introduced its auto-dilution design to use two concentric Feedwells as described in the Technical Description in Section 3. This design: - The Delkor Feedwell has proven to save flocculant in industrial application. The Delkor system saves a substantial amount of flocculant (up to 40%) due to following considerations:

- Allows dilution water to be introduced around the full perimeter of the feedwell. With other designs, water is drawn from specific areas within the thickener tank, which generates currents within the tank and channelling of solution. Thus higher rise rates are seen, which hinder particle settling. The amount of liquid introduced to the Feedwell is substantially higher compared with other existing design.
- Autodilution is also improved due to dynamic considerations within the Feedwell.
- The Delkor Feedwell operation is improved by the meaning of deflector plates and baffles designed to improve the mix within the flocculant and the suspension of solids. The system has been proven in Feedwell up to 13m diameter with optimum results.
- A Flocculant Matrix Pipe Ring is fitted into the Feedwell,. The flocculant is introduced at different levels into the diluted flow and as such it's effectiveness is optimized. The dosing points are optimized based on information collected from industrial operations.
- Has no moving parts that can jam up and require maintenance.



The Delkor Dilution Ring design generates a greater volume of dilution liquid compared with any other existing alternative, minimizing the Flocculant consumption and the dilution does not depend on the feed flow fluctuation as in the adductor type of dilution systems.

Operational Experiences with Delkor 99m Thickeners - SPCC Toquepala

SPCC Toquepala has a mix of three thickener types from three suppliers, the summary of their operating experience was that the Delkor design gave:-

- The most consistent water recovery of any of thickeners, primarily resulting from the flocculation creating a stable sludge bed and clear overflow.
- Most consistent underflow density.
- Generally lower flocculant consumption.

Operating Data - April 2004 - SPCC Toquepala

High Thickener Diameter	43m Delkor	35m Other Supplier
Unit Area Capacity	13.78 tpd/m^2	10.39 tpd/m^2
Flocculant Consumption	+- 3.7 g/t	+-6.5 g/t
Dilution system	Delkor Feedwell Concentric Ring	Feedwell Panels +Overflow Weirs
Dilution Feed Pulp to	12 - 15%	15 - 20%
Rise Rate - $m^3/hr.m^2$	Max 3.88	1.80
Rise Rate - $m^3/hr.m^2$ - 0.8 s.f.	4.85	2.25

Right – Flocculant dosing ring with upper dosing point adding flocculant into diluent. Note flocculation below surface.

Left - Outer concentric ring submerged below the supernatant. Liquid is flowing into feed well down this gap. Note flocculated material inside the feedwell.

As benefits were seen in using auto dilution to reduce flocc usage, Toquepala took the decision to convert some old 99m Dorr Conventional thickeners to use an auto-dilution system. After evaluation of the options, SPCC took the decision to use the Delkor design on the basis of the operating data Details are:-

- Flocc usage on the old conventional design was 5 to 7 g/ton at a feed rate of 12 000 t/day
- The cost of conversion to a High Rate design, including a larger drive and reconfiguring the raking profile was based on a projected flocc consumption of 3g/ton at a feed rate of 24 000 t/day
- The actual installation, started in August 2005, runs at 1 g/ton at 24 000 t/day. SPCC is considering increasing the capacity of the thickener, but current restrictions in the old feed pipe and distributor is delaying this increase.
- Operating torque averages 450 KNm with underflow densities of 62%. At 64% underflow operating torque increases to 1560 KNm.

MINERA ESCONDIDA: In 2001 Delkor supplied two (2) Cu Concentrate Thickeners of 43m diameter for Fase IV. These thickeners were designed under concept of conventional with autodilution. Each one has a capacity of 160tph with 3gpt of flocc. When one of these Cu Concentrate thickeners is out of service for maintenance, the other thickener has a

capacity of 320tph with 6gpt of flocc consumption.

MINERA VALLE CENTRAL - CHILE: In 2006 Delkor supplied two (2) Cu Tailings Thickener of 100m diameter with 4 000 000 Nm COT drive. These thickeners were designed under concept of high rate and the tailing thickeners for Quellaveco project are based in this design.

- 65 000 metric tons per day – design
- 6 g/ton flocculant consumption
- Operating Torque 15% of maximum cut out torque = 4 000 KNm
- 58% solids in the underflow
- Feed density to the thickeners is 40% and after auto-dilution the value drops to <15%

SOCIEDAD MINERA CERRO VERDE - PERU:

In 2007 Delkor supplied thickeners for Bulk Cu-Mo Concentrate, Cu Concentrate and Mo Concentrate of 30-20-15m diameter. These thickeners were designed under concept of conventional with auto dilution and the concentrate thickeners for with the facility for Froth Recovery

Cerro Verde – Concentrate Thickeners

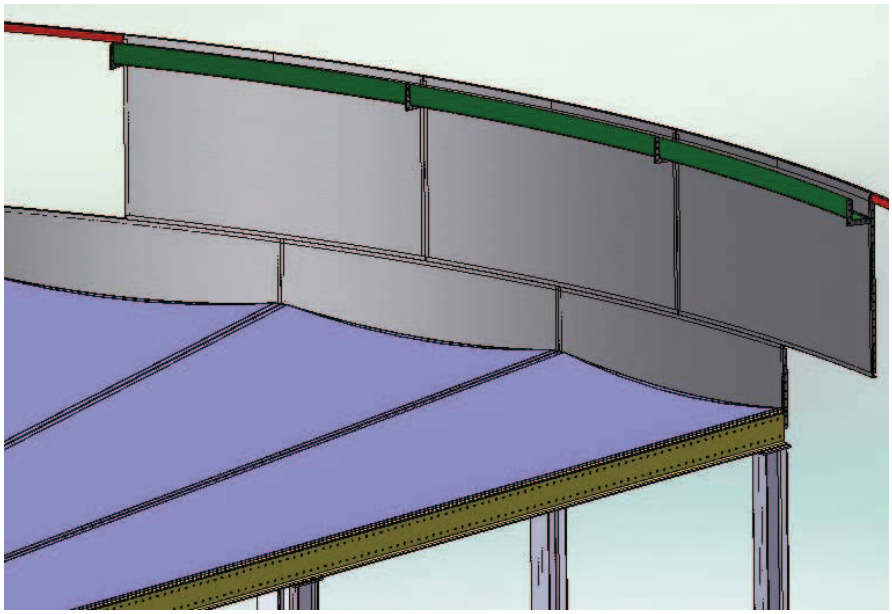
BOLTED TANK DESIGN

Delkor's base proposal is for a standard tank that is shipped in pieces for assembly and welding on site. This is standard practice and if the site has adequate labour force the quickest and simplest supply option. The disadvantage of this option is that as site welding is required, the tank plates cannot be completely lined. This means that site rubber lining will be required.

Alternatively Delkor is offering its Bolted Tank design, which would mean that:-

- Tank is preassembled and bolted up in the workshop.
- Sections are marked up and sent for rubber lining.
- The rubber sections are then packed and shipped to site for assembly.
- Some site rubber repair work should be considered as part of the bolt up process.

Schematic 23m Bolted Tank



HYDRAULIC & ELECTRIC DRIVES

Delkor offers both hydraulic and electric drives. Hydraulic drives are preferred for higher torques as they provide:

- A softer start.
- A reverse drive and variable speed function; a variable speed inverter can be added to electric drives.
- Accurate torque measurement in that hydraulic operating pressure is a direct measurement of torque. Electric drives mechanical or power measuring devices can be subject to error.
- The hydraulic lift is faster than the electric screw and is easier to lift in manual mode, as the lift distance per pump stroke is greater than the lift distance per revolution of the electric screw lift. Delkor lifting and lowering systems are designed to not only lift the rakes 600mm, but also lower the rakes into the mud. On smaller thickeners the rake lift height is 300mm.
- The Delkor control system forces the rakes into the mud in a controlled manner that monitors the torque during the rake lowering. The Delkor philosophy is that the best position for the

rakes is the lowered position. For this reason lifting occurs at 60% of maximum torque and motor cut out is at 100% of the rated torque. Delkor drives are rated to run continuously at 100% and maintain good service life and safety factors.

Delkor can offer hydraulic drives for all the applications if requested.

DELKOR AROUND THE WORLD

- Delkor has active for more than 35 years involving more than 60 countries around the world.
- Delkor also has permanent personnel located in offices around the world, including offices in China, India and Australia.
- Delkor worldwide comprises 270 staff comprising mainly Chemical, Metallurgical and Mechanical Engineers.
- Delkor Americas is specifically dedicated to Solid-Liquid separation with 70 staff which includes 14 process engineers, 30 mechanical engineers and associated QA and project engineering support. We have been active in the Americas since 1980, with our main offices located in Santiago, Chile and Vancouver, BC.

Should you wish to discuss this selection in more detail, please do not hesitate to contact us.

Yours faithfully,

Trevor Bergfeldt
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Joey Gregg De Guzman
Process Engineer
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CONFIDENTIAL PROPOSAL DOCUMENT

The contents of this document are of substantial value to Delkor Inc. and it is presented to **Seabridge KSM Project c/o SGS CEMI** subject to the conditions that the copyright therein remains vested in Delkor Inc.

The technical descriptions, data and drawing must not be reproduced in any form or communicated to any third party without written authority from Delkor Inc., and the proposals must only be used **Seabridge KSM Project c/o SGS CEMI** and its employees for the sole purpose of assessing the merits of the said proposal, and are to be returned to Delkor Inc. in the event of the data ceasing to be of interest **Seabridge KSM Project c/o SGS CEMI**.

February 09, 2010

DELKOR INC.

SECTION I

FINANCIAL PROPOSAL

FINANCIAL PROPOSAL

1 Tailings Thickener : 1 x 60m

1.1 Thickener Drive - Column Jack SR 280 – 5 CJ

Model SR 280 – 5 CJ

- Delkor Column Jack Drive. Drive Frame manufactured in ASTM A36 to allow overhang mounting of gearboxes. The Frame is suitably stiffened to ensure true pinion / gear tooth contact and prevent distortion.
- 2800mm diameter Ring Gear designed for 2 500 000 Nm Maximum Operating Torque (MOT) + 5 Planetary Gearboxes and Pinions to deliver 2 500 000 Nm MOT – with option for the 6th pinion to be installed.
- Hydraulic Power Pack + 1 x hydraulic motor to deliver 2 500 000 Nm + 600mm Rake Lift and lowering system with electric motors
- Rake Lift Indicator – Ultrasonic with 4-20mA signal
- Torque indicator with 4-20 mA output signal.
- Interface Level Detector – Floating Mud Ball with 4-20mA signal Floating Ball Interface Detector with 4-20 mA output signal
- Rake Lift Indicator – Ultrasonic with 4-20mA signal
- Control Panel NEMA 4x with PLC by Others

Value (Ex Works - Chile) **US$ 350 600.00**

1.2 Thickener Mechanism

- Half span bridge, with monorail beam (excluding hoist) and through access walkway (steel platform grating) and handrailings for access from one side.
- Feed Pipe with spool pieces to allow rotation of feed pipe plus stilling drop box and de-aeration launder.
- Flocc Dose Matrix System. Flocculant Pipe Dosing Ring, manifold and valves.
- High Rate Feedwell with auto dilution ring and deflector plate. Includes feed well inlet distributor and internal launders and baffles.
- Torque Cage + Truss design rakes with extended blades in the centre section, 2 long + 2 short with detachable blades and trench scraper; all rated to operate up 3 750 000 Nm.
- Fabricated in ASTM A-36 and 6mm natural rubber lining in feed pipe, drop box and entrance of feed well.

Value (Ex Works – China / India) **US$ 290 450.00**

1.3 Accessories to Thickener Mechanism

- Hollow Centre Column
- Overflow Weir V-Notch plates.
- Underflow Puddle Pipes + 6mm Rubber Lining
- Fabricated in ASTM A-36

Value (Ex Works – China / India) **US$ 34 650.00**

Total Supply (Ex – Works Chile / China / India)	**US$**	**675 700.00**
1 x 60m Thickener Drive & Mechanism – Tailings		

ADDITIONAL EXPENSES

1	Spare Parts for Start up (Ex Works-Chile) for SR 280	**US$**	**8 390.00**
2	Spare Parts for 2-years operation (Ex Works- Chile) for SR 280	**US$**	**11 440.00**
3	Spare Parts - Capital (Ex Works-Chile) for SR 280	**US$**	**37 980.00**
4	Supply of Documents and Drawings and Operating Manuals (English & French)	**US$**	**TBC**
5	Supply and Supervision of Quality Control Docs, Data Books and Material Tests	**US$**	**TBC**
6	Packing for 60m Tailings THK	**US$**	**15 800.00**
7	Field Services Representatives during Mechanical Commissioning and Start Up – 15 days @ US$ 800 per day (Two Visits with travel and lodging costs reimbursable)	**US$**	**12 000.00**
8	Field Services Representatives during Process & Instrumentation Comissioning – 5 days @ US$ 800 per day (Two Engineers)	**US$**	**8 000.00**
9	Training – can be during Start Up – 3 days @ US$ 800 per day	**US$**	**2 400.00**

Kindly note that many of these additional expenses would normally be included in the thickener price. The reason they have been identified separately as they would apply to all options of thickeners.

OPTIONAL ITEMS

10	Hollow Centre Column from bridge level to tunnel floor level (in place of concrete) with internal access ladder to allow access from tunnel to bridge. Including anchor bolts, cage guides and internal access ladders.	**TBA**

Scope of supply considers review in Delkor offices. Costs for travel and accommodation for design review would be invoiced at cost and at a rate of US$ 800 per day per person.

DEFINITIONS

"Supply" shall mean Design, Procurement, Manufacturing, Expediting, Inspection and Delivery on an ex works basis of equipment as specified and defined in the technical specification.

"Supervision of Installation" shall mean the provision of a Field Service Engineer for the assembly, of the equipment quoted, into foundations and/or support structure supplied by others. Should the supervision period be extended for reasons beyond Delkor's control, the extra costs in terms of travelling and accommodation will be charged at cost and manpower at USD 800,00 per man-day (8 h/day).

"Supervision of Installation, Start up / Mechanical Commissioning" shall mean the provision of a Field Service Engineer, on an ex works basis for the supervision of work by others. Time, travel and accommodation costs will be invoiced from ex-works Field Service point of delivery. Supervision services are provided on receipt of the Delkor check lists duly revised and signed off by the client's site project team, verifying that all services and outstanding items are in order. In the event that items on the check lists are not completed, it will be considered as Supervisor standing time and the extra costs in terms of man-hours, travelling and accommodation will be charged at cost and manpower at USD 800.00 per man-day (10 h/day). Should the supervision period be extended for reasons beyond Delkor's control, the extra costs in terms of travelling and accommodation will be charged at cost and manpower at USD 800.00 per man-day (10 h/day).

PAINT SPECIFICATION

ITEMS	PAINT SPECIFICATION
Mechanism & Drive	
Thickener Bridge Assembly Handrailing Floor Grating Feed Well Hanger Bracket Drive Assembly All Non – Submerged Parts Total thickness: 150 micron	Sandblasted to Grade SSPC-SP5 Primer Coat: Epoxy Primer Polyamide. Thickness: 2 mils – 50 microns Sherwin Williams – Iponlac 331 or equivalent Intermediate Coat: Epoxy Primer Polyamide. Thickness: 2 mils – 50 microns Sherwin Williams – Iponlac 331 or equivalent Final Coat: Epoxy Polyamide Paint. Thickness: 2 mils – 50 microns Sherwin Williams – Iponlac 331 or equivalent
Thickener Submerged Parts (Rakes, Feed Well)	Sand Blast to Grade SSPC-SP5 Coal Tar Epoxy to 200 microns

COMMERCIAL CONDITIONS

Validity:	Prices are valid from time of quotation to date of drawing approval or 60 days, whichever is the sooner.
Terms of Payment:	10% @ 0 weeks, Net 30 days, From Order 5% with submission of GA Drawings for approval by client 10% with receipt of instruction to proceed to fabrication 3 x 25% progress payments in accordance with advance of fabrication
Other conditions:	According to our "Standard Condition of Contract". (Attached)

EXCLUSIONS (UNLESS SPECIFIED ABOVE)

- Civil, cast in frames + foundation + mounting bolts
- Connecting up of electric's, MCC or cabling
- External Piping & connections
- Filling of Lubricants
- Travel Expenses & Site Catering
- Off loading on site & cranage
- Site Installation labour
- Final and touch up painting on site
- Power, water and air on site for erection
- Inspection by independent authorities

BATTERY LIMITS (UNLESS SPECIFIED ABOVE)

- Feed
- Flocculent
- Underflow
- Overflow
- Electrical Connections
- Entrance to Feed Pipe not more than 0,3m from edge of Tank
- Entrance to Flocculant Dose Pipe not more than 1m from edge to Tank
- Outlet flange on underflow cone/trench
- Outlet flange on overflow launder
- Connection boxes on Motors and Control Panels

- Instrumentation
- Instrument connection boxes
- Other Services
- Connection point for the service item, e.g. flange on Control Valves

DELIVERY

♦ GA and P&ID Drawings for approval staggered delivery	4 weeks ARO
♦ Allowance for Drawing Review	2 weeks
♦ Certified Drawings	4 weeks ARAD
♦ Structural Equipment – Workshop Completion	48 weeks ARAD
♦ Operating Manuals	40 weeks ARAD
♦ Total Delivery Ex Works	54 weeks ARO

Note:
ARO = After Receipt of Order
ARAD = After Receipt of Approved Drawings
Deliveries can be accelerated if the project programme requires.

QUALITY AND PERFORMANCE WARRANTY

Delkor guarantees that all the equipment of its manufacture are free from defects in materials and workmanship for a period of 18 months from delivery Ex Work or 12 months from the start up, whichever comes first. This is the full extent of the guarantee. This warranty is valid only on equipments that are operating, with maintenance and service according to the manuals that Delkor provides and on equipments that have not been physically damaged and used under abnormal conditions of operation, beyond that the operation agreed with this type of equipments.
Other warranties will be discussed in the case of being awarded.
Any defect must be written and sent to Delkor within 3 days to see if they are inside of the warranty. However, any damage to other equipment, any loss of production or income or payment, or injury to persons or property caused by failure of the unit, are not covered by this warranty.
Yours truly,

Trevor Bergfeldt
Process & Sales Manager
DELKOR AMERICAS
✉trevor.bergfeldt@delkorglobal.com
www.delkorglobal.com

STANDARD CONDITIONS OF CONTRACT

The following are standard conditions of contract, which apply to contracts between Delkor Inc (DELKOR) and the purchaser (CLIENT).

- STATEMENT OF COMPLIANCE

  The equipment and services included in this offer are generally accordance with the specifications, drawings, terms and conditions stipulated by the client, with the exceptions listed in the Financial and Technical sections of this proposal.

- TERMS OF PAYMENT

  The prices quoted allow for settlement within 30 days of invoice date, with part payment for part delivery. Outstanding payments would be subject to interest charges, levied at the accepted bank lending rates + 1.5%. Unless otherwise stated, payments to be guaranteed with a Letter of Credit drawn by an recognised international bank.

- SHIPPING POINTS

  Notwithstanding the information submitted in the Financial Proposal, Delkor reserves the right to reasonably review the option of partial shipments and of different origins of shipment for the equipment so that they suit the client's delivery requirements at the time of contract. These details would be presented within a reasonable time period after contract award.

- APPROVED DRAWINGS

  Our tendered price allows for Certified General Arrangement Drawings to be issued for the equipment proposed with foundation loads and the relevant Process Flow-Sheet, showing battery limits and instruments.

  Should the client require additional drawings or specifications these will be invoiced at normal rates.

- MECHANICAL GUARANTEE

  All equipment covered in this tender is guaranteed against defective workmanship and materials for a period of 12 months from commissioning or 18 months after delivery, whichever is sooner.

  Normal wear and tear are excluded from this guarantee. Cloths and other items subject to wear cannot be guaranteed beyond commissioning due to reliance on operator care.

- QUALITY ASSURANCE

  Our tendered price allows for our standard Quality Assurance Plan, which applies to Delkor and our main sub-contractors. Should the client wish to implement a Q.A. Plan other than our standard we will be pleased to discuss the implications related to delivery and final price.

- FORCE MAJEURE

  Delkor shall not be liable for any penalties, loss or damages resulting from delay due to causes beyond the reasonable control of Delkor, which shall include but not be limited to any of the following events; Acts of God, War, Government acts or regulations, strikes, blockade, sabotage, civil commotion or riot, landslide, windstorm, flood, earthquake, fire or delays in shipping beyond the control of Delkor. Also shortage of materials or components from Vendors or subcontractors will be accepted as reasonably beyond Supplier's control, if they were originated by causes qualified as Force Majeure.

  In addition Delkor shall not be liable for any time lost caused by delays in approval of drawings and other documents by Client.

- COPYRIGHT & OWNERSHIP

  Notwithstanding anything to the contrary anywhere contained copyright and ownership thereof remains the property of DELKOR South America Ltda.

- MAXIMUM DAMAGES AND TOTAL LIABILITY

  Delkor, under no circumstances, will be liable for any consequential damage or losses nor for any damages arising from the client's failure to observe Delkor's recommendations and instructions. Delkor will only accept damages or penalties related to poor performance to the maximum of 5% of the supply value of the order, at a rate of 0.5% per week of delay. This would only be applicable on delays seen on the final end date of the total contract, and assumes clear access at all times to the site.

- TAXES & DUTIES

  Any surcharges, Taxes, IVA or importation duties levied during the contract period are excluded from Delkor´s supply and unless otherwise agreed, these charges are to be paid by client.

TERMS FOR SUPERVISORY ENGINEERS

1. DEFINITIONS

   "Purchaser" shall mean the person or firm for whom the Engineer's services are made available.

   "Supplier" shall mean Delkor Inc. or any associated company.

   "Engineer" shall mean the man or men whose services are made available to the Purchaser under the Contract.

   "Contract" shall mean any agreement between the Purchaser and the Supplier for, or which includes for, the services of the Engineer.

2. ACCOMMODATION

   First-class hotel or the equivalent furnished accommodation with the provision of meals, heating, lighting, bath or shower shall be provided by the Purchaser. If the accommodation is not at the site where the Engineer is working the Purchaser shall provide free transport from the accommodation to the site.

3. EQUPIMENT

   All instruments, tools and equipment except any stated in the Contract to be supplied by the Supplier shall be supplied by the Purchaser. Such instruments, tools and equipment shall be sufficient in quality and quantity for the Engineer to carry out the duty for which he is sent.

4. EXPENSES

   The Purchaser shall pay to the Supplier the sum laid down in the Contract for living expenses.

5. INSURANCE

   The Purchaser shall insure the Contract Works against all damages that may be caused by the act or omission of the Engineer and shall cause the interest of the Supplier and that of the Engineer to be added to the policy of insurance. The Purchaser shall also insure the Engineer and the Supplier against claims by any third party. Except so far as insurance is taken out and maintained as aforesaid neither the Engineer nor Supplier shall have any liability to the Purchaser for any act or omission of the Engineer.

6. FEE

   The Purchaser shall pay the daily rate laid down in the Contract for each day that the service of the Engineer is made available to him. The Engineer will be available to the Purchaser for up to 48 hours per 6 working day period. One working day shall be a holiday in any period of 7 working days. The daily rate shall be paid from and including the day of the Engineer's departure from Santiago up to and including the day of his return back in Santiago. It shall also be payable during those holidays to which Engineer is entitled under Clause 9.

7. OVERTIME

   All hours worked in excess of 48 hours per week (or pro rata) will be charged at a rate of 1.5 times the basic hourly rate.

8. TIMESHEETS

   The Purchaser shall sign a timesheet each week certifying the days and the total working hours for which the Engineer's services were made available to him in that week. The payment of the fee in clause 6 and the overtime in clause 7 shall be calculated form the timesheet.

9. MECHANICAL GUARANTEE

   The Engineer shall be entitled to all public holidays observed at the site.

10. MEDICAL ATTENTION

    The Purchaser shall provide free medical and dental treatment for the Engineer and, if necessary, free accommodation in hospital.

11. EXPENSES

    The Purchaser shall repay the following expenses including a 10% uplift to cover administration costs to the Supplier. Rail, sea and air travel, the cost of any other transport to and from site and the cost of transport of baggage to an from size.

    All reasonable living and out-of –pocket expenses incurred whilst travelling to and from site.

    The cost of obtaining visas.
    The cost of insuring the Engineer against death and accident and of insuring his belongings.
    The cost of special clothing of the Engineer.

12. TERMS OF PAYMENT

    The fee specified in clause6, overtime in clause 7and expenses in clause 11 shall be paid in the agreed currency monthly against Supplier's invoices. If any payment is more than 30 days overdue, the Supplier may remove the Engineer from site. If the Engineer is removed, the cost of his removal and subsequent return to site shall be paid or be recoverable from the Purchase.

WARRANTY TERMS

Equipment or parts manufactured by Delkor Inc. ("SELLER"), is backed by the following warranty:

Solely for the benefit of the original user, SELLER warrants that all new equipment and parts manufactured by it and provided to the original user (collectively, "Products") to be free from defects in material and workmanship for one year from the date of shipment of each Product by SELLER (the "Warranty Period").

If any of SELLER'S Products fail to comply with the foregoing warranty, SELLER shall do one of the following:

- repair or replace free of charge to original user, EX WORKS SELLER'S factories or other location that SELLER designates, any Product or parts thereof returned to SELLER, which examination shall show to have failed under normal use and service by the original user within the Warranty Period; provided, that if it would be impracticable for the Product or part thereof to be returned to SELLER, SELLER will send a representative to the original user's job site to inspect the Product. If it is determined after inspection that SELLER is liable under this warranty to repair or replace the Product or part thereof, SELLER shall bear the cost of returning the Product to SELLER for inspection or sending its representative to the job site; however, if it is determined after inspection that SELLER is not liable under this warranty, SELLER'S customer or the original user shall pay those costs; or
- at SELLER'S sole option, refund all or part of the purchase price allocable to the defective Product, or parts thereof.

For SELLER to be liable with respect to this warranty, the original user must make its claims with respect to this warranty in writing no later than 30 days after the date the original user discovers the basis for its warranty claim and in no event more than 30 days after the expiration of the Warranty Period.

In addition to any other limitation or disclaimer with respect to this warranty, SELLER shall have no liability, with respect to any of the following:

a) failure of the Products, or damages to them, due to original user's negligence or wilful misconduct, abuse or improper storage, installation, application or maintenance (as specified in any manuals or written instructions that SELLER provides to the purchaser);

b) any Products that have been altered or repaired in any way without SELLER'S prior written authorization;

c) any Products damaged while in transit or otherwise by accident;

d) decomposition of Products by chemical action, erosion or corrosion or wear to Products caused by abrasive materials;

or

e) claims with respect to parts that are consumable and normally replaced during maintenance such as filter media, filter drainage belts and the like, except where such parts are not performing to SELLER'S estimate of normal service life, in which case, SELLER shall only be liable for the pro rata cost of replacement of those parts based on SELLER'S estimate of what the remaining service life of those parts should have been; provided, that failure of those parts did not result from any of the matters listed in clauses (i) through (iv) above.

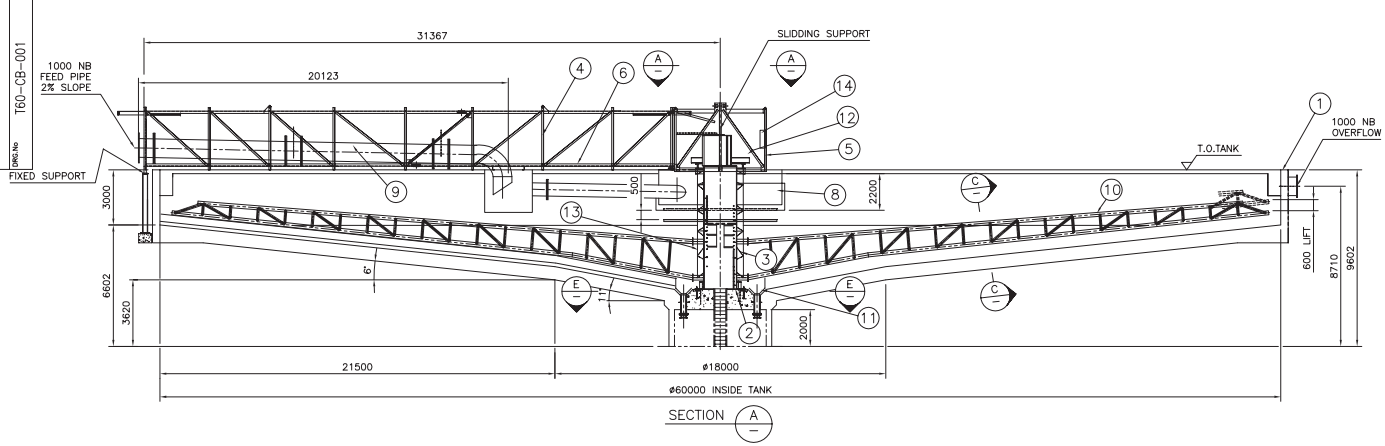
With regard to parts, equipment, accessories or components furnished by third-party suppliers, SELLER'S liability shall be limited solely to the assignment of any third-party supplier's warranties available to the original user with respect thereto. It is the responsibility of SELLER'S customer or the original user to hire or retain engineers and other experts to determine the suitability of the Product for the original user's use. SELLER shall not be liable for the design or suitability of any Products for any particular use (except to the extent that a warranty or guarantee with respect to such a matter is expressly set forth in a written document executed by an authorized representative of SELLER). In making interpretations of data, SELLER'S employees will give its customer the benefit of their reasonable professional judgment as to the correct interpretation, but SELLER cannot and does not guarantee the accuracy or correctness of these terpretations (except to the extent that a warranty or guarantee with respect to such a matter is expressly set forth in a written document executed by an authorized representative of SELLER).

SELLER'S quoted price for the Products is based upon this warranty. Any increase in warranty obligation may be subject to an increase in price.

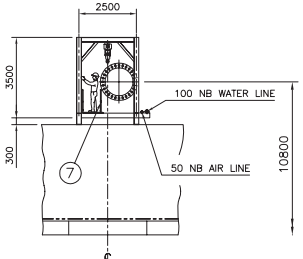
THE PARTIES AGREE THAT ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, WHETHER WRITTEN, ORAL OR STATUTORY, ARE EXCLUDED TO THE FULLEST EXTENT PERMISSIBLE BY LAW. ALL WARRANTIES AND OBLIGATIONS OF SELLER SHALL TERMINATE IF: (1) SELLER'S CUSTOMER OR ORIGINAL USER FAILS TO PERFORM ITS OBLIGATIONS UNDER THIS OR ANY OTHER AGREEMENT BETWEEN THE PARTIES; OR (2) SELLER'S CUSTOMER AND THE ORIGINAL USER FAIL TO PAY ANY CHARGES OTHERWISE DUE SELLER.

SELLER shall not be liable for any indirect, special, punitive, exemplary or consequential damages, including damages for lost production, plant shutdown, service interruptions, increased expense of operation, increased costs of power supply, loss of use of capital, lost revenue, lost product, lost profit or lost business opportunities, from any cause whatsoever, including the negligence of any person or entity.

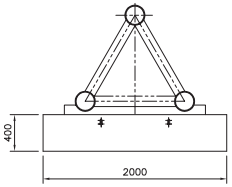
DO NOT SCALE - IF IN DOUBT ASK !



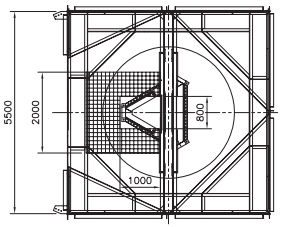
SECTION A



VIEW ON B



VIEW ON C



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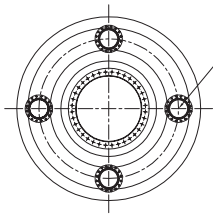

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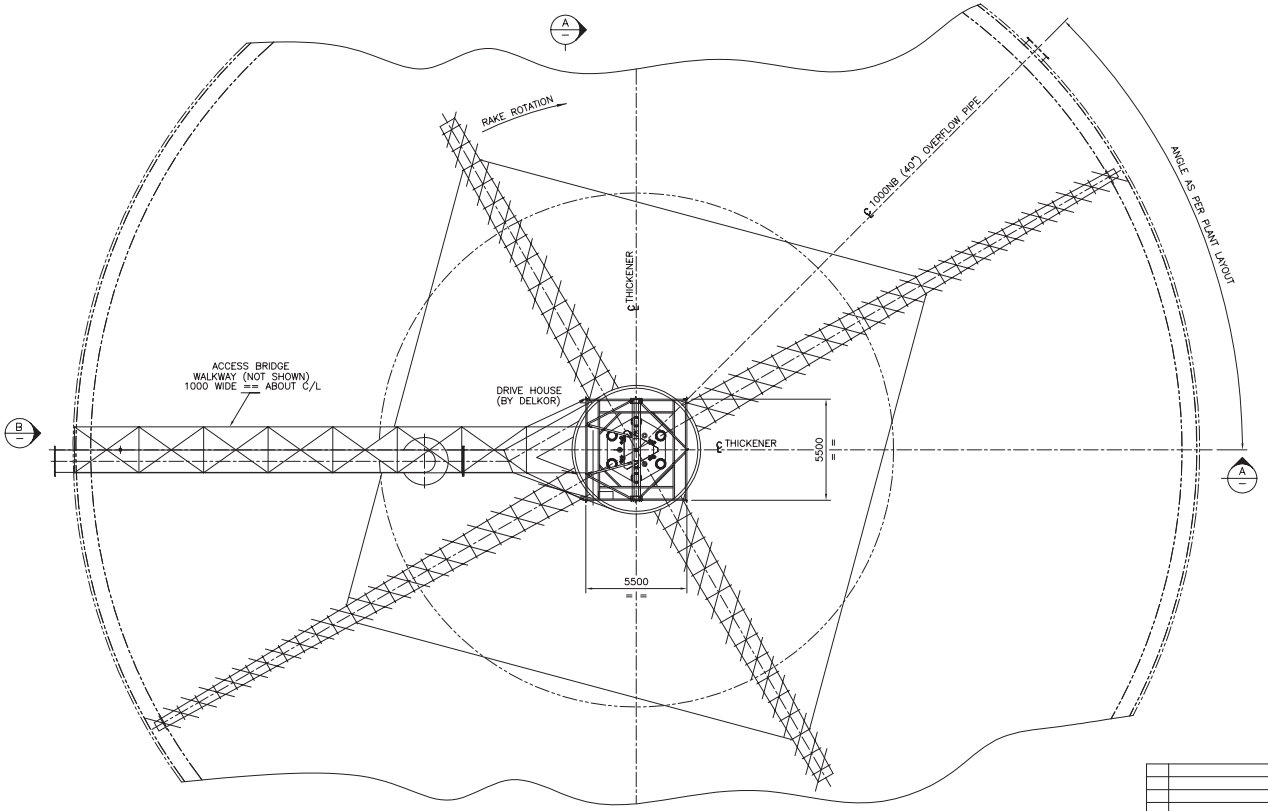

PLAN

CONFIDENTIAL
FOR INFORMATION ONLY

NOTES:

1. ALL FLANGES TO BE PLATE FLANGES DRILLED TO SUIT ANSI 16.5 #150, FLAT FACE U.O.S.
2. ALL FLANGE BOLT HOLES TO STRADDLE NATURAL PIPE CENTRE LINES.

ITEM No	REQD	DESCRIPTION	MAT'L	MASS Kg	DRAWING No.
14	1	CONTROL PANEL			
13	1	TORQUE CAGE			
12	1	DRIVE ASSY			
11	1	UNDERFLOW SCRAPER			
10	4	LONG & SHORT RAKE			
9	1	FEED PIPE 1200 NB			
8	1	FEEDWELL ASSY			
7	1	HANDRAILING			
6	1	GRATING			
5	1	BRIDGE EXTENSION			
4	1	BRIDGE ASSY			
3	1	CENTRE PIER COLUMN			
2	1	C/COLUMN SUPPORT/FIXING			
1	1	TANK ASSY BY CLIENT			

DIMENSIONS WITHOUT LIMITS:
MACHINED: UP TO 1000±0.25/OVER 1000 TO 3000±0.5 OVER 3000±1.
STRUCTURAL: UP TO 3000±1 /OVER 3000 TO 9000±1.5 OVER 9000±2.
ANGULARITY ±1°
BREAK ALL SHARP EDGES AND CORNERS 0.5 MAX.

REV	REVISIONS	BY	CHK	DATE
A	ISSUED FOR INFORMATION ONLY	R.M.		MAR.06

DRAWN	R.M.C.	MAR.06.
CHECKED		
D.O.MAN		
PROCESS		
PR.SPEC		
D.ENG		
SALES		
PR.ENG.		
PRJ.ENG		
PRJ.MAN		
SCALE		SCALE

DELKOR SOUTH AMERICA LTDA

GENERAL ARRANGEMENT
ø60 m. HIGH RATE THICKENER

PAPER SIZE	CONTRACT No	REV
AO	DRG.No T60-CB-001	A

CAD FILE REF: T60-CB-001
REV A
CONTRACT No
DRG.No T60-CB-001

May 31, 2011

SGS Canada Inc.
6927 Antrim Avenue
Burnaby, BC, Canada
V5J 4M5

Attention: **Prab Bhatia**
Project Manager, Water Treatment

Subject: **Seabridge Gold - Budgetary Quote**
Stanco Quotation S-11-2060 Rev 0

Dear Mr. Bhatia,

We are pleased to offer our budget proposal for the design, and supply, of a Vertimill lime slaking system in response to your request. We thank you for the opportunity to quote and look forward to reviewing our submission with you in detail.

Lime System Requirements:

Plant location		Stewart, BC
Chemical to be handled		Quicklime
Quality of chemical		90% CaO
Size distribution of dry chemical		¾" minus less than 10% fines
Dry chemical storage capacity		250 tonnes
Bulk density (volumetric/structural)		880/960 kg/m^3
Chemical usage rate		3 tonne/hr
Solution/Slurry concentration (% wt)		20
Solution/Slurry Storage Capacity		800 m^3
Solution/Slurry Distribution Method		Pump
Power	Less than ½ HP	120 Volt, 1 phase, 60 Hertz
	½ HP to 200 HP	575 Volt, 3 phase, 60 Hertz
	Control Power	120 Volt, 1 phase, 60 Hertz

12391 Horseshoe Way
Richmond, British Columbia
V7A 4X6 Canada
Tel: 604.273.6441
Fax: 604.273.0466
www.stancoprojects.com

Lime System Description:

System is designed to receive quicklime from pneumatic unload trucks. Dry chemical is pneumatically conveyed into the silo via unload blowers. Conveying and displaced air are vented from the silo by a bin vent filter. A high level alarm alerts the fill operator to stop filling the silo.

A vibrating bin activator at the base of a 60-degree cone promotes flow of dry product out of the storage area of the silo via a manually-actuated knife gate isolation valve which also serves as a maintenance shut off gate for downstream components.

The dry product is then split to two slaking trains using a pneumatic diverter. Lime is fed to each slaking system via a rotary valve and screw feeder. In the slaker, water and lime are mixed to form a Hydrated Lime $Ca(OH)_2$ slurry. Logic in the PLC supplied will adjust the water feed automatically to achieve optimum slaking conditions. The produced slurry flows through a separating chamber where oversize material is returned to the slaking mill. Slurry overflows from the separating chamber to a pump head tank where it is diluted to the desired concentration before being pumped to the slurry storage tank. Slurry production is controlled on a batch basis dependent upon the level of the storage tank. Upon reaching the preset low level in the slurry tank the slaking process is activated and continues until the high level is reached.

Milk of Lime System Components:

Item #	Qty	Description
101	**1**	**Pressure Convey Blower**

One (1) only Tuthill Model Pressure Blower for truck/rail car unload complete with:

- 800 ICFM pressure blower unit.
- 60 hp, TEFC motor.
- Discharge pressure relief valve (11 PSI setting).
- Check valve.
- Inlet air filter.
- Discharge silencer.
- High pressure switch, NEMA 4X.
- 3” Schedule 10 convey pipe connection.
- Weather proof sound enclosure.

102	**1**	**Fill Line**

One (1) fill line assembly to transport chemical from blower to silo:

- Schedule 40 carbon steel pipe.
- 90 degree 1.2 (48") centerline radius elbow.
- Support brackets on silo.
- Morris coupling connectors.
- Quickie line adaptor.
- Dust cap.

103 **1** **Silo Fill Panel**

One (1) chemical unloading control panel, NEMA 4X, and includes:

- Dust collector on/off selector switch.
- Blower controls.
- Silo high level indication and horn.

104 **1** **Quicklime Storage Silo**

One (1) 5.6 m diameter x 22.1 m high (18’ x 72’), bolted steel storage silo, complete with the following accessories and features:

- One (1) combination 500 mm (20”) manway, pressure & vacuum relief valve, 2.0 oz pressure, 0.5 oz vacuum.
- One (1) 500 mm (20”) target box with stub nozzle and internal wear plate.
- 1.8 m x 2.0 m (6’ x 6’8”) industrial walk-in double door in skirt.
- 1.8 m (6’) wide x tank diameter internal maintenance platform, with bargrate, handrail, midrail, and toeboard.
- One (1) interior ladder from grade to platform elevation.
- 450 mm (18”) square reinforced opening in sidewall for lime conveyor exit.
- 0.9 m x 2.0 m (3’ x 6’8”) industrial walk-in door platform elevation.
- Bolted steel exterior access ladder with safety and rest platforms. Ladder begins at grade and terminates at silo eave.
- Deck perimeter guardrail; two pipe guardrails with angle posts, bolted.
- Silo High level probe, capacitance type.
- One (1) reflex radar type level transmitter is included to provide a readout of continuous silo level c/w 4-20 mA output for remote readout.
- Trico Bond EP modified epoxy powder on interior coating (5 mils AVG DFT) and exterior primer (3 mils AVG DFT).
- Performance Urethane on interior skirt (1.5 mils AVG DFT) and exterior topcoat (3 mils AVG DFT).
- Silo Skirt Lighting Package.
- Silo Skirt Exhaust Fan.
- The silo will be designed for storage of free flowing chemical at design conditions, centre fill, centre discharge, local codes for seismic, snow and wind loads.

105 **1** **Bin Vent Filter**

One (1) Stanco Model DCC-280 air backwash type bin vent filters, for venting and filtering conveying and displaced air from the silo filling operation, each with the following features:

- Polyester-type filter cartridges.
- 26 m^2 (280 ft^2) filter area.
- Timer board in Nema 4X enclosure.
- Solenoids for reverse air purge.
- Weather-proof hood.
- One (1) pressure regulator and one (1) pressure indicator are also included (shipped loose).

106 **1 Lot** **Fluidization System**

Depending on the source quicklime may have high fines. In these cases we often require aeration to assist in unloading and to prevent ratholling. As an insurance policy, aeration pads will be installed in the silo hoppers. These air pads do not necessarily need to be connected and controlled unless issues are detected.

- Eight (8) aeration pads placed radially in silo cone.
- Clean dry fluidization air to be supplied by others.
- No controls, piping or instrumentation have been included at this time.

107 **1** **Bin Activator**

One (1) Metalfab vibrating bin activator, to promote the flow of chemical out of the silo, with the following features and accessories:

- 1.8 m (6') diameter inlet bolted flanged connection.
- One (1) 1.5 hp TENV unitized vibrator.
- Steel block hanger arms.
- Rubber isolator arms.
- Durable, continuous, 3-ply sleeve with stainless steel band clamps.
- Exterior factory primed and painted carbon steel. Contact parts are primed and painted carbon steel.
- Hammer gate for isolation at discharge.

108 **1** **Silo Isolation Knife Gate**

One (1) manually operated knife gate, to allow the silo to be isolated from downstream equipment for maintenance, with the following features:

- 200 mm (8”) diameter connection.
- Cast iron body with stainless steel blade.
- Metal seated knife edge valve.

109 **1** **Diverter Valve**

One (1) only diverter arrangement to direct flow to either of two slaking trains complete with:

- Two (2) pneumatically operated knife gates with double acting air cylinder with solenoid valve.
- Aluminum body.
- 304 SS blades.
- Carbon steel transitions.
- Primed and painted with grey enamel.

110 **2** **Rotary Valve Material Feeder**

Two (2) Stanco Model RV-308 rotary airlock, for metering chemical, each complete with:

- Cast iron body and endplates.
- Carbon steel open end rotor, with fixed tips.
- 1 hp TEFC gear
- Sealed outboard bearings.
- Sprockets and chain drive.
- OSHA type chain guard.
- Carbon steel motor mount.
- Variable Speed Drive.

111 **2** **Transfer Screw Conveyor**

Two (2) screw CEMA Style conveyors, for transferring chemical downstream, with the following features:

- Maximum rate of 3 tonne/hr.
- Up to 10 m long.
- 1.5 kW Drive driven through gear reducer.
- Site and equipment layout will need to be clarified to finalize screw feeder design.
- Zero Speed Switch.

112 2 Lime Slaker

Vertimill Vertical Lime Slaker,

1. The Vertimill® is a superior Lime Slaker with a high turn down ratio to treat a wide a range of capacity and types of lime.
2. The Vertimill® Lime Plant can be operated remotely.
3. Minimal maintenance and operation cost. Typically Vertimill® offer 98% availability.
4. The Vertimill® does not rotate. The installation is similar to a stationary vessel and therefore any safety related issues to exposed rotating machinery are eliminated.

We have adopted certain philosophies, which we perceive will provide a system with greater operational flexibility and control based on our previous experience in both bulk material handling and lime slaking.

The scope offered for each silo project includes one (1) Vertimill®, beginning at the Metso feed bowl inlet flanged connection with feed pipe to mill; ball charging pipe port inlet flanged connection; mill body and door with upper and lower body; Metso's patented Orebed® magnetic mill lining for field installation by customer; internal agitator screw with liners; drive shaft assembly with bearings; mill drive motor; mill drive speed reducer and couplings; mill separating tank with product overflow and recycle outlet flanges; wet vent scrubber with scrubber fan and motor assembly; and set of interconnecting rubber slurry hose and couplings for customer's field connections between Metso's supplied separating tank mill recycle outlet flange to mill recycle pump and also from recycle pump outlet to mill's recycle inlet flanged connection on mill body. Equipment and component sections are provided loose for shipment purposes, not pre-assembled nor shop tested or match marked, and ready for customer's field site assembly as required.

Complete field assembly for 1 mill typically takes about 3-4 days time, depending upon site install crews expertise and work schedules. Partial shipments shall be allowed.

One (1) only Metso Minerals VERTIMILL™ arranged for lime slaking are more specifically described as follows:

Engineering Information

Model Number - VTM-30-LS
Mill Weight - 13,200 lbs
Rated Capacity – 3.7 t/hr

Reducer -
Reduction Ratio (nominal) - 20:1

Service Factor - 2.0
Number of Reduction Stages - 2
Mill Drive Motor – 30 hp

Components

- **Mill Body:** Fabricated A-36 steel construction consisting of: a partially lined lower body assembly (see mill lining description) with one large hinged access door for maintenance and screw removal, one ball discharge port, and one flanged connection for recycle return and mill drainage; an upper body assembly (which can be rotated at 30 degree intervals about the center line of body) with upper drive shaft assembly, feed premix chamber, ball loading port and enclosed overflow launder for connection to separating tank; a drive pedestal assembly for mounting of reducer and drive motor.

  The exterior is painted with primer and finish paint as per Metso Minerals Standard Paint Specification T-101.

- **Grinding Media Agitator:** Fabricated steel, double flighted helical screw mounted on a solid steel shaft suspended in the mill body. Agitator shaft and flights are covered with vulcanized rubber. Flight liners are bolt on replaceable castings designed to give maximum life**.** (Bolt on liners are shipped separate for field installation by others.) Digging shoes (bottom flight liners) are specially designed for ease of replacement, long life and smooth operation. The agitator is attached to the upper drive shaft by a heavy duty keyed and bolted flange. Fabricated steel vanes bolted to the agitator shaft ensure adequate mixing and eliminate material buildup in the upper portion of the mill body.

- **Separating Tank/Splitter Box:** Welded A-36 tank with steel baffle between mill body and product port. A vapor hood with inspection door and vent connection is bolted to the top of the tank.

- **Mill Orebed Magnetic Lining:** The Orebed lining consists of 6-1/4” x 10” rubber covered modules to be attached magnetically to the lower 69” height of the mill body in the action zone of the mill. These modules attach directly to the shell of the mill and are held in place by magnets imbedded in the rubber. Small balls and other magnetic material form a bed on the liner surface. This bed is continually replaced from the charge. The profile of the bed is a wave form caused by the magnetic fields. Orebed lining to be field installed by others.

- **Bearings and Drive Shaft:** Three (3) bearings total, one (1) radial bearing with replaceable bronze bushing, one (1) spherical radial roller bearing, and one (1) spherical thrust roller bearing, all with double lip seals and designed for grease lubrication. The bearings are located above the mill body (and above the operating pulp level) and are supported by structural steel supports. The solid steel drive shaft connects the low speed reducer shaft to the grinding media agitator.

- **Automatic Grease Assembly:** The automatic grease assembly is a pneumatically driven grease pump system that delivers a particular amount of lubricating grease in set intervals to the bearings of the upper drive shaft assembly. The automatic grease assembly includes the programmable controller, pneumatic grease pump, air control panel, manifold assembly, cycle switch assembly, and the hose assemblies that deliver the grease.

- **Couplings:** High speed and low speed flexible couplings with halves factory mounted.

- **Mill Drive Reducer:** Vertical speed reducer with anti-friction bearings and external oil lubrication consisting of circulating oil system, oil to air cooler filter, flow switch, oil pump and TEFC motor.

- **Mill Drive Motor:** Vertically mounted, shaft down, TEFC, premium efficiency squirrel cage induction motor with grease lubricated anti-friction bearings, Class F insulation with Class B temperature rise, 200% minimum starting torque, 200% breakdown torque and 1.15 service factor.

- **Temperature Probe:** A temperature RTD complete with thermowell and transmitter is provided to provide a signal to shut-off feed and activate emergency water in the event of high temperature in the slaker.

- **Thermometer:** A bi-metallic thermometer with thermowell is provided to indicate slurry temperature.

- **Emergency Water Inlet:** An inlet is provided for emergency water purge in the event of high slurry temperature.

- **Premix Chamber:** A premix chamber is provided to blend lime and slaking water to insure proper wetting of lime prior to entry of the slurry to the mill body. Connection from the chamber to the mill body is included. Premix

chamber is to be supported on Buyer's structure.

113 **2** **Slaker Wet Scrubber & Fan**

Two (2) only wet scrubber and vent system with fan:

- V-belt drive and motor.
- Manually operated balancing tee is provided to obtain desired airflow through the scrubber.
- Ductwork and supports are to be provided by others.
- Pressure regulating controls for the scrubber shipped loose for installation by others.
- Fan motor is 3.7 kW TEFC, 1800 RPM.

114 **2** **Vertical Ball Mill Recycle Slurry Pump,**

Two (2) only Wilfley single stage horizontal seal-less centrifugal pump, including:

- 9.1 m (30') TDH.
- 68 m^3/hr (300 gpm).
- Ductile iron wet end components.
- 7.5 hp motor.
- Dynamic seal.
- Overhead style motor mount.
- V-belt drive and guard.
- Variable Speed Drive.
- Suction spool (shipped loose) complete with pinch valve isolation and flush/drain valve.
- Discharge spool complete with pinch valve, red valve isolation sleeve with pressure gauge, flush/drain valve

115 **2** **Vertical Mill Discharge Pump Box**

Two (2) painted carbon steel tank to collect slurry to be pumped to storage tank:

- 1.5m (5') diameter x 3m (9.75') high
- Sloped bottom.
- Flanged pump suction and overflow nozzles.
- Ultrasonic Level indication.
- Dilution manifold including control valve, flow meter, and manual bypass.

116 **2** **Vertical Mill Discharge Pump**

Two (2) Wilfley discharge pumps for transferring slurry to storage tank. Each features:

- 9.1 m (30') TDH.
- 28.6 m^3/hr (126 gpm).
- Ductile iron wet end components.
- 5 hp motor.
- Dynamic seal.
- Overhead style motor mount.
- V-belt drive and guard.
- Variable Speed Drive.
- Suction spool (shipped loose) complete with pinch valve isolation and flush/drain valve.
- Discharge spool complete with pinch valve, red valve isolation sleeve with pressure gauge, flush/drain valve

117 **1** **Milk of Lime Slurry Storage Tank**

One (1) slurry storage tank, bolted steel construction**,** complete with the following features:

- Approximately 9.6 m diameter x 10.8 m high (32' x 36').
- 300 mm (1') freeboard.
- Flat steel bottom.
- Interior and both sides of bottom painted with one coat of Trico Bond EP thermoset corrosion resistant powder epoxy (7 mils AVG DFT).
- Exterior painted with one coat of Trico Bond EP thermoset corrosion resistant powder epoxy with finish coat of white performance urethane (4.5 mils AVG DFT).
- Coatings are electrostatically applied over a minimum SSPC-SP 10 near-white blast and thermally cured.
- Two (2) mushroom vents with 12.5 mm (½") mesh screen.
- One (1) 600 mm (24") square roof manway with hinged cover.
- One (1) 600 mm (24") diameter shell manway with bolt-on hinged cover.
- One (1) 600 mm (24") x 1150 mm (46") flush cleanout with 2-piece cover.
- One (1) bolted outside ladder with safety cage and lockable hoop – OSHA – HDG.
- One (1) top of ladder swing gate.
- One (1) 1.5 m (60") wide walkway/agitator support across tank top.
- Four (4) 375 mm (15") interior wall baffles.
- One (1) tank nameplate.
- One (1) 150 mm (6") diameter flanged nozzle for drain.

- Two (2) 150 mm (6”) 150# flanged suction nozzle with elbow and vortex breaker for outlets.
- One (1) 200 mm (8") internal overflow weir cone with external Sch. 10 downcomer pipe and flap gate.
- One (1) 300 mm (12") 150# single flanged nozzle for premix cone.
- One (1) 12.5 mm (½”) thick asphalt-impregnated fiber board for placing between tank bottom and full slab foundation.
- Two (2) grounding lugs.
- One (1) ultrasonic continuous level transmitter.

118 1 Agitator

One (1) Hayward Gordon Model LHX-9S top entry slurry storage tank agitators, for keeping chemical in suspension, each with the following features:

- 0.2 m (8”) diameter x 9 m (360”) long extension shaft with mid-shaft rigid coupling.
- Single 3050 mm (122”) diameter 4HP45 high efficiency turbine impeller.
- Base plate mounted.
- Mixer wetted parts are mild steel.

119 2 Lime Distribution Pumps

Two (2) Wilfley distribution pumps for transferring slurry to downstream operations circuit. Each features:

- 22.5 m (75’) TDH.
- 1276 lpm (337 gpm).
- 1750 rpm.
- Ductile iron wet end components.
- 20 hp motor.
- Dynamic seal.
- Overhead style motor mount.
- V-belt drive and guard.
- 4” suction inlet and 3” discharge outlet.
- Suction spool (shipped loose) complete with pinch valve isolation and flush/drain valve.
- Discharge spool complete with pinch valve, red valve isolation sleeve with pressure gauge, flush/drain valve

120	**1**	**Main Control Panel**

One (1) main control panel is included for monitoring, control and indication of components as described with the following features:

- NEMA 4.
- Allen Bradley ControlLogix PLC c/w HMI interface. PLC is with a Panelview 1000 HMI interface.
- Motor starters are by others.

Boundary Limits:

Boundary Limits are as follows:

- Blower and fill line connections.
- Air inlet at bin vent filter. Regulator, gauge and isolation valve shipped loose for installation in air line to be supplied by others.
- Water connection at inlet of slaking water manifold. Manifolds are shipped loose, piping between discharge of the manifold and slaker/pump box is not included.
- Discharge connection at lime distribution pumps. Note that piping scope is limited to the manifolds, suction and discharge spools described above. Field run piping between these points is not included in this proposal.
- Terminals in control panels, motors and field devices. All wiring and conduit by others.

Start-up and Construction Support:

Start-up and construction support are available at Field Service Rates attached. Stanco has experienced field crews based in western Canada that would be capable of completing installation of ship loose items on site. Please let us know if you would like us to provide pricing in this regard.

Documentation:

Proposal includes a complete engineering documentation package. Initial documents for review P&ID, GA, and foundation loads/anchor bolt layout would be expected to take 8-10 weeks depending on the time of order. All documents will be submitted electronically in pdf format. Hard copies if required are available at nominal cost.

Specifications:

The design, fabrication and method of assembly of the proposed system is to standards established by Stanco Projects for the service described, sized in accordance with the process requirements stated above. All equipment is to be supplied with standard coating systems and standard motors (where applicable).

Technical Exceptions & Clarifications:

1) The ladders and platforms quoted are the manufacturer's standard for this service. They comply with the requirements of US Federal OSHA Standard 29 CFR part 1910. Ladders are galvanized steel and are bolted together in sections in the field. They may or may not comply fully site standards.
2) An air backwash type bin vent filter has been proposed. Filter will require 4-6 scfm of compressed air at 653 kPa (80 psig) on an intermittent basis when lime is being unloaded. Depending on the lime used on site air piping may also be required to the silo cone aeration pads. A 37.5 mm (1½") service line is suggested.
3) Process water for lime slaking should be provided at approximately 25-30 deg. C for the slaker to operate efficiently. Water heater and temperature control instruments (for controlling water to the slaker) have not been included in our scope of supply but we could supply these if requested.
4) In lime slaking operations there is always some grit produced. This is a function of the feed lime reactivity or percent CaO. In the majority of lime slaking operations where the lime is around 95% reactive, most of the grit gets ground up in the slaker. However even under these conditions, some grit is rejected at the slaker discharge. When the percent lime reactive drops to 70-80% and it is required that most of the grit be ground, then this becomes not only a slaking application but also a grinding application. As the power required to grind grit varies depending on the source and quality of the lime, in order to determine the power required, we require a Bond ball mill Work index or specific power required to grind the grit down to the required mesh size. As this is not available, we have based the ball mill selection on grinding lime grit of "average" Work index. If the expected lime quality is within these limits the grit rejection will be minimized.
5) Ball storage bins have not been included in the scope. It is recommended that the customer obtain a minimum of two (2) fabricated ball storage bins to facilitate mill charging and discharging. Price extra can be provided for these if required.
6) Silos, as quoted, are fabricated of factory coated bolted steel. Gauges of material will vary with the location in the silo based upon structural design requirements and the experience of the manufacturer.

Delivery:

Initial submittal of approval drawings	8-10	Weeks ARO
Detailed engineering information	10-18	Weeks ARO
Installation, Operation and Maintenance Manuals	20	Weeks ARA
Shipment of Equipment less Vertimill	30	Weeks ARA
Shipment of Vertimill	60	Weeks ARA
Legend: ARO – After Receipt of Order, ARA – After Receipt of Approval,		

Price:

Quicklime System …… CAD$ 2,820,000.00

Commercial Terms:

- Price is **budget** and valid until June 30th, 2011, for shipment on or before August 31, 2012. Confirmation of pricing is required after that date, due to ongoing volatility in commodity pricing and USD/CAD exchange rate.
- Pricing is in CAD funds and based on FCA Manufacturer's facility. Multiple shipping points can be expected including: Richmond, BC, Milton, ON, York, PA, Parsons, KS and others.
- Pricing excludes all permits, taxes and duties (if applicable).
- **VERTIMILL ONLY:** Screw Liners are subject to a scrap and alloy surcharge. The above prices include the surcharge at time of proposal submittal. The liner prices will be adjusted to reflect the actual surcharge at time of shipment.
- The proposed equipment is warranted for a period of 18 months after delivery or 12 months after start-up, whichever comes first. Warranty details are provided in the attached terms and conditions. Warranty will be extended by 6 months at no extra cost, provided Stanco Field Service is contracted to provide an installation inspection and start-up services. Further extended warranty terms are available at additional cost.
- Purchaser is responsible for providing adequate storage and protection of equipment after delivery. Should the equipment need to be stored for a period longer than one (1) month, purchaser shall be responsible for implementing long term storage and handling procedures. Long-term storage and handling procedures will be provided as part of our documentation package. A written record of preservation activities will be required for warranty claims.
- The scope of this project includes engineering of a comprehensive equipment package, purchase of custom equipment and materials, delivery (if so elected) of these materials to the project site, and commissioning. Payment terms reflect this scope with progress billings based on the following schedule:
    - **10%** Upon receipt of order.
    - **10%** Upon submittal of approval drawings (this work is expected to take approximately 8 weeks from approved order), including general arrangement, foundation load, P&ID, and anchor bolt layout.
    - **20%** Upon submittal of un-priced purchase orders for key components (silos, slaker, feeders & blowers).
    - **20%** Upon receipt of critical materials for slakers at fabricators' shop.
    - **35%** Upon notification that the goods are ready for shipment. Partial shipments can be expected.
    - **5%** Upon submission of final documentation.
    - Terms of payment are net 30 days from date of invoice.
- Liquidated Damages are expressly rejected. All other contract conditions per attached terms and conditions.
- Please note that the following items are not included in the scope of supply:
    - Permits, taxes and duties
    - Freight and offloading
    - Chemicals and first fill lubricants
    - Design and supply of anchor bolts, grouting and concrete foundation
    - Utilities including air, water and power
    - Motor starters
    - Safety showers

- Spare parts, unless detailed above
- Mechanical and electrical installation, unless detailed above
- Piping (water, slurry, air), wiring, conduit or supports, unless specifically detailed above
- Field erection and start-up services, unless detailed above

Attachments:

- Field Service Rates

We look forward to working with you on this project. If any additional information or clarification is required at this time please contact our representative, Mequipco Sales, Devlin Wing at 604-273-0553 or the writer at 604-248-8063.

Yours truly,

Stanco Projects Limited

H. Fraser Bringeland, Sales Manager
Encl.

GENERAL TERMS OF SALE

1. Scope. These General Terms of Sale govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's sales contract, purchase order, quotation, proposal, or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Purchaser's assent to these terms. Seller rejects all additional or different terms in any of Purchaser's forms or documents.

2. Payment. Purchaser shall pay Seller the full purchase price as set forth in Seller's Documentation. Where applicable, payments shall become due upon notification to the Purchaser by the Seller that completion of a stage of production of the Equipment, as provided Seller's Documentation has been achieved. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Purchaser. If Seller is required to pay any such charges, Purchaser shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Purchaser shall be charged the lower of 1.5% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation, and may include partial shipments. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility. All shipping terms per Incoterms 2000. Unless otherwise provided, packing of the Equipment shall be in accordance with Seller's normal standards.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Purchaser a non-exclusive, non-transferable license to use any such material solely for Purchaser's use of the Equipment. Purchaser shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Purchaser and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Purchaser that the Equipment shall materially conform to the description in Seller's Documentation and shall be new and free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Purchaser and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Purchaser, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Purchaser under warranty, tort or any other legal theory. If Purchaser gives Seller prompt written notice of breach of this warranty within 18 months from Delivery or one (1) year from acceptance, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Purchaser's sole remedy, adjust, repair or replace the item or any affected part of the Equipment, or refund the purchase price. Purchaser specifically agrees that it shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Purchaser shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Purchaser's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). The foregoing warranty and conditions shall extend to replacement parts furnished by the Seller hereunder, except that the warranty on such replacement parts shall be limited in scope and expiration to the warranty on the original Equipment. The warranties set forth in this section are Seller's sole and exclusive warranties and are subject to Section 10 below. Seller makes no other warranties of any kind, express or implied, including without limitation, any warranty of merchantability or fitness for purpose.

7. Indemnity. Seller shall indemnify, defend and hold Purchaser harmless from any claim, cause of action or liability incurred by Purchaser as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Purchaser (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Purchaser shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Purchaser cancels or suspends its order for any reason other than Seller's breach, Purchaser shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs plus overhead incurred by Seller as a result of such cancellation or suspension.

10. Limitation of Liability. Notwithstanding anything else to the contrary, Seller shall not be liable for any consequential, incidental, special, punitive or other indirect damages, and Seller's total liability arising at any time for the sale or use of the Equipment shall not exceed the purchase price paid for the Equipment. These limitations apply whether the liability is based on contract, tort, strict liability or any other legal theory.

11. Title. Title to the Equipment and risk of loss or damage shall pass to Purchaser at the designed delivery point, except that a security interest in the Equipment, proceeds and any replacement shall remain with Seller until full payment of the purchase price, and any additional amounts, have been paid to Seller.

12. Miscellaneous. These terms, together with any quotation, purchase order, contract or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Purchaser's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Purchaser. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Purchaser may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State or Province where it is signed.

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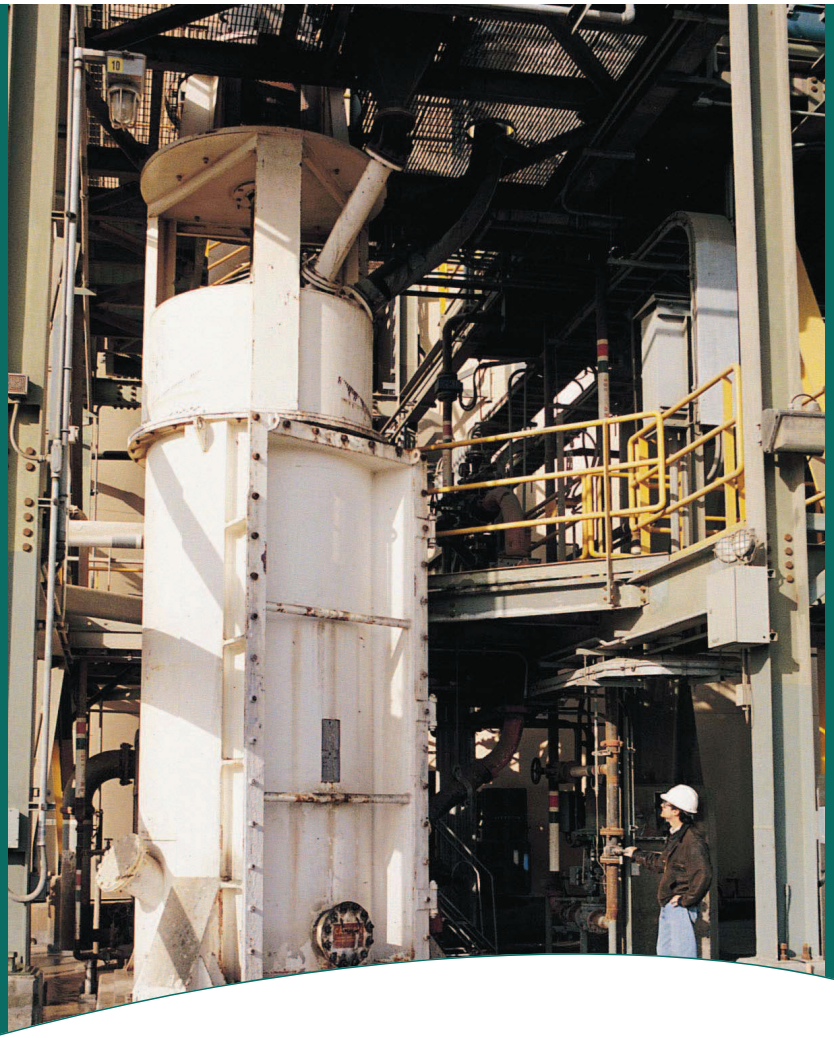
E-mail: mineralsprocessing.info@metso.com

metso minerals
linking innovations™

Brochure No. 57 07-03



www.metsominerals.com

Lime Slaking Systems

metso minerals

Limeslaking Process

Plant processes often require neutralization to adjust pH or neutralize acidic conditions. Uses would include neutralization of plant effluents, pH content for process conditions, and flue gas desulfurization (FGD). Lime provides an economic means to accomplish these requirements.

Hydrated lime is used in aqueous slurry form for many plant processes. When the hydration reaction occurs in an excess amount of water, the process is known as slaking and the resultant slurry as slaked lime. Lime quality, water quality, and water temperature are factors which may affect the quality of the hydrate.

During the slaking process, the formation of extremely small calcium hydroxide particles is desirable. Particle size is important because the smaller the lime particle, the greater the surface area per unit of weight of lime. Since the chemical reaction of the lime occurs on the surfaces of these particles, the lime will react more quickly. When feasible potoble water should be used, because dissolved sulfite and sulfate ions tend to "blind" the surface of the particles. As a result, large particles form and the process slows down.

The quality of the quicklime is a factor in slaking. However, water temperature may improve the reaction rate of lower quality lime. Using preheated water with a medium reactive lime will produce a good quality hydrate, but using hot water with highly reactive quicklimes has no significant value. Under optimum conditions, highly reactive lime will produce a slurry of particles which are typically 1 to 2 microns.

As water contacts the pebble lime surface and enters pores formerly occupied by CO_2, rapid hydration occurs. Quick removal of this hydrate exposes new surfaces to the water. This hydration reaction results in the build up of heat and the formation of small calcium hydroxide particles. If hydrate is not removed quickly, the reaction will be slower and at a lower temperature. As a result, larger particles will form.

The hydration reaction produces a significant amount of heat. Extreme temperatures can destroy equipment and endanger personnel. Unless the mixture is agitated continuously, hot spots will develop and steam pockets will form and "explode". If allowed to continue, the mass could evaporate all the free water and solidify, or the reaction could reverse and reform the oxide. The solid mass may have to be "jackhammered" to remove it from the slaker.

The slurry The slurry temperature is controlled by varying the amount of excess water,. If too much water is added, you "drown" the slurry. This holds down the temperature and coarse hydroxide particles form as the reaction slows down.

Slakers fall into one of two catergories. One type grinds the grit and the other removes the grit.

Conventional slaking systems, such as paste and detention slakers, incorporate a grit removal system. Normally the slurry is screened at 20—48 mesh before entering the next process. Since grit content accounts for 5-15% of the total weight of pebble lime feed, this may create material handling problems in the slaker area as well as grit disposal problems. Handling of grit creates additional operating and personnel costs.

Systems grinding grit utilize either ball mills or VERTIMILLs™. In these grinding systems, all the grit is ground and becomes part of the slurry. This total grinding process utilizes all residual reaction value, eliminates any disposal problems, and decreases lime usage. This results in lower lime cost as well as lower operating costs. Normally, both the VERTIMILL™ and the ball mill are sized to grind the grit to approximately 90% passing 325 mesh or finer.

Metso Minerals draws from over 100 years of mill design and manufacturing expertise. This design experience is engineered into all Metso Lime Slaking Systems. We provide dependable, cost efficient equipment for your lime slaking system. Our experienced personnel will review process specifications and recommend the optimum equipment for your application.

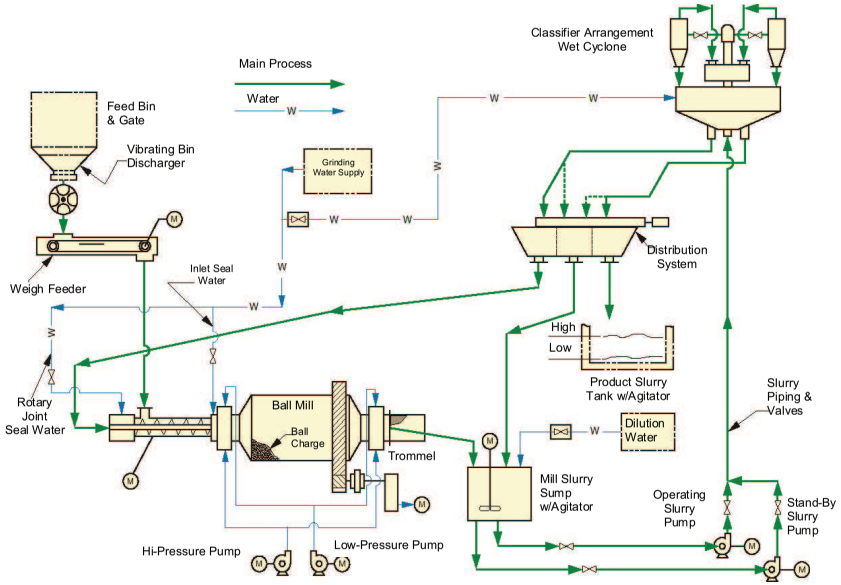
Ball Mills

Ball mills are popular for slaking lime, particularly in mineral processing industry, which use ball mills as part of the size reduction process. Typically, to generate a slurry containing approximately 35% solids and at a temperature ranging from 160˚ to 185˚F (71˚ to 85˚C), ball mill retention varies from 1 to 3 minutes for highly reactive lime and as much as 10 minutes for poorer quality lime. When operated at lower solids and lower temperatures, particle size of the hydroxide increases.

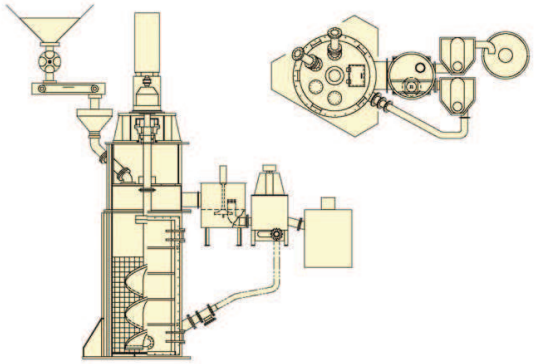
A ball mill has sufficient grinding action to create new surfaces and prevents the problems of sulfite and sulfate "blinding" of quicklime surfaces. Therefore, non-potoble water can be utilized. Since this mill does not rely exclusively on exothermic reaction to generate particle size, it is less sensitive to lime quality and water temperature. A good quality hydrate can be produced from a medium reactive lime using a ball mill with water temperatures as low as 45° F. Therefore, the costs normally incurred for heating water are eliminated.

Typically, ball mills operate in closed circuit with hydrocyclones and provide a 90% minus 325 mesh or finer product.

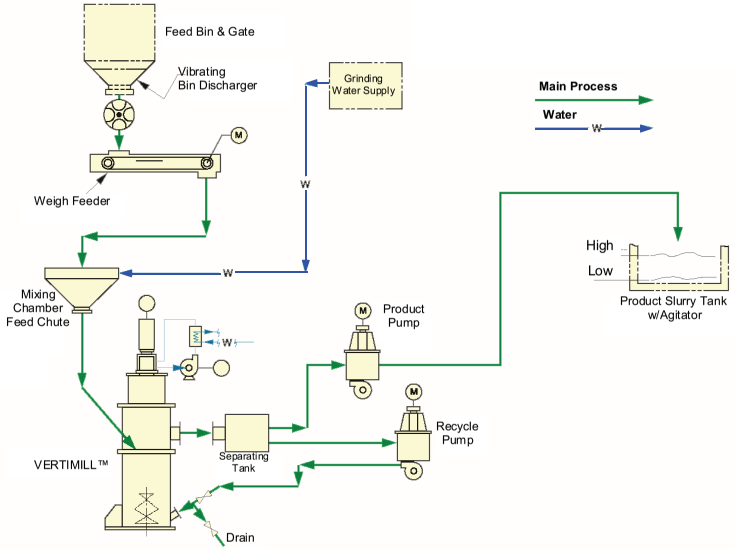
Typical Flow Diagram for Ball Mill Slaking System



Typical VERTIMILL™ General Arrangement



Typical Flow Diagram for VERTIMILL™ Lime Slaking System



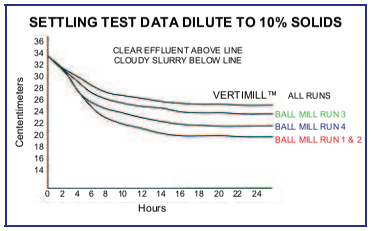
VERTIMILL™ Slakers

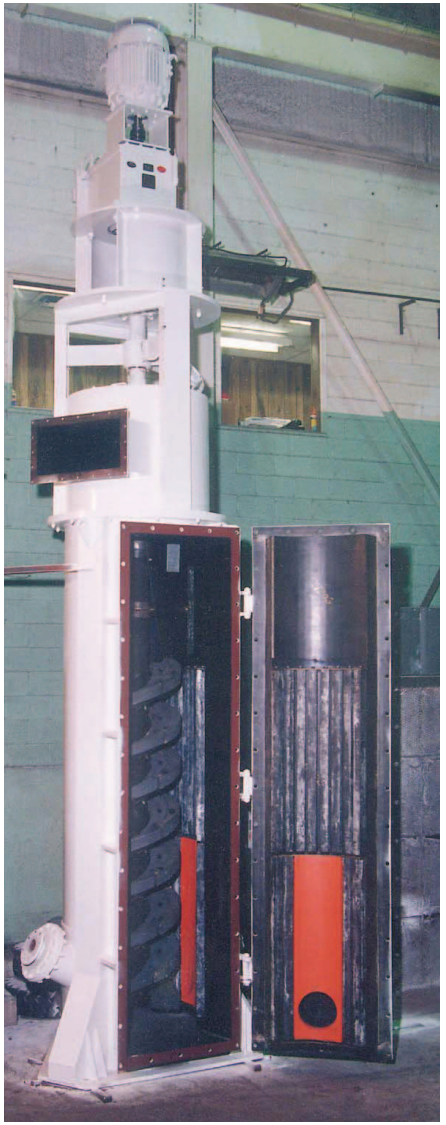
Under most conditions, the VERTIMILL™ has proven itself to be a superior slaker. This energy efficient mill produces a finely ground, grit free, homogenous, slow settling slaked lime in a simple one step operation. Normally, the VERTIMILL™ is operated in open circuit.

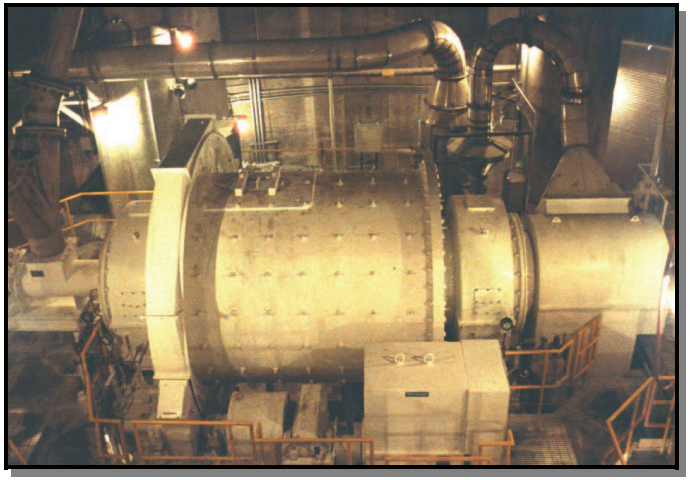
The VERTIMILL™, a vertical stirred mill with a re-circulating pump which produces an uprising current in the grinding chamber, provides a favorable environment for slaking lime. When using this mill, water quality is not a significant factor.

The ultrafine grinding action of the VERTIMILL™ reduces the grit particles in the lime and reduces the amount of unslaked lime or wastage of lime. Generally, the VERTIMILL™ produces a finer hydrate than a ball mill. Please refer to the chart shown at the bottom of this page for settling test data.

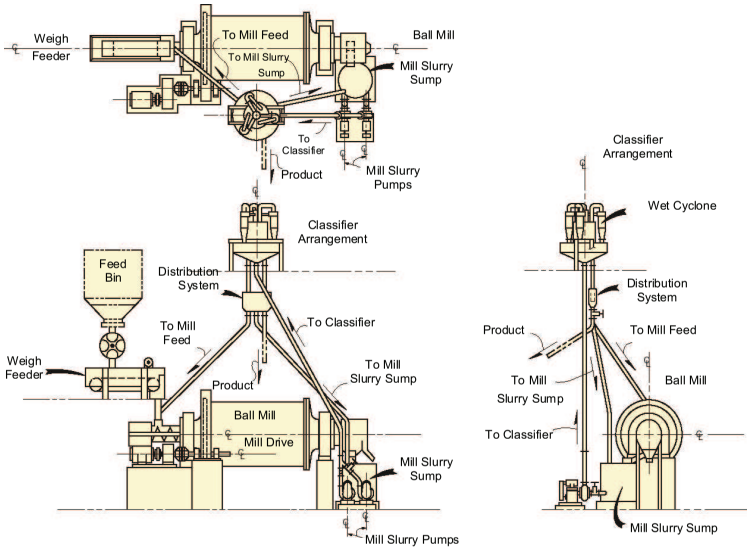
The VERTIMILL™ provides an efficient alternative for slaking lime. The VERTIMILL™ can save as much as 30% on your energy costs, offers lower installation and operating costs, requires less floor space, and operates at a reduced noise level. Additionally, there are no submerged bearings or shaft seals to cause maintenance concerns.







Typical General Arrangement for Slaking System



REACTIONS IN MAKING AND SLAKING LIME

When limestone which is basically calcium carbonate, $CaCO_3$, is calcinated at temperatures of 2000˚ to 2400˚F, carbon dioxide is evolved leaving calcium oxide (CaO). The chemical process is as follows:

$$CaCO_3 + Heat \rightarrow CaO = CO_2\uparrow$$

CaO, commonly known as quicklime, is a rather unstable compound which reacts with water to form a more stable compound, calcium hydroxide Ca $(OH)_2$. This exothermic or heat producing reaction is as follows:

$$CaO + H_20 \rightarrow Ca(OH)_2 + Heat$$

This process is known as hydration and the resulting product as “hydrated lime”. If the hydration reaction takes place in an excess amount of water, the process is known as slaking and the aqueous slurry as slaked lime.

PROPERTIES OF TYPICAL COMMERCIAL QUICKLIME PRODUCTS

CLASSIFICATIONS	HIGH CALCIUM	MAGNESIUM	DOLOMITIC
% CaO	80 to 95%	50 to 92%	45 to 62%
% MgO	Less Than 5%	5 to 35%	35 to 40%
% Grits	1 to 15%	1 to 15%	1 to 15%
% Inert included in Grit	1 to 6%	1 to 6%	1 to 6%
Specific Gravity	3.2 to 3.4	3.2 to 3.4	3.2 to 3.4
Bulk Density lb/cu. ft.	55 to 60	55 to 60	55 to 60
Angle of Repose	50 to 55˚	50 to 55˚	50 to 55˚
Specific Heat at 100˚	0.19	0.21	0.21
Reactivity Time 40˚C Temp. Rise (Typical Ranges)			
High	<3 minutes		
Intermediate	3 to 6 minutes	3 to 6 minutes	
Low	>6 minutes	>6 minutes	>6 minutes

Typical High Grade Quicklime
89-95% CaO, 1-8% Grit ($CaCO_3$) and 1-6% Inerts

Typical High Grade Magnesium Quicklime
87-92% CaO, 5-7% MgO, 1-8% Grit and 1-6% Inerts

BULK DRY CHEMICAL INTEGRATED STORAGE AND FEED SYSTEMS

STANCO PROJECTS

DESIGN • SUPPLY • ERECT • SERVICE

Discover the Guaranteed Fit

- *Water and Wastewater Treatment*
- *Acid Waste Neutralization*
- *Sludge Treatment*
- *Flue Gas Desulphurization*
- *Metal Precipitation*
- *pH Control*
- *Paste Backfill*

EXPERIENCE AND CAPABILITIES

STANCO knows bulk chemical handling systems. From concept through design, supply, installation and start-up, we have led the industry with practical solutions for over 33 years. STANCO has over 1,000 installations, spanning 5 continents.

Choosing from the industry's widest selection of high performance components, we custom design the system to form, fit and function in ***your*** process.

For automatic, dependable and efficient operation, discover ***the guaranteed fit***.

It's your best choice ….every time

STANCO PROJECTS

ENGINEERING AND PROJECT MANAGEMENT EXPERTISE

- Multi-disciplined engineering staff
- Dedicated project execution teams
- Broad customer specification compliance capability—all market sectors
- 3-D integrated system design software
- Turn-key system design
- In-house instrumentation and control technologists
- Comprehensive documentation packages

STANDARD AND CUSTOM DESIGN FEATURES

SILOS:

- Factory coated bolted steel silos
- Factory coated welded silos
- Designed for seismic, snow, wind, and product density
- Capacities in excess of 100,000 ft³ (2,832 m³)
- Diameters from 9’ to 38’ (2.75m to 11.58m)

FILL & TRANSFER SYSTEMS:

- Pressure and vacuum conveying equipment
- Fill station controls with hi-level and alarm
- Truck, railcar and vacuum unload
- Railcar to truck transfer systems

WITHDRAWAL SYSTEMS:

- Bin activators
- Aeration rings
- Air slides
- Impactors
- Screw augers

SLAKERS:

- Detention
- Vertical Mill
- Horizontal Mill
- 200 lb/hr (91 kg/hr) and larger capacities

SOLUTION / SLURRY PREPARATION:

- Tankage as required, complete with mixers, level controls and dust control
- Grit removal and collection

SOLUTION / SLURRY FEED:

- Volumetric or gravimetric (loss-in-weight) screws
- Rotary feeders
- Weighbelt feeders

FILL & TRANSFER STATION CONTROLS:

- PLC or DCS / SCADA controlled
- Local HMI operator panels
- Automatic or manual operation
- Local or remote control
- Programmable controllers
- Local switch stations for DCS interface
- Motor starter panels
- Local fill stations

TYPICAL APPLICATIONS

WATER TREATMENT:

- Softening
- Coagulation
- pH Control
- Silica removal
- Odor and taste control

SEWAGE TREATMENT:

- Sludge dewatering
- Odor control
- Coagulation
- Stabilization

FLUE GAS DESULPHURIZATION:

- Dry scrubbers
- Coal, RDF and MSW fired
- Waste incineration
- Fly ash recycle systems

CHEMICALS HANDLED:

- Hydrated Lime
- Quick Lime
- Magnesium Oxide
- Soda Ash
- Sulphur
- Polymer
- Plastic Pellets
- Arsenic Trioxide
- Alum
- Fly Ash
- PAC-Powdered Activated Carbon
- Cement
- Sodium Sulphate
- Flour
- Salt
- Calcium Sulphate

PARTIAL LIST OF INSTALLATIONS

MUNICIPAL

Edmonton, AB
Sacramento, CA
Atlanta, GA
Los Angeles, CA
Vancouver, BC
Athens, GA
Macon, GA
Portage la Prairie, MB
Jasper, IA
Sioux Falls, SD
Mesa, AZ

OIL AND GAS

CNRL
Shell
OPTI-Nexen
Suncor
Petro-Canada
Imperial Oil
Syncrude
Husky

MINING

Goldcorp
Barrick Gold
Glamis Gold
Osisko
Newmont

INDUSTRIAL

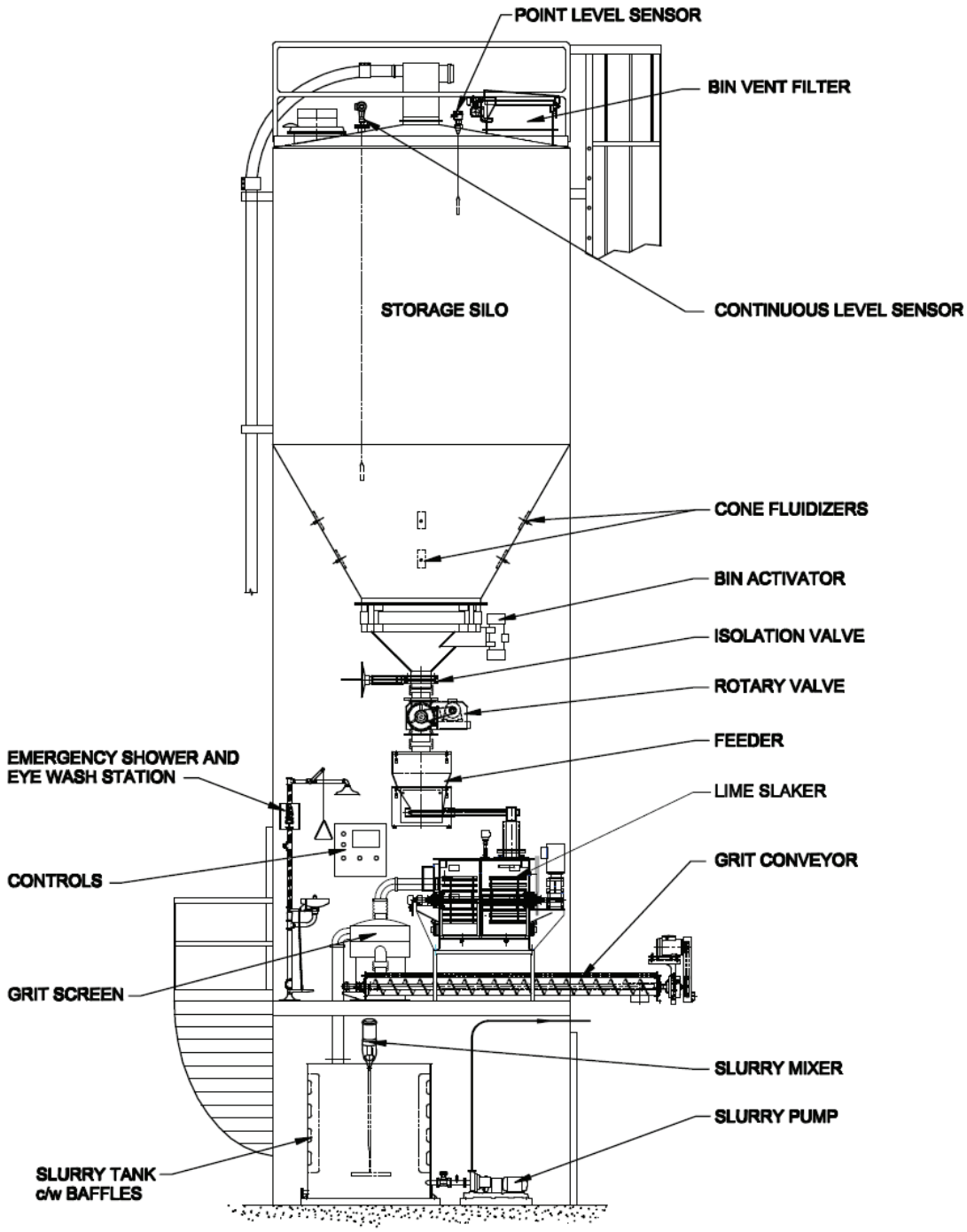
Amalgamated Sugar
Celanese
Suncoke
Specialty Minerals
McCains
LaFarge
American Crystal Sugar

POWER/FGD

Cogentrix
Covanta
Reliance Energy
AEP
Babcock & Wilcox
Marsulex
Nova Scotia Power

STANCO PROJECTS

QUICKLIME STORAGE / SLAKING AND SLURRY FEED SYSTEM



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Fax: (905) 693-9432

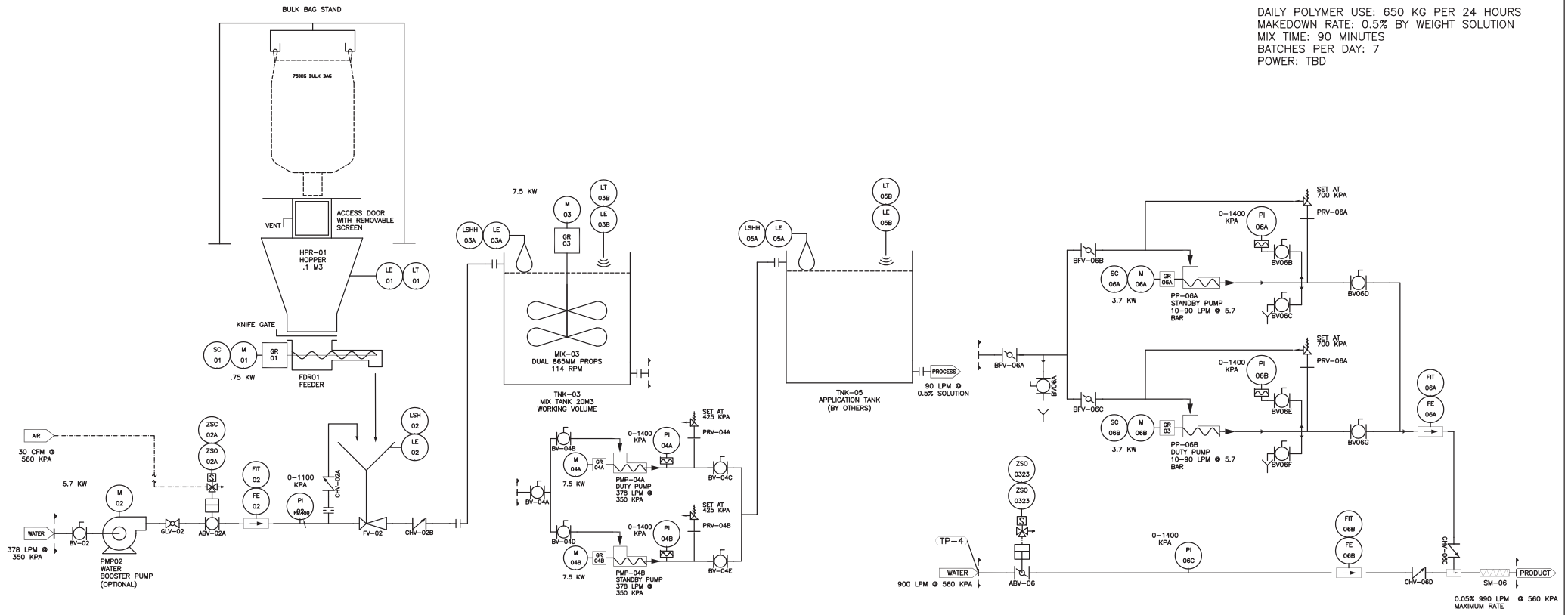
Website: www.stancoprojects.com **Toll-Free 1-800-730-5859**

DB20-BBS-S DRY POLYMER SYSTEM

TAG#	DESCRIPTION
LE-01	CAPACITANCE LEVEL PROBE
PMP-02	VERTICAL CENTRIFUGAL BOOSTER PUMP
ABV-02	PNEUMATIC BALL VALVE
FE-02	WATER MAG METER
FV-02	FLOVAC WETTING SYSTEM
LE-02	OVERFLOW PROTECTION LEVEL PROBE
LE-03A	HIGH HIGH LEVEL FLOAT BALL
LE-03B	ULTRASONIC LEVEL TRANSMITTER
PMP-04A/B	TRANSFER PUMP PROG CAVITY
LE-05A	HIGH LVL FLOAT BALL BY OTHERS
LE-05B	ULTRASONIC LVL XMITTER BY OTHERS

DESIGN CRITERIA

DAILY POLYMER USE: 650 KG PER 24 HOURS
MAKEDOWN RATE: 0.5% BY WEIGHT SOLUTION
MIX TIME: 90 MINUTES
BATCHES PER DAY: 7
POWER: TBD



SNF CANADA LTD.
2525 Place Léon-Trépanier
Trois-Rivières, QC G9A 5E1
Tel.: (819) 378-1331
Fax: (819) 372-1092

NO.	DATE	REVISION	BY
A	05/13/11	PRELIMINARY	AS

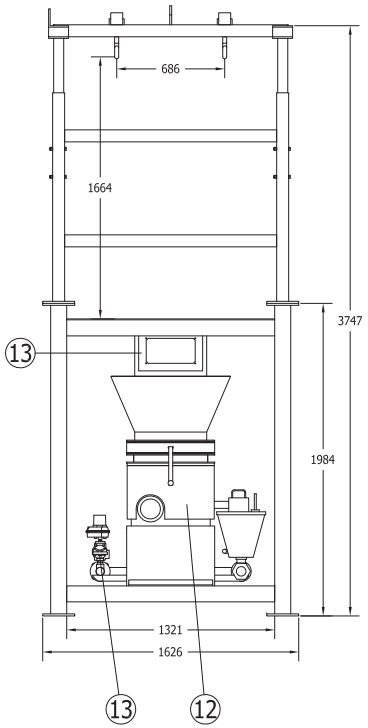
PROJECT: ANGLO AMERICAN CHILE
CUST: CEMI
PRJ No. S11-036
DRAWN: AS DATE: 05/13/11
CHECKED: DATE:
EQUIP No:

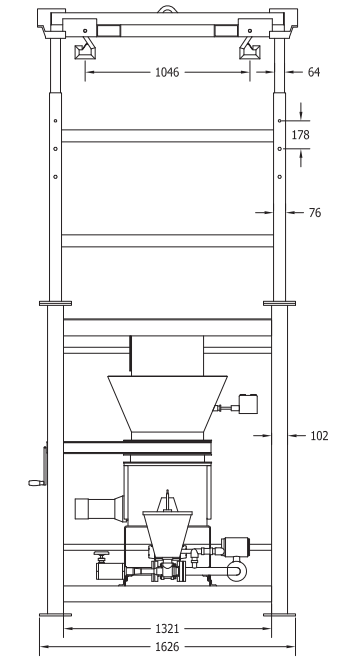
TITLE: DB POLYMER SYSTEM WITH BULK STAND & 20M3 MIX TANK PID

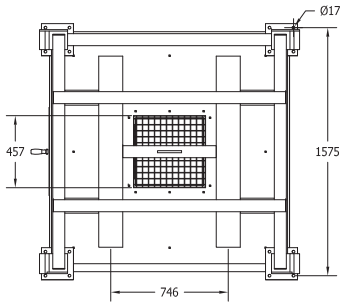
DWG.NO.: DB20-BBS-S PID REV A

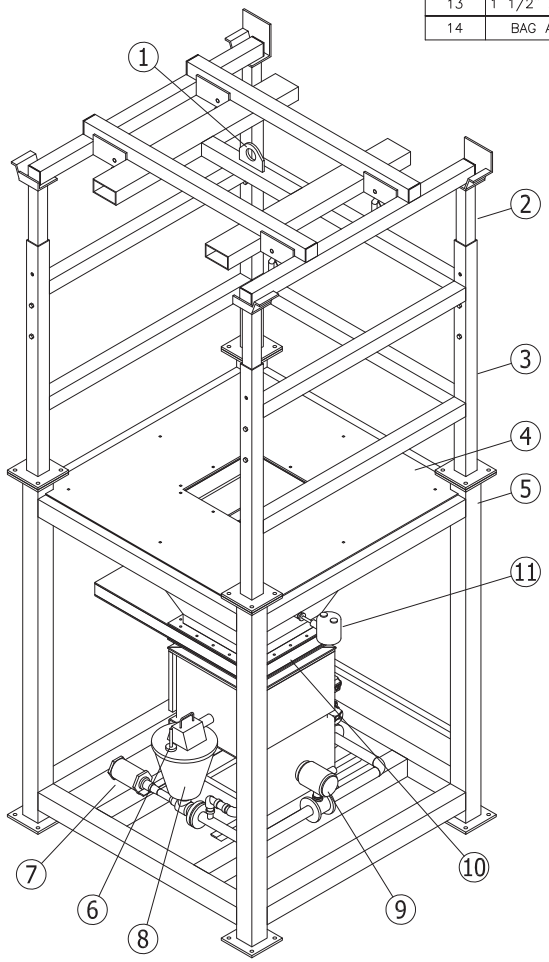
TAG#	DESCRIPTION	MODEL #
1	BAG LIFT/SUPPORT	304SS
2	ADJUSTABLE BAG SUPPORT	304SS
3	UPPER SUPPORT FRAME	304SS
4	1/4" PLATE	304SS
5	LOWER SUPPORT FRAME	304SS
6	CAPACITANCE SWITCH	

TAG#	DESCRIPTION	MODEL #
7	1 1/2" CHECK VALVE	316SS
8	FLOVAC SYSTEM	316SS
9	1 1/2" MAG METER	OPTIFLUX 1300
10	KNIFE GATE	316SS
11	LEVEL TRANSMITTER	
12	SCREW FEEDER	316SS
13	1 1/2" ACTUATED BV SW	316SS
14	BAG ACCESS HATCH	316SS/LEXAN









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NO.	DATE	REVISION	BY
A	04/05/11	PRELIMINARY	GFH

NO.	DATE	REVISION	BY

PROJECT: ANGLO AMERICAN CHILE
CUST: CEMI
PRJ No. S11-036
DRAWN: GFH DATE: 04/05/11
CHECKED: DATE:
EQUIP No:

TITLE
DB DRY SYSTEM
C/W BULK STAND
GENERAL ARRANGEMENT

DWG.NO.: DB-BBS-GA REV A

2525 Place Léon-Trépanier
Trois-Rivières, QC G9A 5E1
Tel.: (819) 378-1331 Fax: (819) 372-1092

To:	**CEMI**	**Date:**	**May 13/11**
Attention:	**Prab Bhatia**	**Email:**	**prab.bhatia@sgs.com**
From:	**Al Struyk**	**Page:**	**5**
Subject	**Anglo American Chile Flocculant System**	**Quote:**	**S11-036**

SNF Canada is pleased to provide the following budgetary proposal:

1.0 Flocculant Mixing System

Model # DB20-BBS Dry Polymer System
Product – TBD
Dry Polymer Consumption - 650 KG/Day
Age Time – 60 Minutes
Process Wetting Water Flow Rate - 378 L/M @ 560 KPA
Concentration – 0.5%
Power Requirement – TBD

1.1 Dry Material Sub-Assembly c/w

- SS Tubular Bulk Bag Support Frame
- SS Intermediate Hopper c/w Bulk Bag Support, Access Door and Level Sensor
- SS Volumetric Screw Feeder
- SNF Canada FloVac Polymer Wetting System

Dilution Water Sub-Assembly c/w:

- 2” Threaded Inlet (Estimated) with Manual Shut Off Valve
- Pneumatic Actuated Shut Off Valve
- Krohne Magnetic Flow Meter - Dilution Water
- Cone Water Piping System w/ check valve
- SS System Check Valve
- All required Pressure Gauges
- SS Frame & Piping System

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1.2 Electrical Panel and PLC

- CSA/UL Certified Nema 4 Enclosure
- Door Interlocked Fused Disconnect Switch
- Allen Bradley Micrologix 1100 PLC
- Allen Bradley Panelview Touchscreen HMI
- Allen Bradley PowerFlex 40 VFD for Screw Feeder
- PLC Surge Protection
- Programming Plug
- Florescent Light
- Allen Bradley Status Lights, Switches & Emergency Stop

1.3 Mix Tank Assembly/Accessories

- 20m³ FRP Tank c/w
  - Vinyl Ester Resin
  - Conically Gusseted Flanges
  - Gusseted Baffles
  - Painted Steel Agitator Support
- 7.5KW Agitator c/w
  - 7.5KW Premium Efficiency Motor
  - Double Helical Gear Reducer 16.5:1 ratio
  - 2.38" 316SS shaft
  - Dual (2) 870mm HYF218 impellers, split hub, 114 rpm
  - SS316 wetted parts
- Krohne Ultrasonic Level Transmitter
- High Level Float Ball Switch
- Isolation Butterfly Valves on Discharge and Drain

1.4 Application Tank Assembly/Accessories

- Due to Size Application Tank to be supplied by others
- Krohne Ultrasonic Level Transmitter
- High Level Float Ball Switch
- Isolation Butterfly Valves on Discharge and Drain

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1.5 Transfer Pump Assembly

Duty/Standby Configuration
Nominal Flow Rate – 23m3/hr

- Qty (2) Progressive Cavity Pumps
  - Cast Iron Casing
  - Stator – BUNA
  - Rotor – Chrome Plated
- 7.5 KW Nord Gear Motor
- Common Suction Sch40 316SS Piping c/w Isolation Valves
- Common Discharge Sch40 316SS Piping c/w Isolation Valves, Pressure Gauges and Pressure Relief Valves
- All the above mounted on a common frame

2.0 Metering Pumps and Dilution Skid

2.1 Metering Pump Assembly

Duty/Standby Configuration
Nominal Flow Rate – 68 LPM @ 5.7 Bar each Pump

Pump Assembly c/w:

- Qty (2) Progressive Cavity Metering Pumps
  - Max Capacity -90LPM @ 5.7 Bar
  - Stator-BUNA
  - Rotor - Chrome Plated
  - Packing Seal
  - 3.7 KW Nord Gear Motor
- Common Suction Piping Sch 40 316SS with Isolation Valves for each Pump
- Common Discharge Piping Sch 40 316SS with Isolation Valves, Pressure Relief, Wika Pressure Gauge with Diaphragm, Check Valves and Krohne Mag Meter

2.2 Dilution Line c/w

Dilution to .05%

- Water Flow Rate 900 LPM
- 3” Air Operated Shut Off Butterfly Valve
- Krohne Magnetic Flow Meter

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- SS Injection Tee & 3" SS Static Mixer
- SS Check Valves on Polymer Solution and Dilution Water Lines
- Piping 316SS Welded Construction

All the above mounted on a 304SS Frame

3.0 Optional

3.1 Dilution Water Booster Pump

- 25m3/hr Vertical Multistage SS Pump
- Mounted on Flocculant Make Down System

TABLE 1 – Flocculant System Details

ITEM #	QTY	DESCRIPTION	PRICE CDN$	TOTAL CDN$
1.0	**1**	**DB20-BBS-AT Flocculant Mixing System**	$209,875.00	$209,875.00
2.0	**1**	**Dual Metering Pump System**	$74,945.00	$74,945.00
		QUOTATION TOTAL		$284,820.00

TABLE 2 – Optional Equipment

ITEM #	QTY	DESCRIPTION	PRICE CDN$	TOTAL CDN$
3.1	**1**	**25m3 Dilution Water Booster Pump**	$4,500.00	$4,500.00
		QUOTATION TOTAL		$4,500.00

TABLE 3 – Packaging, Handling and Shipping

ITEM #	QTY	DESCRIPTION	PRICE CDN$	TOTAL CDN$
4.1	**1**	**Packaging/Crating for Sea Freight**	$11,500.00 estimated	$11,500.00 estimated
		QUOTATION TOTAL		$11,500.00

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TERMS AND CONDITIONS

All Equipment Preassembled Wired & Shop Tested, with Test Results supplied

Delivery: Approx 14 Weeks after Drawing Approval
F.O.B.: Oakville, Ontario
All taxes extra
Terms: - See Attached
Quotation valid 90 days
All systems to be commissioned by SNF Canada approved representative to maintain valid warranty

Warranty is 18 Months from Receipt of equipment or 12 months from Startup, whichever occurs first.

STANDARD TERMS AND CONDITIONS OF SALE – EQUIPMENT

These Standard Terms and Conditions of Sale ("Terms and Conditions") shall apply to all sales of equipment ("Equipment") by SNF Canada Ltd. ("SNF") and an Equipment buyer ("Buyer").

These Terms and Conditions can be changed only by written agreement, duly executed by SNF and the Buyer.

These Terms and Conditions supersede all prior agreements and documents between SNF and the Buyer with respect to the sale of the Equipment.

EXCLUSIVE SUPPLY OF PRODUCT

Subject to the terms of this Agreement, Buyer shall purchase flocculants exclusively from SNF. For greater certainty, but without limitation, during the term of this Agreement, Buyer shall not, except with the written consent of SNF or otherwise in accordance with this Agreement, purchase flocculants for anyone other than SNF.

Notwithstanding the above, the Parties agree that during the term of this Agreement (and renewal or extension periods, if any), Buyer may purchase flocculants from other suppliers such limited quantities of flocculants as are necessary to test such competing products for suitability for use in the Buyer's facilities.

ORDERS FOR EQUIPMENT AND SHIPMENT

Orders for Equipment must be in writing and signed by an authorized representative of the Buyer. Nothing in Buyer's purchase order ("Order") changes any of these Terms and Conditions unless agreed to in writing by SNF. If required by Buyer, SNF will provide the Buyer with preliminary drawings, specifications and/or parts lists (collectively, "Submittals") 4 to 6 weeks after receipt of the Order, which Submittals must be approved by Buyer. SNF expects to ship the Equipment within 8 to 10 weeks after receipt of Buyer-approved Submittals, or after receipt of the Order if Submittals are not required, but the time of shipment is not guaranteed.

FREIGHT COSTS

Terms of sale are F.O.B. point of shipment. Freight costs are not included in the price and will be billed separately. Buyer assumes title and all risks and responsibilities for the Equipment upon shipment.

POINT OF SHIPMENT

Unless otherwise specifically provided in writing, the point of shipment is Toronto, Ontario, Canada.

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2525 Place Léon-Trépanier
Trois-Rivières, QC G9A 5E1
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QUOTE VALIDITY
The price quoted is firm for Orders received within 30 days where SNF anticipates that shipment will be made within 6 months from receipt of Order. If for any reason shipment is anticipated to be later than 6 months from receipt of Order, the price may be adjusted to reflect changes in SNF's costs. All prices are in Canadian dollars.

TAXES
The price quoted does not include any federal or provincial sales tax or other tax, excise or charge imposed or levied by any governmental or taxing authority (other than on income) in respect of Equipment or manufacture, transportation or sale thereof, which amounts shall be added to the price quoted and be payable by Buyer.

TERMS OF PAYMENT
Orders are subject to approval by SNF's Credit Department unless prepaid in full.

Equipment price $50,000 or less:	Payment in full is due within 30 days after shipment of the Equipment.
Equipment price more than $50,000:	Payment is due according to the following schedule: 10% due with the Order; 20% due upon Buyer's receipt of Submittals (or within 30 days after the Order if no Submittals are required); and 70% due upon shipment by SNF

SNF reserves the right to cease production of the Equipment in the event that any payment is more than 30 days past due, and to cancel production of the Equipment if any payment is more than 60 days past due. Buyer shall be responsible for the "Cancellation Cost", as set forth below, if SNF cancels production because of Buyer's failure to make payment when due.

Buyer shall pay interest on all payments more than 30 days past due at a rate per annum equal to 1-1/2% per month, or 18% per annum, to be calculated and payable monthly on the last day of each month. All such interest shall accrue up to and after maturity, default, demand and judgment.

PRICE ADJUSTMENT
The price herein specified may be revised by written notice sent by SNF to Buyer not less than fifteen (15) days before the effective date of such revision. Buyer's failure to deliver to SNF a written notice of objection to the proposed price revision before the effective date thereof shall be considered acceptance of such revision. Failure of Buyer and SNF to agree on a proposed price revision after such notice by SNF releases SNF without

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obligation and permits Buyer to purchase elsewhere the Equipment or related products required thereafter. If any law, regulation or order from a competent government or judicial authority prevents SNF from revising any price of particular goods, SNF shall have the right to terminate its obligations to supply such goods to Buyer.

LIMITED WARRANTY

The Equipment is warranted for a period of one year from date of shipment ("Warranty Period") to be free from defects in material and workmanship under normal use and service. If Buyer notifies SNF in writing of any such claimed defect in the Equipment during the Warranty Period and if, after appropriate tests and inspection by SNF, the Equipment is found to be defective in material and/or workmanship, SNF will, at its expense, provide a replacement.

This warranty does not cover:

- Equipment defects not reported to SNF within the Warranty Period.
- Equipment failures or damage due to neglect, accident, intentional damage, or improper storage, use or maintenance procedures.
- Equipment that has been altered in any way without the prior written consent of SNF.
- Damaged Equipment or lost components to the extent such damage or loss is caused by or incurred during shipment.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO ITS TERMS. SNF MAKES NO WARRANTY OF MERCHANTABILITY OR OF SUITABILITY OR FITNESS OF THE EQUIPMENT FOR ANY PARTICULAR USE. SNF shall in no event be liable for loss, damage, injury, or expense resulting directly or indirectly from the ownership, installation or use of the Equipment, nor for any consequential or special damages. SNF's total liability to Buyer, whether under this warranty or otherwise, shall be limited to the cost of the Equipment. All limitations on SNF's warranty shall survive the expiration, termination or cancellation of related sales.

TECHNICAL ADVICE

Any technical advice furnished by SNF is given without liability or obligation for the advice given or results obtained, all such advice being given gratis solely at Buyer's risk.

CANCELLATION

In the event of cancellation or partial cancellation by the Buyer, the Buyer agrees to confirm the cancellation in writing. Buyer shall reimburse SNF for all actual costs, damages and obligations incurred prior to receipt by SNF of the written notice of cancellation, including, but not limited to, engineering and fabrication costs, including labor, shipping costs and the costs of materials purchased for use in manufacturing the Equipment, plus a 10% administrative fee (collectively, "Cancellation Cost").

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AFTER RECEIPT OF EQUIPMENT
After receipt of Equipment, Buyer shall have 5 days to notify SNF of any missing or damaged components. If, after appropriate investigation, it is determined by SNF that the components were damaged or missing prior to shipment, SNF will, at its expense, provide a replacement(s). If the loss or damage occurred during shipment, or if the loss or damage is not reported to SNF within 5 days, SNF is not responsible. After receipt of the Equipment, but prior to full and final payment by Buyer, SNF shall maintain a purchase money security interest in the Equipment.

RETURNED EQUIPMENT
All sales are final. Buyer shall not return custom Equipment or used, non-defective Equipment to SNF under any circumstances.

Buyer shall not return any Equipment (even if defective) without the prior written permission and shipping instructions from SNF.

Standard, unused, non-defective Equipment that is returned with SNF's prior written permission shall be shipped "FOB destination" at the Buyer's sole cost and expense, including, but not limited to, a 25% restocking fee, plus all necessary costs and expenses incurred in restoring or retrofitting the Equipment to saleable condition. All returned Equipment must be clean and free from chemicals, failing which SNF may refuse delivery.

FORCE MAJEURE
SNF shall not be liable for any loss, claim or damage, whether direct, indirect, consequential or otherwise, resulting from or related to a delay or inability to produce or deliver the Equipment caused by war, civil or military action, fire, embargo, flood, strikes or other labor difficulty, riot or civil commotion, inability to obtain materials, casualties, damage or delays in transportation, or any other circumstances beyond its control.

EXCLUSIONS
All prices quoted are:

- for Equipment supply only - NO installation is included;
- exclusive of export crating or duties, if applicable, unless otherwise noted;
- exclusive of interconnecting piping, wiring or conduit, or other non-integral parts; and
- exclusive of access platforms, except where noted.

CONFIDENTIALITY AND INTELLECTUAL PROPERTY
Buyer acknowledges that the information SNF submits to the Buyer in connection with the proposal or resulting order includes confidential and proprietary information that Buyer agrees not to disclose to any other party without the prior written consent of SNF.

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Trois-Rivières, QC G9A 5E1
Tel.: (819) 378-1331 Fax: (819) 372-1092

Buyer acknowledges that all designs, drawings, specifications, submittals and other materials (other than the Equipment itself) arising out of the design and/or production of the Equipment remain the exclusive property of SNF and that Buyer's purchase of the Equipment does not authorize Buyer to copy, remanufacture, or otherwise replicate the Equipment in any form whatsoever.

SERVICES
Included with this quote, SNF will provide 2 days of assistance with the installation and "Start-up" of the Equipment. Buyer must provide all materials and labour (other than SNF's assistance) necessary for the installation and Start-up. Room, board and travel expenses will be billed at cost. Additional service is billed separately by SNF at $650 per day (including any partial days), plus room & board, travel expenses and other necessary expenses.

RESALE OF GOODS
No goods or equipment purchases by Buyer from SNF shall be resold by Buyer bearing the name or trademark of SNF or any of its affiliates without the prior express written consent of SNF.

NO ASSIGNMENT
Buyer may not assign its rights or delegate the performance of its obligations without the prior written consent of SNF. Any purported assignment in violation hereof is void.

NO THIRD PARTY BENEFICIARIES
Nothing in these terms and conditions shall be construed as creating direct or beneficial rights in or on behalf of any third party.

SEVERABILITY
In the event any provisions of these terms and conditions are held invalid or unenforceable by any court of competent jurisdiction, such holding shall not invalidate or render unenforceable any other provisions hereof.

APPLICABLE LAWS
All sales shall be governed by and construed in accordance with the laws of the Province of Ontario and federal laws applicable in that province. Any and all disputes between SNF and Buyer shall be resolved exclusively before the competent Court in Ontario.

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2525 Place Léon-Trépanier
Trois-Rivières, QC G9A 5E1
Tel.: (819) 378-1331 Fax: (819) 372-1092

9588 Milwaukee Way
Prince George, B.C.
V2N 5T3
Ph. 250-561-1121
Fax 250-561-0954

NORTHERN STEEL LTD. **ISO 9001**

www.northernsteelltd.com

May 13, 2011

SGS Canada Inc.
1636 West 75 Ave
Vancouver B.C.

Attention: Prab Bhatia
Re: Process Tanks **NSL Quote # 2207-05-11**

Thank you for the opportunity to provide our pricing for the above noted project. Please accept this letter as our quotation for this project in accordance with the specification received by email: May 9th .

Total Cost for One 2.5m Diameter Tank (T1)…….$39,500.00 CDN LOT
Total Cost for Two 11.5m Diameter Tanks (T2, T3) .....$450,000.00 CDN LOT

1. Description of Scope of Work:

- No NDE or painting is included.
- Engineering and detailing is included.
- Any changes in the scope of work may result in cost impacts.
- All welding will be as per ASME Sec 9.
- The above pricing is based on a full order and is budget within +/- 20%.
- Quote is based upon current material pricing and is valid for 30 days.
- No restriction on country of origin or manufacturer of materials has been allowed for.
- All taxes are extra. All prices are Canadian dollars.
- No pumps included.
- Includes manways in 11.5m diameter tanks.
- Includes required nozzles and lip around tanks.

2. Delivery and Lead Time

- Allow 20 weeks from receipt of Purchase Order to completion.
- All pricing is FCA Northern Steel LTD. Prince George B.C.

3. Proposed Payment Terms

- 10% upon receipt of PO, 30% upon receipt of materials, and monthly progresses based upon project completion percentage.

We trust that the above information satisfies your Request for Quotation for this project. Should you have any questions or concerns, please do not hesitate to contact our office. We would like to thank you again for considering our firm for quotation on this project and we look forward to assisting SGS Canada Inc. in any way possible.

Sincerely,
Mike Connor
Project Manager
NORTHERN STEEL LTD.

Memorandum

DATE:	April 18, 2012	Refer to File No.: Document1
TO:	Clem Pelletier	
FROM:	Gerry Papini	
COPY:	Paul Greisman, Bob Askin	
SUBJECT:	KSM Water Treatment Plant: Proposed Layout and Costs for Sludge Disposal Facility	

1. Introduction

Acid Rock Drainage from the mine site area will be treated by lime neutralization with the precipitate thickened in High Density Sludge (HDS) thickeners. Rescan was asked by Seabridge to develop a process for further dewatering the sludge to produce a manageable dry filter cake. The sludge filter cake is to be stored in a landfill during the last 3 years of the construction phase of the project. It is assumed that during the operation phase, the sludge filter cake materials will be conveyed to the process plant with the ore, some 26 km away. The materials will then report to the ore stockpile and proceed through the mill for eventual storage in the tailings management facility. At closure the sludge will be stored on the waste rock dumps at the mine site. The design, operation and monitoring of the small landfill will provide a basis for the long term storage of the sludge during closure. Preliminary costs have been prepared for dewatering the sludge, warehousing the dehydrated material during the winter (7 months), as well as re-handling and disposing the material to a landfill during the summer. Photos taken at the Britannia Water Treatment Plant are provided at the end of this memo for illustrative purposes.

2. Sludge Dewatering and Storage

2.1 Dewatering and Storage during the last three years of 5 year construction period

Based on SGS's test work, the mass flow at the HDS thickener (20% solids w/w and 80% water concentration for the first ten years of operation), is estimated to be 100 tonnes per day of dry solids. This amount was adopted for design purposes. In addition, the clarifier underflow will have solids concentration of approximately 20%, with the specific gravity of the solids in the sludge of the clarifier underflow estimated at 1.8.

2.2 Proposed treatment and handling

Sludge from the HDS thickeners will be dewatered in standard plate filter presses producing a cake. The filter presses will be located in the water treatment plant building. During construction of the

project, the sludge will be stored between October 15th and May 15th and will be placed in a landfill for the remaining months. Stored filter cake will be re-handled and loaded on trucks for transport to the landfill during the summer season.

2.3 Agitated storage tanks

The clarifier underflow will be stored in two 250 m^3 agitated storage tanks for feed to the plate filter presses. The tanks will be designed to hold 1 days' worth of clarifier underflow. The HDS sludge in the tanks will be pumped to the filter presses for dewatering.

2.4 Filter Presses

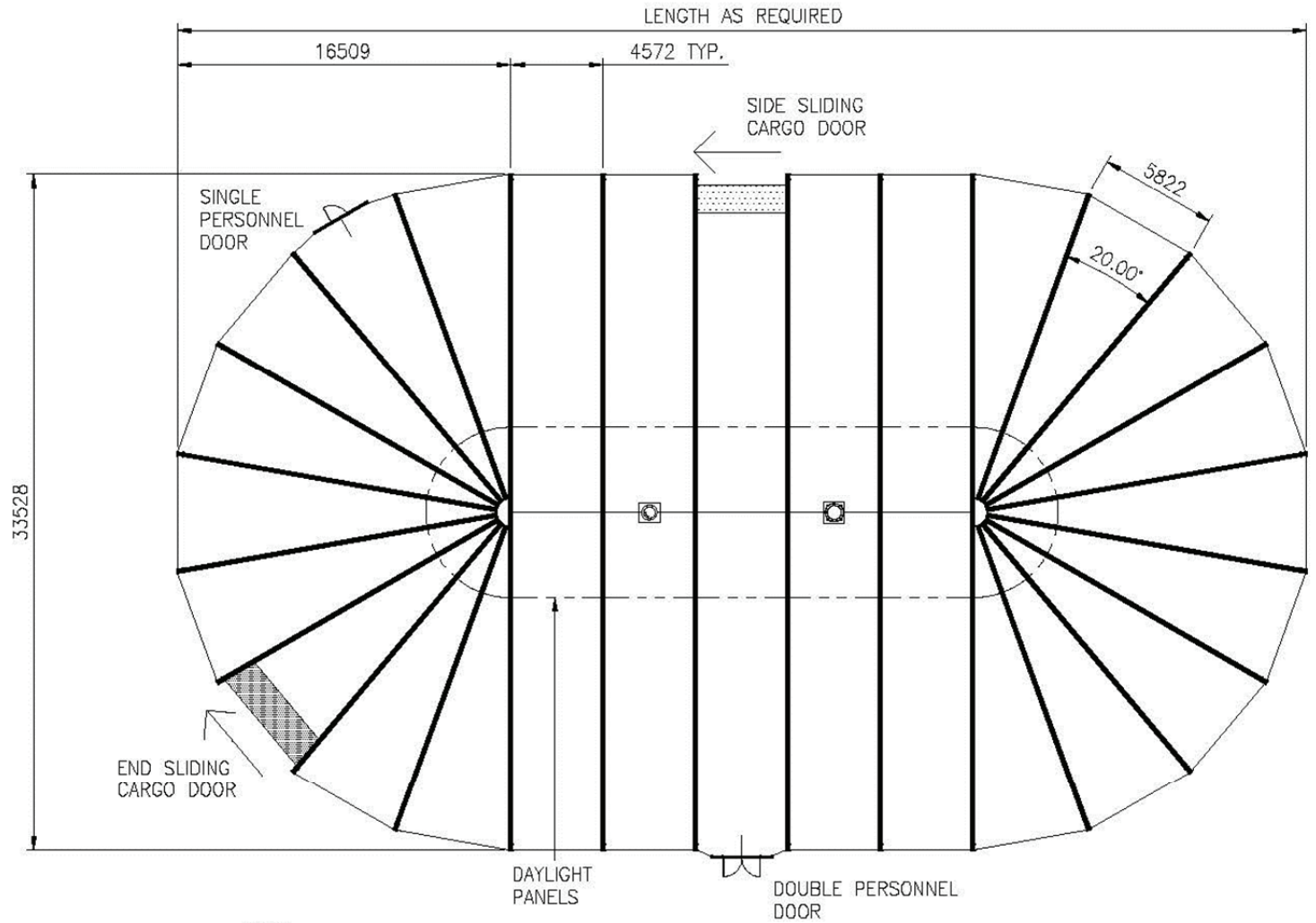
The projected HDS underflow to the filter press is a maximum of 19 m^3/hr or 456m^3/day. The filter presses will be operated at a rate of 45 to 55m^3/hour for 8-10 hours during a 24 hour period. Two filter presses will be required with a third filter press on standby; thus a total of three filter presses are required. Each press will contain approximately 80 plates for solids filtering. There will be two products leaving the filter press: water which will be returned to the process and a sludge cake which will be stored in a landfill or transported to the plant site on the ore conveyor.

The volume of cake depends upon the free water content. Assuming that the filter presses reduce water content from 80% to 40%, the 100 tonnes per day of dry of solids will produce 167 tonnes per day of filter cake. The SG of the cake is estimated to be approximately 1.4, so that 121 m^3/day of filter cake will be produced (one cubic metre of filter cake which will have a mass of 1400 kg) per day. The filter presses will be elevated, and the filter cake would drop from the presses into the box of an end dump truck. The truck will transport the filter cake either to the landfill in summer or to the covered storage area in winter. During operations the filter cake will be transported by truck and deposited on the ore conveyor belt located at the tunnel entrance.

2.5 Winter Storage Building

Winter storage will be required for 7 months or 212 days of production. This period requires approximately 25,700 m^3 of filter cake storage capacity. The filter cake will be end dumped on the floor of the building and stacked with a wheeled loader. A dry storage building capable of accommodating at least 25,700 m^3 of filter cake stacked up to 3.0 m high will require a foot print of 8,700 m^2. The area would be enclosed within a "Sprung" building measuring 30 m X 328 m. See attached Figures 1 and 2. The Sprung™ building could be located adjacent to and upslope of the water treatment plant. See Figure 3 for a layout of the sludge storage building.

It might be desirable to heat the building to prevent freezing of the cake, but at this time we have not included the cost of heating. The roof will need to shed snow and the 26 degree slopes of the Sprung buildings are specifically designed for this purpose.



PLAN VIEW
1:300

Figure 1

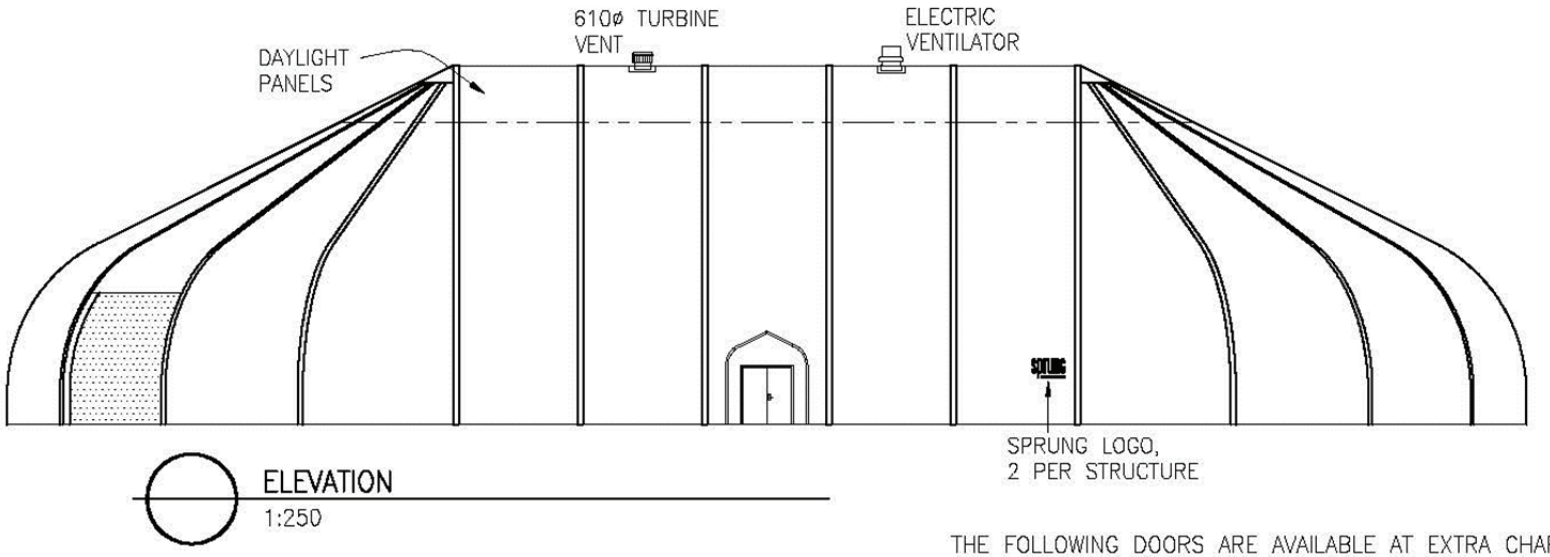
SIGNATURE SERIES

sprung

33.5m WIDE
STRUCTURE W/ROUND ENDS
4.5m OC

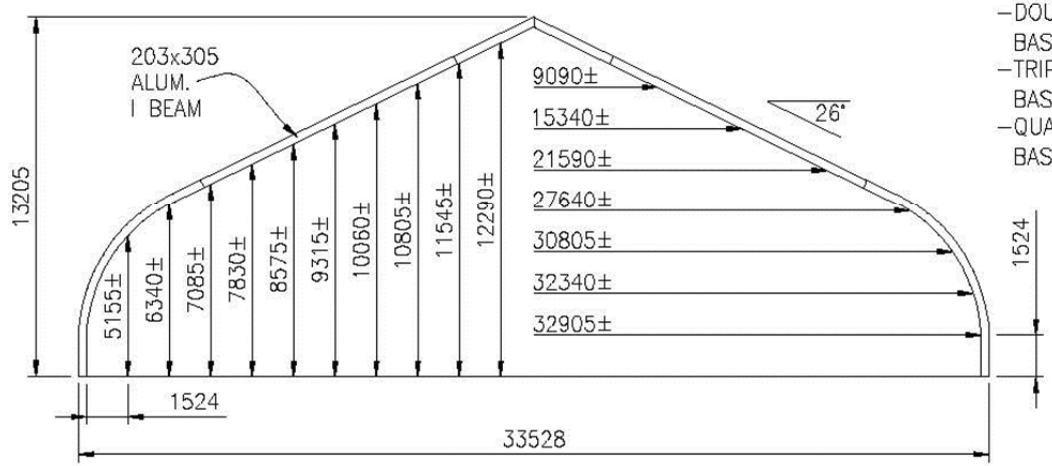
DATE	SCALE
03/23/2012	AS NOTED

DRAWING #
110 RE SALES METRIC A



ELEVATION
1:250

THE FOLLOWING DOORS ARE AVAILABLE AT EXTRA CHARGE:
- SINGLE PERSONNEL DOOR 914w x 2134h (C/W 3048 HOOD)
- DOUBLE PERSONNEL DOOR 1829w x 2134h (C/W 3048 HOOD)
- SIDE SLIDING CARGO DOOR 4369w x 5486h
- END SLIDING CARGO DOOR TOP 4877w, BASE 5512w x 5486h
- DOUBLE PANEL ROLLING DOOR TOP 2743w, BASE 11074w x 10719h (SEE DPRD-110)
- TRIPLE PANEL ROLLING DOOR TOP 3785w, BASE 16281w x 10897h (SEE TPRD-110)
- QUADRUPLE PANEL ROLLING DOOR TOP 4928w, BASE 21006w x 10897h (SEE TPRD-110)



SECTION 33.5m STRUCTURE
1"=20'-0"

Figure 2

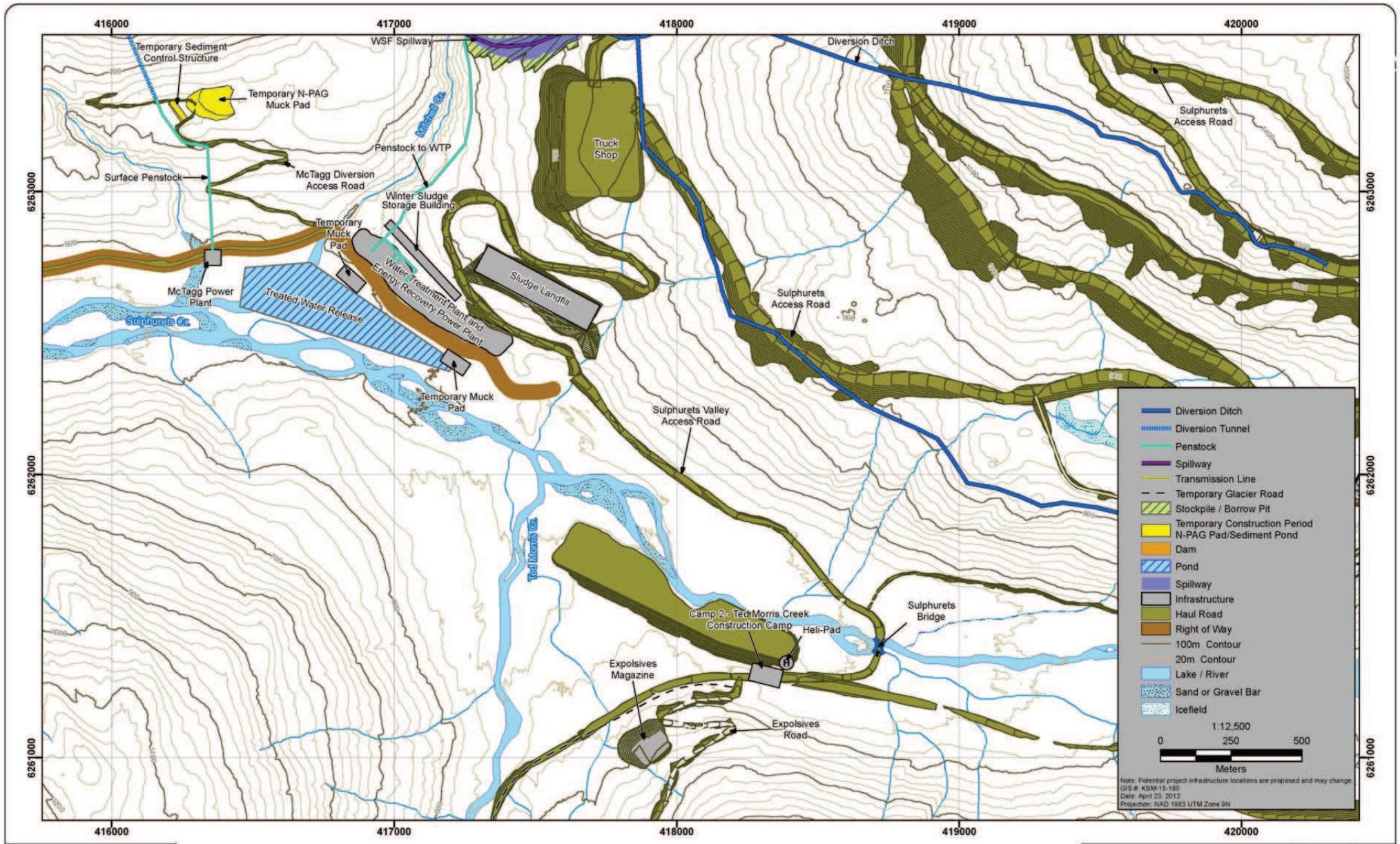
SIGNATURE SERIES

sprung

33.5m WIDE
STRUCTURE W/ROUND ENDS
4.5m OC

DATE	SCALE
03/23/2012	AS NOTED

DRAWING #
110 RE SALES METRIC B



SEABRIDGE GOLD
KSM PROJECT

Figure 3

Rescan™ Engineers & Scientists

Location of Sludge Warehouse and Landfill Site

3. Sludge Disposal

The sludge will be disposed of in a proposed landfill structure that has been designed to accommodate three years of sludge production or about 135,000 m^3 in total. The planned landfill design is based on the following dimensions: a length of 450 m, a width of 110 m and final height of approximately 9.5 m. This includes a 1.0 m compacted foundation base, three lifts of 2.5 m deep composite fill layers, as well as a closure cover of 1 m (see Figures 4 and 5). The estimated volumes and areas of the landfill materials are listed in Table 1.

Table 1: Volume of Landfill Construction Materials

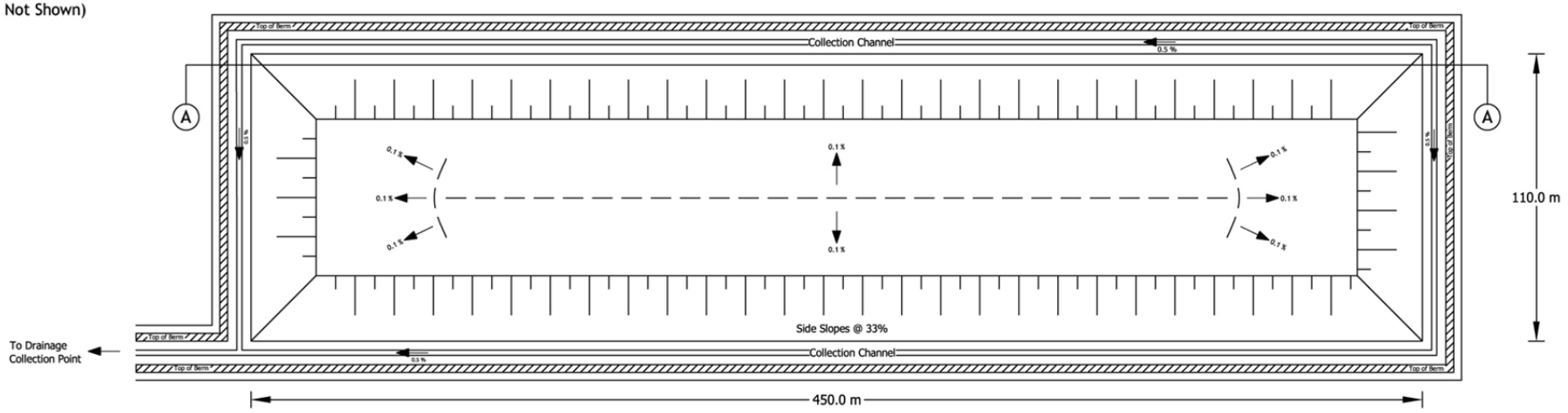
Construction Material	Volume (m^3)	Area (m^2)
Filter Cake	135,500	
Colluvium / Till (landfill between cake)	48,000	
Sand (liner bedding and cover material)	56,000	
Landfill Base (compacted colluvium / till)	51,200	
Filter (gravel) material	3,500	
Waste rock (NPAG)	37,500	
Cover (closure) material	55,000	
Geogrid	n/a	100,000
Geomembrane	n/a	100,000

The conceptual layout for the sludge disposal will be located on the hillside upslope of the water treatment plant (Figure 3). Approximately 5 m of colluvium material is anticipated in this area (Frontier Geoscience seismic survey), so some rock excavation will be required to establish the site. The slope has up to 20% gradient in this area. The landfill base should be gently inclined (~2%) to limit ponding. The base of the landfill will comprise a 1m-thick base of compacted colluvium/till or bedrock. The landfill will be constructed with 2.5m-high NPAG (non-acid generating) waste rock lifts. The lifts are specified at 3:1 slope on the downstream side and 1:1 slope on the upstream side but this may change as a result of geotechnical engineering assessment. The waste rock should be screened to exclude very large pieces (e.g. >500 mm) and compacted with a vibratory roller. A filter (gravel) layer is proposed (at ~ 0.5 m thick) on the upslope face between the waste rock and the filter cake / colluvium fill materials (see Figures 4 and 5).

The sludge filter cake stored in the Sprung™ building, as well as ongoing production from the WTP will be trucked to the landfill site during the five month summer period. It will then be dumped and spread with a wide track Dozer (Cat D6) in lifts not greater than 0.7 m. The inter-bedded 0.5 m-thick granular layer (till mix / colluvium) will subsequently be spread over the sludge filter cake layer and nominally compacted (roller) before adding the second filter cake (0.7 m-thick) layer.

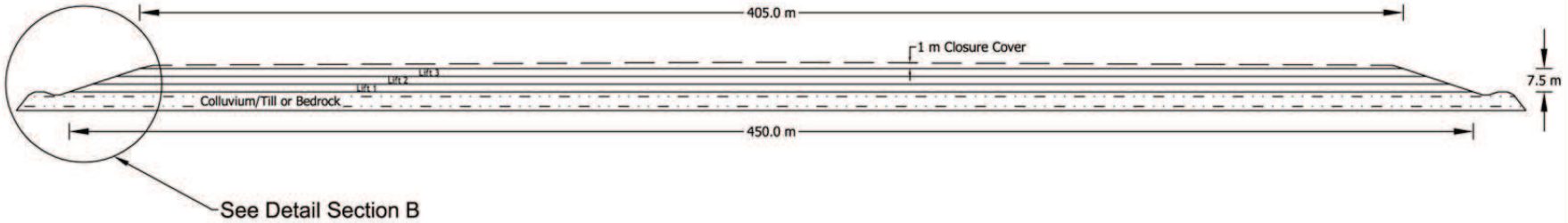
Plan View

(Access Routes Not Shown)



1:1500 m

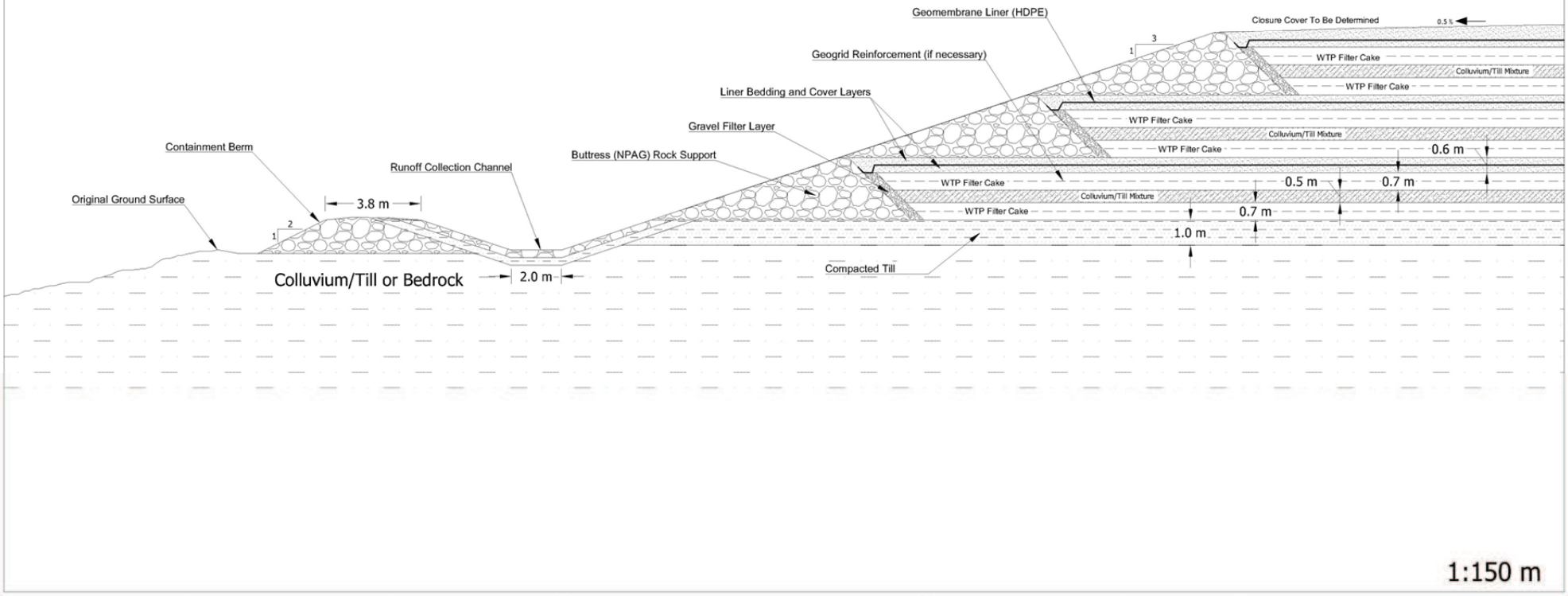
Section A-A



1:1250 m

Rescan ENGINEERS + SCIENTISTS	Kerr-Sulpurets -Mitchell Project	SEABRIDGE GOLD	KSM Water Treatment Plant Sludge Management	This drawing is for planning purposes only. Not responsible for any design and construction completed by others	Figure 4	Conceptual Layout for Landfill Structure - Plan View and Section A-A
				SCALE: As Shown	DATE: April 18, 2012	TITLE:

Detail Section B



Rescan ENGINEERS + SCIENTISTS	Kerr-Sulpurets -Mitchell Project	SEABRIDGE GOLD	KSM Water Treatment Plant Sludge Management	This drawing is for planning purposes only. Not responsible for any design and construction completed by others. SCALE: As Shown	CAD/GIS No: Figure 4 DATE: April 18, 2012	TITLE: Detail Section B for Landfill Structure

Compaction of the sludge filter cake layers (in addition to dozer tracking activities) may not be advisable because of potential liquefaction or other unforeseen physical changes to the material. A geogrid reinforcement layer has been provided to increase the shear strength and load bearing capacity of the sludge filter cake layers (if necessary). Further geotechnical engineering evaluation of the physical properties and load bearing capacity of the sludge filter cake materials is recommended (see Figure 5).

The landfill is designed to accommodate approximately 45,000 m^3 of sludge filter cake each year in two 0.7m lifts with an inter-bedded 0.5m-thick granular layer for strength (Figure 4). Since the composition of the filter cake will consist of a potentially soluble materials (metal hydroxides and gypsum respectively), water management within the landfill is expected to be important. Each year the landfill will be '*closed*' for the winter period by covering the landfilled materials with a geomembrane to exclude moisture penetration. The geomembrane (e.g. HDPE) will be installed on a 300 mm bedding layer (sand) and covered with a further 300 mm of cover material (sand) to conclude the annual landfilling operation. A geogrid is also proposed to provide overall strength and trafficability on the landfill.

Accumulated snow will need to be managed during spring melt. An open channel at the toe of the deposit will be built to convey run-off towards the WTP. Closure of the facility has not been determined, but should include re-use of stockpiled soil and colluvium to reclaim the surface and slopes of the facility. At this time, a 1.0 m-thick soil cover has been included in the conceptual layout for costing purposes (see Figures 4 and 5).

The fill structure could be instrumented with settlement plates, strain gauges, and vibrating wire piezometers etc. to assess the performance of the sludge materials over time. Piezometers should be installed down gradient of the landfill to monitor the effect of any seepage to groundwater quality.

4. Preliminary Costs

Preliminary capital and annual operating costs have been prepared using estimated values from suppliers, calculated cut-and-fill volumes, as well as professional judgement (Table 2). Capital costs include filter presses and support structures; Sprung™ building and erection costs; a loader, dozer and three 10 tonne trucks; landfill preparation and material costs; open channel to convey run-off to the WTP, as well as closure costs. Operating costs include manpower (including accommodation); parts, fuel, water quality monitoring and landfill instrumentation.

Table 2: Preliminary Capital and Operating (During Construction and Operation) Costs

KSM Sludge filtering and storage costs					
Capital Costs					
ITEM	**Quantity**	**Unit**	**unit cost**	**Item cost**	**Source**
Agitated sludge storage tanks 8 x 5	2	ea.	$150,000	$300,000	est.
Filter presses	3	ea.	$350,000	$1,050,000	Fox fluid power
Filter press hopper and support structure	3	ea.	$50,000	$150,000	MM
Site prep for Sprung building	50,000	m3	$6	$300,000	Rescan
Sprung building for 7 mo. storage	1	ea.	$3,371,604	$3,371,604	Sprung
Erection of Sprung building 24 men, 92 days	17,664	hours	$100	$1,766,400	Sprung, MM
Shipping	1	lot	$59,500	$59,500	Sprung
Accommodation for erection crew	2,208	days	$260	$574,080	Highway camp rate
Lock blocks and paving	1	lot	$200,000	$200,000	Rescan
Loader at storage building	1	ea.	$178,000	$178,000	CAT 930 H
Trucks to haul filter cake	3	ea.	$200,000	$600,000	est.
Site prep for landfill (450 x 110 m)					
Soil strip and stockpile	272,250	m3	$2	$544,500	area plus 10%, 5 m thick colluvium
Cut	225,000	m3	$10	$2,250,000	volume Moose Mountai, rate Rescan
Fill	284,000	m3	$6	$1,704,000	volume Moose Mountain rate Rescan
Colluvial till - place, spread and roll	51,200	m3	$6	$307,200	Rescan
Berm - 2.5 m waste rock lifts and compact	37,500	m3	$10	$375,000	Rescan
Sand - bedding layer / filter layer	56,000	m3	$12	$672,000	Rescan
Grave filter layer	3,500	m3	$15	$52,500	Rescan
Dozer at Landfill	1	ea.	$295,000	$295,000	CAT D6
Instrumentation including settlement plates, vibrating wires, etc..	1	lot	$100,000	$100,000	Rescan
Channel from landfill to WTP	1	ea.	$250,000	$250,000	Rescan
Closure Cost - colluvium place, spread and roll - landform	56,000	m3	$10	$560,000	Rescan
TOTAL CAPITAL COST				**$15,659,784**	
Operating costs					
DURING CONSTRUCTION					
ITEM	**Annual q't'y**	**unit**	**unit cost**	**Annual Cost**	
Filter presses					
operator	3650	hrs./yr.	$100	$365,000	MM
parts	8%	capital		$84,000	est.
Loader and Dozer operators	4137	hrs./yr.	$100	$413,667	MM
Loader, Dozer Fuel, maintenance	517	days	$100	$51,708	MM
Truck operators	5353	hrs./yr.	$100	$535,333	MM
Truck fuel maintenance	669	days	$100	$66,917	MM
Land fill yearly materials	1	lot	$100,000	$100,000	Rescan
Geogrid	33,000	m2	$5	$165,000	Rescan
Geomembrane 80 mil HDPE	33,000	m2	$10	$330,000	Rescan
Accommodations for operators	1643	days	$260	$427,050	Highway camp rate
Monitoring and analytical costs	1	lot	$50,000	$50,000	Rescan
TOTAL ANNUAL OPERATING COST DURING CONSTRUCTION				**$2,588,675**	
DURING OPERATIONS					
Filter presses					
operator	3650	hrs./yr.	$100	$365,000	MM
parts	8%	capital		$84,000	est.
Loader operator	2920	hrs./yr.	$100	$292,000	MM
Loader fuel, maintenance	365	days	$100	$36,500	MM
Truck operator (to conveyor)	2920	hrs./yr.	$100	$292,000	MM
Truck fuel maintenance	365	days	$100	$36,500	MM
Accommodations for operators	1186	days	$260	$308,425	Highway camp rate
Monitoring and analytical costs	1	lot	$50,000	$50,000	est.
TOTAL ANNUAL OPERATING COST DURING OPERATION				**$1,464,425**	

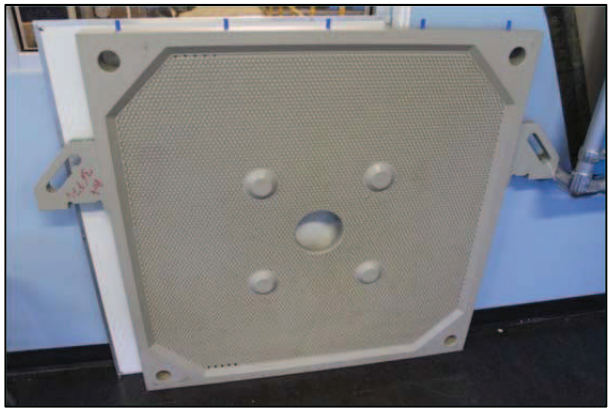
Photos from Britannia Water Treatment Plant

20 Plate Filter Press

Close-up Filter Press Plate Hangers

Filter Cake Off Press

Truck Under Filter Press Dumper



Filter Plate

Filter Cloth

Photos from Britannia Water Treatment Plant

Close-up of Filter Cake

Sludge Filter Cake: 40% Moisture

Sludge Storage Building at Britannia

Front View of Sludge Storage Building at Britannia

Truck Dump Load of Sludge

Sludge in Building at Britannia