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FEASIBILITY STUDY REPORT
ASSAREL MEDET JSC COPPER MINE
BULGARIA

Prepared for:

Assarel Medet JSC.
Bulgaria, 4500 Panagyurishte

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April, 2003
SRK Project No. 141701

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ASSAREL MEDET JSC FEASIBILITY STUDY

EXECUTIVE SUMMARY

SRK was commissioned in February of 2002 to complete a review and improvements feasibility study for the Assarel Medet JSC Copper Mine in Bulgaria. The Feasibility Study was funded by the US Trade and Development Agency. SRK completed the review of the mine mill and operation in June, and subsequently developed this feasibility study identifying and quantifying the improvements that can be made. Our proposed modifications are grouped into two production scenarios: 11, and 12 million tonnes of ore per year. We have focused the Feasibility Study proposed alternatives upon areas in the operation that we believe are bottlenecks, as well as areas that represent opportunities for improvement in production, and reduction in operating costs. We believe that there is a significant opportunity to increase the throughput to the higher rate of 12 million tonnes of ore per year with the related increase in copper production of the mine and mill with minimum relative capital investment.

In the preparation of this report, SRK has pointed out areas where improvements can be made, and specifically in mine planning, we have made the assumption that the improvements will be made, and that the more aggressive approaches can therefore be achieved.

SRK believes that it is possible to produce more copper at a higher recovery rate, for less cost at Assarel Medet than is being experienced in the current operation. A good portion of being able to achieve these improvements lies in simply understanding that it is possible. It is for this reason, that SRK organized the visit to the US copper mines by the Assarel Medet personnel, to view first hand other operations that provided examples of some of the proposed alternative approaches to mining and milling operations.

Mining Review

SRK has found that there are improvements in slope angles within the pit that can be achieved through appropriate dewatering efforts, and this will enhance the mining operation, allowing for economic mining of ore, while reducing the stripping ratio.

We have developed a 3-dimensional geologic model from the drilling data from the mine, and prepared several electronic mine plans based upon varying parameters for the mining operation. With the most aggressive pit slopes (based upon dewatering of the pit), the Assarel Medet Mine can economically mine 172 million tonnes of sulphide ore, and 40 million tonnes of oxide ore (from January 2002 to the end of mine life). This is a reduction from the stated sulphide ore reserves from the Geotechmin Report of 2001, and an increase in the stated oxide reserves from the same report. The reason for the reduction lies in the definition of "economic" used by the electronic model, versus that used by Geotechmin in their previous studies. SRK's resultant grade of ore being mined was 0.486% copper, while that of Geotechmin was 0.455% copper. We have also recommended and included in the Feasibility Study, the use of an automated surveying system using lasers and prisms to monitor the pit slope movement, and allow for management of these slopes. The keys to higher angles on the pit slopes are the continuous monitoring of these slopes, as well as the rigorous hydrologic de-watering of the pit.

SRK's review and recommendations for the mining fleet include a gradual change to larger equipment, with the optimum fleet being 136 mt trucks and 15 m3 shovels. This equipment will improve productivity and capacity, thereby reducing the cost of mining. We are recommending that this shift be accomplished as the older equipment currently in the fleet is retired, with the first equipment being purchased in 2004.

SRK also recommends that a significant effort be initiated to complete the preventive maintenance program, which was started in 2002. Once this program has been completely implemented, and is the standard for maintenance of mining equipment, Assarel Medet should then transition into predictive maintenance programs. These two programs will allow for significantly longer life of the equipment used in mining than has been experienced to date.

Process Review

The processing review conducted by SRK included a review of every stage of processing, and revealed that an increased throughput rate in the mill can be achieved with minor capital investment. In addition, SRK has shown through testing, that improved recoveries can also be achieved with. Areas where we have provided recommended changes in this Feasibility Study include:

- Automation of the milling and flotation operations
- Modification of the disintegration (SAG and autogenous mill) scheme
- Modification of the Cyclones to improve availability, wear, and densities
- Modification of the Ball Mills to incorporate steel liners, new sumps and pumps, and change of the rotation speed
- Modification of the reagent addition system to allow for accurate, measured and automated reagent addition.
- Modification of the flotation system to change out the current agitation mechanisms to Denver mechanisms, automated control of the Ph, and floating at a higher solids density of 35%.
- Modification of the thickening of the concentrate to include a spray bar, and the addition of a reagent to break down the froth.
- Thickening of the tailings to allow for recovery of process water in close proximity to the concentrator, avoiding pumping costs for this water back from the tailings dam.

In addition, SRK has prepared a trade-off study to investigate the potential opportunities of either an SX/EW operation or an H2S precipitation operation at Assarel Medet.

Geotechnical Review

SRK's review of the geotechnical areas of the mine and plant revealed the necessity to dewater both the tailings dam and the waste dump. Both of these areas have high phreatic surfaces, which could pose a danger in a zone as seismically active as the Assarel Medet area. SRK has provided detailed recommendations regarding the specific requirements for the next steps towards dewatering of these two areas, in order to provide improved tailings dam and dump stability for the future.

Implementation

SRK has provided details of how the implementation of these recommendations can take place. Since these changes are fairly fundamental, the existing staff at Assarel will require some technical help in the implementation stage. SRK is prepared to assist Assarel Medet in the implementation of these changes, and we have provided a summary of the proposed personnel, costs and timing which we would recommend for implementation.

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1.0 PROPOSED MODIFICATIONS

SRK and Assarel management personnel met in Tucson Arizona to discuss the various alternatives that may improve the Assarel Medet operation. The scenarios investigated include 11 million tonnes of ore per year, and 12 million tonnes of ore per year.

It should be noted that each of the proposed alternatives / upgrades is defined for each of the throughput scenarios, although most of the alternatives / upgrades are included in all of the scenarios. SRK believes that most of these recommended changes will be required to improve Assarel's operation for each of the scenarios listed.

1.1 Mining

SRK approached this feasibility study by developing scope definition, conceptual capital and operating cost pricing for each of the alternatives, and like building blocks, the scenarios either include or exclude the individual alternatives. In some cases, the alternatives change slightly with the change in throughput for the scenario (such as mining fleet). The assembly of the alternatives included in each scenario allows for a summation of capital cost. Operating costs have been evaluated, and analyzed for each scenario.

The mine operations have been examined to determine the best operating practices going forward for the Life-of-Mine at Assarel. A detailed pit design was constructed from the 'achievable case' Whittle pit shell based on the following design parameters:

- Haul Road Width: 24m
- Ramp Grade: 10m
- Berm Width: 10m
- Bench Height: 15m
- Bench Face Angle: 60°

The final design has resulted in a pit that is the basis for reserve reporting. The pit bottom is the 555m level, the same as that for the Contour B pit prepared previously by Assarel Medet consultants, but contains approximately 15% less total material.

Figure 3.8.1 and Figure 3.8.2 show plan and perspective views of the final pit, respectively.

These can be adjusted if required based modified design parameters such as berm widths and haul road alignment. One scenario for haul road alignment is to develop the ramp exclusively in the relatively stronger propylitic rocks on the east side of the pit utilizing ramp switchbacks. These are alternatives that should continue to be investigated as the mine develops.

Figure 3.8.1: Plan View of Final Pit Design

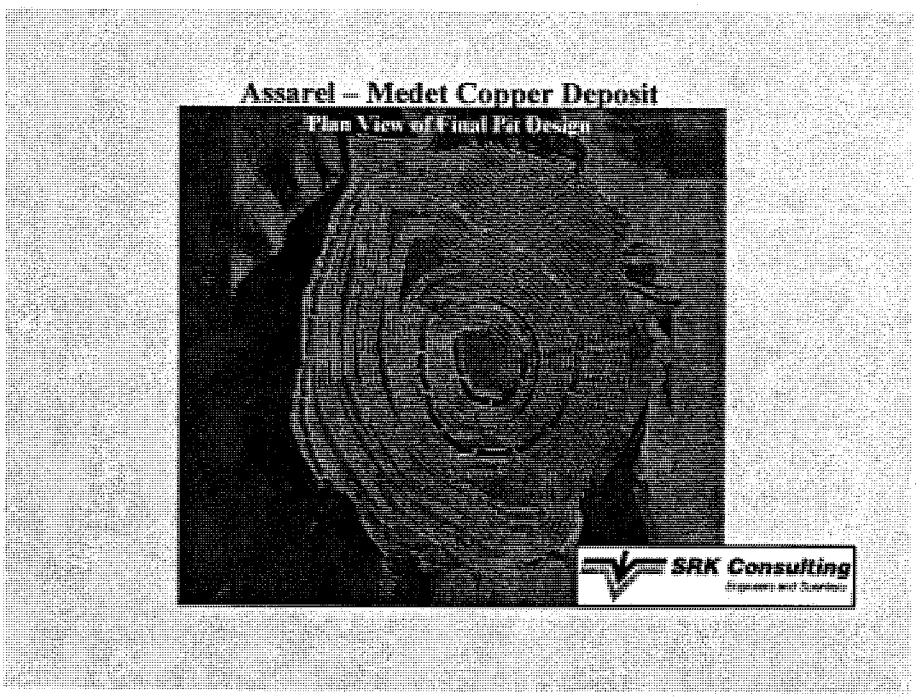
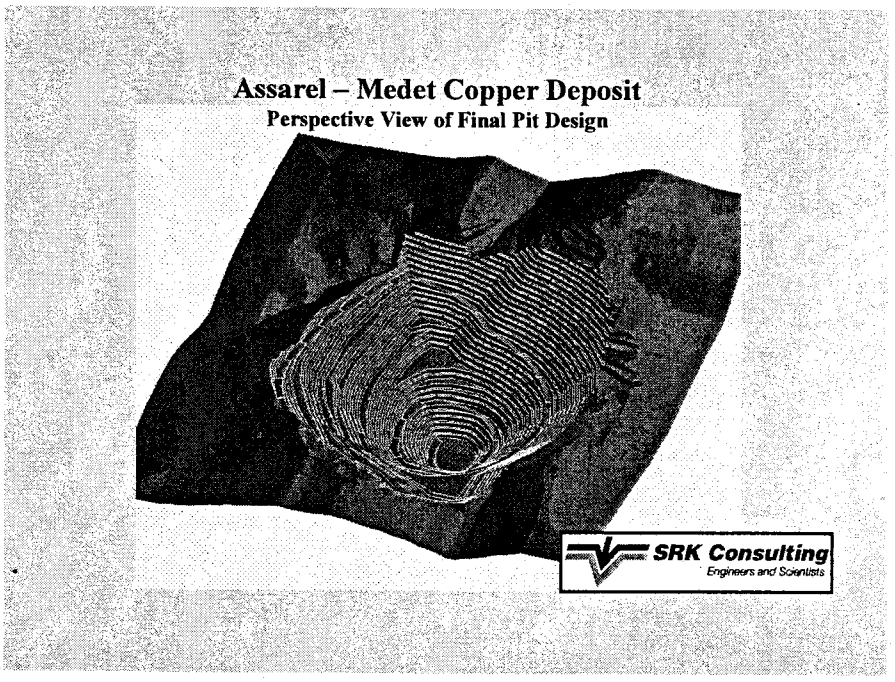


Figure 3.8.2: Perspective View of Final Pit



Proven and Probable reserves are stated as at January 1, 2002 and based on copper cutoff grades of 0.25%Cu for Sulphide ores and 0.1%Cu for Leach ores and detailed in Table 3.8.1. Proven and Probable reserves total 173M tonnes @ 0.486%Cu for the Sulphide ores and 40M tonnes @ 0.167%Cu for the Leach Ores for a total of 908,000 tonnes of contained copper metal. Table 3.8.2 is shown for comparative purposes only and represents "reserves" within the current Contour B design. The Cu cutoff grade of 0.25% Cu, used for the calculations, could be changed during the life of mine. It may be adjusted during the exploitation years, depending on the economical condition of the mine and the Cu price. A further comparative table of Proven and Probable Reserves using ore densities subsequently supplied by Assarel is shown in Table 3.8.3.

Table 3.8.1: Proven & Probable Reserves

Material	Ore/Waste	Grade	Cont. Metal
	Mln. Tonnes	% Cu	K Tonnes
Primary Sulphide ores, Types 1 & 2	142.1	0.479	680
Secondary Sulphide ores, Types 3,4,5 & 6	30.8	0.518	160
Total Sulphide	**172.9**	**0.486**	**840**
Leach ores, Types 7 & 8	40.0	0.171	68
Out-of-balance ores (waste)	67.1	0.185	
Waste (sterile)	135.9		
Total Material	415.9		
Strip Ratio (waste:ore)	0.95		

Table 3.8.2: Comparative Proven & Probable "Reserves" within Contour B

Material	Ore/Waste	Grade	Cont. Metal
	Mln. Tonnes	% Cu	K Tonnes
Primary Sulphide ores, Types 1 & 2	156.7	0.465	729
Secondary Sulphide ores, Types 3,4,5 & 6	32.0	0.508	163
Total Sulphide	**188.7**	**0.473**	**892**
Leach ores, Types 7 & 8	45.1	0.167	75
Out-of-balance ores (waste)	74.8	0.185	
Waste (sterile)	174.0		
Total Material	482.6		
Strip Ratio (waste:ore)	1.06		

Table 3.8.3: Comparative Proven & Probable Reserves with Assarel Ore Density

Material	Ore/Waste	Grade	Cont. Metal
	Mln. Tonnes	% Cu	K Tonnes
Primary Sulphide ores, Types 1 & 2	134.2	0.474	637
Secondary Sulphide ores, Types 3,4,5 & 6	28.0	0.512	143
Total Sulphide	**162.2**	**0.481**	**780**
Leach ores, Types 7 & 8	38.2	0.171	65
Out-of-balance ores (waste)	66.2	0.186	
Waste (sterile)	136.6		
Total Material	403.2		
Strip Ratio (waste:ore)	1.01		

It should be noted that the above-stated reserves correlate directly to Proven and Probable Reserves under the Bulgarian Decision of Ministerial Council No. 413/1998 Classification of Reserves and Resources of the Deposits of Solid underground Natural Resources.

Proven and Probable reserves are stated as of January 1, 2002 and based on copper cutoff grades of 0.25%Cu for Sulphide ores and 0.1%Cu for Leach ores. Reserves total 173M tonnes @ 0.486%Cu for the Sulphide ores and 40M tonnes @ 0.167%Cu for the Leach Ores for a total of 908,000 tonnes of contained copper metal. The reserve closely matches that as previously reported by Geotechmin within their Contour B design pit. It should be noted that the out of balance ore, below cutoff grade, is not economical to mine and process. This material should be treated as waste and disposed of in the existing west waste dump.

Note that the reserves statement above is with higher slope angles than discussed elsewhere in this report. A review of these reserves with the flatter slope angles agreed to between SRK and Assarel Medet indicated that there is less than 20% reduction in the stated reserves under existing economic conditions. However, these same reductions in slope angles with a more favorable economic set of parameters resulting from the implementation of the recommendations contained in this report will increase the reserves stated above. Therefore the change in the slope angles from those used in the reserve statement to those agreed to with Assarel Medet will not have an impact on the conclusions/recommendations of this feasibility report. In addition, Assarel Medet is embarking upon detailed mine planning using computer software,

and the results of this are certain to modify the reserve statement. Also, as stated below, the appropriate slope design parameters will only be known with greater certainty upon completion of recommended geotechnical and hydrological investigations. From these, subsequent optimization and redesign of the pit will yield an ore reserve of greater accuracy.

In order to evaluate different mining fleets, three hypothetical production schedule alternatives were created based on varying the mill ore production rate from 11 million tpy to 13 million tpy and assuming an oxide ore production rate of 3 million tpy and using an overall strip ratio of one. The alternatives represent the approximate current mill ore production rate of 30,000 tpd up to 37,000 tpd and result in a mine life that ranges from 13 to 15 years as shown in Table 1.1.2.

Table 1.1.2: Production Schedule Alternatives

Mill Ore (tpd) (approximate)	Mill Ore (Mtpy)	Oxide Ore (Mtpy)	Waste (Mtpy)	Total (Mtpy)	Mine Life (years)
30,000	11	3	14	28	15
34,000	12	3	15	30	14
37,000	13	3	16	32	13

Note that the anticipated actual mining production schedule based upon a bench-by-bench analysis is included in the capital cost section. The production rates above were used for comparative purposes only to provide a solid basis from which to select the appropriate fleet.

1.1.1 Method of Analysis

The analysis to select the optimum mining fleet was an iterative process that uses a set of annual cycle time sheets in conjunction with an anticipated equipment replacement schedule for the life-of-mine. From these it was determined that two alternatives for primary equipment replacement (shovels and trucks) be investigated in detail to determine the optimum primary mining fleet for the range of production rate alternatives. The two primary mining fleets considered were as follows:

- CAT 5320 15m^3 shovels and CAT 785 (136t) haul trucks, and

- $20m^3$ class shovels and CAT 789 (177t) haul trucks.

Each of the two primary mining fleet configurations was analyzed in conjunction with each production rate alternative to yield six life-of-mine options as follows:

- Option 1: 28Mtpy (11Mtpy mill ore) with $15m^3$ shovels and 136t trucks
- Option 1b: 28Mtpy (11Mtpy mill ore) with $20m^3$ shovels and 177t trucks
- Option 2: 30Mtpy (12Mtpy mill ore) with $15m^3$ shovels and 136t trucks
- Option 2b: 30Mtpy (12Mtpy mill ore) with $20m^3$ shovels and 177t trucks
- Option 3: 32Mtpy (13Mtpy mill ore) with $15m^3$ shovels and 136t trucks
- Option 3b: 32Mtpy (13Mtpy mill ore) with $20m^3$ shovels and 177t trucks

Each of the six options has been detailed to generate estimates of annual and total life-of-mine capital and operating costs. It should be noted that a mix of shovel and truck sizes was not felt to be advantageous because of the need for maintenance and spare parts for multiple truck and shovel sizes. This conclusion may be revisited prior to final selection of the fleet. Once the analysis was completed, the capital costs for the selected fleet and the detailed by-bench ore and waste production was calculated and included in the capital cost section. Therefore the detailed cycle calculation sheets included in Appendix A may vary somewhat from the capital cost information and cycle sheets included in the capital cost section.

1.1.2 Equipment Replacement

The replacement of the mining fleet is consistent with the views enumerated by Mr. Charles Smith from his analysis and recommendations dated February 9, 2002. SRK concur with the view that a unified mining fleet in conjunction with improvements in scheduled and preventive maintenance will allow for equipment to be operated for extended lives beyond those traditionally considered. Given this philosophy, the primary mining fleet (shovels and trucks) should only require replacement one time for the current expected mine life of 15 years. However, availability has been a problem at Assarel in the past. Current availability of the trucks is approximately 75% and shovels is approximately 65%-70%. World standard is in the low 90% availability for

trucks, and upper 80% for shovels. Usually, availability is calculated as the amount of time the piece of equipment is available for operation (not being repaired or maintained) divided by the total amount of time in the period.

Equipment Replacement Calculation

The remaining years of life for each major piece of equipment that could be discerned as being a necessary component of the mining fleet was calculated based on equipment hours and assigned a replacement year. The EKG shovels were not considered for replacement as they are assumed to be near the end of useful life and should be phased-out as the new fleet gradually replaces the existing fleet. Further, it is noted that the 4 loaders consisting of the hydraulic shovels (1 Liebherr & 2 RH120) and CAT 992 FEL have sufficient loading capacity to handle the current production rate of nearly 30,000 tpd. Equipment replacements were calculated on more or less standard equipment lives based on the class of equipment as shown in Table 1.1.3. Based on a previous site investigation, no attempt was made to apply "extended" lives to the existing equipment, nor were rebuilds to existing equipment considered.

Table 1.1.3: Expected Equipment Life – Existing Equipment

Equipment Class	Life (Years) Based on 5,000 hours per year
Trucks	10
Shovels	12
Front-End Loaders (FEL)	8
Drills	6
Dozers	4
Graders	5

A detailed equipment replacement calculation is shown in Exhibit 1.1.1 in Appendix A. Equipment that is not scheduled for replacement will be retired, used as back-up, or used for spare parts.

Equipment Replacement Schedule

Based on the above replacement calculation, a fleet replacement schedule for comparison purposes (Exhibit 1.1.2 in Appendix A) was generated that gives the replacement timing for each of the existing units with the new units for each option.

The equipment replacement schedule, in conjunction with the cycle analysis worksheets, show that for either of the primary mining fleets considered, $15m^3$ shovels/136t trucks or $20m^3$ shovels and 177t trucks, the primary fleet will be completely replaced by 2008 (Year 6). By applying an improved maintenance program as discussed above, the primary mining fleet of new shovels and trucks should last almost the entire remaining life-of-mine. The average annual capacities of the shovels and trucks as shown in Appendix A were used in the various option cycle analysis worksheets.

Mine support equipment including drills, dozers, graders, and water trucks were also included for replacement.

Drill calculations indicate that the annual production drilling requirements can be handled by 3 Ingersol-Rand DML class blasthole drills. These will require additional replacements as drill life is estimated at 7 years.

Two units of each of dozers, graders, rubber-tired dozers (RTDs), and water trucks are sufficient for the size of the mining operation. There is also a requirement for 1 dozer at the waste dump, and 1 dozer at the leach pad. In addition there is a requirement for 3 small front-end loaders throughout the operation. The dozers and graders will require additional replacement with machine lives estimated at 5 and 6 years, respectively. The RTDs and water trucks require replacement only once for the life-of-mine.

Capital Replacement Schedule

Total Life of Mine estimated costs for mining equipment in the comparison total US$40 million for the $15m^3$ shovel /136t truck fleet and US$48 million for the $20m^3$ shovel/177t truck fleet as summarized in Table 1.1.4 and Table 1.1.5, respectively. It should be noted that the actual replacement schedule and costs are based upon somewhat different strip ratios and therefore the capital costs vary somewhat from the comparison tables below. Mine equipment costs are estimated FOB US. Vendor quotes for mine equipment FOB Bulgaria are pending.

Table 1.1.4: Mine Equipment Costs – 15m^3 Shovels & 136t Trucks

Equipment Type	Example Equipment Model	No. Units (LoM)	Cost/Unit M US$	Total LoM M US$
Truck	CAT 785	12	1.6	19.2
Shovel	CAT 5320	3	2.6	7.8
Drill	IR DML	4	0.9	3.6
Dozer	CAT D10R	5	0.9	4.5
Grader	CAT 16H	5	0.5	2.5
RTD	CAT 834G	2	0.6	1.2
Water Truck	14,000 Gallon	2	0.7	1.4
Total LoM				**40.2**

Table 1.1.5: Mine Equipment Costs – 20m^3 Shovels & 177t Trucks

Equipment Type	Example Equipment Model	No. Units (LoM)	Cost/Unit M US$	Total LoM M US$
Truck	CAT 789	12	2.0	24.0
Shovel	20m^3 Class	3	3.7	11.1
Drill	IR DML	4	0.9	3.6
Dozer	CAT D10R	5	0.9	4.5
Grader	CAT 16H	5	0.5	2.5
RTD	CAT 834G	2	0.6	1.2
Water Truck	14,000 Gallon	2	0.7	1.4
Total LoM				**48.3**

1.1.3 Cycle Analysis

Cycle analysis worksheets were developed for comparison purposes on an annual basis for the six mine options as listed above. The worksheets calculate mining fleet productivities given the capacities of the loading and hauling equipment based on the equipment replacement schedule as discussed in the previous section. The average annual capacities of the shovels and trucks as shown in Exhibit 1.1.1 in Appendix A were used in the comparison cycle analysis worksheets for each shovel/truck spread, and determine the number of trucks required for each loading unit given production requirements and other mine cycle variables. As indicated by the equipment replacement comparison schedule, four loading units will be required from 2003 through 2007 (Year 1 through Year 5), after which only 3 loading units will be required for the remaining life-of-mine. The number of loading units was selected

based upon the mining volume and the blending scheme developed in the processing area. This blending scheme requires blending for hardness and blending of the ore grade, rather than blending of the three ore types, which was a requirement prior to 2003. Therefore, the number of loading units is reflective of the different hardness types (one shovel in propylite, one in secondary quartz one in argylite, and one in waste). The Cat 992 is used for loading of the current high grade ore. The reason the number of units may be decreased after year five, is because the high grade area is depleted at that time, and is therefore eliminated as a blending item.

Haul distances were calculated and averaged on an annual basis from the centroid of the open pit to the various dump locations and range from 1,800m in 2003 (Year 1) up to 4,050m in 2017 (Year 15).

Other mine cycle variables can be adjusted to refine equipment requirements but were generally left constant for comparative purposes of the six production options.

In situ material density was held constant at 2.5 t/bank m^3. Applying a swell factor of 1.4 yields a constant loose density of 1.8 t/loose m^3.

The analysis is based on a 2 – 12 hour shift per day, six day per week schedule utilizing a 50-minute hour and a travel/lunch/delay time of one hour per shift. This yields an availability of 18.33 hours per day, slightly over 76%). Again, this was done for comparison purposes only. The cycle sheets included in the Capital Cost section reflect the expected scenario of 8-hour shifts, 3 per day, and these sheets were used to calculate the equipment usage and replacement schedule in the capital and economic analysis.

Other cycle input data held constant for the analysis is given as follows:

- Shovel bucket fill factor: 95%
- Shovel cycle time: 40 seconds
- Haul truck fill factor: 90%
- Truck spot/maneuver time: 30 seconds
- Truck dump time: 1 minute

- Average haul speed (full): 16 kph
- Average haul speed (empty): 32 kph

The cycle analysis worksheets were developed on an annual basis for each of the six mine options are presented in Appendix A.

1.1.4 Operating Cost

Estimated mine operating costs were developed on a consistent basis to evaluate the alternatives. The operating costs average from US$0.48 to US$0.55 per tonne mined for the six mine options considered and average approximately US$0.50 per tonne mined as shown in Table 1.1.6. It is expected that more detailed refinement of the options would produce a slightly larger range in mine operating costs, but not a material difference in the average.

Table 1.1.6: Mine Operating Costs

Option	Units	1	2	3	1b	2b	3b
Production (Total)	**Mtpy**	28	30	32	28	30	32
Production (Mill Ore)	**Mtpy**	11	12	13	11	12	13
Operating Costs							
Total Operating Costs	**M US$**	213.5	206.7	200.8	231.6	223.3	207.7
Per Ore Tonne	**$/Ore t**	1.02	0.98	0.97	1.10	1.06	1.00
Per Total Tonne	**$/Total t**	0.51	0.49	0.48	0.55	0.53	0.50
Per Tonne Copper	**$/t Cu**	284	272	264	308	294	273
Per Pound Copper	**$/lb Cu**	0.13	0.12	0.12	0.14	0.13	0.12

Detailed operating costs for the six mine options are presented in Exhibit 1.1.4. These are all-in mine operating costs and are believed to be comprehensive. That is to say, these are all inclusive costs, or nearly so.

Mine labor remains fairly constant for all of the options and averages approximately 200 mine personnel with minor fluctuations on an annual basis based on 4 crews. The ***cost*** of maintenance personnel are accounted for in the operating cost of the equipment.

Bulgarian labor rates (all-in) were provided for loader, truck, drill, and blast operators. All other positions were factored as a percentage of comparable US rates, determined to average 10% based on the Bulgarian rates provided.

Equipment operating cost rates per hour were also factored for Bulgarian labor. Operating hours per year for the primary mining fleet (shovels and trucks) were taken as 5,000 hours per year for a 6-day per week schedule and 6,000 hours per year if the option required going to a 7-day per week schedule to meet production requirements. This only occurs in some of the options during the last years of mine life. For example, the smaller fleet at the higher production rates. Similarly, the last years of mine life require additional trucks with the smaller fleet. The operating hours per year for all support equipment was taken as 4,000 hours per year.

Drill consumables including drill bits and steel are included in the operating cost at a rate of US$0.01 per tonne mined. Blasting consumables include the explosives, media, detonation chord, delays, and boosters are included at a rate of US$0.065 per tonne mined, taken to match the current Assarel blasting costs. SRK note this is quite low for emulsion-type explosives in comparable Western operations and there may be opportunities to reduce blasting costs by using some percentage of ANFO in blasting where applicable.

The Krupp system is included in the operating cost as an estimate of costs for the components of the system consisting of the crusher, overland conveyor, and stacking discharge unit and approximate US$0.10 per tonne of waste moved. SRK note that the costs of this system appear to be much higher as reported by Assarel to be in the range of US$0.50 per tonne. This increased reported cost is due to depreciation of the Krupp system, and the actual cost of operation is US$0.12 per tonne. This cost is therefore in the range where it is more cost effective to use the Krupp system than to truck the ore to the waste dump.

1.1.5 Fleet Selection

The results of the analysis indicate that the primary mining fleet of 15m^3 shovels and 136t trucks is best suited for the lower production rates of 11 million tonnes of ore per year and 12 million tonnes of ore per year, 30,000tpd and 34,000tpd mill ore, respectively. The 20m^3 shovels and 177t trucks are more optimally suited for the higher production rate of 37,000 tpd mill ore, as summarized below:

- 30,000 tpd mill ore — Fleet Option 1 – 15m^3 Shovels/136t Trucks
- 34,000 tpd mill ore — Fleet Option 2 - 15m^3 Shovels/136t Trucks
- 37,000 tpd mill ore — Fleet Option 3b - 20m^3 Shovels/177t Trucks

It should be noted that this selection was also influenced by the need to blend some of the ore types based on hardness. Assarel and SRK personnel agreed that four shovels would be required to accomplish this, and therefore the 15 m3 shovels matched with 136 tonne trucks became the best selection. The production rate alternatives are not large enough to modify the requirements for support equipment, which therefore remains the same for all of the options.

Fleet Options 1 and 2 as selected will require additional truck capacity for the final 3 years in each of the schedules due to increasing haul distances during these years. A number of alternatives can be investigated to address this, such as using back-up units from the retired fleet or running a few extra months at the end of the mine life.

Fleet Option 3b requires no additional truck capacity late in the mine life.

Refined Option 2 for Cost Comparison and Labor Estimate

1.1.6 Summary Recommendations

Recommendations for the primary mining fleet for the various production rate options are given in the preceding section and indicate 15m^3 shovels and 136t trucks for the lower production rates and blending considered. There is the additional benefit that this equipment is only slightly larger than that currently in use at the mine. Other recommendations that should prove beneficial to lowering mine operating costs are summarized by unit operation below.

Drilling

The higher capacity Ingersol Rand blasthole drills will reduce the number of drills required at Assarel to three. A change to vertical drilling of the blastholes from the current practice of inclined drilling should further enhance drilling productivities.

Blasting

The use of ANFO as the explosive agent may serve to reduce blasting costs as ANFO is typically a less expensive explosive. However, as noted previously, the overall blasting costs appear quite low compared to Western operations. The change to ANFO is most likely tied to the success of a mine dewatering program that in turn adds stability to the pit slopes. The success of dewatering is dependent largely upon the nature of the water in the pit, whether it is "connected" and amenable to a regional pit dewatering program or whether it is "disconnected", rendering a dewatering program largely ineffectual. Hydrological studies will determine this. Dewatering of individual blastholes may also be an alternative in the case of ineffectual pit dewatering.

Loading & Hauling

Loading and hauling will benefit from the standardization of the primary mining fleet reducing the number of required units and lengthening the service and availability of these units through a restructured and improved mine maintenance program. The size envelope of the trucks is being compared to the existing maintenance building. The 136 tonne trucks have the dimensions:

Height to canopy:	5.77 m
Wheel base:	5.18m
Total Width	6.64 m
Length	11.02 m
Loaded height	4.98 m
Height at full dump	11.21 m
Oper weight	6.64 tonnes

It is highly recommended that the vendor selected for the supply of the new trucks and shovels should be selected based upon not just low price, but also willingness and capacity for providing service support, supplies and parts. This is very important in Bulgaria, where not everything is available quickly, and some parts require lead time

to procure and install. Vendors who are willing to work with Assarel Medet in the supply and warehousing locally of the required parts should be given preference in the selection process.

Mine Maintenance

The cornerstone of the recommended operation going forward is dependent upon improvements to the scheduled and preventive maintenance program. World standards for maintenance indicate that standard operations should consist of 11% preventive maintenance, 55% planned major component replacements and overhauls, 17% unscheduled repairs, and 8% emergency repairs. Routine activities such as shop cleanup and safety meetings should be around 9%. Availability as defined within Assarel Medet includes time actually operating divided by total time for the shift. Therefore, time while in the shop for repairs, time traveling from the pit to the shop and back, and time re-fueling is all considered non-available time. Availability figures from world practice indicate for the equipment selected above, we should expect availability of around 90%+ for the trucks, and from 85-90% for shovels. Support for Assarel Medet in the area of preventive maintenance training and implementation is needed, and included in the implementation section of this report.

Mine Support

Mine operations would benefit greatly from the use of rubber-tired dozers (RTDs) as support around the shovels and haul roads. These will complement the new graders that will be critical to improved haul road maintenance that in turn will always reduce operating costs by increasing tire life and overall equipment wear.

For the Survey Section, a modern GPS surveying system should be investigated to replace the current conventional survey practices. Benefits should be realized from increased survey turn-around and reduced costs.

1.1.7 Dewatering of Pit

The final pit slope angles for the Assarel pit were designed using field data collected by SRK during April 2002 supplemented by geotechnical and geohydrological data from previous geotechnical studies. SRK conducted back-analyses of failed and stable pit benches to obtain estimates of the strength of the rock mass based on actual performance of excavated benches. All the available data were evaluated and reduced

to a format suitable for slope design and analysis. The variability in the input parameters was taken into account by assigning distributions to the parameters and conducting probabilistic analyses.

Owing to the relatively low strength of the rock mass, the final pit slope angles were determined by considering large scale circular failure. Earthquake and groundwater loading were considered in the analyses. The failure probability, rather than the factor of safety, was used as a design criterion for the final pit slopes. Interramp slope angles and bench face angles were designed by considering both circular failure and failure along geological structures.

The results showed that the groundwater condition has an overriding effect on the slope angles. The low strength argillite is extremely sensitive to groundwater pressure. It was found that if drainage of the groundwater is not successful, slope angles of 18° in the argillite, and 24° in the remainder of the pit are required. It is clear that these slope angles would severely restrict the amount of ore that could be extracted. For the purpose of continuing with the feasibility study it was assumed that dewatering would be successful, or, that it would be found that water pressure is not significant in the pit walls. The resulting overall slope angles, recommended interramp slope angles and bench face angles are presented below.

Parameter	Strong Rock Propylite	Moderate Strength Propylite/Secondary Qtz.	Low Strength Argillite
Maximum Slope Height	150 m	570 m	430 m
Overall Slope Angle	38°	35°	28°
Interramp angle	38°	37°	29°
Final Bench configuration	30m double bench	30 m double bench	15 m single bench
Bench face angle	60°	60°	60°
Catch bench width	21 m	22 m	18 m
Ramp width	24 m	24 m	24 m

This study has shown that the feasibility of the Assarel mine depends on developing and implementing a successful method of dewatering or depressurizing the rock mass behind the final slopes. It is recommended that the hydrostatic pressure in the walls of the pit should be determined and a dewatering or depressurization system implemented. The strength of the various rock types, especially the argillite, should be determined by laboratory testing. Field data on the characteristics of geological structures should be collected. The new data will allow the final slope angles and pit layout to be optimized.

1.1.7.1 Geohydrology

The geohydrological conditions at Assarel Mine have been studied for several years. A program of monitoring water in blastholes, precipitation and drainage quantities has been established. A review of the reports and current monitoring information shows that the Northern part of the pit appears to be saturated, with many occurrences of groundwater in the blastholes in isolated water occurrences. Attempts at dewatering the rock mass have had limited success in the past. A drainage tunnel underneath the pit only drains about 25 l/s and has not been successful in lowering the overall water table. Horizontal drain holes drilled into one of the bench faces have also had limited success. Approximate calculation of the permeability of the rock mass show that it has a very low permeability. Recent studies of the groundwater show that the major fault "Zone A" in the northern part of the pit forms a water barrier, but water is flowing along structures resulting in many seepages in the Northern part of the pit. Flow through the pit appears to be limited to major structures that conduct water.

For stability analysis it is necessary to know how the water pressure is distributed in the pit walls. Unfortunately this information does not exist. The low permeability of the rock, especially the argillite, may create the appearance that the water occurrences are isolated. However, if the occurrences are connected by faults or joints, the pressure will build up and would have a significant effect on stability. A detailed hydrology analysis and dewatering program is recommended. This will necessarily involve the incorporation of a permanent position in the Assarel Medet organization for a highly experienced and knowledgeable hydrologist.

1.1.8 Slope Stability Monitoring

As described in the SRK Milestone #1 report, slope angles can be increased through rigorous dewatering of the pit, and through constant monitoring of the slope stability. This monitoring will require the installation of an automated surveying system using a laser surveying instrument, and prisms located around the pit at critical points. This system will then allow for constant monitoring, and measurement of the rate of change of movement, which has shown in other operations to be the best indicator of potential failure. This system will also allow for further understanding of the stability of the pit walls, and directional movement, providing for additional understanding of the fault structures and controlling geometry.

In addition to the hardware and installation, there is a requirement for a full-time slope stability expert to be added to the personnel at Assarel Medet.

1.1.9 Waste Crushing & Conveying System

It was noted during the feasibility study preparation, that the Krupp crusher/conveyor will have to be relocated around year 2005 or 2006. SRK recommends that this crusher/conveyor be relocated approximately 200-300 meters to the northwest of the existing location, and if possible, at a somewhat lower level (around elevation 930 or 900m). The relocation of this crusher could be postponed if necessary, because the material that needs to be mined from the current location is rather minor and could be taken as a pushback in the pit later on in the life of the mine. SRK has preliminarily estimated that this relocation will cost on the order of US$ 1million.

1.1.10 Dispatch System

SRK reviewed the cost of a new dispatch system at the request of Assarel Medet. This was quoted by Modular Mining Systems from Tucson Arizona at US$ 592,000. The dispatch system quote and an amount for a new dispatch building closer to the mine is included in the capital cost estimate, Section 2.0, in the total amount of US$ 650,000.

1.2 Processing

1.2.1 Blending

A review of the blending requirements has indicated that the critical factors for blending of ore into the mill and concentrator are hardness and grade. Testing has indicated that the hardness of the ores varies from the Argylitic at a work Bond index of 12 to secondary quartz at a work Bond index of 14, to propylitic at a work Bond index of 18. The composite being fed to the mill should be maintained in the range of 15 with a deviation of +/- 2. This means that the Propylitic ore must be blended with either the Argylitic or Secondary Quartz or both.

Secondarily, the grade to the mill should be somewhat controlled to a level of 0.48% +/-0.1%. This will allow for a maximum recovery. This type of blending is typically achieved in the development of a detailed computerized mine plan, and should not impact the mining operation or impose an undue hardship affecting mining productivity. A third factor for achieving optimum recoveries in the mill and

concentrator is sulphur content, however a review of the ore body indicates that by blending based upon hardness and grade, the sulphur content will be within acceptable ranges (6% +/- 2.5%). Variance in Cu and S content in the ore may require changes in the volume of processed ore for a determined period of time in order to maintain balance in the concentrator processing circuit.

1.2.2 Disintegration Scheme

The disintegrator circuit has been examined. As described in the audit report, the units should be run in an autogenous mode. SRK has selected the autogenous mode as the preferred operation because it will save the cost of balls, and increase the throughput. The operation of the existing autogenous mills compared to the semi-autogenous mills has indicated that the grinding ability is achieved in autogenous mode, and this also provides for reduced costs (saving .07kg/tonne in balls), while increasing throughput per mill. This configuration will allow for throughput at the 11 million tonnes of ore per year rate as well as the 12 million tonnes of ore per year rate. SRK's calculations indicate that each autogenous mill should be able to achieve a throughput of 380 tonnes per hour at a grate size of 80 mm. A simulation of the autogenous mill operation is included in Appendix C. Additionally, SRK is recommending that these units should be run in an open circuit with just the screen and with the spiral classifier removed. The spiral classifier and the screen are doing exactly the same thing. By eliminating the spiral classifier additional head could be built up on the high cyclone in the ball mill circuit, which should increase the efficiency of these units. The disintegrators should be modified to eliminate the clay balls, if they are presently going to the fine crushing area, by reducing the screen opening size. The new screen should have the necessary capacity and should actually operate more efficiently than currently. The undersize material can then be taken in one pipeline, which should allow a minimum increase of 2-3 meters head in the feed to the high cyclone. There is a new closed circuit scheme which has been proposed by Assarel Medet personnel which will be reviewed and evaluated in follow-on segments of work after the completion of the Feasibility Study .

The spiral classifiers are currently running at a pool density of 1,250 grams per liter. The combination of the spiral classifier and screen assembly with each autogenous mill could very effectively be replaced with a closed circuit. The detailed pool analysis is included in the appendices. The analysis shows this to be viable alternative.

The disintegrator circuit has additional unused capacity, which could be utilized by the elimination of both the spiral classifier and the screen. The space vacated by the elimination of the spiral classifiers and screens could then be used for a larger sump, pump and cyclone, that would replace the high cyclone in the circuit to the ball mills. The appropriate cyclones are currently being tested at the Assarel Facilities. The high cyclone would be a standard circuit with the undersized material, the 6-millimeter split going back to the autogenous mills and the 4-millimeter split going to the ball mills. This will place more of the grinding loads on the disintegrators which currently have excess capacity. These units appear to have excellent availability as shown in the data included in the appendix. These units will support both the 11 million tonnes per year production scenario as well as the 12 million tonnes per year production scenario, with the modification to autogenous operation. Availability of the streamlined configuration is expected to be 90-95%. The size of the grates and trommel screens is not expected to change from the current sizing.

1.2.3 Fine Crushing

The fine crushing circuit is an area of great concern. There are six cone crushers 2.2 meters in diameter, of the type KMDT, with a maximum feed size of 80 millimeters by 70 mm. The discharge product is supposed to be 15% + 15 millimeters with a motor capacity rating at 250 kilowatts. Even though these motors have been operating between 18 and 19 amps per hour, at full load they are rated at 38 amps. It has been determined that the units are being fed both with too small a volume, and with material that is too large for the system. The feed size of 80 millimeter reduced to 15-milometer is approximately a 10-1 reduction ratio. This 10-1 ratio will require at least two stages of size reduction. These first stage crushers need to be as large and as robust as the primary unit, and must feed into a smaller unit. In contrast to the discussion of low speed, the fine reductions crushers are of high speed. The inlet feed opening of the current crushers, with an eccentric speed of 224 rpm's (revolutions per minute), is approximately 100 millimeters.

Although the crushers should have a capacity in the range of 200 - 250 tons per hour, they are currently only producing 50 tons per hour (please refer to the Bruno simulation of a seven-foot cone; both standard and short head cone crushers for this matter). If clay is the problem with the crushers, then they are unsatisfactory pieces of equipment. In the analysis, shown through Mineral Labs and RDi Reports, clay has

not been a problem and should not be a problem to the fine crushing area, after the rock material has been through the disintegrator. SRK is recommending adding lime in the disintegrators which is anticipated to reduce greatly the sticky properties of clay if present. However, on three different inspections of this facility, the rock reporting to the fine crushing area appears to be quite competent and easily pliable. The capacity of these units should be easily into the range of 200 tons per hour.

There are two solutions to the size reduction ratio problem: 1. installation of new crushers specifically designed for the application, or 2. Reconfiguring of the existing crushers to establish a two-stage crushing circuit.

The first option is to install a primary crusher, an HP 500 with a size reduction ratio of four to six, and take the initial feed material from 140 x 70 millimeters down to 70 millimeters or less. One HP 500 should have the capacity to accomplish this reduction in a single pass. The minimum setting on the HP 500's is 19-millimeters, this would be a standard cone design with course liners and an open side setting of 248 millimeters. The HP 500 at a 12-millimeter setting would have a capacity of approximately 200 metric tons per hour to 250 metric tons per hour. The discharge of this product could also go into a HP 700 short head cone crusher, with an open side setting of 112 millimeters and a closed side setting of 6 millimeters. The capacity of an HP 700, with medium liners and a short head design, would be in the range of the 200 to 250 tons per hour. On both the HP 500 and HP 700 the counter shift speeds will be between 1,020 and 1,120 rpm. The recommended minimum horsepower is either 250 or 350 kilowatts, which does not require any changes in the power supply. Utilizing the HP design would require a secondary platform built above and/or a unit placed underneath. The current fine crushing building has sufficient room for this addition. Using the HP 500 and HP 700 and re-installing the enclosed circuit conveyors (installed in initial construction) and transporting the material back up to the storage bin, then back down to be re-crushed and sent to the fine crushing section, would eliminate a great deal of the mechanical problems that have been currently experienced in the Fine Ore Crushing Section.

BRUNO PROCESS SIMULATION

PLANT:
INFO:
LICENSED USER: Nick Lynn
DATE: 01/07/03 11:41 AM
FILE: C:\MyFiles\Jobs\02003-Assarel Medet\fineCrushing.brn
Bruno v2.61, DB v2.01, c1.00 s1.00 nn 91

PLANT:

Part 1: Top capacity: 250 t/h

1) Feed
   - Material: Granite
   - Capacity: 250 t/h
2) Cone crusher HP500
   - Setting (css): 15 mm
   - Capacity coefficient: 1
   - Load: o 84 %
3) Product
   - Capacity: o 250 t/h
   - Product percent: o 100 %
   - Max size: o 30 mm
4) Selected flows
   - ->3
   - Capacity 250t/h

1mm	10%
2mm	18%
4mm	31%
8mm	52%
16mm	84%
32mm	
64mm	
128mm	
256mm	

Maxsize 30mm

The cone wear pattern that has been identified on the current KMDT's 2.2 meter units show they are being underfed. A lighter profile was requested. This has not been received for the worn liners. Liner profiles shown under cutting at the lower edge of the units, while the upper portion of the throat of the liner is hardly worn at all. The units were inspected in February and again in October. Photographs were taken which show the constant wear pattern.

The second option is to reconfigure the existing crushers into a two-stage system. Three crushers can be equipped with a standard cavity profile which would allow the two hundred millimeter materials in, and have a reduction ratio down to 50 millimeters. The second set of crushers can be run in an open circuit with a closed side setting of 12 millimeters which would allow 15 millimeter rocks to pass through the units. These crushing alternatives can be made by segregating the triple conveyor and reinstalling the recycle conveyors on the systems. SRK recommends that these crushers be modified to a 3X3 serial configuration. In this configuration, the first 3 crushers would handle the material from the SAG mill and that the other three crushers would be set as secondary crushers with a discharge of the feed belt going to the ball mills.

The three-crusher set-up should be operated in open circuits. This would allow rocks of a reasonable size range in and still have reduction ratios in a much smaller range.

If the clay is a problem, then the method of segregating the clay material into the crusher should be evaluated and determined to be acceptable or unacceptable. This may be done by closing the grate systems on the disintegrators, and allowing for pan caked material to be retained in the disintegrators.

New instrumentation and controls around the fine crushers should be installed. The recommended instrumentation should be taking a measured average production rate to a centralized control station, so the operators may use the variable speed controls on the cone crushers and the feeders directly. The controls should be set-up in closed circuits to where the units can be operated at approximately 80% of the motor rated average on the units. These units currently are operating at 38%, or between 19 and 20 amps and the motors full loaded amp rating is approximately 38 amps. It was determined by examination that the oversized material and the reduction ratio results in rapid erosion of the cavity of the crusher, this is why the two-stage crushing would be preferable.

Both of the recommended configurations above will support production at 11 million tonnes per year and 12 million tonnes per year throughput rates, and will provide a product which is 80% passing 7.5 mm. Detailed simulations are included in appendix C.

1.2.4 Feed to the Ball Mills

Upon review of the current installation, it was apparent that two additional slide gate chutes need to be added for each ball mill from the intermediate stockpile. SRK anticipates that each of these feeders will require an installation cost of US$2300 ea, for a total of US$ 36,800.

1.2.5 Ball Mills

The ball mill circuits with the current operating parameters are working very inefficiently. The combination of the grinding mill, pump, and cyclone has major problems. There are eight ball mills that are 4.5-meter diameter by 6 meters in length. The power connected is 2,500 kW each. The average production is between 120 and 150 tph. The solids recirculation rate around the mills is very much higher than the normal industry range of 150 to 300 %. The uncorrected grinding energy (Bond work Index) is16.05 kWh/tonne.

After applying the correction factors the net energy required is 16.42 kWh/tonne. The net capacity of the mill is 155 tph based upon a F_{80} of 7,000 μm and a P_{80} of 100 μm. The Bond Work index was determined by laboratory tests. The composite test sample had a work index of 14.03 which indicated an average hardness. The work indices of the ore types were 18.67 for propylitic ore, 13.83 for secondary quartz and 11.85 for argylitic ore. The capacity of the grinding units with proper cyclone operation should be greater than160 tph and should have a smaller amount of material >125 microns.

The mill speed is currently at 81 to 82% of critical. This reduces the mill capacity while increasing the wear on the liner and balls. The slippage of balls on the shell reduces the available grinding energy and develops liner and ball wear. The higher mill speed increases the height that the ball is lifted and the balls then land on the liners and not the ore. The effect is also a loss of grinding energy and increased liner and ball consumption.

It was reported that the pinions had to be replaced at 16,000 hours (two years of operation). This was attributed to the poor quality of the pinion at the time of manufacture. The faster speed could also be contributing to the short life of the pinion.

A pinion which is manufactured under good quality control will last, on a similar mill, 10 to 20 years in the same application. SRK strongly recommends that the ball mill speed be reduced to 76% of critical speed. This speed should be accomplished with a 34 tooth pinion gear. This calculation is based upon critical speed of 20.97 rpm. The speed reduction should reduce the ball consumption from the 1 kg/ton to 0.5-0.7 kg/ton and increase production and liner life.

The shell liners in the ball mills should be all changed to steel liners. The heads can still be rubber lined for ease of maintenance. This should increase the capacity of the mills by 4 to 5 percent simply as a result of increasing the inside diameter. The steel liner should have the same life as the rubber liners. A liner machine should be purchased to assist in the changing of the steel liner. This will reduce the time required to change a set of liners in the mill and increase the % availability. The steel liners currently being used have been demonstrated to have good life, and these should be put into use in all of the ball mills.

The current maximum feed size to the mill is 15,000 microns and the finished product is 100 micron. The reduction ratio of the ball mill is currently 150:1. The recommended reduction ratio of the mill is about a ratio of 120:1. The data shows that the recirculation load is high. This is very inefficient and is a result of both the high recirculation load, rotational speed and the large feed size.

SRK recommends the use of 80mm balls in the ball mills. This type and size of ball will work most efficiently with the feed ore and configuration of the equipment.

The mill changes as described above and changes to the fine crushing, cyclone and pumps should increase the capacity of the mills to a range of 165 tph which is an annual capacity of 11,400,000. This rate of 165 tph assumes that the blend of ore being fed to the mill is maintained at the ratio of the reserves in the pit. The production rate of the ball mill will be less for the propylitic ore, with a work index of 18, than that of the secondary quartz (13.83) or the argylitic ore (11.85). If the propylitic ore is processed exclusively for extended periods then an additional ball mill circuit will be required to increase the capacity to12,million tpy. However, if the recommended blending scheme is followed, the existing ball mills have the capacity to process over 12 million tonnes of ore per year. Simulations for the ball mill configuration are included in Appendix C.

1.2.6 Cyclones

The cyclone performance at the moment is very poor. This is due to the high recirculation load of the solids and the variable density feed to the units. The amount of fines in the underflow is high and this adds to the solids loading in the mill. On the other hand, coarse mineral particles are being sent to flotation. The cyclones are not making an effective size classification.

Three experimental cyclones were supplied to the plant by the Warman International (Ltd.) Company. However, these tests were not run under proper conditions. The pressure was too low (0.4 bar) and the density was too variable and also too high. The tests show that the Warman units performed like the units that are currently installed. The test data indicates that recirculation loads are from 400 to 900 % and shows the cyclone efficiency is poor. The capacity of the ball mill is reduced by the very high recirculation load. This must be reduced by a change in the control and the equipment that supports the mill itself.

SRK recommends that this be corrected with new cyclones, 800 mm in diameter. These cyclones can handle the flow of 1000 m3/hr and will reduce the recirculation load to 300-400 %. The total new feed tonnage can be then increased. The new cyclone addition should be either the Krebs G-Max or the Warman Cavex type. The density to the cyclones must remain constant for optimum performance. SRK recommends the installation of density meters with a control circuit to allow the operators to control the classification of the solids. A particle size monitor should be installed which would be a unit that would have real time monitor and would control the water to the sump, pump speed and feed to the ball mill. This modification of the cyclones and installation of a variable speed cyclone feed pump, along with the other recommended changes, should increase the capacity of the ball mills to the range of 190 tph, and will therefore support both the 11 million tonnes per year production scenario as well as the 12 million tonnes per year production scenario.

Cyclone Feed Pumps

Some of the current cyclone feed pumps are an ASH 14 X 12 with a material flow rate of 1,000 cubic meters per hour at a specific gravity of between 1.3 and 1.4. The unit is equipped with a 600-millimeter impeller and has a speed of approximately 300 – 400 rpm. The pumps are equipped with 250 kW motors. The other pumps are of Bulgarian

origin, and are a 1250 X 31.5 and have a flow rate of approximately 1,250 cubic meters per hour. The impeller diameter on those is 600 mm but the speed is approximately 700 rpm. These pumps are also equipped with 250 kW motors. Both of these pump models have efficiencies in the 55-65% range.

It is recommended that all the cyclone feed pumps be replaced by Warman 10 X 12 pumps. The Warman's have a capacity of approximately 1,200 cubic meters per hour. These units will have an efficiently of approximately 75% and will decrease the electrical load from 250 to 200 KW. The replacement pumps will have a variable speed drive and the total electrical load will be lower.

The Warman Pump will also have a much longer life for both the impeller and the liners. The superior wear of these pumps and the increased pump efficiencies will typically allow for a pay back of approximately 2 ½ years for this installation in power and liner savings alone.

SRK recommends that the ball mill circuit be redesigned as a complete package. The benefits that can be attributed to the individual equipment changes are significant. Combined, with a complete system design, the benefits will be even more significant.

As an alternative to installing two brand new Warman Pumps made by the Weir Slurry Group, the ASH pump could be placed in a stand-by mode and this would reduce the ultimate effect. The 250 kW motor on the ASH pump should be placed on a variable speed controller.

The pipeline going to the existing facility is a 360-millimeter pipeline and should be satisfactory for the installation with either the Krebs G-Max or the Warman Cavex Cyclone.

1.2.7 Reagent Mixing and Handling

The following recommendations apply to both the 11 million tonnes per year scenario and the 12 million tonnes per year production scenario.

The reagent mixing and handling systems at Assarel Medet were found to be lacking substantially in the following areas:

1. Reagent mixing of the X133 and the 3477 is inadequate.

2. There is no control of reagent addition.

3. The distribution to all regions of the plant was inadequate.

4. There are questions regarding inventory control. A variety of reagent sourcing exists. Information related to actual reagent addition rate is different than what is specified in the data that has been provided to SRK.

The flotation reagent addition of potassium isopropyl xanthate, X133, and 3477 must be corrected. Without the proper addition and monitoring of reagents at a required dosage, the flotation section will never operate properly.

Potassium Isopropyl Xanthate

The initial mixing system, mixing potassium isopropyl zanthate to a 5% solution and added to day tanks, appears to be adequate although there was no indication of level control, flow control and/or the monitoring of the xanthate. The xanthate is currently supposed to be added at a 5% solution and at forty or fifty grams per ton in a normal operation. During a check made during process monitoring, the reagent quality, as determined by the QAQC Lab, was 5.05%. This appeared to be something very close to target - the range was specified to be from 4% to 6%. It is pointed out, however, that a 1% variation in flow rate in this area is a substantial quantity and can either increase or decrease recovery substantially. All the lab test work carried out by SRK has shown that the 80 or 90 grams per liter of isopropyl xanthate that is being added at Assarel Medet is too high. Lower dosages will not reduce recovery from the system, according to the test work results.

The xanthate dosage system is haphazard; there is little or no actual control. During the first visit all the reagents were being added to the launder system. During the second visit in October, reagents were being added partially in the launder system in section one of the flotation circuit, and partially in other parts of the flotation circuit. The flow rates to each of the three parallel rows of cells varied greatly (see table blank for the reagent additions at an instantaneous rate). Table 2 shows the instantaneous rates on another given day. The additions to the circuit are by manual control using faulty valves and a gravity flow system creating a non-existent control system. In section two of the flotation circuit, the major reagent addition is to the first flotation cell resulting in little to no conditioning time. The first cell functions predominately as

a conditioning cell, as can be seen by the flotation froth on the first cell. The flotation froth coming off of cells two through sixteen was very adequate during the second mill inspection visit.

Recommended Modifications to the Xanthate Addition Circuit

The piping for the xanthate addition is already in place. Although the required flow rate to each of the individual cells is slow, the rate can be achieved with the installation of either a Clarkson Feeder or a positive displacement pump. In the future the pump can be tied in to an automatic control system that would regulate the dosage based on either the clay content and/or the throughput tonnage. The positive displacement pumps are the preferred method since they are easily regulated in the automatic control scheme. The Clarkson Feeders are the standard of reagent addition through most of the operations that are not completely computer controlled. In addition, the Feeders are simple to modify using a positive system of volumetric cups to dispense the liquid, which can be put on a variable speed controller and the number of cups may be increased or decreased. An automated dosing system recently installed at Assarel Medet is recommended to be augmented with the changed discussed here.

The existing xanthate installation has positive displacement pumps in various states of disrepair, and none have been operating in any of the SRK visits to the Assarel Medet facilities. The equipment appears to be satisfactory if it were in good repair. Over the last ten years parts have been taken apart, and disassembled. The lack of maintenance shows that the reagent circuit, an essential system and primary control mechanism for the recovery of copper, has had very little attention during the ten-year period.

Although the piping has been in place, it appears that in section two of the flotation circuit, the reagent pumps have never been used. If automatic control were anticipated then it would be very advantageous to get these pumps up and running. The reagent addition should be placed within the piping system.

Addition of X133 Flotation Frother

X133 flotation frother is an oil-base reagent currently being added to the circuit in a 5% solution to the mill circuit. This material is added to the sumps for the ball mill discharge. During the last three visits, the frother reagent was being added to three - five, at the maximum number of mills out of the eight running. This is totally

inadequate. This reagent can be added to the feed end of the ball mill, to achieve proper conditioning in the mill. The reagent is currently pumped into the system and then distributed through a series of hand control valves. Four of these were not operating or had no handles and four of the units were not controlled under proper supervision during SRK's inspections.

SRK tested the REX133 addition and found that a much cheaper reagent methol iso butyl carbonol (MIBC) has been found to be a more effective frother. The dosage is a little bit higher, but the cost is substantially lower. Refer to the RDI report in the Appendix. Using stage-wide addition of this frothing agent would require adding it to cells one and eleven in rows one, two, and three, but also the frother addition would also be in these locations. The additional frother has appeared to be one of the contributing factors to the proper operation of the Denver 500 and the Sala 1500 flotation cells.

Addition of 3477

Adding 3477 to the circuit for gold recovery is inconclusive regarding whether or not this will improve recovery of gold or gold credits coming from the smelter, according to current data. It would appear that the gold is very small but visible. The 3477 would promote the collection of this gold. An intensive testing program should be put into place for analyses and equipment placed into the laboratory so that gold assaying can be done not only on the initial feed, but also on the flotation concentrates sent to the Pirdop smelter.

3477 addition could be an active method to increase the profits of the Assarel Medet facility if the gold values are significant. Currently the concentrate being shipped to the smelter has a gold content anywhere from 3.5 to 7 grams per tonne. Testing should be accomplished to determine the effective levels of gold content which can be recovered with this reagent addition.

Automation and Control

The entire reagent addition system should be initially set up so that automatic addition and controls can be utilized in the future. This is why the recommendation for either the Clarkson feeders or the positive displacement pumps is so critical. The use of an

automated system for these reagents and their addition points should increase the recovery of the current flotation cells by at least 3-4%.

With the ultimate goal of increasing recovery to 85 to 88 %, automation would be a significant advance in the circuit. The control can be easily automated using the Amdell system; covered in the flotation section. The Amdell system, although not currently being utilized, can produce process data measurements. With the results from both the lab and the Amdell instrumentation system available, the modifications can be made to a computerized program that will monitor and control the reagent addition throughout the entire flotation circuit. The operators will no longer be manually controlling, but will be manually checking the automatic controls. This is an integral part of the operation and continued success of Assarel Medet.

1.2.8 Flotation

Assarel Medet Mineralogy

Mineralogy provides important information regarding the recovery of the minerals at Assarel Medet. Mineralogy has been completed on both of the major ore types and also the tailing from both section I and section II of the plant. The basic sulfide ore minerals are pyrite (Fe_2S), chalcopyrite ($FeCuS_2$), and chalcocite (Cu_2S). Secondary sulfide ore minerals are bornite (Cu_5FeS_4), and covellite (CuS). Also, there are small amounts of magnetite, black jack (sphalerite), galena, and native gold.

Ore Mineralogy

Three stages of ore mineralization are indicated by viewing the thin sections. The first stage is associated with complex metasomatic changes on the host rock. The second stage is hydrothermal, during which the primary ore and rock minerals formed. The third stage is supergene, which resulted in the development of oxide and secondary (supergene) sulfide ore minerals. Secondary (supergene) sulfide copper minerals include chalcocite, bornite, covellite, malachite, azurite, and ferrous hydroxides (copper-bearing).

The sulfide ore minerals include pyrite, chalcopyrite, and bornite. The oxide ores are situated on the topmost parts of the deposit (up to 20-30 m). The copper minerals are mainly copper carbonates and sulphates, cuprite, tenorite, native copper and native

gold. It interesting that four generations of pyrite are indicated, ranging in grain size from several microns to cubic grains up to 15-20 mm in size.

There are also three generations of chalcopyrite formations indicated. The first generation forms microscopic chalcopyrite grains with irregular shape associated, in veinlets, with magnetite and potassium feldspar. The second generation of chalcopyrite is the widest spread in the deposit and forms grains of several microns up to 0.5 mm in size, which fill cracks in diorite porphyrites, dike rocks, and microcracks in quartzite and leucocratic granite. The third generation is chalcopyrite is only found in quartz-pyrite veinlets and accounts for a small proportion of the total chalcopyrite.

Copper is the "principle useful ore component on whose distribution and concentration the industrial value of the sorts of ores depends". Copper is mainly attributed to chalcopyrite, chalcocite, covellite, and bornite.

The rocks are thermally and chemically altered to metasomatites, which are primarily formed of secondary minerals, namely quartz, sericite, kaolin, montmorillonite, chlorite, epidote, alunite, and diaspore minerals. The "metasomatites" are classified as propylites, argillites, and secondary quartzites:

Tailing Samples Mineralogy

The mill tailing were sampled and thin sections were made. The tailing samples in polished sections showed the following characteristics:

- Copper minerals observed in the tailing samples are attributed mainly to locked hypogene sulfides (chalcopyrite – $CuFeS_2$), and supergene sulfides (digenite (Cu_9S_5) and covellite (CuS)).
- The oxide copper minerals, such as malachite and azurite were not observed but are less than 5 % of the total copper.

The copper particles are much larger than the grind is supposed to be. There are several particles > 125 micron in the tailing. This could account for the losses of copper in the circuits. This is also a pretty strong indication that the sizing portion of the grinding section is not doing an efficient job.

Significant amounts of copper sulfide minerals were detected accounting for the major portion of contained copper in the tailing samples. The tailing samples appeared to contain a larger proportion of supergene copper minerals than would have been expected based on ore type samples. The only liberated copper sulfides minerals were observed in the Row 4 and Row 5 samples from each Section. SRK recommends that tailing from row 5 should be recycled to row 4 and tailings from row 4 be recycled to the regrind mill. Based on the tailing samples, increased copper recovery could possibly be obtained by better classification and by a regrind of coarse particle sizes.

Control of flotation conditions (pH and reagents) could also enhance recovery of the supergene sulfides. The addition of a promoter could increase the recovery of the native gold.

The flotation circuit at Assarel Medet has been shown to be the major problem in the overall copper recovery from this facility. The average copper recovery in flotation has increased from 70 % at start-up to approximately 81.70% today. In SRK's opinion, the copper recovery should be in the 88 to 90 % range. The current testing has made it apparent that the facility could be performing better. SRK recommends that the circuit be modified, and the operation of the unit should be changed.

It has been found in the composite testing that the propylitic, argillitic, and secondary quartz ores respond very favorably to flotation. The speed of this flotation renders the option of flash flotation a non-option. There would be nothing gained in flash flotation. This response is from a grind P_{65} of 106 microns down to a P_{65} of 70 microns. These test results indicate that the operation of the circuit and the setup of the circuit should be modified to improve recoveries.

The overall system was originally designed to handle the feed material from the open pit mine. The feed material has constantly changed but it has been found, during the course of the operation, that there is some oxidation occurring in the the overall feed to the mill.

The test work performed on the flotation circuit shows that the major copper minerals, both oxide and sulfide, are recovered in a primary flotation circuit in approximately 6 minutes. This means that, the design retention time for a given process plant would need to be approximately 12 minutes. At the 30,000 tons per day and 32% solids, the available flotation capacity is more than adequate to achieve this flotation time. In the

staged flotation tests, it was shown that the majority of the copper will float in 1 – 2 minutes and that the additional time is a system that should be modified. At the higher density flotation, there is sufficient capacity and residence time in the cells to support the 12 million tonnes per year production scenario.

Currently Section I has rougher cells only with the tails going directly to tailings pond. SRK recommends that these cells be set up to function as a rougher/scavenger arrangement. The first ten cells in each row would be the rougher and the final twelve cells would be set-up as a scavenger. The froth from the scavengers is collected and pumped back to the initial feed tank in each section. This arrangement should produce a much higher-grade concentrate and lower the overall tail losses from the circuit. A staged reagent addition will be required to do this. The stage reagent piping is in place and new feeders are anticipated in order to get the overall feed to the system and to have a constant reagent feed based upon the tonnage being fed to the mill.

The test work indicates that any where from 88 – 93% of the copper will be floated in the rougher circuit. Currently the overall recovery of the plant is from 80 – 82% with the rougher circuit recovery being only about 88 – 90%. The current rougher concentrate grades are a low of 1% and a high of approximately 1.5% . The cyclone density is currently between 22 and 24%. SRK strongly recommends that the overflow of the cyclones be controlled at between 30 and 32% solids. This will increase the retention time in the flotation circuit and it will enhance the separation of the mineral and the gangue particles in the cells.

It is very important to note that the collection of the copper in the rougher circuit is directly dependant upon three items - particle size, reagent addition, and adequate flotation mechanism performance. By controlling these three parameters, it will be possible to achieve an optimum performance. The long-term goal of 88 – 90% recovery is realistic. Additional performances enhancement is possible but it is important to recognize that the cyclone performance is highly variable with respect to volume, particle size and density. The inefficient classification of this slurry coming from the ball mill circuit is a major contribution to the overall flotation circuit instability.

The flotation circuit is in two parallel sections. In Section I there are three rows (1-3) containing 66 Denver 500 cells with 25 kW motors. The losses from this section appear to be in the range of 9 to 10%.

The pH in the rougher section should be held in a range of 9.5 to 10.2 maximum. Currently, the pH of the circuit has been above 11 all times that tests have been preformed. Holding the higher pH wastes a great amount of lime and reduces the activity of the reagents.

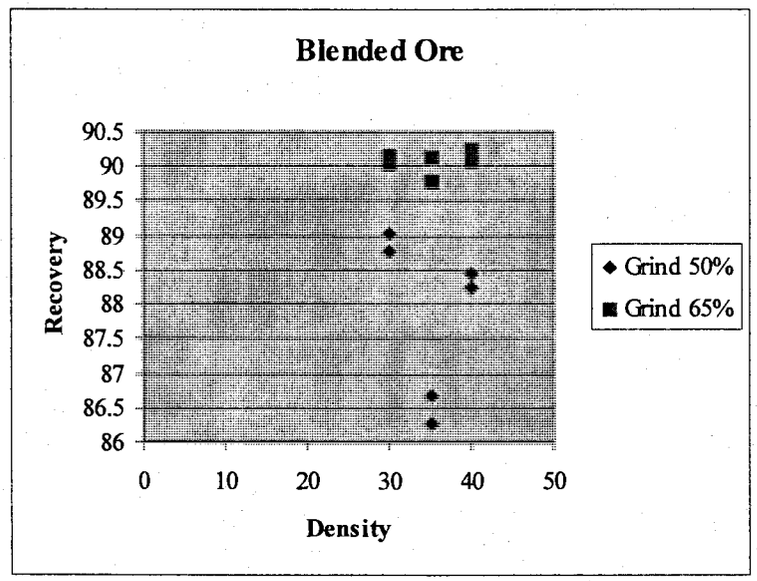
The cleaning of the concentrates is done in row 4 which has 22 Denver 500 cells with 25 kW motors. The rougher concentrate cleaner has a configuration 8 cells (4-4) in the cleaner and 14 cells (6-4-4) in the re-cleaner. The copper losses in this section appear to be about 1 to 2 percent. The regrinding of the concentrates from row 4 is done with a 2.7 m by 3.6 m regrind mill in closed circuit with 750 mm cyclones. The overflow from the cyclone goes to a thickener and the underflow is going back to the regrind mill. The thickener is a 50-meter unit and there are two of these thickeners operating in series. The thickener overflow is pumped to the process water pond for reuse in the plant. The thickener underflow is pumped to Row 5 which contains 20 Denver 500 arranged in an 8 cell (4-4) cleaner and a 12 cell (6-6) re-cleaner. The re-cleaner product is pumped to a cyclone and thickened and placed in to the feed end of row 4. The tails from this circuit are sent directly to the tailings line and losses are about 1 to 2 percent. The froth from row 5 is sent to row 6 which has 14 Denver 300 units which are arranged6-4-4 where the 1st cleaner has 6 cell, the 2nd cleaner has 4 cells, and the 3rd cleaner has 4 cells. The tails from the 1st re-cleaner are sent to the feed of row 5. The concentrate from the 3rd cleaner is pumped to the concentrate thickener.

The reagent addition to all of the units is manually controlled and is, at best, +/- 20 percent of the required reagent addition. This has to be rectified. The reagent addition points have varied each time SRK has been present on site. The X-133 is added to the ball mill at a given rate of 6-7 g/tonne and the Promoter 3477 was added to the ball mills but was not being added during the last visit. The reagent dosage has been increased per the data sheets provided by Assarel but the quantities have not been verified. The reagent dosage appears to be very high compared with other operations through out the world. There is potential for substantial cost saving and increased recovery with proper reagent addition to the proper areas of the flotation circuit.

The density of the flotation circuit is between 22-24 percent. This is very low and reduces the time the solids are in the circuit. When the tonnage is increased to the 36,000 tpd the recovery would decrease further at the existing solids percentage. A simple way to overcome this is to increase the density of the flotation circuit. Test

work to date shows that the density can be increased to 30-35 percent with an increase in recovery of copper in the rougher circuit. It follows that this would also increase the density in the Row 4 circuit.

The following table shows the relationship of density to recovery for the testwork accomplished at Assarel:



The 65% grind is the obvious target grind size for improvement in recovery, and as can be seen from this chart, there is no relationship between recovery and density of solids within this range. The conclusion is that a higher density flotation is possible and advantageous because it allows for increased capacity. SRK suggests that the changes to the ball mills and cyclones be accomplished, then the changes to the flotation sections. Having made these changes, then the density can be gradually increased keeping close watch on recovery. With everything but density constant, this test can be completed using the entire concentrator, and accurate data regarding the relationship with density compiled. It should be noted that SRK is confident that the density can be increased with no impact on recovery.

The pH of the Cleaner circuit should be 11 to 11.5 which is close to that of the plants in Arizona and the other plants in the World.

Section II row 1 contains 16 Denver-Sala 1500 cells. These cell are arranged in a (4-4-4-4) in a standard rougher configuration. The units are currently being operated at a pulp range of 22 to24 percent. The test data indicates that the pulp density can be increased without increasing the losses and should actually result in an increase in recovery. The losses from this circuit are in the range of 8 to 10 percent.

The cleaning of the concentrates is done with row 4 which has 22 Denver 500 with 25 kW motors. The rougher concentrate cleaner is in row 4 and has a configuration of 8 cells (4-4) in the cleaner and 14 cells (6-4-4) in the recleaner. The losses in this section appear to be about 1 to 2 percent. The regrinding of the concentrates from row 4 is done with a 2.7 m by 3.6 m regrind mill in closed circuit with 750 mm cyclones. The overflow from the cyclone goes to a thickener and the underflow is going back to the regrind mill. The thickener is a 50 meter unit and there are two of these operating in series. The thickener overflow is pumped to the process water pond for reuse in the plant. The thickener underflow is pumped to Row 5 which contains 20 Denver 500 arranged in an 8 cell (4-4) cleaner and a 12 cell (6-6) in a re-cleaner. The re-cleaner product is pumped to the feed end of row 4. The tails from this circuit are sent directly to tail line and losses are about 1 to 2 percent. The froth from row 5 is sent to row 6 which has 9 Denver 300 units which are arrange 4-3-2 where the 1st cleaner has 6 cells, the 2nd cleaner has 4 cells, and the 3rd cleaner has 4 cells. The tails from the 1st re-cleaner are sent to the feed of row 5. The concentrate from the 3rd cleaner is pumped to the concentrate thickener. It should be noted that row 6 will have to be modified in the recommended scheme to a 6-4-4 configuration.

The maintenance of the flotation section occurs monthly and lasts for about 12 hours. The Denver 500 in the rougher section have a life of 7,000 to 9,000 hours in the rotor and the cone lasts 13,000 to 15,000 hours. The IVA machines are being reviewed with regards to the power savings. The review of the operation of these machines will be accomplished with controlled tests of the installed units in the concentrator, compared with Denver 500 units also installed. The results of the tests will dictate the future use of the units at Assarel Medet.

1.2.9 Thickening and Filtration

Although the five 50-meter diameter thickeners and the three 20-meter diameter thickeners were designed for operation of the thickening facilities at Assarel Medet, they have never been in complete operation. They were installed exterior to any

structure with the underflow pumps, equipped with variable speed drivers, housed in pump houses with adequate control.

The online availability of the thickeners used has been in excess of 98% and the only comment that can be made is that the units might be equipped with flocculation systems to assist in the settling of the solids and/or a "froth buster" spray bar to assist in the elimination of the froth on the surface. There appears to be sufficient capacity with the concentrate thickeners to support the higher production rate of 12 million tonnes of ore per year.

SRK recommends the intermittent use of both filter units to spread the load being placed on the single unit in operation at this time. It is felt that by putting the second unit into operation in times of high concentrate production, better drying of the concentrate will result.

Tailings Thickening

The tailings thickening has been reviewed as an option for Assarel Medet. Currently the tailings go directly to the tailings pond bypassing the thickeners. The thickening studies have shown that with the aid of flocculant and using a 30-meter diameter thickener would result in tailings of approximately 45% solids and using a 60-meter diameter thickener would yield a 50% solids (by weight) tailings product.

By utilizing one of the 50-meter diameter thickeners, currently not in use, Assarel Medet can significantly reduce the power cost of pumping excess water from the tailings pond back up the hill to the water storage pond. The 50-meter diameter thickeners would simply be placed into operation and there would be 100% stand-by capacity to alleviate any problems with the tailings circuit. This would support both the 11 million tonnes of ore per year production scenario as well as the 12 million tonnes per year production scenario.

SRK recommends using one tailings thickener and a gravity flow to the tailing pond for the underflow. Calculations have shown the thickened tailings flowing down the concrete tailings launder will have an adequate hydraulic flow at 50% solids by weight. Discussions in Panagyurishte regarding this hydraulic flow reflected some different calculations by another consultant Geotechcopper. SRK is confident of the ability of the tailings to flow down the launder at 50% solids, however this operation

could be brought gradually into operation, with careful monitoring of the percent solids and the flow. By gradually increasing the percent solids in the tailings flow, and monitoring the flow characteristics at the flattest area (just as the tailings line exits the tunnel), we can assure that the operation will not experience any plugging of the launder. The cycloning operation with tailings at 50% solids would have to be reviewed to ensure the split is accomplished both efficiently and effectively for the slime separation. Utilizing the tailings thickeners could allow the cyclones, at the base of the hill, to be operated longer than the current 6 - 8 months; thereby, permitting blending of additional sand for the stability of the dike at the base of the tailings pond.

The thickeners that are located to the west of the current mill facilities at Assarel Medet would be used. The tailings at the current 23 - 20% solids would be placed in the center feed well with the required polymer. Adding the flocculant at a maximum rate of 78 grams per metric tonne of solids has been found to have a significant effect in decreasing the unit settling area. The test results indicate that unit-settling area for the tailings is 0.107 square meters per tonne per day at underflow solids of 52% by weight, 0.08 at 50% solids, and 0.019 at 45% solids. (See the RDI Report included in the appendix)

Thickening will effectively reduce the pumping and pipeline requirements for the tailings water recovery. Pumping the supernate (approximately 36,000 - 50,000 tonnes of water at a pH of 10.2 - 11.0) directly from the thickener up to the water holding pond adjacent to the west of the truck shop will not only yield significant power savings but could also alleviate some of the previous large swings in Ph in the mill process water feed.

The underflow tailings solids would be pumped to the tailings launder, from the underflow system into the tailings line or if possible the tailings might be able to gravity flow.

The thickener bridge and mechanism should be reviewed to make sure that these units are capable of handling the 36,000 tons per day. The thickener units appear to be high enough quality to handle the additional feed rate.

If the existing mechanisms are inadequate, an alternative Eimco mechanism has been investigated at the 50-meter diameter. These units, with supporting bridge and center feed well, fully automated, with a polymer feed system could be available for

$236,000 each. These units will be 50 meters in diameter with a 3.5-meter sidewall. Full rake assembly and other installation work would also be available.

The water pumping system going up to the water storage pond would have to have an overflow surge tank to handle any of the possible upsets from extraneous events throughout the plant that can affect the tailings. This surge tank and/or pond should be sized, based on the operators' experience of upset throughout the plant and the water-pumping plan. Upsets in the plant that would affect the tailings operation include: sag mill solution collection, ball mill solution collection, flotation solution collection, wash down water, rainwater, precipitation events, and/or maintenance events that occur throughout the mill.

The water recovered at the thickener should be pumped up from the water surge tank during the evening hours or pumped continuously with a reduced size of the surge tank or pond.

Polymer Mixing System

Using a proposed fully automatic polymer mixing system would require little or no operator assistance. The polymer currently being investigated is a strong anionic polymer that is manufactured in the US and available at approximately $2.50 per kilogram. The strong anionic polymer would initially be made up into a 0.25% solution and then diluted and distributed throughout the plant at a 0.01 - 0.02% solution.

The addition of the polymers to the thickener would be through the feed launder. The polymer would be injected into the feed launder and into the center feed well of the unit. The slime level for the thickener would be measured by an ultrasonic and/or radar level element. These measurements will be used to vary the amount of flocculant being added to the system. Using the recommended durable flocculant at an addition rate of 78 grams per ton is high but it showed excellent performance and the flocculant requirement is by no means optimized. The rate is based on the result of a single test showing that flocculation does significantly reduce the surface area requirement for thickening.

Utilizing the slime level to adjust the operation of the thickener is not critical if two thickeners are used in series. The second thickener would require little or no

flocculant to clarify the solution and to make a final clear product that would be pumped up to the hill. The sizing of the line that would go from the lower thickener to the water storage pond would have to be determined and would depend on the decision of whether it would be pumped using off peak power only or whether it would pump continuously around the clock.

1.2.10 Lime Mixing and Distribution

The lime mixing system, located at the west end of the mill building in a structure that has been added on to the original building, appears to be working but there are some areas that need improvement. The lime is delivered as quick lime (CaO) and is slaked with water in a continuous slaker. The lime mixing system product flows through a trommel de-gritting screen that takes out the majority of coarse particles. The resulting slurry flows into a spiral classifier and this de-grits any of the remaining insoluble product from the lime. The reject grit discharges directly out onto the ground and is removed to another location. The slaked lime is pumped to two lime storage tanks.

The lime distribution system is a complex arrangement of pipes most of which are plugged. Piping is in place to pump lime through the disintegrators building into the ball mill building and into the flotation section. The line to the disintegrator has never been operational. As a result, the pH of the disintegrators has been between four and five, which accelerates both lime usage and the activation of pyrite in this circuit. Lime should be added to the disintegrators to raise the pH to 9.0 as quickly as possible. If the pH control is not added in the disintegrators, it definitely should be added to the ball mills. This will reduce some of the ball consumption due to grinding in slurry at a pH between four and five. Lower pH increases the iron sulfate that is absorbed into solution and becomes a perfect media for faster consumption of the balls due to the acid media. If the lines require pigging or replacing, this is a small price to pay for the benefits that are achieved in lower ball consumption in the ball mills and lower steel consumption and wear.

During the last visit, the lime distribution system into the ball mills was supplying some lime to the mills and the pH coming out was 5.0. It was stated that the lime was too costly and the pH could not be maintained. The pH in the flotation circuit, however, was running between 10.5 and 11.2. The function of the lime is the issue. If the slurry is neutralized in the disintegrators or in the ball mills, little or no lime will

have to be added into the main rougher flotation circuit and less lime will be used overall. Meaning the pyrite will not have been activated and additional lime will still be required in the cleaning of the concentrates because there the pH must be elevated to a pH of -12.0. There is lime currently being added to the cleaner circuit and the pH there was verified to be 11 or greater.

The lime distribution system is a re-circulating loop. It pumps from the tank through the piping system and then back into the tank. The current distribution system has the lime being pumped back into the tank and the tank is open to the atmospheric air. Any time the lime solution comes in contact with air it absorbs any CO_2 that is in the air and makes CO_3. CO_3 is the scaling agent that is creating most of the plugging in the lines. The lime should be returned to the tank below the surface of the lime so that additional CO_2 is not absorbed into the circuit.

The lime feed control system appears to be under maintenance in the flotation section, in that a flow meter and a hand control valve are currently being installed. These were not currently in operation. These modifications should also be done in the disintegrator area. Raising the pH should happen in this area of the process facility. This is a simple circuit with either a hand or an automatic control valve located on a slurry line, together with a pH meter. The pH meter would require cleaning daily. To reiterate, this simple modification would help the total operation of the system by reducing the consumption of lime and neutralizing that material as soon as possible.

The current flotation operation has lime being pumped into the launders that feed the flotation section (this is where the pH is raised to 10.2 – 11.0) and the lime addition is strictly manually controlled. Adding a simple pH loop with a control valve can substantially decrease the amount of lime consumption throughout the system.

The operator only monitors the pH in the first cell, where the adjustment is made, in each of the units. Since lime takes a period of time to react, anywhere from 4 - 5 minutes, and is continually taking place, while the lime is in the flotation section it is reacting to the slurry and increasing the pH. During the visit in October, the pH of the incoming launder feed was 5. The pH in the first cell was 10.2, and the pH of the final tailings going out of the system was 11.2. The slurry residence time in the flotation circuit is approximately 13 minutes, and the lime is not fully reacted halfway through each of the circuits.

Adding the lime in the ball mills allows the reaction time to take place away from the flotation circuit, reducing the amount added at the flotation circuit, and improving control of the flotation process. Overall, this not only reduces the amount of lime consumed but also lowers operating costs.

1.2.11 Automatic Lime Feeding and Automatic Control

SRK recommends installing an automated pH control system preferably using computer controlled feeders or feed valves either at the disintegrators or the ball mills. The automatic control could also be used for pH adjustment at the front-end of the flotation cells based upon the mixture of ore, and the lab results. Refer to the RDi report in the Appendix.

It is extremely important that the pH in the cleaner circuit be elevated above 11.0 and should be operated between 11.2 and 12.2. This enhances the cleaning of the chalcopyrite and aids in the separation of the pyrite from the chalcopyrite, covellite, and the bornite.

After installation of an automation system, the full operator training and review should be done either on a monthly or bi-weekly basis so that the operators know the delicate care that the pH meters require, and the amount of attention required for maintenance in a slurry service. Simple cleaning of the probe, if done properly, increases the life of the pH probes possibly greater than 4 - 5 months.

The pH control in the other areas of the mill could improve with automatic control rather than manual. The consumption of lime is one of the major reagents throughout the flotation circuit, therefore, automated control will result in substantial cost savings in lime. In addition, there is an issue of acid generation in the waste dumps. The pH of the tailings can be controlled so that the water coming up from the tailings pond would have a lower calcium content, reducing the scaling of the water pipeline up to the main plant.

1.2.12 Water Recovery

The current water recovery system involves the settling of tailings water through two ponds down stream from the tailings storage facility, Liuliakovica, and subsequent pumping of this water back up the hill to the reservoir above the concentrator. There are three pumping stations in this system, with a dual pipeline carrying the return water

back to the concentrator reservoir. The overall usage of power from this water return system is approximately 5 kwh/tonne of processed ore. The major reasons for such high power usage, are the encrustation within the pipeline, reducing the effective diameter, and also the sheer volume of water recovered and pumped up the concentrator and the low efficiency ratio of the pumps.

Assarel is currently de-scaling the pipeline through a third party contract, which is expected to be completed early in 2003. The cost for this de-scaling is approximately $250,000. Reagent usage was investigated to determine what reagent could be added to the return water to prevent the scaling which has been experienced. The reagent recommended is a NALCO product. When NALCO was contacted for volume and price, it was determined that the cost of this reagent addition would be 3 to 4 times the cost of the cleaning operation per year. SRK therefore recommends that the pipeline be cleaned every two years or so.

1.2.13 Automation

The following suggested automation system would apply to both production scenarios; 11 million tonnes of ore per year and 12 million tonnes of ore per year. There is a schematic included in Appendix C.

The existing automation and controls for the Assarel Medet facilities are characterized as a series of monitors, which feed back into a centralized viewing port. Several sections of the plant are connected in this way, several sections of the plant are not. The primary areas of major concern are the disintegrators fine crushing, ball mill area, flotation section, cleaning flotation section, and thickening and filtering.

The existing instrumentation around the jaw crusher facility appears to be adequate. It needs to be tied into the main control loop so that there is constant feed supply of material to the disintegrators, this should be very simple in that the apron feeders are already on a variable speed drive and the jaw crushers have existing amp meters. These can be tied together in a simple control loop with input/output that would feed back to the main centralized control station in the mill building.

1.2.13.1 Disintegrators

The disintegrators have little or no instrumentation currently provided for their operation. An organized attempt to gather the data from the disintegrators and put into a centralized control loop should be followed. This would include allowing the mill operator to vary the feed to the disintegrators based upon mill density, mill amperage, and PH of the circuit. These should be automatically controlled and the system setup where the feed into the disintegrator either is increased or decreased. The amount of water and lime is proportionately added. The control would require the gathering of signals from the current motor control center for the disintegrator and putting them into input/outputs into a centralized control loop and following routing of the signals to the main PLC.

The water addition to the disintegrators will require an automatic valve with by-pass. The lime will require an automatic valve with by-pass and the variable speed control on the feeder will adjust the feed rate base upon the mill amperage. The density will be monitored on the discharge of the mill and the feed belt will either increase or decrease. This solution discharge from the disintegrators flows from the trommel across the screen. The screen will have an on/off control which will be controlled from a centralized control panel.

The algorithm for the disintegrators is an simple one and should allow for variations in not only ore type, but also viscosity and variations of hardness of the ore.

A scale should be installed on the oversized material leaving the trommel from the disintegrators going into the fine crushing area. This could control the feed going to the disintegrators.

1.2.13.2 Fine Crushing

The fine crushing area needs to be controlled under a standard cone crusher scenario. This would allow for the control amperage of each of the machines being fed back into the main control panel, which will increase or decrease the amount of feed going to each of these of the 8 cone crushers. Typically in a normal cone crusher control system, this is controlled at approximately 80% of full load rated amps on the motor this should allow for a increased production and increased throughput through the system.

Based upon the selection of cone crusher alternatives presented here, the control to each of the cone units would be established. From a remote location and the fine crushing product will either be directed to the ball mill grinding section or back into the existing disintegrator feed bin, depending upon the alternative configuration selected.

The lubrication system for the cone crusher should be input into the PLC for monitoring and maintenance assistance.

1.2.13.3 Ball Mill Control

The control of the ball mill system is complex because we are trying to tie in particle size monitoring , optimum feed rate to ball mill and density to the flotation circuit all in one system. The independent variables in this circuit are feed rate from the feed bin, the water added to the cyclone sump and to the ball mill, and the over-flow and under-flow densities of this cyclone. The complexing agent for this system is the high cyclone from the disintegrator feed. This unit automatically goes directly into the feed throat of the ball mill. This may be modified so that the cyclone would feed directly into the ball mill sump, which would then feed the bank of two cyclones, dependently. This would increase the power required for the pumping, but it would reduce the complexity of the overall control scheme for the ball mills circuit. The density from the mill must be monitored because this is a totally dependent upon the cyclone underflow and the new feed from the disintegrators bin. This coupled with the feed-back from both the density meter feeding the cyclone and the particle size monitor on the overflow of the cyclone can be combined in a algorithm to control the independent variable so the a total system can be stable and reliable. The ph in the ball mill will be trimmed with the lime in a control loop that is independent of the main control of this system. The ph from the ball mill will be controlled between 9.5 and 10.5 for the flotation circuit this should be easily controlled. There will also be reagent addition to the ball mill of either MIBCX133 or a promoter 3477 for the gold collection. These are independent of the entire circuit from the ball mill other than the feed rate from the overflow of the cyclone will vary the reagent addition.

The control of this circuit will be an Algorithm that will be interfaced into the main panels located in and around this area. This system will be able to control all eight mills independently and the collective units can be monitored and minor adjustments made to the eight mills throughout the circuit.

1.2.13.4 Flotation Section

The flotation section control will be based upon the feed from the ball mill, the amdel response, both for the feed copper and other items, the particle size monitor with corresponding adjustments to the reagent being fed into the circuit via the tails analysis and the rougher scavenger min flotation circuit.

The control of the flotation reagents will be based on the amdel system and this will add the frother collectors xanthate and the promoters based upon the feed analysis of the copper coming into the circuit. The frother will be controlled in a stage wise addition at the point of the ball mill and the centralized feed box in all of the flotation circuits and the intermediate feed boxes . This flotation reagent addition can either be an algorithm or a total automatic system utilizing cameras that will view the bubbles, analyze the bubble size and control both air and frother addition. This is a simple control loop that has been worked out effectively by Outokumpu and this technology can be directly applied to the main rougher section. This should enhance performance while minimizing the reagent addition and increasing the recovery into the 85-88% range.

This automatic control system will be coupled with automatic level control for each of the individual banks and the addition to each of the flotation machines in an automatic system where the amount of air will be controlled and the supply of air should be controlled through out the entire flotation circuit.

The cleaner sections will be modified so that the reagent addition will be placed, not only in the collective flotation that remains in the circuit, but in the main collective flotation section, both rougher scavenger and in the cleaner section in the ball mill circuit with minor additions of xanthate and collector being added in the cleaner circuit throughout a sequentially placed addition points both in the first, second, and thirds stage cleaner. The Amdel unit will be retro fitted for input from the tails from each of the sections, which will control the addition of xanthate and collector for the circuit. This will also be utilized for the total copper grade going to the concentrate. There will also be an Algorithm developed around the Amdel system where there will be a sulfur balance, and iron balance, and a copper balance. The copper speciation is placed so that high grade and low-grade concentrates can be blended for more stable controlled environment.

Each of the individual flotation cells will have to have automatic level controls on each of the banks, with automatic air addition for each of the individual sections. This will be a circuit that will be tied all back into a major PLC which will be tied into the overall plant control.

1.2.13.5 Regrind

The regrind control will be similar to the main ball mill control. The feed to the unit will be varied via the cyclone underflow density and the thickener density going to these units at this point in time, hopefully that the concentrate grade will take a major jump from the 4 – 5% to 7-8% range and even higher. Because of this, the control of particle size and the ability to regrind will also be monitored based upon the filtration cake density in the filter circuit and the moisture content coming off the filters. This is an optimization between the grade of copper, the regrind capability and the moisture content of the discharged cake. These all can be monitored and variations can be made in the regrind circuit through automatic control, density and flow rate to the cyclone system.

1.2.13.6 Thickeners and Filtration

The thickener and filter section is currently controlled manually. This circuit is sufficiently large to handle any and all of the process variations throughout the plant. At any given time there should only be two filters running throughout the entire circuit. As seen in the moisture content, the moisture has varied slowly increasing through 2002 from January through October. This would be variation in the regrind system, this can be monitored and modeled, and the moisture content can be varied slightly by reducing the RPM's or increasing the RPM "s of the disks on the units. The filter blow back area can also be monitored and if the moisture starts creeping higher then the heated air from the vacuum pumps can be utilized as a heat source to reduce the moisture content 1 or 2% . It has not been determined that this moisture content is diliterous but if it is then this system can be put into place.

1.2.13.7 Major Control of the Entire Facility

It is visualized that a main central control system with 100% back up would be installed in a new mill office located in and around the flotation section. This control system would have seven major input/outputs going into the centralized control system. This centralized control system would have major IO ports in the coarse

crushing, disintegration, fine crushing, ball milling area, flotation upper section, flotation cleaner section, and the thickening and filtering. These all would feed independently into each of the individual circuits. The control system would be configured with fiber optic cable into a PLC, which will process all of the data, and the software provided will be able to do the majority of automatic control.. There will be manual back up for all of the systems incase of system lock down and /or system failure. Although system failure is not a common occurrence, it can create major problems if spare parts and other areas of each of the plants go down or individually. The reliability of the automatic control system in today's environment is extremely high and extremely effective.

It is anticipated that the automatic control system will reduce the total amount of labor but not significantly. What labor will be saved through out the mill operation circuit will be made up in instrument techs and maintenance people. The system will be set-up to monitor and log, and data points so that maintenance records can be updated and a maintenance schedule developed through out the automatic control system. This control system will take approximately 1 year to implement, and will have significant results as the implementation is progressing. It is anticipated that the major cost of this system will be the instruments and the IO systems themselves. The major PLC and algorithm systems are reasonably inexpensive for the additional costs. The major cost of the instruments will be in retro fitting the Amdell system and the particle size and density monitoring throughout the plant.

1.2.14 Laboratory Changes

The laboratories facilities at Assarel Medet have produced some of the most pertinent data developed for the project. It is a compliment to the staff that the data has been received in both an effective and an efficient manner.

The facilities that the laboratory technicians are working in are substandard even for a small mine, let alone a mine that is to produce 30 – 36,000 tons per day. The entire laboratory will require complete modification of the sample preparation facility, analytical facility, metallurgical facility, and the mineralogy facility. Each of these must be completely redone and additional equipment provided so that the laboratory can work on a prudent schedule and give the operating data needed to effectively enhance the performance of the entire processing facility.

Sample Preparation Facility

Crushing and sample preparation must be completely redone. The facility currently has drying ovens, two jaw crushers, disk crushers, grinders, and other things. In SRK's opinion, the equipment is undersized for a facility such as Assarel.

The sample preparation facility should be equipped with a minimum of two jaw crushers, two cone crushers, and two disk pulverizers. Each of these units must be provided with dust collection and the dust collection should be a downward-vented system. In addition, for sample preparation, this area must be provided with a blending table, a sample weigh scale, drying ovens, sample storage, and a barcode reader for sample identification.

This facility should be set up to handle the drill samples from the drilling operation from the mine, the samples from the crushing and grinding facility, and from the flotation, thickening and concentrate.

Analytical Section

The analytical section should be completely modernized. The current equipment that the technicians are working with are x-ray fluorescence and an AA machine. These units appear to be adequate and give reliable, repeatable information. These units should, however, be replaced by a new x-ray fluorescence unit, an ICP, and AA that will all be tied into the barcode sample identification program. These will allow the facility to give a rapid and accurate response of the metallurgical data,. These data can be directly integrated into a system where the mill facilities can receive information within the hour on the metallurgical samples and how they are processed. This will produce an error free system, which will allow the entire facility to be more efficient.

Metallurgical Lab

The metallurgical testing facility has produced the most reliable, repeatable data from the facility. This is with antiquated machines. This laboratory also needs a complete infusion of metallurgical testing equipment. This equipment should include, drying ovens, new flotation machines, both of the Denver and the Wemco variety - in the 30-liter, 4 liter, 2 liter, and 1 liter machines.

New grinding mills including rod, ball, and an autogenous grinding test facility should be included in this facility. This will allow studies to be run for the comminution and size reduction of this facility. This is one of the major points as technology has

increased the ability to test, particle size, and the other items helpful in enhancing the performance of the Assarel facility.

Mineralogy Laboratory

A mineralogy lab should be included in this area. This should include the sample grinding and slide preparation with polishing facilities, microscopes, and a digital camera. This will allow for determination of ore types and development of a routine procedure as the pit is lowered into the system. Through the mineralogy data, changes can be made to the metallurgical test program to significantly reduce the overall operating costs.

The proposed changes for this facility will have an approximate cost of $453,000.00. This would include metallurgical benches for the crushing and sample preparation facility, mineralogy. and metallurgical facility. These new laboratory benches, fume hoods, etc. will allow for a much cleaner operation and should give more accurate and reliable information.

Precious Metals Lab

It is also recommended that a fire assay system be installed. This will include a muffle and cupellation furnace to be installed with the sample preparation and blending system. These furnaces are readily available and will be able to track the gold and silver credits much closer than is currently being done. The gold credit may be greatly enhanced if the grade of gold is assayed regularly on site. If the grade of gold or silver continues to increase and/or decrease then the credits from the smelter will be increased. A facility should have these if the gold credits are substantial. The repeatable metallurgical assays will indicate if a promoter should be used for the collection of gold from the flotation circuit.

1.2.15 Precipitation vs. SX/EW

Heap Leach Facilities

The Oxide Heap Leach Facilities are located to the south of the main processing ore area. About 1.8 million metric tons are mined per year and the annual copper production is between 750 – 800 tons of copper per year. The active leach area is approximately 129,120 square meters. Assarel-Medet tries to send an ore grade of

between 0.14 and 0.175 percent with an oxide greater than 8%. The overall plant is currently solution-treating 4,300 cubic meters per 24 hours, which is about 50 liters per second. The average grade of the pregnant solution varies between 680 milligrams to 1 gram per liter, with an average of approximately 760 milligrams per liter.

The active Heap Leach area is approximately 129,120 square meters. They are currently stacking in 12-meter lifts, and their recovery is less than 25%. A recommendation has been made to stack a maximum of 6 meters.. Reports produced by Geotechcopper and a multitude of recommendations from other leaching operations around the world indicate that 6 meter lifts are optimal for maximizing recovery. The Heap Leach pad currently allows for three active areas to be operated at a single time. Once new ore is placed on the pad, it is leached for approximately 7 months. This includes 3 ½ months of leaching, a rest period, and then followed by two additional cycles of leaching on the reduced content ore. Test information from Geotechcopper indicates that with a 1 gram per liter H_2SO_4 solution, recoveries of 65% or better can be achieved in a period of 3 months. This leaching scenario should be put into place immediately to avoid the loss of copper in the heap. There is more than enough leaching surface for a 6-meter lift operation.

The overall sulfur content of the ore is approximately 1.16 – 2%, which is being placed on to the Heap Leach pad as secondary sulfites and sulfides. Approximately 12.84% of the material is chalcopyrite and approximately 51% is colvalite. The majority of the ore is from the north or northwest area from the pit. Currently the mine has a capacity of approximately 1.8 – 2 million tons per year to the oxide pad. SRK has determined that there is a minimum of 20 years of oxide life on the pad itself. This is currently being used for the calculations of the plant additions to the oxide ore and the analysis is below.

Processing Plant

The process flow sheet for the existing precipitation plant is shown in Drawing 02003-F-20, in Appendix C.

The solution is collected from the base of the oxide leach pad. From there it is pumped upon from the rich solution reservoir is pumped up the hill in a pipeline to a solution holding tank. From this solution-holding tank, it flows in to 14 rows with 10

cells per row. The initial first two are control rows where the solution is contacted initially with iron.

The flow rate into the plant is approximately 4300 cubic meters per day, or 50 liters per second. The head grade as stated before is between an average 760 – 830 milligrams per liter of solution. Approximately 4 tonnes of copper is harvested over a 24-hour period. The current ore density is approximately 2.5 tonnes per cubic meter and has the low of 2.1 tonnes per cubic meters. The application rate for the leach solution is approximately 5.7 liters per tonne, per 24 hours. The sulfuric acid consumption is approximately 1.14 liters per cubic meter of ore. Currently Assarel has stated an achieved 26.88% recovery. The oxides in the ore are greater than 15%. The maximum oxide content is 20% with a grade of 0.168. The cutoff for the Heap Leach system is 0.1% copper.

Currently the operation has to pay approximately 36 lev per tonne of 80% sulfuric acid. Pirdop has just completed an expansion and upgrading of their acid system. They have raised the concentration from 80 to 97%. Typical precipitation plants use scrap at about 4 tonnes per tonne of precipitation recovered. The scrap iron currently is running about 220 Lev per tonne, and will increase to approximately 400 Lev per tonne. The scrap iron has slowly degraded in quality and a minus 4-millimeter scrap must be used. Anything greater than 4 millimeter is typically reduced with a shovel then loaded with a magnet into each of the fourteen rows and the 10 cells. The solution flow rate is through a series flow into row one an exit on row 14.

After the copper rich solution has contacted the iron and copper is precipitated as Cu_0. The iron, which is then Fe_3SO_4 flows by gravity to the iron precipitation zone. From here iron is precipitated and the resultant Ferric Hydroxide that is settled out in the settler is pumped into the tailings pipeline of the Assarel concentrator. The overflow from this solution flows into another area where concentrated sulfuric acid and fresh water are added. These are mixed and bleed is established based on the iron content. The bleed is pumped into the tailings pipeline. The acidic solutions are then transposed over into the ore leach, put in slots, and the solution then percolates down through the heap and the solution is collected in the rich solution holding pond.

The copper precipitate is withdrawn through pinch valves into a launder into the bottom parts of the cementation reactors. The copper precipitate flows into the

steeling area and is picked up by a clam shovel out of the solution collection launder and the decanted solution from this area is pumped back into cell #1. The cemented copper is picked up by the clamshell and placed into a holding area to drain and the drained solution is also pumped back into the cementation unit. The resulting copper precipitate has been double handled and picked up with a front end loader and either carried to the cemented copper pad or placed into a conical holding bin from where the solution is slurried and pumped into the Leroux filter. This is a multipass filter where pressure and time reduces the moisture content, to 9-11% water. The copper content is 78-82% in the concentrate.

The overall scheme of the cementation plant is to recover whatever copper it can. It currently appears that based upon the economics and the prices given, that the cost for each tonne of copper produced is not in excess of the average daily price on the LME

INFORMATION

				Assarel-Medet JSCo		
				average values		
Active Leach Tonnage	1800000	Tonns/year				
Annual Copper Produced	750	Tonns/year		750 TPY		
Grade of Cu precipitation		%		76 - 82 %		
Active leach Area		M2		3000 sq.m.		
% of Copper to Leach		%		0.140 - 0.175 %	0.18	
% of Oxied Copper		%		8 % relative		
Flow to the leach area		liters/sec		4300 cub.m./24 hours	49.76851852	liter/sec
Grade of the barren solution		g/liter		150 - 250 mg/l	0.2	ppm
Flow to the Precipitation Plant		liters/sec		4300 cub.m./24 hours	49.76851852	
Grade of the Feed to Precipitation Plant	1	g/liter		600 - 1000 mg/l	0.8	ppm
pH of flow to leach pad		pH		1.8 - 2.3		
pH of flow to leach plant		pH		2.7 - 3.3		
Recovey of Copper on leach Pad		%		none		
Leach Lift height		m		12.5 m		
Total leach Height		m		80.0 m		
Acid concetration to leach pad		g/liter		1 - 3 g/l	2	g/l
Acid concetration to leach plant		g/liter		1 g/l	1	g/l
Iron concetration to leach pad Fe++		g/liter		4.5 - 5.5 g/l	5	g/l
Iron concetration to leach plant Fe++		g/liter		1.8 - 2.2 g/l	2	g/l
Iron concentration to leach pad Fe+++		g/liter		0.180 - 0.280 g/l	0.23	g/l
Iron concentration to leach plant Fe+++		g/liter		1100 - 1800 g/l	1350	g/l
Concentration Mo		g/liter		< 6.5 mg/g		
Concentration Mn		g/liter		127.8 +/- 4.4 mg/g		
Concentration Zn		g/liter		35.5 +/- 0.9 mg/g		
Concentration						
Copper Sales price		USD/Tonne		1577.77 average for 2001/LME		
Calculated recovery	0.4166667	kg/ton leached			0.1575	% in orgina
Copper Produced per year					903	tpy
8/14/02						

exchange but does not take into account the cost of mining or transporting the oxide ore. This does not take into account the labor which is required for the overall

operation. Please see the table below for the overall production costs, which have been calculated based upon the numbers of Assarel Medet.

Heap Precipitation and SX Ore Processing

During the site visit, SRK inspected the copper precipitation facilities, reviewed the process facility modification and expansion plans, reviewed reports prepared by Asseral Leach plant personnel, and discussed metal recovery projections and future ore processing plans. SRK has investigated the possibility of solvent extraction (SX) and electrowinning (EW) plants to replace this part of this facility.

SRK believes that Assarel-Medet could be operating the leach process facilities in a more effective and efficient manner. No fatal flaws have been identified that would prevent the achievement of 1,200 tpa copper production plan from the leach plant operation.

SRK reviewed the possibility of an SX/EW plant, and the related capital and operating costs. The conceptual plant itself and the processing scheme is shown in the drawings located in the appendix.

The solvent extraction (SX) and electrowinning (EW) analysis within this section has been conceptually designed based on the data from the cementation That is approximately 2.0 million tons per year of ore will be placed on the leach pads but the overall recovery for this system has been estimated to be in the 60 to 65 % range. This recovery rate is achievable given test data from Geotechcopper reports, and experience at other leaching operations.

Compared to the cementation operation, the overall copper recovered with SX/EW is substantially higher. The higher recovery can be explained by the lowering of the leach lift height and increase in solution application (use of sprinklers). The flow to the solvent extraction system has been assumed to be 80 liters per second. The overall solvent extraction (SX) and electowinning (EW) has been assumed to be fully operational two years after the initial go ahead had taken place.

The initial ore reserves have been calculated to be approximately 40 million tonnes at a grade of 0.2% oxide copper. Recovery is estimated to be 60-65% of the total amount of copper sent to the leach pad. The overall active leach area is 6,000 square meters,

which is double the active leach area of the cementation operation. It should be noted that there is approximately 120,000 m2 in leaching area available.

Solvent Extraction

The solvent extraction system is been designed with two extraction units and two stripping units. These units have been sized to handle the 80-liter per second with a calculated retention time in the mixers of three minutes. The settlers are sized with 0.01328 square meters per liter of flow rate. The overall aqueous to organic ratio is 1.05. This sizes the mixers for a total flow rate to the mixers of 102 liters per second. The electrowinning is sized to handle the total copper production and a higher grade of solution.

The pregnant solution is fed into the #1 mixer which is a two stage mixing system. The first mixer is equipped with a ten-horse power motor and the second mixer a five-horse power motor. The mixer on the extraction units is 3 meters in diameter with a three-meter height, with a free board of 0.3 meters. The calculated total retention time is 3.25 minutes. The extraction settler size is approximately 82 square meters. The settler length is 14 meters by a width of 10 meters and a settler height of 0.9 meters with a free board of 0.3 meters. The tank volume is 126 cubic meters. The organic flows from the first stage to the second extraction stage and then into an organic holding tank and/or into the first stage of the stripping settlers. The stripper mixer size is based upon a retention time of 3 minute and a total flow rate of 95 liters/second.. The overall system is a parallel unit and there are two strip settlers for the overall organic stripping. The first stage extractions are estimated to be 75% efficiency and the second stage is approximately 80%. The copper content of the barren tail is 0.005 grams per liter. The organic is contacted with concentrated sulfuric acid.

The stripped organic is recycled back into the barren organic surge tank, then pumped back into the #1 extraction stage mixer. The organic losses throughout the system are calculated to be approximately 0.01 liters per cubic meter of solution.

The rich electrolyte is collected into the filter feed tank from the filter feed it is pumped through the electrolyte filter where the material can be clarified for the rich electrolyte surge tank.

The rich electrolyte is pumped into the main commercial electrowinning cells for the operation. It has been calculated that 6 cells are required with 30 cathodes each and 31 anodes each. This will meet the require production needs of the overall copper production. Because of the small number of cells, increased production can be added by increasing the number of cells in the parallel lines. A typical run of commercial cells is approximately 10 per row with 3 or 4 rows per unit.

Each of the electrowinning cells are approximately 1 meter x 1 meter x 10 meters long. They each contain 31 anodes and 30 cathodes. The anodes are calcium lead with a trace of strontium. The starter sheets have been estimated as being purchased directly. Alternately, a starter cell could be design into the circuit.

The initial starting sheets will be replace a stainless steel blank and stripped manually. The starter cell, if required, would only be 1 unit and would contain 30 anodes and 31 cathodes and would have approximately a 3-day harvest time. From here the units would be stripped and placed on the cathode in the main commercial cells. The commercial cells and the starter cells would be of the same size and same make.

The new electrolyte would go directly from the rich electrolyte surge tank through the starter cells and from there into the electrolyte recirculation tank. The electrolyte recirculation tank would feed continuously into the future commercial cells and the starter cell. A heat exchanger is situated between the spent electrolyte and the rich electrolyte lines to transfer the heat of the spent electrolyte into the new feed. The new feed will have a temperature rise of approximately 2.8 degrees Centigrade (5.1 degrees Fahrenheit). The temperature rise is all the heat that should be required through the entire SX/EW System, for that the heat is transferred from the spent electrolyte into the bin or through the organic into the extraction mixers. The solution temperature going onto the heaps should be maintained throughout the winter at least 5 degrees Centigrade. This should be sufficient heat to keep the entire feed open throughout the winter operation without creating serious freezing problems.

The overall layout of the solvent extraction system has been set-up so that a total of 24-34 people will maintain all of the solvent, heat pads, and the pregnant leach solution ponds. These ponds along with the reagent make-up should be easily placed upon the flat area just to the west of the current leach pad operation. The total overall area of 100 meters square should be sufficient for the entire SX and EW complex.

The solvent extraction system will be completely separated from the electro winning section. The solvent extraction system has the capability of handling much higher copper concentrations so that an intermediate leach system can be placed into operation. The underflow from the last pond would be pumped into an intermediate pond, which would then be pumped onto the new heap. This would be a way of enhancing the overall copper production while not increasing the overall pad size substantially.

The electrowinning is currently housed in a building and has adequate ventilation from the floor up. The main ventilation to keep the acid misting down is via boor ducts underneath the cells, rising up to main collection headers above the unit. This will eliminate the side draft blow through the electro winning which concentrates the acid misting towards the center section of the unit. The electrowinning system is in a building with a total of 10 electrowinning cells. The rectifier system has been sized to handle this increased production. It should be anticipated that, as the confidence in the system grows, an increased leach cycle will occur. Additional ore will be transmitted from the mill to the oxide leach pad and this will increase the overall production of the area. An overhead bridge crane has been allowed for in the electrowinning building. It is used not only to remove the stainless starter unit from the starter cells but also to remove the anodes and cathodes from the existing units. Only half of the cells will be pulled at one time. The cathodes will then are placed in the holding tank and then into a cathode wash tank. Here the cathode copper production would be placed and banded for shipment to the overall operation.

The SX/EW leaching system generates acid on a ratio or 1.5 kg of acid per kg of copper. The only additional acid that will be required will be that that is placed upon and consumed by the oxide material on the heap leach pad. This will reduce the overall operating cost of the unit. There will be an increase in power consumption due to the pumping and electrowinning. The power required for the entire SX-EW system is estimated to be 2-kilowatt hours per kilogram of copper produced. An overall capital and operating costs of the SX-EW system is given below.

The overall economic benefit of the SX-EW versus the cement precipitation revolves around three different matters.

1. Basically the major assumption is that the amount of acid consumed will be only limited to that which is consumed on the heap.

2. Both plants have the same number of operating personnel.

3. The difference in capital cost is for the solvent extraction side. The difference in the cost of operation is limited to the cost factors of the acid, organic diluents, and power.

In general, the demonstration costs are the same as for the precipitation operation. This would tend to make the salable price of copper the major economic factor. The price of the SX/EW copper is the full LME price and should be about $1,565 per ton of copper produced (the price used in this economic analysis).

The capital costs are shown below.

SX-EW PLANT ERECTION & FITTING COST ESTIMATE			
DIRECT COST ESTIMATE			
CIVIL	$520,128		
MECHANICAL	$2,889,601		
STRUCTURAL	$462,336		
INSTRUMENTATION	$202,272		
PIPING	$462,336		
FACILITIES	$433,440		
ELECTRICAL	$606,816		
DIRECT COST--SUBTOTAL		$5,576,929	
CHEMICALS	$79,648		
INDIRECT COST ESTIMATE			
CONTRACTORS O'HEAD & PROFIT	$836,539		
ENGINEERING	$334,616		
PROJECT MANAGEMENT	$223,077		
FRIEGHT	$312,308		
SMALL TOOLS	$167,308		
RENTAL EQUIPMENT	$278,846		
INDIRECT COST--SUBTOTAL COST		$2,152,695	
SUBTOTAL COST		$7,729,624	
INSURANCE		$270,537	
CONTINGENCIES @ 25%		$1,932,406	
SX-EW PLANT ERECTION AND FITTING TOTAL COST EST.			**$9,662,029**

The operational cost of the SX/EW system is shown below and has a total cost of $1149 per tonne of copper produced. Please note that the price of acid used in this analysis is somewhat more conservative than current prices.

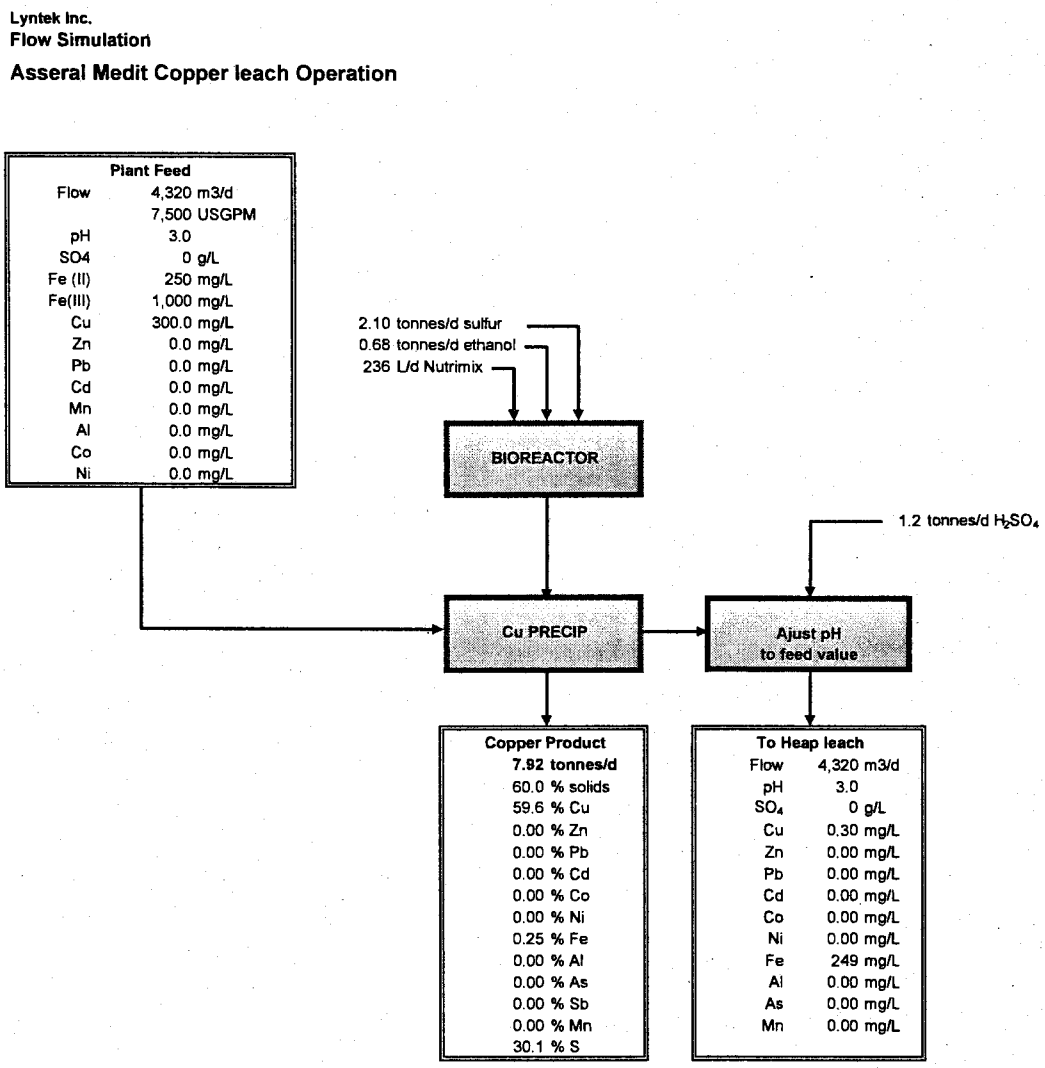
OPERATING COST ESTIMATE						
					$/ton Cu Product	
LABOR COST				$411,768	$195.51	$0.21
MINING COST		$0.00		$0	$0.00	$0.00
WASTE		$1.10		$0	$0.00	$0.00
CRUSHING		$0.00		$0	$0.00	$0.00
STACKING		$0.15		$300,000	$142.44	$0.15
CHEMICALS						
ACID-COST/TON	15	$24.00		$360,000	$170.93	$0.18
ORGANIC-DIL.($/GAL)		$2.00		$65,988	$31.33	$0.03
ORGANIC-LIX84($/POUND)		$12.50		$28,456	$13.51	$0.01
POWER		$0.032		$210,610	$100.00	$0.11
OPERATIONS		$0.29		$576,685	$273.82	$0.29
LAB & RECOVERY		$0.02		$42	$0.02	$0.00
GENERAL & ADMIN.		$0.33		$660,000	$313.38	$0.33
TOTAL COST				$2,613,549		$1.31
CAPITAL COST				$9,662,029	$0.46	
GROSS PROFIT/YEAR						
GROSS INCOME @ Cu($/LB)			$0.75	$3,159,144		
GROSS EXPENCE				$0		
INTEREST REPAYMENT			8.00%	$2,419,918		
LIFE OF PROJECT			5			
NET ANNUAL INCOME				$739,226		
RETURN ON INVESTMENT				7.65%		
PAYBACK PERIOD						

SX/EW operation at Assarel Medet is considered a viable alternative at a 5-year payback, and viewing the SX/EW as a standalone operation. It is noted that at the higher throughput of 12 million tonnes of ore for the milling operation, approximately 3 million tonnes of leach ore per year will be produced. SRK expects that the return on investment and overall viability of the SX/EW operation will only improve with this increase in leach ore production. Additionally, there should be more than ample leaching space (at 120,000 m2 area) to handle this additional ore, at a faster leaching rate of around 3 months per lift.

1.2.16 H_2S Precipitation Process

SRK reviewed the potential of installation and operation of an H2S precipitation process to replace the existing cementation process. The conceptual plant would have two stages: Biological and Chemical. Copper is removed from the leach solution in the chemical stage by precipitation with biogenic sulphide produced in the biological stage. Copper can be precipitated separately into a saleable product that can be shipped with the copper concentrates. A simplified flowsheet is shown in Figure 1. None of the leach liquor is passed through the bioreactor. The bioreactor is sized for the maximum metal content and is much smaller than the other components in the metal recovery stage.

Figure 1



The leach solution flow is estimated to be approximately 50 l/s and will contain 1 to 2 g/l copper. The copper is precipitated as a sulfide according to the following reaction:

$$Cu^{+2} + S^{-2} = CuS$$

The hydrogen sulphide is produced in a bioreactor in which a mixed anaerobic bacterial culture reduces elemental sulphur, with the addition of an electron donor and nutrients.

$$S^{0} + 2e- = S^{-2}$$

The contactor off-gas containing N_2 and CO_2 is recycled to the bioreactor where it is used to strip off the H_2S for the bioreactor liquor to the gas phase. There is no gaseous discharge during normal operation. H_2S and CO_2 are consumed by the process and N_2 is recycled as a carrier gas. The system is equipped with a caustic scrubber to capture any gas bleed that might occur on an infrequent basis with the resulting NaHS added to the gas liquid contactor.

Copper can be precipitated without any pH adjustment and produces a product greater than 50 % copper by weight. Sulfuric acid is regenerated in the process and no iron is added to the circuit. The solution will flow into a thickener. The thickener underflow will flow to the press where the precipitated copper will be filtered and dumped onto the ground to be transported to the concentrate bins. The product will be combined and sold with the concentrates.

The main disadvantage of sulfide precipitation is that the product is sold with the concentrates and produces only about 75% of the LME price of copper.

The leach data used for the H_2S model is shown below:

INFORMATION WITH H_2S PROCESS

			Assarel-Medet JSCo			
			average values			
Active Leach Tonnage	1800000	Tonns/year				
Annual Copper Produced	2338.555	Tonns/year		6.4959861	Tpd	
Grade of Cu precipitation		%		76 - 82 %	59.6446	%
Active leach Area		M2		3000 sq.m.		
% of Copper to Leach		%		0.140 - 0.175 %	0.18%	
% of Oxied Copper		%		8 % relative		
Flow to the leach area		liters/sec		4300 cub.m./24 hours	50	liter/sec
Grade of the barren solution		g/liter		10 mg/l	0.01	ppm
Flow to the Precipitation Plant		liters/sec		4300 cub.m./24 hours	50	
Grade of the Feed to Precipitation Plant	1	g/liter		600 - 1000 mg/l	1.5	ppm
pH of flow to leach pad		pH		1.8 - 2.3		
pH of flow to leach plant		pH		2.7 - 3.3		
Recovey of Copper on leach Pad		%		138.55%		
Leach Lift height		m		6		
Total leach Height		m		80.0 m		
Acid concetration to leach pad		g/liter		1 - 3 g/l	2	g/l
Acid concetration to leach plant		g/liter		1 g/l	1	g/l
Iron concetration to leach pad Fe ++		g/liter		1 g/l	1	g/l
Iron concetration to leach plant Fe ++		g/liter		1.8 - 2.2 g/l	2	g/l
Iron concentration to leach pad Fe +++		g/liter		0.180 - 0.280 g/l	0.23	g/l
Iron concentration to leach plant Fe +++		g/liter		1100 - 1800 g/l	1350	g/l
Concentration Mo		g/liter		< 6.5 mg/g		
Concentration Mn		g/liter		127.8 +/- 4.4 mg/g		
Concentration Zn		g/liter		35.5 +/- 0.9 mg/g		
Concentration						
Copper Sales price		USD/Tonne	1577.77 average for 2001/LME			
Calculated recovery	1.30	kg/ton leached			1.8	% In orgina
Copper Produced per year					2242.45	tpy
Total Operation Cost				$959,544		
Total Cost per tonne of Cu				$427.9		
Total Capital Cost				$2,695,321		

The capital cost of $2,695,321 is derived from the following equipment list.

COMMERCIAL PLANT CAPITAL COST ESTIMATE

Asseral Medit first cut

Item No.	Description		Equip.cost	Installed Cost US$	Installed Cost $US
	FERRIC PRECIPITATION				
1	Lime reactor	0 gallons			$0
2	Agitator	0.0 kW			$0
3	Clarifier	0 ft2			$0
	BIOREACTOR MODULE				$1,302,535
4	Bioreactor and internals	442 m3			incl.
5	Heat exchanger, ancillary tanks				incl.
6	Bioreactor feed/discharge pumps				incl.
7	Instrumentation, PLC				incl.
	NPK REAGENT SUPPLY SYSTEMS		$15,000	$15,000	$22,500
8	Dissolving and supply tanks				incl.
9	Tank mixers				incl.
10	Transfer pumps				incl.
	PRECIPITATION CIRCUIT				
11	1 Gas-Liquid Contactor - Cu	145,280 gallons		$245,858	$144,194
11	1 Gas-Liquid Contactor - Zn	0 gallons			$0
12	1 Agitator - Cu contactor	182.3 kW	$114,590	$183,343	$171,715
12	Agitator - Zn contactor	0.0 kW			$0
13	1 Clarifier dia (ft) = 30	708 ft2	$14,864	$46,077	$60,941
14	Filter Press - Cu product	0.0 t/d			$0
15	2 Gas blowers	1339 CFM @ 12 PSIG ea.	$12,352	$24,704	$37,056
16	Process pumps				incl.
17	1 H_2S Safety System		$3,000	$3,000	$4,500
	H_2S SCRUBBING SYSTEM		$15,000	$15,000	$22,500
18	1 NaHS / NaOH loop pump				incl.
19	1 Scrubber				incl.
20	1 Flare system				incl.
21	1 NaHS storage tank, c/w agitator				incl.
22	1 NaOH metering pump				incl.
	FLOCCULANT SYSTEM		$15,000	$15,000	$22,500
23	1 Flocculant module/vendor package				incl.
24	1 Flocculant metering pumps				incl.
25	BUILDING		$60,000	$60,000	$40,000
TOTAL ESTIMATED INSTALLED MAJOR EQUIPMENT COSTS ($US)			**$349,419**	**$607,983**	**$2,034,350**
	Equipment Installation	10 % of major equipment	$34,942		$34,942
	Plant Piping	10 % of major equipment	$34,942		$34,942
	Plant Electrical	10 % of major equipment	$34,942		$34,942
	Plant Instrumentation	5 % of major equipment	$17,471		$17,471
	Concrete/Civils	8 % of major equipment	$27,954		$27,954
	Engineering and Construction Mgmt.			$0	$59,098
	Construction Overhead				$50,000
	Commissioning and Startup			$0	$30,000
	Contingency			203,435	$203,435
	Working Capital	3 months operating costs	$168,187		$168,187
TOTAL ESTIMATED COST ($US)			**$318,437**	**$203,435**	**$2,695,320**

* Installed costs include allowances for equipment installation, piping, electrical, instrumentation and concrete/civil works and freight

Operational Cost

The operational cost of the sulfide precipitation has been calculated to be based upon the 50 l/s and the copper leaching on 6 meters with 65% recovery

The operational cost of the sulfide precipitation is based upon a reduction of the iron concentration over a period of time. The cost of reagent is based on US supply without the freight.

The annual costs amount to approximately US$ 1,868,474, for a production of approximately 2,242 tonnes of Cu. The resulting cost per tonne of copper using the H2S precipitation process would be approximately US$ 833. The current cost per tonne of produced copper from the iron precipitation plant is approximately US$ 778, and is therefore less expensive than the operating cost of the H2S precipitation process, and the H2S precipitation process will require capital investment. Higher throughput rates may result in a different conclusion.

The costs are shown below:

Lyntek
COMMERCIAL PLANT OPERATING COST AND REVENUE ESTIMATE

Assarel Medet

Item	Units	Units/day	$US /Unit	Total $US /day
EXPENSES				
Ethanol	tons	2.06	$710	$1,465
Sulphur	tons	10.72	$40	$429
Lime for ferric precipitation	tons	0.00	$100	$0
Lime to balance acidity produced by Cu precip	tons	16.51	$100	$1,651
Soda Ash	tons	0.00	$175	$0
KH_2PO_4	lb	56	$0.25	$14
$(NH_4)_2SO_4$	lb	283	$0.20	$57
Flocculant at 3.5 kg/t concentrate	lb	196	$1.28	$250
Flocculant at 1.5 mg/L for ferric sludge	lb	0	$1.28	$0
NaOH	lb	107	$0.29	$31
Nitrogen	Nm3/d	2	$2.87	$6
General Supplies	$/day	1	$20.00	$20
Assays	$/day	1	$20.00	$20
Maintenance Supplies	$/day	1	$20.00	$20
Power	kWh	10,529	$0.032	$337
Labour:				
25 Operators/mechanics	h	8	$3	$500
1 Supervisor	h	8	$40	$320
Gross Operation Expenses				**$0.83**
Gross Daily Expenses			**($US)**	**$5,119**
Gross Annual Expenses				**$1,868,474**
Gross Operating Costs per 1000 m3				**$0.001**
Gross Operating Costs per 1X10 ^{6} gallons				**$0.005**
REVENUES			**($US)**	
Copper Product:				
80 % NSR Cu price ($US) = $1.57	Kg	6,144	$1.17	$7,214
Assume Cu Sells to smelter @ 75%				
Gross Cost of Cu/kg				**$0.34**
Gross Daily Revenues			**($US)**	**$7,214**
Gross Annual Revenues				**$2,633,001**
Gross Revenues per 1000 m3				**$0.0017**
Gross Revenues per 1,000,000 gallons				**$0.0063**
NET REVENUES			**($US)**	
Net Daily Profit				**$2,095**
Net Annual Profit				**$764,527**
RETURN ON INVESTMENTS				
PAYBACK PERIOD				

1.3 Ancillaries - Geotechnical Stability

The SRK team visited the West Waste Dump and the Tailings Storage Facility (TSF) Liuliakovica during the site visit in February 2002. The objective of the visit was to obtain a general understanding of the operation of the facilities and to provide an overview of their stability.

1.3.1 Waste Rock Dump Stability

General Description

The waste dump is a side-hill structure, located approximately 1.5 km northwest of the Assarel open pit. Its construction commenced in 1990. From 1990 until 2000 the waste was transported by trucks and end dumped. Some compaction was achieved due to the vehicle traffic. Since December 2000 the waste rock was transported to the waste dump via 3116 m long conveyor belt and is deposited with a stacker VASP 1200/35+50 in 2-meter wide layers parallel to the slope. The waste dump is designed to accommodate approximately 408 million metric tonnes of waste. The current height of the dump is approximately 150 meters. Its maximum height will reach approximately 280 meters at the end of the construction.

Waste Material

The waste consists of three types of secondary altered rock (argillites, propilites, and quartzites at a ratio of approximately 1:1:1). While the propilite and the quartzite rock is considered relatively strong, the argillic rock is extremely weak and breaks down easily. The end dumping deposition method facilitates segregation of the material along the slope. Due to the segregation, the coarsest particles settle at the bottom of the slope and the finest settle close to the crest. The concentration of the coarsest particles at the base of the dump serves as a drain to avoid build up of a phreatic surface within the dump. However, the effectiveness of the drain system could be compromised if the weaker argillic material broke down to a finer clayey soil with an associated lower permeability.

The groundwater regime within the area of the open pit is not fully understood. Based on discussions with the mine personnel, it could be defined as a fracture flow. Although, the drainage channel below the bottom of the pit is to a large extent effective in dewatering the pit, pockets of water are often found during the

excavations. For this reason, wet waste material is occasionally deposited at the waste dump. In cases when a finer soil with high moisture content is loaded rapidly and not sufficient drainage is provided, high pore pressures could be generated leading to a reduction in the effective stress and to instability. The generated high pore pressures could lead to "blow outs" (when the material behaves like a liquid), or may trigger a slope failure.

Foundation conditions

Based on the descriptions of the dump operators, any soil at the dump foundation has been removed and stockpiled for future use. Topsoil removal and stockpiling in the areas downstream of the current waste dump toe was observed by the SRK team during their site visit in February 2002. The dump foundation is believed to consist of weathered rock. The depth to the groundwater in the area is unknown at present, but it is likely that it is located at a few meters below the surface. In general, slope failure of the waste dump through its foundation is considered highly unlikely.

Effect of the tailings impoundment pond

The waste dump is located immediately upstream of the confluence of two drainages, which contributed to the Liuliakovitca river. The Liuliakovitca tailings impoundment is located downstream of the waste dump within the river valley. The toe of the waste dump has been previously submerged by the tailings dam pond. In 2000 – 2001an embankment was constructed to prevent the tailings pond water from reaching the toe of the waste dump. The embankment was constructed of waste rock. Its current level is approximately 800 m above mean sea level (mamsl) and its final design level is 820 mamsl, which coincides with the final design level of the tailings pond in this area. No low permeability lining and/or a drain layer has been incorporated within the embankment to prevent the build up of a phreatic surface. Although the embankment is believed to be constructed of relatively low permeability material, a phreatic surface is expected to develop. SRK is not aware of any analyses conducted to evaluate the seepage conditions through the embankment as the pond level raises. In addition, the water that drains through the bottom of the waste dump might pond against the upstream face of the embankment, which could affect the stability of both the embankment and the waste dump. SRK is not aware of any evaluations conducted to assess the stability of the facilities under such conditions.

Surface Water/Diversions

Diversion channels have been built upstream of the dump to collect the runoff and limit the runoff collection area of the dump. The adequacy of the channel design and construction has not been reviewed as part of this study.

A small stream was observed running around the northwestern toe of the dump. The source of the water was unknown. Some orange (iron) staining, evident along the stream bed, indicated that the stream has been running at its present course for an extended period of time. The stream disappears under the piles of waste rock upstream of the tailings pond embankment and downstream of the dump toe. It is unclear if the water accumulates within the material upstream of the embankment or it has found a drainage path.

Waste Dump Stability

Longitudinal cracks are evident within approximately 20 meter wide strip along the crest of the waste dump. Based on the reports of the site management and survey teams, the cracks appear within a 24 hour period after the placement of the waste. Only miner movement is recorded in the crack development afterwards. Based on the available information and the observations at the site, it is believed that the cracks are due to the immediate settlement that occurs within the waste due to its own weight after its deposition. Although the settlement cracks are not considered a significant threat to the dump stability, it is highly recommended that the cracks are mapped immediately after their appearance and the movement monitored until the recorded movement is smaller than the allowable monitoring error. The monitoring results should be reviewed by a qualified geotechnical engineer. Any changes to the crack pattern or acceleration in the crack opening/vertical displacement should be immediately reported to the person in-charge and appropriate measures taken to ensure the safety of the personnel and the equipment at the site. At any time the conveyor should be kept at a secure distance from the edge of the dump. Based on the stability analyses provided by Geotechmin, the conveyor should be kept at a distance of at least 50 meters from the edge of the dump.

A bulging of the slope within the highest part of the dump was observed in December 2001. The bulging was demonstrated within the top two thirds of the slope. The most likely mechanism of its occurrence was a sliding of a slice of the slope. Although no

back analysis has been conducted, most likely reasons for the demonstrated slope instability are considered to be either a development of a high phreatic surface or a development of excess pore water pressure within the dump.

Phreatic Surface Development

The "bulged" area is located in one of the two drainages underlying the waste dump. An elevated phreatic surface could be developed if the permeability of the waste at the dump base is insufficient to drain the incoming water flows due to precipitation, natural springs or other sources. Although the segregation of the material during deposition facilitates the accumulation of the coarser particles at the bottom of the slope, which serve as a drain, a significant part of the waste is very weak and easily breaks down to a finer clayey soil with lower permeability. The development of such zones may hinder the drain flow and facilitate a raise in the phreatic surface level. The water that drains through the bottom of the dump is expected to daylight somewhere along the toe of the dump due to the lack of a formal drainage collection system. Currently, a significant portion of the dump toe is buried by the waste placed to serve as a buttress, as designed by Geotechmin. Seepage along the exposed parts of the dump toe or along the slope was not observed during the site visit. Several possibilities could be considered as an explanation of this fact: 1) the water drains through the buttress; 2) the water accumulates within the waste dump; 3) the water seeps into the foundation. The most likely scenario is that a low permeability screen was formed within the lower portion of the waste dump, which obstructs the drainage of the water that percolates through the dump. Under wet weather conditions the water infiltrates into the dump and drains towards the two natural drainage channels at the dump footprint. If the water reaches a low permeability zone, it would accumulate behind it, thus raising the phreatic surface. Geotechnical investigations should be conducted to establish the location of the phreatic surface within the waste dump and the drain flow path.

Excess Pore Pressure Development

Approximately one third of the waste from the open pit is argillic material. As discussed above, the argillic material tends to break down easily to a clayey soil with low permeability. Occasionally, when a localized pocket of water is encountered within the pit, or during a wet weather period, the argillic waste material is deposited at relatively high moisture content. When the wet low permeability material is loaded

quickly with the next lift of waste, excess pore pressures could be generated. The low permeability combined with the quick loading, results in insufficient time for the soil to respond to the load and consolidate by expelling the water from the pores. This could lead to the generation of excess pore water pressure within the dump. The excess pore water pressure reduces the effective stress within the facility thus affecting its stability. The development of excess pore pressure in a layer/zone within the dump could be a reason for the observed slope instability (bulging).

Possible remediation measures could be unloading the area of instability, flattening the slope angle, and/or draining it.

Conclusion

The stability of the waste dump under static conditions is considered marginal. A slope failure could be expected under the design earthquake loading conditions. Therefore, for each production scenario, the following actions are included in the recommended feasibility study modifications:

Feasibility Study Actions

Seismicity: Conduct a site specific seismic hazard assessment to establish the seismic design parameters required for the stability evaluation of the dump.

Phreatic surface: Continue monitoring the water level in the existing piezometer on a daily basis. Drill two additional boreholes/wells within the location of the two drainages. Log the core and take samples for testing. Evaluate the possibility for pumping the water from the wells. Establish the water recharge sources, the fluctuation boundaries for the phreatic surface, and its effect on the stability of the dump. If required, install additional piezometers.

Stability evaluation: Conduct analyses to establish the static and dynamic stability of the dump. Review the soil properties used in the analysis considering the change in the deposition method (conveyor use) in December 2000. Consider using zero cohesion for the conveyor placed waste and conducting back analyses using the information from the observed slope instability.

Conveyor safety: Move the conveyor as far away as possible from the area were the bulging is observed. Verify the minimum distance from the edge of the dump, at which

the conveyor should be kept. In the evaluation consider both the effect of the settlement cracks (shallow failures) and the effect of the phreatic surface or excess pore pressure, which may result in a deep failure. (Based on the stability analyses provided by Geotechmin, the conveyor should be kept at a distance of at least 50 meters from the edge of the dump. However, the effect of a phreatic surface or excess pore pressure on the dump stability was not considered, which makes the Geotechmin recommendations unconservative.)

Monitoring: Implement a program for monitoring the cracks on the dump surface. The monitoring results should be reviewed by a qualified geotechnical engineer. Any changes to the crack pattern or acceleration in the crack opening/vertical displacement should be immediately reported to the person in-charge and appropriate measures taken to ensure the safety of the personnel and the equipment at the site. Conduct regular site inspections to check for seepage, new cracks, slope instability.

Emergency procedure: Prepare an emergency procedure to be followed during emergency situations like an earthquake, 1 in 100 year storm, slope instability, excessive settlement, etc.

Drainage: Divert surface water flows (e.g. the stream along the toe of the dump) to the tailings impoundment. Provide adequate drainage for the water that drains from the waste dump and water that may accumulate upstream of the tailings pond embankment.

Deposition plan: Prepare a deposition plan for the waste that is closely linked to the mine plan. Segregate the waste in the pit according to quality and place it selectively according to the deposition plan. Consider placing the poor waste material (argillic, highly weathered, etc.) at the lower portions of the waste dump towards the abutments, where the dump is buttresses by the existing slope and the probability of a failure is lower. Place material with high moisture content at thin layers, which will facilitate drainage, drying and avoid rapid loading. Consider that flattening the slope to 2.5H:1V or similar may be required at closure.

Closure: Develop a closure plan. The study will include analysis for acid generating potential; cover design; re-vegetation plan; surface water management plan. Make sure good quality waste is used for the final lifts. Preferably, a 50 m wide shell of good quality waste should be formed at the completion of the dump. Flattening of the dump

slope typically to 2.5H:1V or flatter could be required. Stability evaluations for closure may need to include stability analysis for the effect of the Maximum Credible Earthquake on the dump stability.

Tailings pond: Evaluate the effect of the tailings pond on the stability and the development of the waste dump currently and in the future.

1.3.2 Tailings Dam Stability

General Description

The Liuliakovitza Tailings Impoundment is located at approximately 7 km west from the Assarel plant in the valley of Liuliakovitza river, immediately downstream of the West Waste Dump. The impoundment was designed to accommodate all of the tailings, planned to be produced during the life of the mine. The current maximum height of the embankment is approximately 140 m (level 776 mamsl), and the maximum height at the end of the deposition according to the design is 190 m (level 829 mamsl).

Site Inspection

During the site inspection conducted by the SRK team in February 2002, tailings deposition took place from an open end at a point a few hundred meters upstream of the embankment. The current lift of the embankment was nearing completion. The pond was located at approximately 600 meters away from the embankment. Water was seen springing from a point on the western abutment and running down along the embankment benches. The source of the water was not identified. It is unlikely that the seep originates from the tailings, as the tailings water is basic (pH of approximately 11), while the seep water was acidic (pH 4).

One of the old decant water sumps located midway along the western side of the embankment was partly removed and water was flowing from the sump along the bench and disappearing into the embankment rockfill. It was not evident if the water was flowing out at the toe of the embankment or was recharging the drain flow.

Some standing water on top of some of the embankment benches was observed. A conclusion regarding the source of the standing water could not be made based on the visual observation.

Embankment construction and tailings deposition

The initial design of the facility envisioned the construction of an 84 m high rockfill retaining dam, reportedly to provide for seismic stability of the tailings dam, followed by the upstream construction of a series of secondary rockfill embankments to the maximum embankment height, required to accommodate the total planned tailings production. In 1997 a design amendment was suggested, according to which the rockfill embankments were replaced by cycloned tailings. According to the design amendment, 8.2 million cubic meters of fockfill as from the initial design were replaced by approximately 10 million cubic meters of cycloned tailings and 1.7 million cubic meters of rockfill.

Currently, the tailings are transported from the plant via a 7 km long covered concrete trench. The tailings undergo first cycloning at a cyclone station located on the east abutment of the impoundment. The overflow of the first cycloning is deposited open-ended into the impoundment basin a few hundred meters upstream of the embankment, while the underflow is delivered to the second set of cyclones located at the embankment. The underflow produced by the second set of cyclones is used for the embankment construction, and the overflow is discharged into the impoundment basin. During the time when the embankment is raised and the cyclones relocated to a higher position, the tailings are discharged through a small valley on the eastern side of the impoundment.

For a number of reasons, probably including delivery of low density slurry (20 – 25% solids), prolonged embankment construction periods, and inappropriate or unadjusted cyclones, the produced underflow was significantly less than was required for the embankment construction. To complete the embankment construction at the current level (775 m) as per the design from 1997, additional 6 million cubic meters of coarse tailings would be required. Due to the lack of sufficient cyclone underflow, the buttressing effect of the cycloned tailings is not achieved. Following the upstream the embankment is constructed.

Water Management

The water bled from the tailings after deposition runs to a supernatant water pond, which is kept at a distance of approximately 400 to 600 m upstream of the embankment. Water from the supernatant water pond is decanted via a series of decant

towers and collectors. The decanted water runs into a settlement pond immediately downstream of the impoundment embankment. From there, water is collected in a return water pond and pumped back to the plant for reuse. Complete water balance for the facility was not available during the site visit. Approximately 3 million cubic meters of make-up water are required in the plant annually. Between 1.5 and 2 million cubic meters of make-up water per year are delivered from a dam (Jekov Vir) located at approximately 35 km northeast of the Assarel plant.

A blanket drain of selected rockfill was constructed at the base of the embankment. The drain extended approximately 180 m across the valley and varied in thickness from 0 at the sides to 36 m at the bottom of the valley. The drain was covered with a geotextile to prevent infiltration of tailings into the drain. Limited amount of water was observed flowing out of the drain outlet at the toe of the embankment during the SRK site inspection.

Embankment Stability

Extensive stability, seepage and consolidation analyses have been conducted for the facility during its design. In 2001, Hydroengineering Ltd. conducted geotechnical investigations along the embankment and within 100 meters along the tailings beach. The objective of the investigations was to verify the tailings properties used for the design and for the previous analyses, and to assess the current condition of the impoundment. As part of the investigations, 15 boreholes were drilled through the embankment and 10 along the tailings beach. Samples of tailings were collected and a number of tests to establish the density, strength and elastic properties of the tailings were conducted. In addition, pneumatic piezometers were installed in nine of the boreholes and connected to an automatic monitoring network.

Limited piezometer results were presented to SRK in the form of cross sections though the embankment at the locations of the piezometers with an indication of a "phreatic surface" line. Based on the observations the phreatic surface is located at approximately 10 m depth from the existing embankment surface. The review of the expected tailings zonation behind the dam construction presented in Drawing 4 of the design report from 1997 shows that the phreatic surface closely follows the expected location of the boundary between the coarser and finer tailings. Two theories have been reviewed in evaluating the piezometer results: 1) the results represent the existing phreatic surface, and 2) the results identify the existence of excess pore pressure within

the layer where the tips of the piezometers are located. The observed consistency of the piezometer results along all profiles is more likely to support the first theory, as larger variations in the readings would be expected in the case when excess pore pressure is being recorded.

Our experience from other projects has shown that geotextile blinding can occur. The consolidation of the fine tailings and the potential geochemical precipitation (silica or iron) on top of the geotextile layer may create a low permeability boundary, which would hamper the effectiveness of the drain layer. The observed drain outflow can be characterized as insignificant in the overall scale of the facility, in addition to the possibility that the source of some of the draining water could be surface water flows observed during the site inspection.

If the first theory (high phreatic surface) is the correct one, then the current stability of the embankment can be characterized as marginal. There is a large mass of saturated tailings, which are at a significant risk of liquefaction if a trigger event as an earthquake or overtopping occurs. The static stability of the embankment is questionable due to the high phreatic surface. While an overall embankment failure through the starter dam is very unlikely, the probability of a failure of the upper embankment portion (above level 750 m) is considered to be very high.

If the piezometer results represent excess pore pressure, the stability of the facility could also be considered marginal for the reasons listed above.

Conclusions

Due to the current condition of the tailings dam it is recommended with the Feasibility Study improvements, that the following actions be taken with all of the throughput scenarios.

Proposal for Actions on the Feasibility Study

- **Seismicity**: Conduct a site specific seismic hazard assessment to establish the seismic design parameters required for the stability evaluation of the dump.
- **Phreatic surface**: Verify the location of the phreatic surface within the embankment and impoundment. Install drive-point standpipe piezometers to approximately 20 m depth in close proximity to the existing piezometers.

Install additional standpipe piezometers in the embankment within the area currently not covered by piezometers, between the starter dam crest (level 722) and the first line of existing piezometers.

- **Tailings Properties**: Compile and carefully analyze the existing information on the tailings properties to identify various layers within the impoundment and potential zones of excess pore pressure. Evaluate the liquefaction potential of the tailings. Prepare representative sections through the impoundment to be used in a stability evaluation. Consider conducting piezocone (CPTU) testing. The piezocone testing would provide a continuous profile of the tailings layers with depth, information on the location of the phreatic surface, presence of excess pore pressure, strength and consolidation properties of the tailings.

- **Stability evaluation**: Update the existing cross sections to represent the actual embankment configuration and tailings properties. Conduct analyses to establish the current static and dynamic stability of the impoundment.

- **Water balance**: Conduct a complete water balance study for the impoundment. Establish a meteorological station at the mine site. Measure the decant and drains outflow. Account for any additional water streams reporting to the tailings impoundment. Increase the slurry density from the current 20-25% solids to at least 35% solids. Take measures to reduce the quantity of the required make-up water by an improved water management program.

- **Embankment construction**: Evaluate the feasibility of the current embankment construction plan in terms of stability, availability of construction materials, and capacity.

- **Storage capacity**: Review the capacity of the impoundment based on the current mine plan, the embankment construction plan, measured tailings density, and beach slope.

2.0 PROJECT CAPITAL COSTS

Capital costs have been developed for each of the proposed modifications in the project for the two production scenarios. In all instances, the capital costs are the same for both production scenarios, and in all cases, the capital costs reflect the changes needed to establish the higher throughput and recovery rates. The proposed changes that SRK has investigated in this Feasibility Study will improve the current operation substantially, and no other changes are necessary to increase the throughput to 12 million tonnes of ore per year.

The following table shows the capital costs developed from the alternatives investigated for the both the 11 million and 12 million tonnes of ore per year scenarios:

Assarel Medet Study
Capital Cost

Item	Stage 1 Estimated Cost	Stage 2 Estimated Cost	Total
Trucks	$3,200	$32,000	$35,200
Shovels & Mining Equipment	$2,600	$10,400	$13,000
Other Mining Equipment	$3,800	$17,100	$20,900
Use of Anfo	$0		$0
Pit Slope Monitor	$60		$60
SAG to AG Conversion	$879		$879
Fine Crushing	$1,556		$1,556
Ball Mill Modification	$3,188		$3,188
Reagent Dosing	$0		$0
Flotation Density Shift	$0		$0
Automation	$2,878		$2,878
Tailings Thickening	$627		$627
Laboratory	$526		$526
Additional Items Listing	$5,027	$2,473	$7,500
SX/EW Facility		$7,700	$7,700
SUBTOTAL	**$24,341**	**$69,673**	**$94,014**
Operations Support	$1,014		$1,014
Contingency (10%)	$2,535		$2,535
TOTAL	**$27,890**	**$69,673**	**$97,563**

It should be noted that the Remaining LoM (Life of Mine) capital costs are additional development and operational enhancements anticipated in the future, as well as replacement capital for mining equipment.

2.1 Trucks

Trucks capital costs include two CAT 785 or equivalent trucks which are planned to be purchased (from the mining recommendations) in 2004. The truck and mining fleet capital costs for 2003 and 2004 are shown in the table below:

Mining Equipment FleetRequirement for 15 m3 Shovels and 78 m3 Capacity Trucks

Equipment type	Equipment Model	No.Units LoM	Cost/ Unit M US $	Total LoM M US$	Stage 1	
					2003	2004
Truck	CAT785 (136t)	22	1.60	35.20		2@3.2
Loader	CAT 5320 (15m3)	5	2.60	13.00	1@2.6	
Loader	CAT 992C	1	1.30	1.30		
Drill	IR DML	6	0.90	5.40		1@0.9
Dozer	CAT D10R	9	0.90	8.10		2@1.8
Grader	CAT 16H	7	0.50	3.50		1@0.5
RTD	CAT 834G	2	0.60	1.20		1@0.6
Water Trk	14,000 Gal	2	0.70	1.40		
Total LoM Capital Requirements (2003-2015)				**$69.10 M**		
Stage 1 Fleet Capital Requirements (2003-2004)					**$2.6 M**	**$7.0 M**
Stage 2 Fleet Capital Requirements (2005-2015)				**$59.50 M**		

2.2 Shovels and Mining Equipment

The mining equipment capital costs include the costs for purchased equipment in 2003 and 2004, which include one Ingersoll Rand DML drill, two CAT D10R dozers, one CAT 16H grader, and one CAT 834G rubber tired dozer. As described for the truck capital costs, the replacement costs for the remainder of the equipment are included in the sustaining capital costs, and not therefore reflected in the project capital cost estimate for the proposed modifications.

2.3 ANFO and 12-hour Shift

Increased use of ANFO is not expected to consume any capital costs. Assarel Medet and SRK do not think that 12-hour shifts are currently possible with the Bulgarian labor legislation.

2.4 Pit Slope Monitoring

Pit Slope monitoring includes the purchase and installation of a prism system for monitoring, purchase of software and computer hardware to provide the necessary data interface into the operating systems. The capital costs related to pit slope monitoring are shown in the table below. These costs include a robotic laser scanner, a weatherproof shed, and appropriate hardware,, software, and transmitters and receivers.

Item	Qty	Unit $	Cost
Prisms & Laser System	1	LS	$30,000
Software and Computers	1	LS	$20,000
Installation	1	LS	$10,000
Total			$60,000

2.5 SX/EW Plant

The SX/EW plant costs were developed in detail, and are excluded from the remainder of the improvements. SX/EW will be considered a stand-alone option, and is discussed in detail in section 1 above. The capital costs associated with the SX/EW plant and implementation is shown in Remainder of Life of Mine Capital Costs in the summary capital cost table.

2.6 Disintegrator Modifications

The conversion of the disintegrators to autogenous and the elimination of the screens and spiral classifiers would require a capital cost of $879,000. This includes the demolition, new concrete, steel, equipment, etc. The breakdown of this cost is shown in the table below:

DESCRIPTION		TOTAL H/P	TOTAL HOURS	LABOR COST	Equipment & Material COST	Sub-Cont. COST	OTHER COST	TOTAL COST
Direct Cost Civil		0	480	720	300	0	0	$1,020
Concrete		0	960	1,440	18,000	0	0	$19,440
Architectural/Buildings		0	0	0	0	0	0	$0
Structural Steel (inc. misc. stl.)		0	1,200	1,800	47,450	0	0	$49,250
Mechanical		0	1,720	2,580	199,400	0	0	$201,980
Piping		0	9,065	13,598	94,150	0	0	$107,748
Electrical		400	1,140	53,000	102,165	0	0	$155,165
SUB TOTAL =		400	14,565	73,138	461,465	0	0	534,603
Subtotal - Direct Costs			14,565	73,138	$461,465	$0	$0	$534,603
In-Bound Freight	5.60%				$25,842			$25,842
Total Direct Costs:			14,565	$73,138	$487,307	$0	$0	$560,445
Engineering, Procurement & Project Management								
Detail Engineering			2,503	132,570			12,884	$145,454
SUB TOTAL EPCM =			2,503	132,570	0	0	12,884	145,454
Total EPCM Hours & Costs:			2,503	$132,570	$0	$0	$12,884	$145,454
TOTAL PROJECT BEFORE PROFIT & INSURANCE			17,068	205,708	487,307	0	12,884	705,898
Material & Subs Mark-	10.00%				46,147	0		$46,147
VAT	0.00%			0	0	0	0	$0
Contingency	15.00%			30,856	73,096	0	1,933	$105,885
Insurance	2.50%							$21,448
TOTAL INSTALLED COST:			17,068	236,564	606,550	0	14,816	$879,378

2.7 Fine Crushing

The cost for the changes to the fine crushing section include a reconfiguration of the existing crushers and the appropriate changes to modify the system to a two-stage crushing system. The total cost for this is approximately $ 1,556,000shown in the table below:

Project: Assarel Medet
Descriptior 12 MM TPY Copper Conc. Fine Crushing Area
Location: Bulgaria

DESCRIPTION		TOTAL H/P	TOTAL HOURS	LABOR COST	Equipment & Material COST	Sub-Cont. COST	OTHER COST	TOTAL COST
Direct Cost Civil		0	0	0	0	0	0	$0
Concrete		0	9,600	12,000	30,000	0	0	$42,000
Architectural/Buildings		0	0	0	0	0	0	$0
Structural Steel (inc. misc. stl.)		0	720	900	58,800	0	0	$59,700
Mechanical		190	2,792	3,490	769,000	0	0	$772,490
Piping		0	3,600	140,400	1,800	0	0	$142,200
Electrical		0	914	45,700	43,520	0	0	$89,220
SUB TOTAL =		190	17,626	202,490	903,120	0	0	1,105,610
	avg. rate =	11.49						$0
Spares & Start-Up	0				$0			$0
Contractor Mob & Demobilization	0.00% labor		0	0	$0			$0
Contractor Construction (Rental & Operating) Equipment Cost						$0		$0
								$0
								$0
Small Tools & Consumables		0		0				$0
Subcontractor Overhea	0			0				0
								$0
Subtotal - Direct Costs			17,626	202,490	903,120	0	0	1,105,610
	avg. rate =	1148.81%						
In-Bound Freight	5.60%				50,575			$50,575
Total Direct Costs:			17,626	202,490	953,695	0	0	1,156,185

Engineering, Procurement & Project Management

Detail Engineering		380	15400.94			1644.05	17044.9912
Procurement/Expediting		0	0			0	0
Project Management		6.8	466.128			40.0264	506.1544
SUB TOTAL EPCM =		386.8	15867.07	0	0	1684.07	17551.1456
Field Engineering/Construction Management:		120	12983.4			3155.4	16138.8
Start-Up &Commissioning		0	0			0	0
SUB TOTAL CM and Start-Up =		120	12983.4	0	0	3155.4	16138.8
Total EPCM Hours & Costs:		506.8	28850.47	0	0	4839.47	33689.9456
TOTAL PROJECT BEFORE PROFIT & INSURANCE		18132.8	231340.5	953694.72	0	4839.47	1189874.67
Material & Subs Mark-	0.1			90312	0		90312
VAT	0		0	0	0	0	0
Contingency	0.2		46268.09	190738.944	0	967.895	237974.933
Insurance	0.025						37954.04
TOTAL INSTALLED COST:		18132.8	277608.6	1234745.66	0	5807.37	1556115.64

2.8 Ball Mills

The cost estimated for Ball Mill conversion includes new pinion gears, new sumps and pumps and cyclones and installation. The total capital costs are expected to be approximately US$ 3,188,000. Details of this capital cost are shown below:

DESCRIPTION			TOTAL H/P	TOTAL HOURS	LABOR COST	Equipment & Material COST	Sub-Cont. COST	OTHER COST	TOTAL COST
Direct Cost:	Civil		0	0	0	0	0	0	$0
	Concrete		0	0	0	0	0	0	$0
	Architectural/Buildings		0	0	0	0	0	0	$0
	Structural Steel (inc. misc. stl.)		0	520	780	10,000	0	0	$10,780
	Mechanical		0	3,088	3,860	1,095,500	72,000	0	$1,171,360
	Piping		0	3,376	4,220	206,060	0	0	$210,280
	Electrical		2,696	2,360	5,900	645,100	40,500	0	$691,500
	SUB TOTAL =		2,696	9,344	14,760	1,956,660	112,500	0	2,083,920
	Subtotal - Direct Costs			9,344	14,760	$1,956,660	$112,500	$0	$2,083,920
	In-Bound Freight	5.60%				$109,573			$109,573
Total Direct Costs:				9,344	$14,760	$2,066,233	$112,500	$0	$2,193,493
Engineering, Procurement & Project Management									
	Detail Engineering			3,268	171,947			16,746	$188,693
	Procurement/Expediting			0	0			0	$0
	Project Management			46	3,229			258	$3,487
	SUB TOTAL EPCM =			3,314	175,176	0	0	17,004	192,180
Field Engineering/Construction Management:				250	27048.75			$6,574	$33,623
	Start-Up &Commissioning			0	0			0	$0
	SUB TOTAL CM and Start-Up =			250	27,049	0	0	6,574	33,623
Total EPCM Hours & Costs:				3,564	$202,225	$0	$0	$23,578	$225,802
TOTAL PROJECT BEFORE PROFIT & INSURANCE				12,908	216,985	2,066,233	112,500	23,578	2,419,295
	Material & Subs Mark-	10.00%				195,666	11,250		$206,916
	VAT	0.00%			0	0	0	0	$0
	Contingency	20.00%			43,397	413,247	22,500	4,716	$483,859
	Insurance	2.50%							$77,752
	TOTAL INSTALLED COST:			12,908	260,382	2,675,146	146,250	28,293	3,187,822

2.9 Reagent Dosing

The estimated capital cost for reagent dosing includes refurbishment of existing pumps, purchase and installation of new pumps, installation of new feeders, agitator replacements, and additional instrumentation and controls. The capital costs for modified installation is included in the automation capital costs.

2.10 Flotation Density

It is not currently expected to cost anything to increase the density of flotation. It should be noted that this change at the current throughput rate of 11 million tonnes of

ore per year is expected to idle some of the flotation machines, and will therefore save on operating costs. At the higher throughput rate of 12 million tonnes of ore per year, no flotation cells will be idled, and the flotation section becomes more optimally loaded.

2.11 Automation

In order to automate the mill and flotation section of the plant, SRK reviewed in detail the requirements and prepared a conceptual estimate. This estimate is included in the table below. It is expected to cost approximately $ 2,878,000 to fully automate the mill and concentrator.

DESCRIPTION			TOTAL H/P	TOTAL HOURS	LABOR COST	Equipment & Material COST	Sub-Cont. COST	OTHER COST	TOTAL COST
Direct Cost:	Civil		0	0	0	0	0	0	$0
	Concrete		0	0	0	0	0	0	$0
	Architectural/Buildings		0	0	0	0	0	0	$0
	Structural Steel (inc. misc. stl.)		0	480	888	15,000	0	0	$15,888
	Mechanical		0	3,229	4,036	800,051	352,798	0	$1,156,885
	Piping		0	640	800	92,920	10,750	0	$104,470
	Electrical		0	3,919	5,313	438,030	0	0	$443,343
	SUB TOTAL =		0	8,268	11,037	1,346,001	363,548	0	1,720,587
		avg. rate =	1.33						$0
	Subtotal - Direct Costs			8,268	11,037	$1,346,001	$363,548	$0	$1,720,587
	In-Bound Freight	5.60%				$75,376			$75,376
Total Direct Costs:				8,268	$11,037	$1,421,377	$363,548	$0	$1,795,963
Engineering, Procurement & Project Management									
	Detail Engineering			5,502	290,516			28,261	$318,777
	Procurement/Expediting			0	0			0	$0
	Project Management			0	0			0	$0
	SUB TOTAL EPCM =			5,502	290,516	0	0	28,261	318,777
Field Engineering/Construction Management:				384	40132.68			$10,087	$50,220
	Start-Up &Commissioning			240	24,542			7,694	$32,237
	SUB TOTAL CM and Start-Up =			624	64,675	0	0	17,781	82,457
Total EPCM Hours & Costs:				6,126	$355,191	$0	$0	$46,043	$401,233
TOTAL PROJECT BEFORE PROFIT & INSURANCE				14,394	366,228	1,421,377	363,548	46,043	2,197,196
	Material & Subs Mark-	10.00%				134,600	36,355		$170,955
	VAT	0.00%			0	0	0	0	$0
	Contingency	20.00%			73,246	284,275	72,710	9,209	$439,439
	Insurance	2.50%							$70,190
	TOTAL INSTALLED COST:			14,394	439,474	1,840,253	472,612	55,251	2,877,780

2.12 Thickening

To thicken the tailings and recover water at the thickeners (near the concentrator), is expected to cost approximately $ 627,000. This cost includes appropriate Eimco mechanisms, all concrete, steel, pumps for the transport of the underflow, and

electrical for installation and operation of the two 50m thickeners existing at the site. Details of this cost are shown below:

	DESCRIPTION		TOTAL H/P	TOTAL HOURS	LABOR COST	& Material COST	COST	OTHER COST	TOTAL COST
Direct Cost	Civil		0	0	0	0	0	0	0
	Concrete		0	720	1080	10000	0	0	11080
	Architectural/Buildings		0	0	0	0	0	0	0
	Structural Steel (inc. misc. stl.)		0	302	453	23,316	0	0	$23,769
	Mechanical		0	200	350	152,000	0	0	$152,350
	Piping		0	1,250	2,188	8,790	0	0	$10,978
	Electrical		136	1,245	2,490	43,399	0	0	$45,889
	SUB TOTAL =		136	3,717	6,561	237,505	0	0	$244,065
		avg. rate =	2						$0
	Spares & Start-Up	0.095				$22,563			$22,563
	Contractor Mob & Demobilization	0 labor		0	0	0			0
	Contractor Construction (Rental & Operating) Equipment Cost						$0		$0
									$0
									$0
	Small Tools & Consumables		0.00%		0				$0
	Subcontractor Overhea	0.03			$197				$197
									$0
	Subtotal - Direct Costs			3,717	6,757	$260,067	$0	0	$266,825
		avg. rate =	2						
	In-Bound Freight	0.056				$14,564			$14,564
Total Direct Costs:				3,717	$6,757	$274,631	$0	$0	$281,389
Engineering, Procurement & Project Management									
	Detail Engineering			2,184	113,294			11,084	$124,378
	Procurement/Expediting			0	0			$0	$0
	Project Management			201	13,623			1,085	14,708
	SUB TOTAL EPCM =			2385	126917.2	0	0	12169.06	139086.2
Field Engineering/Construction Management:				1228	58056.1			26901.34	84957.44
	Start-Up &Commissioning			40	4354.096			1321.456	5675.552
	SUB TOTAL CM and Start-Up =			1268	62410.19	0	0	28222.79	90632.99
Total EPCM Hours & Costs:				3653	189327.3	0	0	40391.85	229719.2
TOTAL PROJECT BEFORE PROFIT & INSURANCE				7370	196084.7	274631.2	0	40391.85	511107.7
	Material & Subs Mark-	0.1				23750.45	0		23750.45
	VAT	0			0	0	0	0	0
	Contingency	0.15			29412.7	41194.68	0	6058.778	76666.16
	Insurance	0.025							15288.11
	TOTAL INSTALLED COST:			7370	225497.4	339576.3	0	46450.63	626812.4

2.13 Laboratory upgrades

Upgrades to the laboratory according to the recommendations by SRK above are expected to cost $ 526,000.

2.14 Additional Items

During meetings with Assarel Medet, there were several items which surfaced as being required for improved operations. These items and their associated capital costs are shown in the table below:

Additional Items for operational improvement		
Item	**Description**	**US $**
	STAGE 1	
1	6 Grunfus Pumps for pit dewatering	$108 000
2	Rubber Impact Slide	$64 000
3	Belt Vulcanization Cost	$32 000
4	automated ball loading system	$225 000
5	sump pumps and piping for ball mill area	$54 000
6	pumps for pump station II & III	$221 000
7	video observation of concentrator	$62 500
8	Power consumption monitor	$250 000
9	Maintenance improvements	$600 000
10	New computer configurations	$120 000
11	Replace 2 meter belts for conveyor 1&2	$970 000
12	Auto lubrication system for mill 13 units	$445 000
13	new transformer	$100 000
14	Metal detector and belt magnets for all belts (10 total)	$125 000
15	Dispatcher system	$650 000
16	Automation of Petrol Station	$150 000
17	Backhoe for tailings Dam	$150 000
18	Upgrade water system for sanitation facility	$300 000
19	Stage 1 Telecommunicatons upgrade	$100 000
20	Heating system improvements for bldgs	$300 000
	TOTAL COST FOR STAGE 1	**$5 026 500**
	STAGE 2	
1	New Concentrate loading crane	$77 500
2	Ball Mill scrap crushing station	$150 000
3	Mini water power generator	$250 000
4	Replace auto transport vehicles	$320 000
5	Man-lift hoist truck	$100 000
6	Rubber tired cranes - 16T&25T	$300 000
7	Forklifts for maintenance and warehouse	$200 000
8	Universal tractor for mine waste conveyor system	$75 000
9	Stage 2 Telecommunications upgrades	$100 000
10	Cat D10 Dozer for tailings maintenance	$900 000
	TOTAL COST FOR STAGE 2	**$2 472 500**

2.15 Other Costs

Detailed Engineering has been included in each of the capital costs estimates for the alternatives. The operations support figure was calculated from the support and implementation information contained in this feasibility study.

Contingency was included at a rate of 10% of the sum of all capital costs.

ASSAREL MEDET JSC - Copper Feasibility Study
Capital Replacement Schedule

Exhibit 1.1.3: Capital Replacement Schedule

Case 1: Replacement with 15m^3 capacity loaders and 78m^3 (136t) capacity trucks.

Equipment Type	Equipment Model	No. Units LoM	Cost/Unit M US$	Total LoM M US$	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	
Truck	CAT 785 (	22	1.60	35.20	No		2.0	4.0	3.0	2.0	5.0					2	4	0	0	
					Cost		3.2	6.4	4.8	3.2	8.0	0.0	0.0	0.0	0.0	3.2	6.4	0.0	0.0	
Loader	CAT 5320	5	2.60	13.00	No	1.0			1.0		2.0			1						
					Cost	2.6		0.0	2.6	0.0	5.2	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	
Loader	CAT 992C		1.30	1.30	No			1.0												
					Cost			1.3												
Drill	IR DML	6	0.90	5.40	No		1			2				1			2			
					Cost		0.9	0.0	0.0	1.8	0.0	0.0	0.0	0.9	0.0	0.0	1.8	0.0	0.0	
Dozer	CAT D10R	9	0.90	8.10	No		2	2				1	3				1			
					Cost		1.8	1.8	0.0	0.0	0.0	0.9	2.7	0.0	0.0	0.0	0.9	0.0	0.0	
Grader	CAT 16H	7	0.50	3.50	No		1.0	2					1	2				1		
					Cost		0.5	1.0	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.0	0.0	0.5	0.0	
RTD	CAT 834G	2	0.60	1.20	No		1.0		1											
					Cost		0.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Water Trk.	14,000 Gall	2	0.70	1.40	No				1	1										
					Cost		0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Total LoM			69.10		2.6	7.0	10.5	8.7	5.7	13.2	0.9	3.2	4.5	0.0	3.2	9.1	0.5	0.0	0.0
	Replacement Capital in thousands US$					$2,600	$7,000	$10,500	$8,700	$5,700	$13,200	$900	$3,200	$4,500	$0	$3,200	$9,100	$500	$0	

Exhibit 1.1.2: Equipment Replacement Schedule

Case 1: Replacement with 15m³ capacity loaders and 78m³ capacity trucks.

No.	Equipment Class	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
	Trucks		Numbers are truck capacities in cubic meters. Highlights indicate replacements.														
1	Belaz №23,110 t		63.0	63.0	63.0	63.0	63.0										
2	Belaz №24,110 t		63.0	63.0	63.0	63.0	63.0	78	78	78	78	78	78	78	78	78	78
3	Belaz №37,120 t		69.0	78	78	78	78	78	78	78	78	78	78	78	78	78	78
4	CAT №33,85 t		60.0	78	78	78	78	78	78	78	78	78	78	78	78	78	78
5	Belaz №30,110 t		63.0	63.0	78	78	78	78	78	78	78	78	78	78	78	78	78
6	Belaz №29,110 t		63.0	63.0	78	78	78	78	78	78	78	78	78	78	78	78	78
7	CAT №40,85 t		60.0	60.0	78	78	78	78	78	78	78	78	78	78	78	78	78
8	O&K №32,85 t		60.0	60.0	78	78	78	78	78	78	78	78	78	78	78		
9	Belaz №36,120 t		69.0	69.0	69.0	78	78	78	78	78	78	78	78	78	78		
10	CAT №34,85 t		60.0	60.0	60.0	78	78	78	78	78	78	78	78	78	78		
11	CAT №41,85 t		60.0	60.0	60.0	78	78	78	78	78	78	78	78	78	78		
12	Belaz №35,110 t		63.0	63.0	63.0	63.0	78	78	78	78	78	78	78	78	78		
13	O&K №39,85 t		60.0	60.0	60.0	60.0	78	78	78	78	78	78	78	78	78		
14	Belaz №44,110 t		63.0	63.0	63.0	63.0	63.0	78	78	78	78	78	78	78	78		
15	TR №42,100 t		63.0	63.0	63.0	63.0	63.0	78	78	78	78	78	78	78	78		
16	CAT №43,100 t		60.0	60.0	60.0	60.0	60.0	78	78	78	78	78	78	78	78		
17	O&K №38,85 t		60.0	60.0	60.0	60.0	60.0	78	78	78	78	78	78	78	78		
													78	78	78		
													78	78	78		
	Avg. Capacity		62.3	63.9	67.8	70.4	72.4	78	78	78	78	78	78	78	78	78	78
	No. of Trucks		17	17	17	17	17	16	16	16	16	16	18	18	18	6	6
	New Trucks			2	4	3	2	5	0	0	0	0	2	4			

	Loaders		Numbers are truck capacities in cubic meters. Highlights indicate replacements.														
1	CAT992 No.4		9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
2	RH 120 No.1		13.0	13.0	13.0	15	15	15	15	15	15	15	15	15	15	15	
3	RH 120 No.2		13.0	13.0	13.0	13.0	13.0	15	15	15	15	15	15	15	15	15	15
4	Liebherr No.3		12.0	12.0	12.0	12.0	12.0	15	15	15	15	15	15	15	15	15	15
5			15.0	15.0	15.0	15.0	15.0	15	15	15							
	Avg. Capacity		11.9	11.9	11.9	12.4	12.4	13.65	13.65	13.65	13.65	13.65	13.65	13.65	13.65	13.65	9.9
	repl. Shovels		1			1		2									

Drills, Dozers, & Graders

No.	Equipment Class	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
	Drills		Highlights indicate replacements.														
1	SBH 250 No. 10		SBH 250	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML
2	DET 250 No. 12		DET 250														
3	DET 250 No. 18		DET 250	DET 250	DET 250	DET 250	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML
4	DET 250 No. 19		DET 250	DET 250	DET 250	DET 250	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML
	Dozers																
1	CAT D9N No. 1		D9N	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R
2	CAT D8N No. 2		D8N	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R
3	K 701 No. 2		K701	K701	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R
4	TK 80 No. 2		TK80	TK80	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R
	Graders																
1	Grader No. 4		No. 4	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G
2	Grader No. 3		No. 3		16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G
3	Grader No. 7		No. 7	No. 7	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G
4	Grader No. 8		No. 8	No. 8													

Assarel Open Pit @ 0.25% Cu Mill Cutoff & 0.10% Cu Leach Cutoff
Indicative Mine Schedule @ 12Mtpy Mill Ore, 3Mtpy Leach Ore

Year	2003			2004			2005			2006			2007		
Tonnes	Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste
1080															
1065															
1050			159,723												
1035			463,581												
1020			811,050												
1005			1,123,676												
990			2,653,705												
975			4,545,373												
960		135,838	4,000,000			2,023,408									
945	74,419	0	4,000,000			4,126,327									
930	56,842	1,000,000	242,892		967,575	7,000,000			1,894,519						
915	596,157	1,000,000			486,495	4,850,265			7,001,418						
900	1,105,024	500,000			800,000			790,037	4,000,000			7,000,000			3,964,893
885	2,340,758	364,162			500,000			1,500,000	3,000,000		1,500,000	6,000,000		638,714	5,000,000
870	3,326,800			1,432,094	245,930			709,963	2,104,063		1,000,000	5,000,000		1,500,000	5,000,000
855	2,500,000			3,567,906			3,154,359				500,000			861,286	4,035,107
840	2,000,000			3,500,000			3,000,000			1,838,610					
825				3,500,000			3,000,000			3,500,000			1,300,242		
810							2,845,641			3,500,000			3,659,396		
795										3,161,390			3,540,362		
780													3,500,000		
765															
750															
735															
720															
705															
690															
675															
660															
645															
630															
615															
600															
585															
570															
555															
Total	12,000,000	3,000,000	18,000,000	12,000,000	3,000,000	18,000,000	12,000,000	3,000,000	18,000,000	12,000,000	3,000,000	18,000,000	12,000,000	3,000,000	18,000,000
Strip Ratio (w:o)			1.20			1.20			1.20			1.20			1.20

2008			2009			2010			2011			2012		
Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste
		3,906,010												
	969,687	5,605,086												
	1,400,000	5,000,000		1,339,348	5,000,000			2,697,746						
	630,313	3,488,904		1,300,000	6,000,000		1,322,189	3,500,000			3,349,422			
				360,652	4,000,000		1,400,000	5,000,000		1,653,595	5,465,931			
					3,000,000		277,811	3,802,254		1,000,000	3,500,000		1,400,000	3,000,000
4,179,338										346,405	2,684,647		1,000,000	5,000,000
3,920,662			2,225,986										600,000	2,000,000
3,900,000			5,738,931											2,000,000
			4,035,083			4,000,000			2,328,863					
						4,000,000			3,400,000			2,557,867		
						4,000,000			3,400,000			1,964,764		
									2,871,137			4,878,182		
												2,599,187		
12,000,000	3,000,000	18,000,000	12,000,000	3,000,000	18,000,000	12,000,000	3,000,000	15,000,000	12,000,000	3,000,000	15,000,000	12,000,000	3,000,000	12,000,000
		1.20			1.20			1.00			1.00			0.80

2013			2014			2015			2016		
Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste	Mill	Leach	Waste
	671,920	401,401									
	1,074,305	3,080,067									
	700,000	5,000,000		899,030	3,065,014						
	553,775	3,518,532		937,605	2,865,111						
				600,000	3,500,000		670,534	1,457,696			
				563,365	2,569,875		397,346	1,078,106			
							885,997	2,587,511			
							140,485	2,977,031			
3,000,000			1,871,791				61,437	2,376,327			
3,000,000			3,710,204				7,756	1,523,329			54,081
3,000,000			3,575,631				7,368				410,873
3,000,000			2,608,975								423,992
			233,399			4,964,861					94,499
						4,137,940					180,539
						2,897,199			511,257		12,964
									2,625,669		5,644
									1,851,109		77,153
									1,176,276		145,997
12,000,000	**3,000,000**	**12,000,000**	**12,000,000**	**3,000,000**	**12,000,000**	**12,000,000**	**2,170,923**	**12,000,000**	**6,164,311**	**0**	**1,405,742**
		0.80			**0.80**			**0.85**			**0.23**

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
TOTAL TONNES PER YEAR MINED MATERIAL	33000000	tonnes
NUMBER OF SHOVELS	4	ea
TOTAL QUANTITY PER SHOVEL	8,250,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	8	hrs
SHIFTS PER DAY	3	shift
PRODUCTIVE MIN/HOUR	50	min
AVAILABILITY	6	days/wk

AVAILABILITY		
NOMINAL SHIFT TIME	480	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	420	min
AVAILABLE PER SHIFT	5.833	hrs
AVAILABLE PER DAY	1260	min
AVAILABLE PER DAY	17.5	hrs

FLEET DATA		
TRUCKS PER SHOVEL	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	2,221	t
TONNES PER DAY	6,663	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	8,884	t
TONNES PER DAY	26,651	t
TONNES PER MONTH	685,197	t/mo
DURATION	309.56	days
DURATION	12.04	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
TOTAL TONNES PER YEAR MINED MATERIAL	33000000	tonnes
NUMBER OF SHOVELS	4	ea
TOTAL QUANTITY PER SHOVEL	8250000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	8	hrs
SHIFTS PER DAY	3	shift
PRODUCTIVE MIN/HOUR	50	min
AVAILABILITY	6	days/wk

AVAILABILITY		
NOMINAL SHIFT TIME	480	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	420	min
AVAILABLE PER SHIFT	5.833	hrs
AVAILABLE PER DAY	1260	min
AVAILABLE PER DAY	17.5	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	64.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	57.60	LCM
AVERAGE WEIGHT PER TRUCK	102.86	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	387	t/hr
TONNES PER SHIFT	2,256	t
TONNES PER DAY	6,769	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,547	t/hr
TONNES PER SHIFT	9,025	t
TONNES PER DAY	27,074	t
TONNES PER MONTH	696,073	t/mo
DURATION	304.72	days
DURATION	11.85	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
TOTAL MINED MASS PER YEAR	33000000	
NUMBER OF SHOVELS	4	
TOTAL MINED MASS PER SHOVEL	8,250,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	8	hrs
SHIFTS PER DAY	3	shift
PRODUCTIVE MIN/HOUR	50	min
AVAILABILITY	6	days/wk

AVAILABILITY		
NOMINAL SHIFT TIME	480	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	420	min
AVAILABLE PER SHIFT	5.833	hrs
AVAILABLE PER DAY	1260	min
AVAILABLE PER DAY	17.5	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	13.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	68.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	12.35	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	61.20	LCM
AVERAGE WEIGHT PER TRUCK	109.29	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	411	t/hr
TONNES PER SHIFT	2,397	t
TONNES PER DAY	7,192	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,644	t/hr
TONNES PER SHIFT	9,589	t
TONNES PER DAY	28,766	t
TONNES PER MONTH	739,578	t/mo
DURATION	286.80	days
DURATION	11.16	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
TOTAL TONNES PER YEAR MINED MATERIAL	33000000	
NUMBER OF SHOVELS	4	
TOTAL QUANTITY PER SHOVEL	8,250,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	8	hrs
SHIFTS PER DAY	3	shift
PRODUCTIVE MIN/HOUR	50	min
AVAILABILITY	6	days/wk

AVAILABILITY		
NOMINAL SHIFT TIME	480	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	420	min
AVAILABLE PER SHIFT	5.833	hrs
AVAILABLE PER DAY	1260	min
AVAILABLE PER DAY	17.5	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	70.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	63.00	LCM
AVERAGE WEIGHT PER TRUCK	112.50	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	2,468	t
TONNES PER DAY	7,403	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	9,871	t
TONNES PER DAY	29,612	t
TONNES PER MONTH	761,330	t/mo
DURATION	278.60	days
DURATION	10.84	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
TOTAL TONNES PER YEAR MINED MATERIAL	33000000	
NUMBER OF SHOVELS	4	
TOTAL QUANTITY PER SHOVEL	8,250,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	72.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	64.80	LCM
AVERAGE WEIGHT PER TRUCK	115.71	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	2,467	t
TONNES PER DAY	7,401	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	9,868	t
TONNES PER DAY	29,603	t
TONNES PER MONTH	761,096	t/mo
DURATION	278.69	days
DURATION	10.84	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
TOTAL TONNES PER YEAR MINED MATERIAL	33000000	
NUMBER OF SHOVELS	4	
TOTAL QUANTITY PER SHOVEL	8,250,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	435	t/hr
TONNES PER SHIFT	2,536	t
TONNES PER DAY	7,607	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,739	t/hr
TONNES PER SHIFT	10,143	t
TONNES PER DAY	30,428	t
TONNES PER MONTH	782,305	t/mo
DURATION	271.13	days
DURATION	10.55	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
TOTAL TONNES PER YEAR MINED MATERIAL	33000000	
NUMBER OF SHOVELS	4	
TOTAL QUANTITY PER SHOVEL	8,250,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	414	t/hr
TONNES PER SHIFT	2,412	t
TONNES PER DAY	7,236	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,654	t/hr
TONNES PER SHIFT	9,649	t
TONNES PER DAY	28,946	t
TONNES PER MONTH	744,201	t/mo
DURATION	285.01	days
DURATION	11.09	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
TOTAL TONNES PER YEAR MINED MATERIAL	30000000	
NUMBER OF SHOVELS	3	
TOTAL QUANTITY PER SHOVEL	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.90	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.98**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	377	t/hr
TONNES PER SHIFT	2,196	t
TONNES PER DAY	6,589	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,883	t/hr
TONNES PER SHIFT	10,982	t
TONNES PER DAY	32,947	t
TONNES PER MONTH	847,079	t/mo
DURATION	303.51	days
DURATION	11.81	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
TOTAL TONNES PER YEAR MINED MATERIAL	30000000	
NUMBER OF SHOVELS	3	
TOTAL QUANTITY PER SHOVEL	10,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	8	hrs
SHIFTS PER DAY	3	shift
PRODUCTIVE MIN/HOUR	50	min
AVAILABILITY	6	days/wk

AVAILABILITY		
NOMINAL SHIFT TIME	480	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	420	min
AVAILABLE PER SHIFT	5.833	hrs
AVAILABLE PER DAY	1260	min
AVAILABLE PER DAY	17.5	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.06	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**20.02**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	376	t/hr
TONNES PER SHIFT	2,192	t
TONNES PER DAY	6,576	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,879	t/hr
TONNES PER SHIFT	10,959	t
TONNES PER DAY	32,878	t
TONNES PER MONTH	845,293	t/mo
DURATION	304.15	days
DURATION	11.83	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,835	meters
TOTAL TONNES PER YEAR MINED MATERIAL	27000000	
NUMBER OF SHOVELS	3	
TOTAL QUANTITY PER SHOVEL	9,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	16.95	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.85	min
TOTAL ROUND TRIP TIME	**21.64**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	348	t/hr
TONNES PER SHIFT	2,027	t
TONNES PER DAY	6,081	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,738	t/hr
TONNES PER SHIFT	10,136	t
TONNES PER DAY	30,407	t
TONNES PER MONTH	781,751	t/mo
DURATION	295.99	days
DURATION	11.51	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,120	meters
TOTAL TONNES PER YEAR MINED MATERIAL	27000000	
NUMBER OF SHOVELS	3	
TOTAL QUANTITY PER SHOVEL	9,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	18.55	min
WAIT TIME PER TRUCK	0.70	min
MISCELLANEOUS DELAYS @ 5.0%	0.93	min
TOTAL ROUND TRIP TIME	**24.03**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	313	t/hr
TONNES PER SHIFT	1,826	t
TONNES PER DAY	5,478	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,878	t/hr
TONNES PER SHIFT	10,956	t
TONNES PER DAY	32,869	t
TONNES PER MONTH	845,051	t/mo
DURATION	273.82	days
DURATION	10.65	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,405	meters
TOTAL TONNES PER YEAR MINED MATERIAL	27000000	
NUMBER OF SHOVELS	3	
TOTAL QUANTITY PER SHOVEL	9,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.15	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.01	min
TOTAL ROUND TRIP TIME	**25.01**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	301	t/hr
TONNES PER SHIFT	1,754	t
TONNES PER DAY	5,263	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,804	t/hr
TONNES PER SHIFT	10,525	t
TONNES PER DAY	31,576	t
TONNES PER MONTH	811,829	t/mo
DURATION	285.02	days
DURATION	11.09	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,690	meters
TOTAL TONNES PER YEAR MINED MATERIAL	26170923	
NUMBER OF SHOVELS	3	
TOTAL QUANTITY PER SHOVEL	8,723,641	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	21.76	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.09	min
TOTAL ROUND TRIP TIME	**26.69**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	282	t/hr
TONNES PER SHIFT	1,644	t
TONNES PER DAY	4,931	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,691	t/hr
TONNES PER SHIFT	9,862	t
TONNES PER DAY	29,585	t
TONNES PER MONTH	760,636	t/mo
DURATION	294.86	days
DURATION	11.47	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

12 Mtpy Mill Ore

Year 2016

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,975	meters
TOTAL TONNES PER YEAR MINED MATERIAL	7570053	
NUMBER OF SHOVELS	2	
TOTAL QUANTITY PER SHOVEL	3,785,027	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	8 hrs
SHIFTS PER DAY	3 shift
PRODUCTIVE MIN/HOUR	50 min
AVAILABILITY	6 days/wk

AVAILABILITY	
NOMINAL SHIFT TIME	480 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	420 min
AVAILABLE PER SHIFT	5.833 hrs
AVAILABLE PER DAY	1260 min
AVAILABLE PER DAY	17.5 hrs

FLEET DATA	
TOTAL TRUCKS	3 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	23.36	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.17	min
TOTAL ROUND TRIP TIME	**28.38**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	265	t/hr
TONNES PER SHIFT	1,546	t
TONNES PER DAY	4,638	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	795	t/hr
TONNES PER SHIFT	4,638	t
TONNES PER DAY	13,915	t
TONNES PER MONTH	357,759	t/mo
DURATION	272.01	days
DURATION	10.58	mo

Haul Distances (meters)

Year	11Mtpy ore	12 Mtpy ore
2003	1,800	1,800
2004	1,800	1,800
2005	1,800	1,800
2006	1,800	1,800
2007	1,950	1,950
2008	1,950	2,100
2009	2,100	2,250
2010	2,100	2,400
2011	2,250	2,550
2012	2,400	2,835
2013	2,550	3,120
2014	2,700	3,405
2015	3,000	3,690
2016	3,450	3,975
2017	4,050	

This section contains confidential information and has therefore been removed.

4. 0 IMPLEMENTATION

SRK is interested in assisting Assarel Medet to implement the work identified during this investigation and outlined in this report. Considerable detail engineering work and final selection of process changes need to be accomplished in the next phase of work. SRK has gained considerable knowledge and insight to Assarel's processes and organization and believes it is in an excellent position to offer immediate help. SRK recognizes that Assarel Medet has the right to make an independent selection of the engineering firm it wishes to implement the changes identified in this report, however, we believe that our knowledge and understanding of the work to be done would be of invaluable service to Assarel Medet in moving forward and quickly achieving significant cost reductions. Therefore, SRK offers the following implementation plan and schedule for your consideration.

4.1 Personnel and Support

SRK believes because of the fundamental changes required for the implementation of the recommended changes, that specialized support will be required for Assarel Medet to achieve success. The opportunity to realize a significant per tonne of copper savings in mining and production costs represent much too high a return to allow "business as usual" momentum to kill the opportunity. Like any other mining and milling operation in the world, the existing personnel establish working procedures and norms which will ensure consistent operation of the plant within the parameters currently understood at the plant. To make a fundamental change in those parameters is difficult to accomplish with the same people who established the norms currently guiding the operation. Specialist support must be brought in to assist the operational personnel to make the change. These specialists will provide not only the expertise and experience needed to assist in making the changes, but more importantly, these personnel will provide the confidence and positive attitude needed to convince the operating personnel that change is possible.

4.2 Scope of Work

Mining

Mine Planning

The Contractor will provide support for mine planning for Assarel Medet. A specialist will work with the mine planning staff at Assarel Medet, during the initial mine planning exercise to develop the yearly mine plan. This will involve training as well as hands-on support. The specialist will also provide support for each 3-month mine plan, and the revision to the yearly plan when necessary.

Maintenance

The Contractor will provide support to the maintenance staff to define and develop a preventive maintenance program and implement this program with the assistance of a specialist who will be a recognized expert in equipment maintenance. He will start with a training evaluation, working directly with the maintenance personnel, and preparing an evaluation of the depth and breadth of training needed. He will then provide one week of intense training.

Fleet Selection and Replacement

The Contractor's selected specialist will provide support to the Assarel Medet mining personnel in selecting the replacement fleet, with time and schedules, as well as providing support in selection of the optimum fleet for the operation. He will also provide support in operation of the fleet in order to minimize costs and improve operation costs.

Pit Dewatering

Hydrogeologists will be provided by the Contractor to complete a comprehensive hydrological model of the pit. As described in the feasibility study, dewatering of the pit is key to achieving steeper slopes, improving stability, and minimizing mining costs both now and in the future. The hydrogeologists will identify missing data, prepare a scope for information gathering and any geotechnical investigations, support any field drilling necessary, and prepare a model of the hydrology of the pit area. This hydrological model will then provide the information necessary to develop a plan for

dewatering, while making the maximum use of the existing drainage gallery. The dewatering plan will be developed by the Contractor with support from Assarel Medet mining and geotechnical personnel.

Slope Stability

Monitoring the slopes at the pit and the waste dump is a critical area of support needed to move the Assarel Medet operation forward. The Contractor will provide the support necessary to finalize the specification of slope monitoring equipment (both hardware and software). He will also assist Assarel Medet in the procurement of this equipment and installation. He will provide the experts necessary for this installation and checkout, as well as providing the experts necessary to train the Assarel personnel responsible for slope stability and monitoring. The Contractor will assist Assarel Medet in the selection and/or training of an expert in slope stability that will become a permanent part of the Assarel Medet organization.

Processing

Disintegration modifications

The Contractor will provide detailed engineering, specification of equipment, support for procurement of this equipment, and construction supervision for the changes to the disintegrators. These changes are currently anticipated to include:

- Removal of the spiral classifiers
- Installation of a larger sumps and pumps
- Installation of cyclones

Fine Crushing

The Contractor will provide detailed engineering, specification of equipment, support for procurement of this equipment, and construction supervision for the changes to the fine crushing system. This will involve the reconfiguration to a two-stage crushing system, and may involve the installation of new cone crushers.

Ball Mill changes

The Contractor will provide detailed engineering, specification of equipment, support for procurement of this equipment, and construction supervision for the changes to the ball mills. These changes are expected to include:

- Installation of new pinion gears to reduce the speed
- Installation of new steel liners

Reagent Mixing and Handling

The Contractor will provide detailed engineering, specification of equipment, support for procurement of equipment, and construction supervision for the changes to the reagent mixing and handling. This is expected to include:

- Reagent mixing for X133 and 3477
- Distribution of reagent to the appropriate parts of the plant
- Control of reagent addition
- Inventory control of reagents
- Modification of the lime mixing and feed system

Flotation reconfiguration

The Contractor will provide detailed design, specification of equipment, support for procurement of equipment and parts, and construction support for the changes to the flotation configuration. As identified in the feasibility study, the flotation configuration should be modified to a simpler flow in order to maximize recovery and minimize contaminants in the concentrate. The scope anticipated with this reconfiguration include:

- Re-piping

- Modification of reagent addition to establish staged addition
- Replacement of the IVA flotation machines with Denver 500s (if necessary)

Thickening and Filtration

The Contractor will provide detailed design, specification of equipment, support for procurement of equipment and parts, and construction support for the changes to thickening and filtration. This modification includes:

- Addition of flocculation system for concentrate thickening and installation of a froth buster spray bar
- Refurbishment of tailings thickeners
- Modification of tailings piping
- Addition of pumps for the overflow
- Addition of an Eimco (or equivalent) agitation mechanism

Automation

The Contractor will provide detailed design, specification of equipment and software, support for procurement of equipment and parts, and construction support for the changes necessary to support automation of the mill and concentrator. This will be accomplished in the following areas:

- Disintegrators
- Fine crushing
- Ball mills
- Flotation section
- Regrind circuit
- Thickeners and filtration
- Central control

Laboratory changes

The Contractor will provide detailed design, specification for equipment, and support for installation of the new laboratory equipment. The areas affected include:

- Sample preparation
- Analytical section
- Metallurgical laboratory
- Mineralogy laboratory
- Precious metals laboratory

Tailings Dam Dewatering

The Contractor will provide detailed engineering and recommendations for the dewatering of the upstream raise portion of the tailings dam. Specialists will assist with testing and sampling, identification of the dewatering scheme to be used, and support during implementation of the dewatering scheme. This is currently expected to be drilling drain holes into the drainage layer at the bottom of the tailings dam which will then drain the water from the raise portion of the dam and lower the phreatic surface thus stabilizing the dam.

Waste Dump Stabilization

The Contractor will provide additional consulting support to Assarel Medet for the stabilization of the waste dump. The actions currently being taken by Assarel Medet in development of diversions are thought to be major steps towards stabilization. However, these steps need to be followed with additional monitoring and analysis of the phreatic surface within the waste dump to determine if draining needs to take place, or if the diversions are providing the dewatering necessary for the stability of this dump.

Training

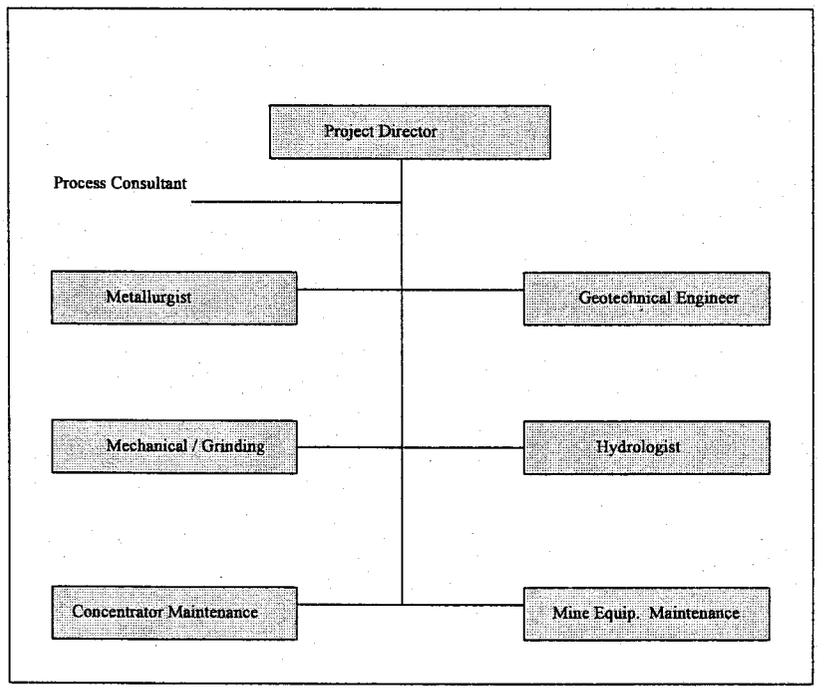
The Contractor will provide training and operations support for Assarel Medet supervisory personnel in the following areas:

- Mining (shovels, haul trucks, drills)
- Dispatch
- Pit slope stability
- Pit hydrology
- Milling and flotation
- Maintenance of mining fleet
- Maintenance of concentrator
- Tailings dam
- Heap leaching

It is anticipated that, the selected Contractor would provide training support to the additional experts that Assarel Medet must add to its staff, in the areas of slope stability, metallurgy, hydrology, and maintenance.

4.3 Personnel

The selected Contractor should prepare an organization to provide the support which it believes will provide the best expertise available to assist Assarel Medet in implementing the changes recommended in this Feasibility Study. The following organization is an example of specialists that would be needed during the implementation:



The Contractor must provide operations personnel to direct the modifications required to achieve the savings identified in the Feasibility Study, and change the operations to take advantage of the recommendations. Contractor personnel will work along side the Assarel Medet personnel, and provide training and advice in order to achieve the required results identified in this Feasibility Study. It is recognized that to make major changes such as those included herein, requires a change in the mind-set of the personnel, or infusion of personnel who understand the changes and have experience in operations where the changes have been implemented. The Contractor should anticipate that this operational support will require a minimum period of 1 year to accomplish the changes recommended.

Personnel (specialists), provided by the Contractor, in the following list would work directly with the Assarel Medet personnel. For example, two project directors have been nominated, and will rotate every six weeks working directly with the Director Production Activities, and will report to the Executive Director at Assarel. The process metallurgists will rotate and will work directly with the Head of Concentrator Assarel. The Contractor Process Metallurgists will report to the Contractor Project Directors. The Contractor mechanical and grinding specialists will work directly with the Assarel personnel responsible for the grinding and milling area, and the Contractor

concentrator maintenance specialist will work directly with the maintenance personnel responsible for maintenance in the concentrator. The Contractor mining equipment maintenance specialists will work directly with the Director Maintenance and Power Supply and the Assarel personnel responsible for maintenance of the mining equipment.

It is expected that Contractor operational personnel will work 6 weeks on site, and will rotate with their counterparts who will then work 6 weeks on site. The "schedule of work" program and specific personnel must be identified by the Contractor in his scope of work:

Contractor nominated personnel to support this effort should include:

Project Management and Direction (2 Directors)

On-site clerical support (at least 2 local hires)
Mining Support (planning)
Mining Support (operations)
Slope Stability
Slope Stability Monitoring
Mining Equipment Maintenance
Project Metallurgy
Project Engineering (concentrator)
Project Engineering (heap leaching)
Concentrator Operations (2 specialists)
Concentrator Training
Geohydrology (2 specialists)
Geotechnical Engineering (2 specialists)

These individuals should have specific tasks which will be accomplished and they should then transition off of the project. For example, the Slope Stability Monitoring specialist will provide technical expertise in the identification of appropriate vendors for the laser slope monitoring equipment, and will provide the expertise to connect and program this equipment such that it will provide the data necessary for the slope stability expert to monitor slope movement and provide advise to the mining personnel. He will also provide training in this area.

There may be a requirement for additional support personnel who will work with the above-named individuals. These support personnel will be assigned as necessary.

4.4 Implementation Costs

In the submitted scope of work the Contractor. should describe the expected work periods for each specialist and how Assarel would be charged for the personnel cost (e.g. cost-reimbursable basis). The total anticipated costs for Contractor personnel should be indicated in the scope of work.

4.5 Implementation Schedule

Assarel believes that the implementation can be accomplished in approximately 1 year from kickoff. Implementation should be prioritized based upon the ratio of resulting savings divided by capital cost. Detailed implementation schedule will require additional discussion with Assarel Medet, and should be integrated with anticipated shutdowns and turnarounds in order to minimize any impact to ongoing operations. A detailed implementation schedule will be the first order of business for the selected Contractor.

4.6 Early Start Activities

SRK and Assarel believe that there are certain upgrade activities that will result in immediate results, but which are very low cost to implement. In addition some of the recommended projects that are critical should also begin as soon as possible. SRK and Assarel recommend work in the following areas be initiated as soon as possible:

Reagent mixing and handling
Mine planning
Thickening of tailings
Tailings Dam stabilization
Amdel System Upgrade

This section contains confidential information and has therefore been removed.

6.0 Environmental Impacts

6.1 Current Condition

SRK reviewed the current environmental conditions at the Assarel Medet Copper mine during the Phase I of the Feasibility Study. A comprehensive environmental monitoring system has been established at the site since 1989. The objective of the monitoring program has been to establish the effect of the mine on the air quality, water quality and the soils and vegetation of the area. The results of the monitoring are summarized in annual reports, which are accepted by Expert Technological Economical Counsel. The conclusions in the reports are based on the proposed measures for remediation and setting the Company's activity in compliance of the National Normative Basis. Figure 6.1 shows the location of the monitoring stations. The results of the monitoring summarized in a report prepared by the Bulgarian Academy of Sciences, dated 2001, were reviewed by SRK.

Air Quality Monitoring

The reported indexes from the examinations of the atmosphere air quality by the Executive Environmental Agency at the Ministry of Environment and Water in the Company's area and in the town of Panagyurishte are in compliance with the Bulgarian and International standards.

Radio-environmental Media

Assarel-Medet has in its possession a report from the Regional Environmental Inspection Authority (REI), a government environmental controlling authority located in the town of Plovdiv, that states "... Assarel Medet JSCo has no radiation problem and is not influencing the environment from a radiation point of view."

Water Quality Monitoring

The data from the program for water monitoring flowing through the area which is affected by the Company's activities are summarized as monthly and annual average values for each of the rivers. Based on the reviewed by SRK information, the following conclusions can be made:

- Liuliakovica River. The monitoring points are located downstream of the river. The results show that the water quality is in compliance with both World Bank effluent standards and the Bulgarian legislation. From an environmental stand point of water protection the tailings area is managed relatively well compared with other facilities in the former Eastern block countries. It was apparent that the tailings collection from the processing and return system was functioning well and have a minimum impact on the Liuliakovitca river.

- Panova River. The monitoring points are located west of the open pit and at crossings with the line for the mining waste. The average monitoring results show that the river water is acidic with elevated content of Cu and Mn. A detailed review of the results of the individual monitoring points on the river was made during December 1999 by Carl Bro Group. The measures for the water quality improvement of the Panova River are included in the Program for removal of previous environmental damages and are in process of implementation, financed by the government and the World Bank. We consider that re-evaluation could be made after implementation of the Program when it is expected the environmental problems to be solved.

- Assarelska River. The Oxide heap leach, the open pit and the plant area affect the water quality of the Assarelska River. The average results show elevated sulphates, Cu and Mn contents. A detailed review of the results of the monitoring is made during December, 1999 by the Carl Bro Group. The measures for the water quality improvement of the Assarelska river are included in the Program for removal of previous environmental damages and are in the process of implementation. After its completion, it is expected the environmental problems will be resolved.

- Banska Luda Yana / Mechanska/ River. Liuliakovitca, Assarelska and Panova river combine with and form the Banska Luda Yana river. The presented average values for the water quality are in point B1 according to the Plan for Company's monitoring. Similar to Assarelska and Panova, the results show elevated levels of Cu and Mn, although lower, probably due to the dilution effect of the Liuliakovitca. It is expected the problems will be resolved with the implementation of the Program for removal of previous environmental damages.

- Mareshka River. The measured concentrations of sulphates, Cu, Mn and Fe are consistently higher than the Acceptable Limit Concentrations set up by the

Bulgarian regulatory laws. It should also be mentioned that while the observed trends for the other rivers show a consistent reduction in the concentration of the contaminants, for Mareshka River the current trend shows an overall worsening of water quality, which is a result of current construction activities to remediate the East Dump. The observed low pH and high concentration of sulphates is an indication of acid drainage. The East waste dump is a serious source of pollution. Its impact is investigated during December 1999 by Carl Bro Group. The measures for the water river quality improvement are included in the Program for removal of previous environmental damages and are in the process of implementation. After its completion, it is projected the environmental problems of Mareshka river will be resolved.

Based on the review of the available monitoring information and the observations at the site, SRK recommends the following actions:

- Review of the monitoring program and its detailed results to be analyzed by a qualified geochemist.

Biogeochemical Monitoring (Phitomonitoring)

The concentration of Cu, Mn, Fe, Pb and Zn in vegetation samples from the site and undisturbed natural areas, was measured. The results showed that the elevated concentrations of Pb and Cu in the vegetation may be affected by the mine activities. In comparison with the natural background levels of Pb, the elevated Pb concentrations are reported for some vegetation types near the road, which are not connected with the company's activities. The higher concentration levels for Cu are due to the natural geochemical abnormalities of this metal in the region.

6.2 Impact of the Proposed Modifications

In general, the proposed modifications in this project will improve the environmental condition of the mine and the surrounding areas. Specifically:

- Shift to larger mining fleet – this change will reduce the amount of equipment, and therefore the amount of contamination to the environment resulting from equipment operation and maintenance. Less equipment means less oil and cooling radiator liquids to spill and less exhaust gas emissions.

- Dewatering of the pit will ultimately result in more available water for the process, and therefore less water that will have to be added from other sources. This water should be recycled into the process if at all possible, or used for leaching of the oxide heap. If this water must be discharged, the capacity and capability of the water treatment plant must be modified to handle the increased volume of water to be treated.

- Changes to the disintegration scheme, including fine crushing, ball mills, cyclones, reagent mixing and handling, flotation, thickening and filtration, lime mixing and distribution, and automation are not expected to negatively impact the environment, since these changes are within an existing concentrator.

- Changes to the laboratory are not expected to impact the environment either positively or negatively, since these changes are upgrading equipment and modernizing the existing laboratory. There will be no new chemicals or materials introduced, nor an increase in the current volume of chemicals and materials, therefore no change in the environmental impact of this existing area is expected.

- Recommended actions for the geotechnical stability of the waste rock dump and the tailings dam will obviously be environmentally beneficial. The measures for stability control of these two areas will potentially avoid slides and/or catastrophic material flows.

- It is anticipated that the proposed changes, resulting from the project and the technical providing will also impact favorably on the tailings management, as an integral part of the management of the mining technology and maintenance of the machines and facilities. Tailing management is an essential issue for achieving environmental protection.

7.0 PERSONNEL

On the basis of the modernization of the plant and implementation of the more productive equipment in the mine SRK believes that the personnel should be reduced from the current levels. While SRK feels that the ultimate levels should approach the levels of personnel which we noted in the mines visited during the trip to Arizona in 2002, we also recognize that socioeconomic factors will almost certainly require a higher level of personnel.

In discussion with Assarel Medet we concluded that the personnel should be reduced in the mine by 323 to average 191, i.e 132 people less.

From the implementation of automation in the Concentrator the technological personnel should be reduced in the next years from 197 to 100 people or about 97 people less.

From the implementation of new effective equipment and centralizing of the maintenance activity the maintenance personnel to be reduced from 329 to approximately 229 people or about 100 people less.

From the full implementation of the automation systems for production management, Integrated Systems for Management and Integrated Information Systems the non-production personnel to be reduced from 374 to approximately 250 people or about 124 people less.

In summary the total personnel reduction until 2008 will be with about 453 people or an annual average of 80-100 people.

APPENDIX A

Mining Calculations & Exhibits

(note, these calculations were accomplished for comparison purposes only, to select an optimum fleet. The actual replacement capital costs and fleet count is included in the capital cost section)

Exhibit 1.1.1: Equipment Replacement Calculation

Equipment Class	No.	Type Unit No.	Capacity tonnes	Capacity m^3	Inventory No.	Service Year	Hours to 1/1/2002	+5000hrs to 1/1/2003	Life Used years	Life Rem. years	Replace year	Comment
Trucks										10 yr base		
	1	Belaz №23,110 t	110	63.0	19410	01-Dec-90	53,915	58,915	11.8	-1.8	2002	New Terex Lease 2002 (110t)
	2	Belaz №24,110 t	110	63.0	39223	05-Aug-93	39,275	44,275	8.9	1.1	2002	New Terex Lease 2002 (110t)
	3	Belaz №37,120 t	120	69.0	44054	30-Apr-96	38,378	43,378	8.7	1.3	2004	Replace with CAT 785 (136t) class truck
	4	CAT №33,85 t	85	60.0	43751	05-Oct-95	37,136	42,136	8.4	1.6	2004	Replace with CAT 785 (136t) class truck
	5	Belaz №30,110 t	110	63.0	43725	31-Aug-95	34,616	39,616	7.9	2.1	2005	Replace with CAT 785 (136t) class truck
	6	Belaz №29,110 t	110	63.0	43724	31-Aug-95	34,583	39,583	7.9	2.1	2005	Replace with CAT 785 (136t) class truck
	7	CAT №40,85 t	85	60.0	44090	30-Apr-96	34,291	39,291	7.9	2.1	2005	Replace with CAT 785 (136t) class truck
	8	O&K №32,85 t	95	60.0	42634	31-Mar-95	33,172	38,172	7.6	2.4	2005	Replace with CAT 785 (136t) class truck
	9	Belaz №36,120 t	120	69.0	44053	30-Apr-96	30,657	35,657	7.1	2.9	2006	Replace with CAT 785 (136t) class truck
	10	CAT №34,85 t	85	60.0	43752	05-Oct-95	30,587	35,587	7.1	2.9	2006	Replace with CAT 785 (136t) class truck
	11	CAT №41,85 t	85	60.0	44091	30-Apr-96	29,347	34,347	6.9	3.1	2006	Replace with CAT 785 (136t) class truck
	12	Belaz №35,110 t	110	63.0	44662	31-Dec-96	27,489	32,489	6.5	3.5	2007	Replace with CAT 785 (136t) class truck
	13	O&K №39,85 t	95	60.0	50183	31-Aug-99	26,953	31,953	6.4	3.6	2007	Replace with CAT 785 (136t) class truck
	14	Belaz №44,110 t	110	63.0	44663	31-Dec-96	21,430	26,430	5.3	4.7	2008	Replace with CAT 785 (136t) class truck
	15	TR №42,100 t	110	63.0	50410	31-Jul-00	13,940	18,940	3.8	6.2	2009	Not scheduled for replacement
	16	CAT №43,100 t	95	60.0	50425	30-Aug-00	12,754	17,754	3.6	6.4	2009	Not scheduled for replacement
	17	O&K №38,85 t	95	60.0	50156	30-May-96	10,430	15,430	3.1	6.9	2010	Not scheduled for replacement
Loaders		Reported Hours Taken as Jan 2003								12 yr base (shovels), 8 yr base (FEL)		
	1	CAT992 No.4		9.6		31-Mar-96		31,053	6.2	1.8	2005	Replace with CAT 5320 ($15m^3$) class hydraulic shovel
	2	RH 120 No.1		13.0		30-Apr-94		42,496	8.5	3.5	2006	Replace with CAT 5320 ($15m^3$) class hydraulic shovel
	3	RH 120 No.2		13.0		31-Aug-95		36,564	7.3	4.7	2008	Replace with CAT 5320 ($15m^3$) class hydraulic shovel
	4	Liebherr No.3		12.0		01-Oct-01		5,000	1.0	11.0		Not scheduled for replacement
Drills		Reported Hours Taken as Jan 2003								6 yr base		
	1	SBH 250 No. 10				31-May-96		21,600	4.3	1.7	2004/2011	Replace with Ingersol-Rand DML class drill
	2	DET 250 No. 12				10-Jan-90		10,228	2.0	4.0		Not scheduled for replacement
	3	DET 250 No. 18				31-Mar-96		7,142	1.4	4.6	2007/2014	Replace with Ingersol-Rand DML class drill
	4	DET 250 No. 19				31-Mar-96		7,560	1.5	4.5		Not scheduled for replacement
Dozers		Reported Hours Taken as Jan 2003								4 yr base		
	1	CAT D9N No. 1				06-May-95		18,228	3.6	0.4	2004/2009	Replace with CAT D10R class dozer
	2	CAT D8N No. 2				10-May-95		18,988	3.8	0.2	2005/2010	Replace with CAT D10R class dozer
	3	K 701 No. 2				07-Jan-89		8,245	1.6	2.4		Not scheduled for replacement
	4	TK 80 No. 2				10-Jan-88		7,422	1.5	2.5		Not scheduled for replacement
Graders		Reported Hours Taken as Jan 2003								5 yr base		
	1	Grader No. 4				11-Jan-89		16,020	3.2	1.8	2004/2010	Replace with CAT 16H class grader
	2	Grader No. 3				09-Jan-91		15,048	3.0	2.0	2005/2011	Replace with CAT 16H class grader
	3	Grader No. 7				29-Jan-93		12,194	2.4	2.6		Not scheduled for replacement
	4	Grader No. 8				31-Mar-95		10,450	2.1	2.9		Not scheduled for replacement

Note: Where unit is "Not scheduled for replacement", unit is either retired, used as back-up unit, or used for spare parts.

Exhibit 1.1.2: Equipment Replacement Schedule

Case 1: Replacement with 15m³ capacity loaders and 78m³ capacity trucks.

No.	Equipment Class	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
	Trucks		Numbers are truck capacities in cubic meters. Highlights indicate replacements.														
1	Belaz №23,110 t		63.0	63.0	63.0	63.0	63.0										
2	Belaz №24,110 t		63.0	63.0	63.0	63.0	63.0										
3	Belaz №37,120 t		69.0	78	78	78	78	78	78	78	78	78	78	78	78	78	78
4	CAT №33,85 t		60.0	78	78	78	78	78	78	78	78	78	78	78	78	78	78
5	Belaz №30,110 t		63.0	63.0	78	78	78	78	78	78	78	78	78	78	78	78	78
6	Belaz №29,110 t		63.0	63.0	78	78	78	78	78	78	78	78	78	78	78	78	78
7	CAT №40,85 t		60.0	60.0	78	78	78	78	78	78	78	78	78	78	78	78	78
8	O&K №32,85 t		60.0	60.0	78	78	78	78	78	78	78	78	78	78	78	78	78
9	Belaz №36,120 t		69.0	69.0	69.0	78	78	78	78	78	78	78	78	78	78	78	78
10	CAT №34,85 t		60.0	60.0	60.0	78	78	78	78	78	78	78	78	78	78	78	78
11	CAT №41,85 t		60.0	60.0	60.0	78	78	78	78	78	78	78	78	78	78	78	78
12	Belaz №35,110 t		63.0	63.0	63.0	63.0	78	78	78	78	78	78	78	78	78	78	78
13	O&K №39,85 t		60.0	60.0	60.0	60.0	78	78	78	78	78	78	78	78	78	78	78
14	Belaz №44,110 t		63.0	63.0	63.0	63.0	63.0	78	78	78	78	78	78	78	78	78	78
15	TR №42,100 t		63.0	63.0	63.0	63.0	63.0										
16	CAT №43,100 t		60.0	60.0	60.0	60.0	60.0										
17	O&K №38,85 t		60.0	60.0	60.0	60.0	60.0										
	Avg. Capacity		62.3	63.9	67.8	70.4	72.4	78	78	78	78	78	78	78	78	78	78
	Loaders		Numbers are truck capacities in cubic meters. Highlights indicate replacements.														
1	CAT992 No.4		9.6	9.6	15	15	15	15	15	15	15	15	15	15	15	15	15
2	RH 120 No.1		13.0	13.0	13.0	15	15	15	15	15	15	15	15	15	15	15	15
3	RH 120 No.2		13.0	13.0	13.0	13.0	13.0	15	15	15	15	15	15	15	15	15	15
4	Liebherr No.3		12.0	12.0	12.0	12.0	12.0										
	Avg. Capacity		11.9	11.9	13.25	13.75	13.75	15	15	15	15	15	15	15	15	15	15

Case 2: Replacement with 20m³ capacity loaders and 105m³ capacity trucks.

No.	Equipment Class	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
	Trucks		Numbers are truck capacities in cubic meters. Highlights indicate replacements.														
1	Belaz №23,110 t		63.0	63.0	63.0	63.0	63.0										
2	Belaz №24,110 t		63.0	63.0	63.0	63.0	63.0										
3	Belaz №37,120 t		69.0	105	105	105	105	105	105	105	105	105	105	105	105	105	105
4	CAT №33,85 t		60.0	105	105	105	105	105	105	105	105	105	105	105	105	105	105
5	Belaz №30,110 t		63.0	63.0	105	105	105	105	105	105	105	105	105	105	105	105	105
6	Belaz №29,110 t		63.0	63.0	105	105	105	105	105	105	105	105	105	105	105	105	105
7	CAT №40,85 t		60.0	60.0	105	105	105	105	105	105	105	105	105	105	105	105	105
8	O&K №32,85 t		60.0	60.0	105	105	105	105	105	105	105	105	105	105	105	105	105
9	Belaz №36,120 t		69.0	69.0	69.0	105	105	105	105	105	105	105	105	105	105	105	105
10	CAT №34,85 t		60.0	60.0	60.0	105	105	105	105	105	105	105	105	105	105	105	105
11	CAT №41,85 t		60.0	60.0	60.0	105	105	105	105	105	105	105	105	105	105	105	105
12	Belaz №35,110 t		63.0	63.0	63.0	63.0	105	105	105	105	105	105	105	105	105	105	105
13	O&K №39,85 t		60.0	60.0	60.0	60.0	105	105	105	105	105	105	105	105	105	105	105
14	Belaz №44,110 t		63.0	63.0	63.0	63.0	63.0	105	105	105	105	105	105	105	105	105	105
15	TR №42,100 t		63.0	63.0	63.0	63.0	63.0										
16	CAT №43,100 t		60.0	60.0	60.0	60.0	60.0										
17	O&K №38,85 t		60.0	60.0	60.0	60.0	60.0										
	Avg. Capacity		**62.3**	**67.1**	**77.3**	**84.7**	**89.8**	**105**	**105**	**105**	**105**	**105**	**105**	**105**	**105**	**105**	**105**
	Loaders		Numbers are truck capacities in cubic meters. Highlights indicate replacements.														
1	CAT992 No.4		9.6	9.6	20	20	20	20	20	20	20	20	20	20	20	20	20
2	RH 120 No.1		13.0	13.0	13.0	20	20	20	20	20	20	20	20	20	20	20	20
3	RH 120 No.2		13.0	13.0	13.0	13.0	13.0	20	20	20	20	20	20	20	20	20	20
4	Liebherr No.3		12.0	12.0	12.0	12.0	12.0										
	Avg. Capacity		**11.9**	**11.9**	**14.5**	**16.25**	**16.25**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**

Drills, Dozers, & Graders

No.	Equipment Class	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
	Drills		Highlights indicate replacements.														
1	SBH 250 No. 10		SBH 250	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML
2	DET 250 No. 12		DET 250														
3	DET 250 No. 18		DET 250	DET 250	DET 250	DET 250	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML	IR-DML
4	DET 250 No. 19		DET 250	DET 250	DET 250	DET 250											
	Dozers																
1	CAT D9N No. 1		D9N	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R
2	CAT D8N No. 2		D8N		D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R	D10R
3	K 701 No. 2		K701	K701													
4	TK 80 No. 2		TK80	TK80													
	Graders																
1	Grader No. 4		No. 4	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G
2	Grader No. 3		No. 3		16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G	16G
3	Grader No. 7		No. 7	No. 7													
4	Grader No. 8		No. 8	No. 8													

Exhibit 1.1.3: Capital Replacement Schedule

Case 1: Replacement with 15m³ capacity loaders and 78m³ (136t) capacity trucks.

Equipment Type	Equipment Model	No. Units LoM	Cost/Unit M US$	Total LoM M US$	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
Truck	CAT 785 (136t)	12	1.60	19.20			3.2	6.4	4.8	3.2	1.6									
Loader	CAT 5320 (15m³)	3	2.60	7.80				2.6	2.6		2.6									
Drill	IR DML	4	0.90	3.60			0.9			0.9				0.9			0.9			
Dozer	CAT D10R	5	0.90	4.50			0.9	0.9				0.9	0.9				0.9			
Grader	CAT 16H	5	0.50	2.50			0.5	0.5			0.5	0.5						0.5		
RTD	CAT 834G	2	0.60	1.20			0.6		0.6											
Water Trk.	14,000 Gallon	2	0.70	1.40					0.7	0.7										
	Total LoM			40.20		0.0	6.1	10.4	8.7	4.8	4.7	1.4	0.9	0.9	0.0	0.0	1.8	0.5	0.0	0.0

Case 2: Replacement with 20m³ capacity loaders and 105m³ (177t) capacity trucks.

Equipment Type	Equipment Model	No. Units LoM	Cost/Unit M US$	Total LoM M US$	Year	2003 1	2004 2	2005 3	2006 4	2007 5	2008 6	2009 7	2010 8	2011 9	2012 10	2013 11	2014 12	2015 13	2016 14	2017 15
Truck	CAT 789 (177t)	12	2.00	24.00			4.0	8.0	6.0	4.0	2.0									
Loader	20m³ Class Shovel	3	3.70	11.10				3.7	3.7		3.7									
Drill	IR DML	4	0.90	3.60			0.9			0.9				0.9			0.9			
Dozer	CAT D10R	5	0.90	4.50			0.9	0.9				0.9	0.9				0.9			
Grader	CAT 16H	5	0.50	2.50			0.5	0.5			0.5	0.5						0.5		
RTD	CAT 834G	2	0.60	1.20			0.6		0.6											
Water Trk.	14,000 Gallon	2	0.70	1.40					0.7	0.7										
	Total LoM			48.30		0.0	6.9	13.1	11.0	5.6	6.2	1.4	0.9	0.9	0.0	0.0	1.8	0.5	0.0	0.0

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	3,490	t
TONNES PER DAY	6,980	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	13,960	t
TONNES PER DAY	27,920	t
TONNES PER MONTH	717,826	t/mo
DURATION	250.72	days
DURATION	9.75	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	64.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	57.60	LCM
AVERAGE WEIGHT PER TRUCK	102.86	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	387	t/hr
TONNES PER SHIFT	3,545	t
TONNES PER DAY	7,091	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,547	t/hr
TONNES PER SHIFT	14,182	t
TONNES PER DAY	28,363	t
TONNES PER MONTH	729,220	t/mo
DURATION	246.80	days
DURATION	9.60	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	13.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	68.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	12.35	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	61.20	LCM
AVERAGE WEIGHT PER TRUCK	109.29	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	411	t/hr
TONNES PER SHIFT	3,767	t
TONNES PER DAY	7,534	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,644	t/hr
TONNES PER SHIFT	15,068	t
TONNES PER DAY	30,136	t
TONNES PER MONTH	774,796	t/mo
DURATION	232.28	days
DURATION	9.03	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
* Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	70.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	63.00	LCM
AVERAGE WEIGHT PER TRUCK	112.50	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	3,878	t
TONNES PER DAY	7,756	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	15,511	t
TONNES PER DAY	31,022	t
TONNES PER MONTH	797,584	t/mo
DURATION	225.64	days
DURATION	8.78	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	72.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	64.80	LCM
AVERAGE WEIGHT PER TRUCK	115.71	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	3,877	t
TONNES PER DAY	7,753	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	15,506	t
TONNES PER DAY	31,013	t
TONNES PER MONTH	797,339	t/mo
DURATION	225.71	days
DURATION	8.78	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	458	t/hr
TONNES PER SHIFT	4,200	t
TONNES PER DAY	8,399	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,833	t/hr
TONNES PER SHIFT	16,799	t
TONNES PER DAY	33,597	t
TONNES PER MONTH	863,784	t/mo
DURATION	277.80	days
DURATION	10.81	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	435	t/hr
TONNES PER SHIFT	3,985	t
TONNES PER DAY	7,969	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,739	t/hr
TONNES PER SHIFT	15,938	t
TONNES PER DAY	31,877	t
TONNES PER MONTH	819,557	t/mo
DURATION	292.79	days
DURATION	11.39	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	435	t/hr
TONNES PER SHIFT	3,985	t
TONNES PER DAY	7,969	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,739	t/hr
TONNES PER SHIFT	15,938	t
TONNES PER DAY	31,877	t
TONNES PER MONTH	819,557	t/mo
DURATION	292.79	days
DURATION	11.39	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	414	t/hr
TONNES PER SHIFT	3,791	t
TONNES PER DAY	7,581	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,654	t/hr
TONNES PER SHIFT	15,162	t
TONNES PER DAY	30,324	t
TONNES PER MONTH	779,639	t/mo
DURATION	307.78	days
DURATION	11.97	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.08**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	394	t/hr
TONNES PER SHIFT	3,614	t
TONNES PER DAY	7,229	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,577	t/hr
TONNES PER SHIFT	14,458	t
TONNES PER DAY	28,916	t
TONNES PER MONTH	743,429	t/mo
DURATION	322.77	days
DURATION	12.55	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.06	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**20.02**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	376	t/hr
TONNES PER SHIFT	3,444	t
TONNES PER DAY	6,889	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,879	t/hr
TONNES PER SHIFT	17,222	t
TONNES PER DAY	34,444	t
TONNES PER MONTH	885,545	t/mo
DURATION	270.97	days
DURATION	10.54	mo

STEFFEN ROBERTSON & KIRSTEN 22-Apr-03 01:25 PM

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,700	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	16.19	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.81	min
TOTAL ROUND TRIP TIME	**20.85**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	361	t/hr
TONNES PER SHIFT	3,307	t
TONNES PER DAY	6,615	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,804	t/hr
TONNES PER SHIFT	16,536	t
TONNES PER DAY	33,073	t
TONNES PER MONTH	850,301	t/mo
DURATION	282.21	days
DURATION	10.98	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,000	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	17.88	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.89	min
TOTAL ROUND TRIP TIME	**22.62**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	333	t/hr
TONNES PER SHIFT	3,048	t
TONNES PER DAY	6,096	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,663	t/hr
TONNES PER SHIFT	15,241	t
TONNES PER DAY	30,482	t
TONNES PER MONTH	783,692	t/mo
DURATION	306.19	days
DURATION	11.91	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2016

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,450	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.41	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.02	min
TOTAL ROUND TRIP TIME	**25.28**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	298	t/hr
TONNES PER SHIFT	2,728	t
TONNES PER DAY	5,455	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,785	t/hr
TONNES PER SHIFT	16,366	t
TONNES PER DAY	32,732	t
TONNES PER MONTH	841,544	t/mo
DURATION	285.14	days
DURATION	11.09	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2017

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	4,050	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	23.78	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.19	min
TOTAL ROUND TRIP TIME	**28.82**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	261	t/hr
TONNES PER SHIFT	2,392	t
TONNES PER DAY	4,785	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,566	t/hr
TONNES PER SHIFT	14,354	t
TONNES PER DAY	28,707	t
TONNES PER MONTH	738,068	t/mo
DURATION	325.12	days
DURATION	12.65	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m³ Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	3,490	t
TONNES PER DAY	6,980	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	13,960	t
TONNES PER DAY	27,920	t
TONNES PER MONTH	717,826	t/mo
DURATION	250.72	days
DURATION	9.75	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	67.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	60.30	LCM
AVERAGE WEIGHT PER TRUCK	107.68	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	405	t/hr
TONNES PER SHIFT	3,712	t
TONNES PER DAY	7,423	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,620	t/hr
TONNES PER SHIFT	14,846	t
TONNES PER DAY	29,693	t
TONNES PER MONTH	763,402	t/mo
DURATION	235.75	days
DURATION	9.17	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	77.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph
CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	69.30	LCM
AVERAGE WEIGHT PER TRUCK	123.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	465	t/hr
TONNES PER SHIFT	4,266	t
TONNES PER DAY	8,531	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,861	t/hr
TONNES PER SHIFT	17,062	t
TONNES PER DAY	34,125	t
TONNES PER MONTH	877,342	t/mo
DURATION	205.13	days
DURATION	7.98	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	16.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	85.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	15.20	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	76.50	LCM
AVERAGE WEIGHT PER TRUCK	136.61	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	514	t/hr
TONNES PER SHIFT	4,709	t
TONNES PER DAY	9,417	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,055	t/hr
TONNES PER SHIFT	18,835	t
TONNES PER DAY	37,670	t
TONNES PER MONTH	968,495	t/mo
DURATION	185.82	days
DURATION	7.23	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	16.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	90.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	15.20	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	81.00	LCM
AVERAGE WEIGHT PER TRUCK	144.64	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	529	t/hr
TONNES PER SHIFT	4,846	t
TONNES PER DAY	9,691	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,115	t/hr
TONNES PER SHIFT	19,383	t
TONNES PER DAY	38,766	t
TONNES PER MONTH	996,674	t/mo
DURATION	180.57	days
DURATION	7.02	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	617	t/hr
TONNES PER SHIFT	5,653	t
TONNES PER DAY	11,307	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,467	t/hr
TONNES PER SHIFT	22,613	t
TONNES PER DAY	45,227	t
TONNES PER MONTH	1,162,786	t/mo
DURATION	206.37	days
DURATION	8.03	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	585	t/hr
TONNES PER SHIFT	5,364	t
TONNES PER DAY	10,728	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,341	t/hr
TONNES PER SHIFT	21,456	t
TONNES PER DAY	42,911	t
TONNES PER MONTH	1,103,250	t/mo
DURATION	217.50	days
DURATION	8.46	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	585	t/hr
TONNES PER SHIFT	5,364	t
TONNES PER DAY	10,728	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,341	t/hr
TONNES PER SHIFT	21,456	t
TONNES PER DAY	42,911	t
TONNES PER MONTH	1,103,250	t/mo
DURATION	217.50	days
DURATION	8.46	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	557	t/hr
TONNES PER SHIFT	5,103	t
TONNES PER DAY	10,205	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,227	t/hr
TONNES PER SHIFT	20,411	t
TONNES PER DAY	40,821	t
TONNES PER MONTH	1,049,514	t/mo
DURATION	228.64	days
DURATION	8.89	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.08**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	531	t/hr
TONNES PER SHIFT	4,866	t
TONNES PER DAY	9,731	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,123	t/hr
TONNES PER SHIFT	19,463	t
TONNES PER DAY	38,925	t
TONNES PER MONTH	1,000,769	t/mo
DURATION	239.78	days
DURATION	9.33	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**19.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	507	t/hr
TONNES PER SHIFT	4,650	t
TONNES PER DAY	9,299	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,029	t/hr
TONNES PER SHIFT	18,599	t
TONNES PER DAY	37,198	t
TONNES PER MONTH	956,352	t/mo
DURATION	250.91	days
DURATION	9.76	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,700	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	16.19	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.81	min
TOTAL ROUND TRIP TIME	**20.85**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	486	t/hr
TONNES PER SHIFT	4,452	t
TONNES PER DAY	8,904	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,943	t/hr
TONNES PER SHIFT	17,808	t
TONNES PER DAY	35,617	t
TONNES PER MONTH	915,709	t/mo
DURATION	262.05	days
DURATION	10.19	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,000	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	17.88	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.89	min
TOTAL ROUND TRIP TIME	**22.62**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	448	t/hr
TONNES PER SHIFT	4,103	t
TONNES PER DAY	8,207	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,791	t/hr
TONNES PER SHIFT	16,413	t
TONNES PER DAY	32,827	t
TONNES PER MONTH	843,976	t/mo
DURATION	284.32	days
DURATION	11.06	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2016

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,450	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.41	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.02	min
TOTAL ROUND TRIP TIME	**25.28**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	401	t/hr
TONNES PER SHIFT	3,672	t
TONNES PER DAY	7,344	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,602	t/hr
TONNES PER SHIFT	14,688	t
TONNES PER DAY	29,375	t
TONNES PER MONTH	755,232	t/mo
DURATION	317.73	days
DURATION	12.36	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

28 Mtpy (11 Mtpy Mill Ore)

Year 2017

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	4,050	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	9,333,333	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	23.78	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.19	min
TOTAL ROUND TRIP TIME	**28.82**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	351	t/hr
TONNES PER SHIFT	3,220	t
TONNES PER DAY	6,441	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,757	t/hr
TONNES PER SHIFT	16,102	t
TONNES PER DAY	32,204	t
TONNES PER MONTH	827,961	t/mo
DURATION	289.82	days
DURATION	11.27	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	3,490	t
TONNES PER DAY	6,980	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	13,960	t
TONNES PER DAY	27,920	t
TONNES PER MONTH	717,826	t/mo
DURATION	268.62	days
DURATION	10.45	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	64.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	57.60	LCM
AVERAGE WEIGHT PER TRUCK	102.86	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	387	t/hr
TONNES PER SHIFT	3,545	t
TONNES PER DAY	7,091	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,547	t/hr
TONNES PER SHIFT	14,182	t
TONNES PER DAY	28,363	t
TONNES PER MONTH	729,220	t/mo
DURATION	264.43	days
DURATION	10.28	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	13.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	68.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	12.35	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	61.20	LCM
AVERAGE WEIGHT PER TRUCK	109.29	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	411	t/hr
TONNES PER SHIFT	3,767	t
TONNES PER DAY	7,534	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,644	t/hr
TONNES PER SHIFT	15,068	t
TONNES PER DAY	30,136	t
TONNES PER MONTH	774,796	t/mo
DURATION	248.87	days
DURATION	9.68	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	70.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	63.00	LCM
AVERAGE WEIGHT PER TRUCK	112.50	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	3,878	t
TONNES PER DAY	7,756	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	15,511	t
TONNES PER DAY	31,022	t
TONNES PER MONTH	797,584	t/mo
DURATION	241.76	days
DURATION	9.40	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	72.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	64.80	LCM
AVERAGE WEIGHT PER TRUCK	115.71	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	3,877	t
TONNES PER DAY	7,753	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	15,506	t
TONNES PER DAY	31,013	t
TONNES PER MONTH	797,339	t/mo
DURATION	241.84	days
DURATION	9.41	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	435	t/hr
TONNES PER SHIFT	3,985	t
TONNES PER DAY	7,969	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,739	t/hr
TONNES PER SHIFT	15,938	t
TONNES PER DAY	31,877	t
TONNES PER MONTH	819,557	t/mo
DURATION	313.71	days
DURATION	12.20	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	414	t/hr
TONNES PER SHIFT	3,791	t
TONNES PER DAY	7,581	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,654	t/hr
TONNES PER SHIFT	15,162	t
TONNES PER DAY	30,324	t
TONNES PER MONTH	779,639	t/mo
DURATION	329.77	days
DURATION	12.83	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.08**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	394	t/hr
TONNES PER SHIFT	3,614	t
TONNES PER DAY	7,229	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,577	t/hr
TONNES PER SHIFT	14,458	t
TONNES PER DAY	28,916	t
TONNES PER MONTH	743,429	t/mo
DURATION	345.83	days
DURATION	13.45	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.06	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**20.02**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	376	t/hr
TONNES PER SHIFT	3,444	t
TONNES PER DAY	6,889	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,879	t/hr
TONNES PER SHIFT	17,222	t
TONNES PER DAY	34,444	t
TONNES PER MONTH	885,545	t/mo
DURATION	290.33	days
DURATION	11.29	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,835	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	16.95	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.85	min
TOTAL ROUND TRIP TIME	**21.64**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	348	t/hr
TONNES PER SHIFT	3,185	t
TONNES PER DAY	6,371	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,738	t/hr
TONNES PER SHIFT	15,927	t
TONNES PER DAY	31,854	t
TONNES PER MONTH	818,977	t/mo
DURATION	313.93	days
DURATION	12.21	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,120	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	5	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	18.55	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.93	min
TOTAL ROUND TRIP TIME	**23.33**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	322	t/hr
TONNES PER SHIFT	2,956	t
TONNES PER DAY	5,911	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,612	t/hr
TONNES PER SHIFT	14,778	t
TONNES PER DAY	29,556	t
TONNES PER MONTH	759,881	t/mo
DURATION	338.34	days
DURATION	13.16	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,405	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.15	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.01	min
TOTAL ROUND TRIP TIME	**25.01**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	301	t/hr
TONNES PER SHIFT	2,757	t
TONNES PER DAY	5,513	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,504	t/hr
TONNES PER SHIFT	13,783	t
TONNES PER DAY	27,567	t
TONNES PER MONTH	708,739	t/mo
DURATION	362.76	days
DURATION	14.11	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,690	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	21.76	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.09	min
TOTAL ROUND TRIP TIME	**26.69**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	282	t/hr
TONNES PER SHIFT	2,583	t
TONNES PER DAY	5,166	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,409	t/hr
TONNES PER SHIFT	12,914	t
TONNES PER DAY	25,828	t
TONNES PER MONTH	664,048	t/mo
DURATION	387.17	days
DURATION	15.06	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2016

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,975	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	23.36	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.17	min
TOTAL ROUND TRIP TIME	**28.38**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	265	t/hr
TONNES PER SHIFT	2,430	t
TONNES PER DAY	4,859	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,325	t/hr
TONNES PER SHIFT	12,148	t
TONNES PER DAY	24,296	t
TONNES PER MONTH	624,658	t/mo
DURATION	411.59	days
DURATION	16.01	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	3,490	t
TONNES PER DAY	6,980	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	13,960	t
TONNES PER DAY	27,920	t
TONNES PER MONTH	717,826	t/mo
DURATION	268.62	days
DURATION	10.45	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	67.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	60.30	LCM
AVERAGE WEIGHT PER TRUCK	107.68	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	405	t/hr
TONNES PER SHIFT	3,712	t
TONNES PER DAY	7,423	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,620	t/hr
TONNES PER SHIFT	14,846	t
TONNES PER DAY	29,693	t
TONNES PER MONTH	763,402	t/mo
DURATION	252.59	days
DURATION	9.82	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	77.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	69.30	LCM
AVERAGE WEIGHT PER TRUCK	123.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	465	t/hr
TONNES PER SHIFT	4,266	t
TONNES PER DAY	8,531	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,861	t/hr
TONNES PER SHIFT	17,062	t
TONNES PER DAY	34,125	t
TONNES PER MONTH	877,342	t/mo
DURATION	219.78	days
DURATION	8.55	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	16.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	85.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	15.20	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	76.50	LCM
AVERAGE WEIGHT PER TRUCK	136.61	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	514	t/hr
TONNES PER SHIFT	4,709	t
TONNES PER DAY	9,417	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,055	t/hr
TONNES PER SHIFT	18,835	t
TONNES PER DAY	37,670	t
TONNES PER MONTH	968,495	t/mo
DURATION	199.10	days
DURATION	7.74	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m³ Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	7,500,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	16.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	90.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	15.20	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	81.00	LCM
AVERAGE WEIGHT PER TRUCK	144.64	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	529	t/hr
TONNES PER SHIFT	4,846	t
TONNES PER DAY	9,691	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,115	t/hr
TONNES PER SHIFT	19,383	t
TONNES PER DAY	38,766	t
TONNES PER MONTH	996,674	t/mo
DURATION	193.47	days
DURATION	7.53	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	585	t/hr
TONNES PER SHIFT	5,364	t
TONNES PER DAY	10,728	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,341	t/hr
TONNES PER SHIFT	21,456	t
TONNES PER DAY	42,911	t
TONNES PER MONTH	1,103,250	t/mo
DURATION	233.04	days
DURATION	9.06	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	557	t/hr
TONNES PER SHIFT	5,103	t
TONNES PER DAY	10,205	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,227	t/hr
TONNES PER SHIFT	20,411	t
TONNES PER DAY	40,821	t
TONNES PER MONTH	1,049,514	t/mo
DURATION	244.97	days
DURATION	9.53	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.08**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	531	t/hr
TONNES PER SHIFT	4,866	t
TONNES PER DAY	9,731	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,123	t/hr
TONNES PER SHIFT	19,463	t
TONNES PER DAY	38,925	t
TONNES PER MONTH	1,000,769	t/mo
DURATION	256.90	days
DURATION	9.99	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**19.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	507	t/hr
TONNES PER SHIFT	4,650	t
TONNES PER DAY	9,299	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,029	t/hr
TONNES PER SHIFT	18,599	t
TONNES PER DAY	37,198	t
TONNES PER MONTH	956,352	t/mo
DURATION	268.83	days
DURATION	10.46	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,835	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	16.95	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.85	min
TOTAL ROUND TRIP TIME	**21.64**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	468	t/hr
TONNES PER SHIFT	4,288	t
TONNES PER DAY	8,576	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,871	t/hr
TONNES PER SHIFT	17,152	t
TONNES PER DAY	34,305	t
TONNES PER MONTH	881,976	t/mo
DURATION	291.50	days
DURATION	11.34	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,120	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	18.55	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.93	min
TOTAL ROUND TRIP TIME	**23.33**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	434	t/hr
TONNES PER SHIFT	3,979	t
TONNES PER DAY	7,957	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,736	t/hr
TONNES PER SHIFT	15,915	t
TONNES PER DAY	31,829	t
TONNES PER MONTH	818,334	t/mo
DURATION	314.18	days
DURATION	12.22	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,405	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.15	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.01	min
TOTAL ROUND TRIP TIME	**25.01**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	405	t/hr
TONNES PER SHIFT	3,711	t
TONNES PER DAY	7,422	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,619	t/hr
TONNES PER SHIFT	14,844	t
TONNES PER DAY	29,687	t
TONNES PER MONTH	763,258	t/mo
DURATION	336.85	days
DURATION	13.10	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,690	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	21.76	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.09	min
TOTAL ROUND TRIP TIME	**26.69**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	379	t/hr
TONNES PER SHIFT	3,477	t
TONNES PER DAY	6,954	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,517	t/hr
TONNES PER SHIFT	13,908	t
TONNES PER DAY	27,815	t
TONNES PER MONTH	715,128	t/mo
DURATION	359.52	days
DURATION	13.98	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

30 Mtpy (12 Mtpy Mill Ore)

Year 2016

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,975	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	23.36	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.17	min
TOTAL ROUND TRIP TIME	**28.38**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	357	t/hr
TONNES PER SHIFT	3,271	t
TONNES PER DAY	6,541	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,427	t/hr
TONNES PER SHIFT	13,083	t
TONNES PER DAY	26,165	t
TONNES PER MONTH	672,708	t/mo
DURATION	382.19	days
DURATION	14.87	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	3,490	t
TONNES PER DAY	6,980	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	13,960	t
TONNES PER DAY	27,920	t
TONNES PER MONTH	717,826	t/mo
DURATION	286.53	days
DURATION	11.14	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	67.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	60.30	LCM
AVERAGE WEIGHT PER TRUCK	107.68	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	405	t/hr
TONNES PER SHIFT	3,712	t
TONNES PER DAY	7,423	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,620	t/hr
TONNES PER SHIFT	14,846	t
TONNES PER DAY	29,693	t
TONNES PER MONTH	763,402	t/mo
DURATION	269.43	days
DURATION	10.48	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	77.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	69.30	LCM
AVERAGE WEIGHT PER TRUCK	123.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	465	t/hr
TONNES PER SHIFT	4,266	t
TONNES PER DAY	8,531	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,861	t/hr
TONNES PER SHIFT	17,062	t
TONNES PER DAY	34,125	t
TONNES PER MONTH	877,342	t/mo
DURATION	234.44	days
DURATION	9.12	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	16.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	85.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	15.20	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	76.50	LCM
AVERAGE WEIGHT PER TRUCK	136.61	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	514	t/hr
TONNES PER SHIFT	4,709	t
TONNES PER DAY	9,417	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,055	t/hr
TONNES PER SHIFT	18,835	t
TONNES PER DAY	37,670	t
TONNES PER MONTH	968,495	t/mo
DURATION	212.37	days
DURATION	8.26	mo

STEFFEN ROBERTSON & KIRSTEN 22-Apr-03 01:25 PM

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	16.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	90.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	15.20	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	81.00	LCM
AVERAGE WEIGHT PER TRUCK	144.64	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	529	t/hr
TONNES PER SHIFT	4,846	t
TONNES PER DAY	9,691	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,115	t/hr
TONNES PER SHIFT	19,383	t
TONNES PER DAY	38,766	t
TONNES PER MONTH	996,674	t/mo
DURATION	206.37	days
DURATION	8.03	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	585	t/hr
TONNES PER SHIFT	5,364	t
TONNES PER DAY	10,728	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,341	t/hr
TONNES PER SHIFT	21,456	t
TONNES PER DAY	42,911	t
TONNES PER MONTH	1,103,250	t/mo
DURATION	248.57	days
DURATION	9.67	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	557	t/hr
TONNES PER SHIFT	5,103	t
TONNES PER DAY	10,205	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,227	t/hr
TONNES PER SHIFT	20,411	t
TONNES PER DAY	40,821	t
TONNES PER MONTH	1,049,514	t/mo
DURATION	261.30	days
DURATION	10.16	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.08**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	531	t/hr
TONNES PER SHIFT	4,866	t
TONNES PER DAY	9,731	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,123	t/hr
TONNES PER SHIFT	19,463	t
TONNES PER DAY	38,925	t
TONNES PER MONTH	1,000,769	t/mo
DURATION	274.03	days
DURATION	10.66	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**19.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	507	t/hr
TONNES PER SHIFT	4,650	t
TONNES PER DAY	9,299	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,029	t/hr
TONNES PER SHIFT	18,599	t
TONNES PER DAY	37,198	t
TONNES PER MONTH	956,352	t/mo
DURATION	286.76	days
DURATION	11.15	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,850	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	17.03	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.85	min
TOTAL ROUND TRIP TIME	**21.73**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	466	t/hr
TONNES PER SHIFT	4,271	t
TONNES PER DAY	8,541	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,864	t/hr
TONNES PER SHIFT	17,082	t
TONNES PER DAY	34,165	t
TONNES PER MONTH	878,380	t/mo
DURATION	312.21	days
DURATION	12.14	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,200	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	19.00	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.95	min
TOTAL ROUND TRIP TIME	**23.80**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	425	t/hr
TONNES PER SHIFT	3,900	t
TONNES PER DAY	7,799	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	2,127	t/hr
TONNES PER SHIFT	19,498	t
TONNES PER DAY	38,997	t
TONNES PER MONTH	1,002,609	t/mo
DURATION	273.53	days
DURATION	10.64	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.05	min
TOTAL ROUND TRIP TIME	**25.87**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	391	t/hr
TONNES PER SHIFT	3,588	t
TONNES PER DAY	7,176	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,957	t/hr
TONNES PER SHIFT	17,940	t
TONNES PER DAY	35,880	t
TONNES PER MONTH	922,485	t/mo
DURATION	297.28	days
DURATION	11.56	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 2: Replacement with 20m^3 Shovels & 177t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,900	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	20.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	105.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	19.00	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	22.94	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.15	min
TOTAL ROUND TRIP TIME	**27.93**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	94.50	LCM
AVERAGE WEIGHT PER TRUCK	168.75	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	362	t/hr
TONNES PER SHIFT	3,323	t
TONNES PER DAY	6,645	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,812	t/hr
TONNES PER SHIFT	16,613	t
TONNES PER DAY	33,225	t
TONNES PER MONTH	854,220	t/mo
DURATION	321.04	days
DURATION	12.49	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2003

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	63.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	56.70	LCM
AVERAGE WEIGHT PER TRUCK	101.25	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	381	t/hr
TONNES PER SHIFT	3,490	t
TONNES PER DAY	6,980	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,523	t/hr
TONNES PER SHIFT	13,960	t
TONNES PER DAY	27,920	t
TONNES PER MONTH	717,826	t/mo
DURATION	286.53	days
DURATION	11.14	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2004

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	12.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	64.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	11.40	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	57.60	LCM
AVERAGE WEIGHT PER TRUCK	102.86	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	387	t/hr
TONNES PER SHIFT	3,545	t
TONNES PER DAY	7,091	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,547	t/hr
TONNES PER SHIFT	14,182	t
TONNES PER DAY	28,363	t
TONNES PER MONTH	729,220	t/mo
DURATION	282.05	days
DURATION	10.97	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2005

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	13.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	68.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	12.35	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	61.20	LCM
AVERAGE WEIGHT PER TRUCK	109.29	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	411	t/hr
TONNES PER SHIFT	3,767	t
TONNES PER DAY	7,534	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,644	t/hr
TONNES PER SHIFT	15,068	t
TONNES PER DAY	30,136	t
TONNES PER MONTH	774,796	t/mo
DURATION	265.46	days
DURATION	10.33	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2006

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,800	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	70.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.13	min
WAIT TIME PER TRUCK	0.43	min
MISCELLANEOUS DELAYS @ 5.0%	0.56	min
TOTAL ROUND TRIP TIME	**15.96**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	63.00	LCM
AVERAGE WEIGHT PER TRUCK	112.50	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	3,878	t
TONNES PER DAY	7,756	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	15,511	t
TONNES PER DAY	31,022	t
TONNES PER MONTH	797,584	t/mo
DURATION	257.88	days
DURATION	10.03	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2007

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	1,950	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	8,000,000	tonnes

MATERIAL VARIABLES		
IN SITU DENSITY	2.5	t/BCM
SWELL FACTOR	1.4	
LOOSE DENSITY	1.786	t/LCM

PRODUCTIVITY VARIABLES		
HOURS PER SHIFT	12	hrs
SHIFTS PER DAY	2	shift
PRODUCTIVE MIN/HOUR	50	min
DAYS PER WEEK	6	days

AVAILABILITY		
NOMINAL SHIFT TIME	720	min
TRAVEL TIME	15	min
LUNCH	30	min
MISCELLANEOUS DELAY	15	min
AVAILABLE PER SHIFT	660	min
AVAILABLE PER SHIFT	9.167	hrs
AVAILABLE PER DAY	1320	min
AVAILABLE PER DAY	18.33	hrs

FLEET DATA		
TOTAL TRUCKS	4	ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	14.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	72.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	13.30	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	11.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.60	min
TOTAL ROUND TRIP TIME	**16.42**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	64.80	LCM
AVERAGE WEIGHT PER TRUCK	115.71	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	423	t/hr
TONNES PER SHIFT	3,877	t
TONNES PER DAY	7,753	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,692	t/hr
TONNES PER SHIFT	15,506	t
TONNES PER DAY	31,013	t
TONNES PER MONTH	797,339	t/mo
DURATION	257.96	days
DURATION	10.03	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2008

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,100	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	12.81	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.64	min
TOTAL ROUND TRIP TIME	**17.30**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	435	t/hr
TONNES PER SHIFT	3,985	t
TONNES PER DAY	7,969	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,739	t/hr
TONNES PER SHIFT	15,938	t
TONNES PER DAY	31,877	t
TONNES PER MONTH	819,557	t/mo
DURATION	334.62	days
DURATION	13.02	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2009

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,250	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	13.66	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.68	min
TOTAL ROUND TRIP TIME	**18.19**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	414	t/hr
TONNES PER SHIFT	3,791	t
TONNES PER DAY	7,581	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,654	t/hr
TONNES PER SHIFT	15,162	t
TONNES PER DAY	30,324	t
TONNES PER MONTH	779,639	t/mo
DURATION	351.75	days
DURATION	13.68	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2010

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,400	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	4 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	14.50	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.73	min
TOTAL ROUND TRIP TIME	**19.08**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	394	t/hr
TONNES PER SHIFT	3,614	t
TONNES PER DAY	7,229	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,577	t/hr
TONNES PER SHIFT	14,458	t
TONNES PER DAY	28,916	t
TONNES PER MONTH	743,429	t/mo
DURATION	368.89	days
DURATION	14.35	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2011

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	15.34	min
WAIT TIME PER TRUCK	0.06	min
MISCELLANEOUS DELAYS @ 5.0%	0.77	min
TOTAL ROUND TRIP TIME	**20.02**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	376	t/hr
TONNES PER SHIFT	3,444	t
TONNES PER DAY	6,889	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,879	t/hr
TONNES PER SHIFT	17,222	t
TONNES PER DAY	34,444	t
TONNES PER MONTH	885,545	t/mo
DURATION	309.68	days
DURATION	12.05	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2012

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	2,850	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	5 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	17.03	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	0.85	min
TOTAL ROUND TRIP TIME	**21.73**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	346	t/hr
TONNES PER SHIFT	3,172	t
TONNES PER DAY	6,345	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,730	t/hr
TONNES PER SHIFT	15,862	t
TONNES PER DAY	31,725	t
TONNES PER MONTH	815,639	t/mo
DURATION	336.23	days
DURATION	13.08	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m³ Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2013

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,200	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph
CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	19.00	min
WAIT TIME PER TRUCK	0.25	min
MISCELLANEOUS DELAYS @ 5.0%	0.95	min
TOTAL ROUND TRIP TIME	**24.05**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	313	t/hr
TONNES PER SHIFT	2,867	t
TONNES PER DAY	5,734	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,876	t/hr
TONNES PER SHIFT	17,201	t
TONNES PER DAY	34,402	t
TONNES PER MONTH	884,464	t/mo
DURATION	310.06	days
DURATION	12.06	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2014

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,550	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	20.97	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.05	min
TOTAL ROUND TRIP TIME	**25.87**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	291	t/hr
TONNES PER SHIFT	2,665	t
TONNES PER DAY	5,331	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,745	t/hr
TONNES PER SHIFT	15,992	t
TONNES PER DAY	31,985	t
TONNES PER MONTH	822,330	t/mo
DURATION	333.49	days
DURATION	12.97	mo

ASSAREL MEDET JSC
COPPER FEASIBILITY STUDY
Case 1: Replacement with 15m^3 Shovels & 136t Trucks

Shovel/Truck Cycle Worksheet

32 Mtpy (13 Mtpy Mill Ore)

Year 2015

ACTIVITY VARIABLE INPUT		
AVERAGE TRUCK HAUL DISTANCE (each way)	3,900	meters
EQUIVALENT HAUL ROAD GRADE (loaded)	na	
EQUIVALENT HAUL ROAD GRADE (unloaded)	na	
TOTAL QUANTITY THIS ACTIVITY	10,666,667	tonnes

MATERIAL VARIABLES	
IN SITU DENSITY	2.5 t/BCM
SWELL FACTOR	1.4
LOOSE DENSITY	1.786 t/LCM

PRODUCTIVITY VARIABLES	
HOURS PER SHIFT	12 hrs
SHIFTS PER DAY	2 shift
PRODUCTIVE MIN/HOUR	50 min
DAYS PER WEEK	6 days

AVAILABILITY	
NOMINAL SHIFT TIME	720 min
TRAVEL TIME	15 min
LUNCH	30 min
MISCELLANEOUS DELAY	15 min
AVAILABLE PER SHIFT	660 min
AVAILABLE PER SHIFT	9.167 hrs
AVAILABLE PER DAY	1320 min
AVAILABLE PER DAY	18.33 hrs

FLEET DATA	
TOTAL TRUCKS	6 ea

CYCLE INPUT DATA		
SHOVEL BUCKET CAPACITY	15.00	LCM
SHOVEL BUCKET FILL FACTOR	0.95	
SHOVEL CYCLE TIME*	0.67	min
Shovel Avail. Factor	1.00	
HAUL TRUCK CAPACITY - HEAPED	78.00	LCM
HAUL TRUCK FILL FACTOR	90%	
MANEUVER TIME PER TRUCK	0.50	min
AVERAGE HAUL SPEED - FULL	16	kph
DUMP TIME PER TRUCK	1.00	min
AVERAGE HAUL SPEED - EMPTY	32	kph

CALCULATED DATA		
NET SHOVEL BUCKET CAPACITY	14.25	LCM
BUCKETS PER TRUCK	5	ea
LOAD TIME PER TRUCK	3.85	min
ROUND TRIP HAUL TIME	22.94	min
WAIT TIME PER TRUCK	0.00	min
MISCELLANEOUS DELAYS @ 5.0%	1.15	min
TOTAL ROUND TRIP TIME	**27.93**	**min**

ACTIVITY SUMMARY		
AVERAGE VOLUME PER TRUCK	70.20	LCM
AVERAGE WEIGHT PER TRUCK	125.36	t
PER TRUCK DATA		
NOMINAL TONNES PER HOUR	269	t/hr
TONNES PER SHIFT	2,468	t
TONNES PER DAY	4,936	t
TOTAL PRODUCTIVITY		
NOMINAL TONNES PER HOUR	1,616	t/hr
TONNES PER SHIFT	14,809	t
TONNES PER DAY	29,618	t
TONNES PER MONTH	761,476	t/mo
DURATION	360.14	days
DURATION	14.01	mo

MODULAR

INTELLIMINE®

MasterLink™ Mine Management System
including DISPATCH®

Preliminary Quotation

Prepared for:

SRK Consulting
7175 W. Jefferson Ave.
Suite 3000
Lakewood, Colorado
USA

Modular Mining Systems, Inc.
3289 E. Hemisphere Loop
Tucson, AZ 85706
USA
Tel: (520) 806-3257
Fax: (520) 806-3334
Internet: www.modularmining.com

Reference: DAC_042203-1
Date of Issue: 22-Apr-2003
Valid Until: 22-Jul-2003
Supercedes all other Quotations

MODULAR

SRK Consulting

Date of Quotation: 22-Apr-2003 Quotation Valid Until: 22-Jul-2003

IntelliMine® Software Solutions:	US$
FLEET MANAGEMENT SOFTWARE LICENSES (CORE)	86,500
MATERIAL MANAGEMENT SOFTWARE LICENCES	
CREW MANAGEMENT SOFTWARE LICENSES	
POWERVIEW	
MINECARE	
	$ 86,500

Field Solutions:	Units	US$
TRUCK SOLUTION	16	176,560
SHOVEL SOLUTION (DC)		
SHOVEL SOLUTION (AC)		
PROVISION EXCAV SOLUTION (DC)		
PROVISION EXCAV SOLUTION (AC)		
LOADER SOLUTION	4	53,260
PROVISION LOADER SOLUTION		
DRILL SOLUTION		
PROVISION DRILL SOLUTION		
DOZER SOLUTION		
PROVISION DOZER SOLUTION		
GRADER SOLUTION		
PROVISION GRADER SOLUTION		
WATER TRUCK SOLUTION		
FOREMAN SOLUTION		
CRUSHER SOLUTION		
AUXILIARY SOLUTION		
TRAINING & MAINTENANCE EQUIPMENT		995
RECOMMENDED SPARES	Variable	20,378
		$ 251,193

Infrastructure:	Units	US$
HIGH PRECISION GROUND STATION	1	18,833
BASE STATION ACCESS POINT	1	8,400
WIRELESS ACCESS POINTS (SOLAR)	5	51,500
WIRELESS ACCESS POINTS (AC)		
IBM WORKSTATION(s)	2	12,384
		$ 91,117

Services:	US$
PROFESSIONAL & TECHNICAL SERVICES	163,800
	$ 163,800

Turn Key (Travel & Freight):	US$
TRAVEL:	
SHIPPING AND FREIGHT:	
	$ -

Project Investment:	U.S.	$ 592,610
Less: Commercial Discount		$ -
GRAND TOTAL:	U.S.	$ 592,610

Notes:

Does not include mine specific software.
PLUS reimbursable expenses including airfare, ground transportation, lodging and meals for Modular personnel involved with the installation and training on the project. Shipping term FOB Tucson.

April 25, 2003

Mr. Tim Mosey
SRK Consultants
7175 W. Jefferson Ave.
Suite 3000
Lakewood, Colorado
80235

Dear Mr. Mosey,

Thank you for your recent inquiry pertaining to the feasibility of a Modular Mining Dispatch system. As you may know, Modular is the world leader in Mine Management Systems. Over the last 20 years, our Dispatch system has set the standard at over 130 properties worldwide, 40 of which are located here in North America.

In your request you asked for a "ballpark" figure for a small Truck/Loader copper operation. Without knowing more about the specifics I have compiled a brief quote based on your supplied numbers of 16 trucks and 4 loaders.

In breaking down this quote, the core Fleet Management software is a requirement. This is the basic version of our software and reporting package. It includes the Dispatch algorithm for truck fleet optimization and a number of reports outlining production, equipment availability, utilization, etc. There are a number of other features available at an added cost such as High precision GPS positioning, auxiliary equipment management, simulation modeling, fueling optimization, crusher management, pre-shift equipment checklists, payload management, machine health, operator training databases, crew line up, environmental reporting, OLAP database management etc.

The infrastructure is also a best guess for a small operation and can only accurately be estimated by a detailed radio survey of the actual property.

Professional and technical services is our term for manpower and historically averages 25 – 28 % of the project.

There may also be discounts available to current corporate customers or partners willing to participate as a showcase operation.

I'm sure this quote provides more questions than answers, so I am looking forward to discussing this with you at your convenience.

Sincerely,

Douglas A. Chapman P.E.
Account Manager – North America

APPENDIX B

Metallurgical Test Results

Metallurgical Test Results

There were two sets of metallurgical tests performed on the Assarel Medet Ore. The Assarel Medet laboratory performed a series of tests to determine the optimum grinding size, and flotation density. Variables investigated with these tests included:

For each ore type, and a combined ore mix,

- Grind size
- Reagent addition
- Flotation percent solids

The second set of tests were run in a U.S. laboratory (RDI and Hazen). The tests run there verified the results obtained in the Assarel Medet Laboratory and investigated the optimum reagent addition, optimum flotation time, flotation approach, and confirmed the density results.

The first section within this appendix presents the results from the U.S. Laboratory, and the second section presents the results from the Assarel Medet Laboratory.

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Appendix A: Head Analyses of Ore Type and Composite Sample
Appendix B: Bond's Ball-Mill Work Indices Determination Data
Appendix C: Grind Study for Composite Sample
Appendix D: Rougher Flotation Test Results for Composite Sample
Appendix E: Thickening Data for Rougher Flotation Tailing

INTRODUCTION

Resource Development Inc. (RDi) undertook a study for metallurgical testing of Assarel Medet copper samples in order to confirm the results obtained at site. The study was a part of the Trade Development Agency Project awarded to SRK.

RDi received three samples designated propylitic (No. 2), secondary quartz (No. 4) and argylitic (No. 7) for the study. Sample of the reagents and water were also received at the same time.

This report summarizes the sample preparation of each sample and a composite sample, Bond's ball mill work indices determinations, head analyses, rougher flotation tests and thickening tests.

SUMMARY

Resource Development Inc. (RDi) undertook a metallurgical test program on a composite sample of the three ore types (i.e., propylitic, secondary quartz and argylitic) to confirm the results obtained at the mine site. The composite sample was based on resource estimate of SRK and the ratio of the remaining ore in the deposit.

The testwork included head analyses, Bond's ball mill work index determination of the composite sample and the ore types, rougher flotation tests and thickening tests.

The highlights of the study indicated the following:

- X The composite sample assayed 0.600% C_T and 0.287% Cu_{oxide}. The oxide copper accounted for 4.8% of the total copper in the sample.

- X The composite sample had a work index of 14.03 which indicated an average hardness. The work indices of the ore types were 18.67 for propylitic ore, 13.83 for secondary quartz and 11.85 for argylitic ore.

- X Base-case flotation test using standard grind (P_{85} of 80 micrometers) and reagent suite (90 g/T SIBX, 12 g/T X-133 and 8 g/T AP 3477) at a pH of ± 10.5 recovered 89.3% of the copper in six minutes of flotation time. The concentrate, assaying 4.67% Cu, also recovered 11% of the feed material. The rougher flotation copper recovery was similar to that obtained in the plant. However, the concentrate weight recovery was two to three times less than that obtained at site.

- X The plant conditions were duplicated by increasing the aeration and agitation in the laboratory flotation cell. Twenty percent of the material was floated in two minutes of float time. These operating conditions result in loosing selectivity of copper mineral flotation. Hence, the operating procedures in the plant and the laboratory at site should be re-evaluated.

- X The dosage of SIBX collector can be reduced from 90 g/T to 40 g/T without sacrificing copper recovery. This will result in reduction of operating cost.

- X Stage-addition of SIBX may be beneficial for copper metallurgy and should be evaluated at site.

- X Copper recovery improved by ± 2% in the rougher flotation by increasing the fineness of grind from P_{65} of 78 micrometers to P_{65} of 70 micrometers. The tailing grade dropped from 0.069% Cu to 0.050% Cu.

- X The pH of the slurry in the flotation process may have an effect on copper recovery. The higher the pH, the higher the recovery. This trend needs to be confirmed with additional testing at site.

X Preliminary testing indicates that MIBC may be a better frother than X-133. A copper recovery of 93.5% was obtained at a concentrate grade of 5.36% in one of the flotation tests. This finding needs to be confirmed in additional testing at site.

X Flotation tailings can be thickened to 50% solids or more using a small dosage of high molecular weight and high ionic charge flocculent. The thickener overflow can be used as process water in the plant. This will result in significant power savings by not pumping the slurry to the tailing pond and pumping water back from it to the plant.

RESULTS AND DISCUSSION

The three ore types samples, the currently used reagents in the plant and mill process water were received by RDi from Lyntek Inc. on October 4, 2002 for metallurgical testwork.

The following sections provide the test procedures, results and discussion.

CHARACTERIZATION OF SAMPLES

The three samples, namely propylitic, secondary quartz and argylitic weighed 57 Kgs, 56 Kgs and 46 Kgs, respectively. Each sample was crushed to pass 3/8 inch, blended and riffle split in half. One half was bagged and set aside. The other half was blended and crushed to pass 6 mesh. A representative portion was further split, pulverized and a portion of the pulverized material was submitted for chemical analyses.

Composite Sample

A composite sample (60 Kgs) was prepared by combining the three crushed samples to minus 3/8 inch in the following proportions: 35% of propylitic, 37% of secondary quartz and 27% of argylitic sample. The sample composite was based on resource estimate of SRK and the ratio of the remaining ore in the deposit. The composite sample was blended, crushed to 6 mesh and blended again. The minus 6-mesh material was split into 1-Kg samples and bagged in plastic bags and stored in the freezer to avoid further oxidation. A 1-Kg sample was pulverized and representative portion submitted for chemical analyses.

Head Analyses

The head analyses of the three ore types and the composite sample are given in Appendix A and summarized in Table 1. The composite sample was also analyzed by x-ray fluorescence (XRF) and x-ray diffraction (XRD) techniques and the results are summarized in Tables 2 and 3.

The highlights of the test results indicate the following:

- X The ore types assayed between 0.406% Cu to 0.978% Cu. Approximately 3.8% to 7.5% of the copper in the ore was present as oxide.

- X The composite sample prepared from the three ore types assayed 0.600% Cu_T and 0.0287% Cu_{Oxide}. The oxide copper accounted for 4.8% of the total copper in the sample.
- X The major host rock minerals in the composite sample are quartz (38%), chlorite

(22%), plagioclase feldspar (17%) and mica/illite (16%).

X The predominant sulfide minerals present in the composite sample are pyrite and chalcopyrite. The ore contains small quantity of arsenic (669 ppm).

Table 1. Head Analyses of Assarel Medet Copper Samples

Sample No.	Description	Assay, %		% Oxide Cu In Sample
		Cu_T	Cu_{OX}	
2	Propylitic	0.406	0.0200	4.9
4	Secondary Quartz	0.974	0.0368	3.8
7	Argylitic	0.528	0.0395	7.5
Composite Sample		0.600	0.0287	4.8

Table 2. XRF Analyses of Composite Sample			
Element	Assay, %	Element	Assay, ppm
Na_2O	1.95	V	78
MgO	3.59	Cr	139
Al_2O_3	15.1	Co	12
SiO_2	70.3	Ni	<10
P_2O_5	0.11	W	<10
S	1.71	Cu	6717
Cl	<0.02	Zn	86
K_2O	1.96	As	669
CaO	0.57	Sn	95
TiO_2	0.27	Pb	31
MnO	0.05	Mo	28
Fe_2O_3	4.71	Sr	109
BaO	0.04	U	<10
		Th	<10
		Nb	<10
		Zr	52
		Rb	43
		Y	18

Table 3. XRD Analyses of Composite Sample	
Mineral	**Approximate Weight %**
Quartz	38
Mica/Illite	16
Chlorite	22
Plagioclase Feldspar	17
K-Feldspar	<3
Pyrite	<3
Chalcopyrite	<2
Unidentified	<5

Bond's Ball-Mill Work Indices

Bond's ball mill work index determination was made for the composite sample at 100-mesh grind. The indirect method of work index determination was used to develop the work indices for the three ore types, namely propylitic, secondary quartz and argylitic.

The test procedure and data are given in Appendix B and the results are summarized in Table 4.

Table 4. Bond's Ball-Mill Work Indices at 65-Mesh Grind

Sample	Wi
Composite Sample	14.03
Propylitic	18.67
Secondary Quartz	13.83
Argylitic	11.85

The highlights of the test results indicate the following:

- The composite sample has a work index of 14.03 which indicates an average hardness.
- The propylitic ore was the hardest of the ore types with a work index of 18.67.
- The secondary quartz had a work index of 13.83.
- The argylitic ore was relatively softer than the other ore types and had a work index of 11.85.

ROUGHER FLOTATION TESTS

The analyses of the plant data and laboratory testwork at site indicated that the primary grind was maintained at a P_{65} of 80 micrometers (P_{80} of 106 micrometers). The reagent addition in the circuit included lime to pH∃10, 90 g/T sodium isobutyl xanthate, 10 g/T X-133 and 8 g/T Aero Promoter 3477. The overall plant recovery of copper is 81% to 82% whereas the rougher circuit recovery is around 88% to 90%. The rougher concentrate grade assays 1.2% to 1.5% Cu. The rougher concentrate weight recovery ranges between 20% and 30%. This implies that the copper recovery in the cleaner circuit is 90%-93%.

The initial testing was directed at confirming the rougher flotation metallurgy where the major losses occur in the tests.

Grind Studies

The first step in the rougher flotation optimization study was to establish the grind time versus particle size relationship in the laboratory in order to achieve grind size distribution similar to that produced in the plant. A series of grind tests were performed where the composite sample was ground for varying times at 50% solids in the laboratory rod mill. The laboratory rod mill simulates the ball mill-cyclone circuit in the mill. The test data are given in Appendix C and the results are summarized in Table 5.

The test results indicated that 25 minutes of grinding at 50% solids in a laboratory rod mill produced a product size similar to the cyclone overflow in the plant. Hence, these conditions were used for subsequent flotation testing except for the finer grind test.

Table 5. Summary of Grind Study Results for Composite Sample

Grind Time Minute	P_{65} Microns	P_{80} Microns	% Minus 75 Microns
10	189	252	43.8
20	91	130	52.7
25	78	106	59.6
30	70	94	64.9
45	53	63	90.1

Base-Case Flotation Test

A base-case flotation test was performed following a 25-minute grind of the composite sample (Test No. 1). The reagents and the dosages were same as used in the plant. The reagents were provided by the mill personnel at the Assarel Medet Copper plant. Though we had received three xanthate samples, we used the sodium isobutyl xanthate (SIBX) from Srbiya in our study.

The grind was done at natural pH which was at 6.3. The flotation test was performed at pH 10.5 using Bulgarian lime and Golden tap water. The reagents dosages in the rougher flotation conditioner were 90 g/T sodium isobutyl xanthate, 12 g/T X-133 and 8 g/T AP 3477. Timed concentrates were collected at cumulative time intervals of 1, 3 and 6 minutes. Majority of the copper floated in the first minute of flotation. The froth had no mineralization after about 5 minutes of flotation time.

The flotation test data are given in Appendix D and the results are summarized in Table 6.

Table 6. Base-Case Flotation Test Results using Plant Process Conditions and Reagents (Test No. 1)							
Product	Cumulative Flotation Time, min	Recovery %				Grade % Cu	
		Individual		Cumulative		Individual	Cumulative
		Wt.	Cu	Wt.	Cu		
Con 1	1	7.3	70.0	7.3	70.0	5.50	5.50
Con 2	3	2.5	17.1	9.8	87.1	3.95	5.11
Con 3	6	1.2	2.2	11.0	89.3	1.066	4.67
Tailing	—	89.0	10.7	100.0	100.0	0.069	0.573

Note: Tailing assayed 0.007% Cuoxide. Total Cuoxide recovery was 79.3%.

The test results indicate the following:

X The laboratory flotation process recovered 89.3% of copper in a concentrate assaying 4.67% Cu. The concentrate weight recovery was 11%.

X The copper recovery was similar to that obtained in the plant whereas the concentrate grade was two to three times that obtained in the plant i.e., 4.67% versus 1.5% to 2% Cu.

X The test indicates that 6 minutes of flotation time in the laboratory produces similar recovery to that obtained in the plant. The tailing grade of 0.069% Cu is similar to that obtained in the plant.

Higher Aeration and Agitation

A bench-scale flotation test with the grind and reagents dosages similar to the base-case was performed. The agitation (RPM) in the cell was increased by 31% from 1600 to 2100 rpm (Test No. 9). This also increased the aeration. The pulp overflowed from the cell when air value was opened. Twenty percent of the material floated in two minutes of float time as compared to 10% in the six minutes of flotation time in the base case test. The products were not assayed in this test.

These conditions simulated the process conditions in the laboratory at plant site as well as in the plant. Excess agitation and hence aeration results in loosing selective flotation of the copper minerals. We recommend that operating procedures be re-evaluated both in the plant and the laboratory at site.

Lower Dosage and Stage-Addition Reagents

The current dosage of 90 g/T of sodium isobutyl xanthate (SIBX) is excessive when compared to similar operations in other countries. Hence, a flotation test was performed with lower dosage of SIBX (70 g/T) and the reagent was added in two stages — 40 g/T ahead of flotation bank and 30 g/T to middle of flotation bank (Test No. 2).

The test data are given in Appendix D and the results are summarized in Table 7.

Table 7. Flotation Test Results using Lower Dosage of SIBX (70 g/T) and Stage Addition (Test No. 2)

Product	Cumulative Flotation Time, min	Recovery %				Grade % Cu	
		Individual		Cumulative		Individual	Cumulative
		Wt.	Cu	Wt.	Cu		
Con 1	1	7.3	73.4	7.3	73.4	5.84	5.84
Con 2	3	2.8	17.0	10.1	90.4	3.52	5.20
Con 3	6	1.6	1.8	11.7	92.2	0.672	4.59
Tailing	—	88.3	7.8	100.0	100.0	0.051	0.581

Note: Tailing assayed 0.011% Cu_{oxide}. Total Cu_{oxide} recovery was 67.7%.

The test results indicate the following:

- Decrease in reagent dosage from 90 g/T SIBX to 40 g/T SIBX ahead of the circuit floated 90.4% of the copper in 3 minutes of flotation time (Test 2) as compared to 87.1% in Test No. 1.

- Stage-adding 30 g/T SIBX after 3 minutes floated 1.8% of copper in additional 3 minutes of flotation time.

- The overall copper recovery in the test was 92.2% as compared to 89.3% in the base-case test. The concentrate grades were also identical in the two tests. This was despite lower oxide copper recovery in the test.

The results indicate that the addition of SIBX collector can be reduced by at least 25% without sacrificing copper recovery.

A bench-scale flotation test was performed with no stage addition of SIBX. The total addition of SIBX in the test was 40 g/T (Test No. 7). The test data are given in Appendix D and the results are summarized in Table 8. The test results indicate that the recovery in the third concentrate was the same as in Test No. 2 with stage addition of 30 g/T SIBX. However, the overall copper recovery in the test was lower (90.5% vs. 92.2%). Though additional testing may be needed, one can postulate that stage-addition of collector may not be needed.

Table 8. Flotation Test Results Using Lower Dosage of SIBX (40 g/T) and No Stage Addition (Test No. 7)							
Product	Cumulative Flotation Time, min	Recovery %				Grade % Cu	
		Individual		Cumulative		Individual	Cumulative
		Wt.	Cu	Wt.	Cu		
Con 1	1	6.3	75.3	6.3	75.3	6.80	6.80
Con 2	3	2.3	13.3	8.6	88.6	3.34	5.88
Con 3	6	1.2	1.9	9.8	90.5	0.874	5.26
Tailing	—	90.2	9.5	100.0	100.0	0.060	0.570

Finer Grind

A bench-scale flotation test (Test No. 6) was performed at a grind size of P_{65} of 70 micrometers (P_{80} of 94 micrometers) which was finer than the standard conditions of P_{65} of 78 micrometers (P_{80} of 106 micrometers). The test data are given in Appendix D and the results are summarized in Table 9. The results indicate that finer grind improves copper recovery by ± 2% at a slightly lower grade. The concentrate weight recovery was 12.1% as compared to 11% in the base-base test. The tailing grade also dropped from 0.069% Cu to 0.050% Cu which indicates better recovery at finer grind.

Table 9. Flotation Test Results for Finer Primary Grind (P_{65}=70 micrometers)							
Product	Cumulative Flotation Time, min	Recovery %				Grade % Cu	
		Individual		Cumulative		Individual	Cumulative
		Wt.	Cu	Wt.	Cu		
Con 1	1	7.9	74.9	7.9	74.9	5.27	5.27
Con 2	3	2.6	14.5	10.5	89.4	3.14	4.75
Con 3	6	1.6	2.7	12.1	92.1	0.93	4.24
Tailing	—	87.9	7.9	100.0	100.0	0.05	0.558

pH

Two additional flotation tests were performed to determine the effect of pH on copper metallurgy (Test No. 4 and No. 5). The test data are given in Appendix D and the results are summarized in Table 10. The highest copper recovery was obtained at the

highest pH and the lowest copper recovery was obtained at intermediate pH. The copper grades were similar in the test series. Though no definite trend was observed regarding pH, it appears that pH does not have a significant effect between 8 and 11.5 on copper grade provided aeration and agitation conditions are optimum. However, the copper recovery improved with higher pH. The lowest copper tailing assay of 0.043% Cu was obtained at the highest pH.

Table 10. Effect of pH on Copper Metallurgy (Flotation time: 6 minutes)

Test No.	pH	Recovery %		Grade % Cu	Tailing % Cu	Cal. Feed % Cu	Lime Consumption Kg/T
		Wt.	Cu				
4	7.9	10.8	91.5	4.99	0.056	0.591	0.90
1	10.5	11.0	89.3	4.67	0.069	0.573	1.36
5	11.5	11.3	93.2	4.67	0.043	0.567	1.66

Frother

A bench-scale flotation test was performed similar to Test No. 2 where 70 g/T of SIBX was stage added and X-133 frother was replaced by methyl isobutyl carbonal (MIBC). The test data are given in Appendix D and the results are summarized in Table 11 (Test No. 3).

Table 11. Flotation Test Results Using MIBC Instead of X-133 as Frother (Test No. 3)

Product	Cumulative Flotation Time, min	Recovery %				Grade % Cu	
		Individual		Cumulative		Individual	Cumulative
		Wt.	Cu	Wt.	Cu		
Con 1	1	6.3	81.7	6.3	81.7	7.18	7.18
Con 2	3	2.0	10.2	8.3	91.9	2.80	6.12
Con 3	6	1.3	1.6	9.6	93.5	0.684	5.38
Tailing	—	90.5	6.5	100.0	100.0	0.040	0.550

The test results indicate the following:

X The rougher flotation copper recovery increased to 93.5% at a concentrate grade of 5.38%. The concentrate weight recovery was 9.6%.

X The copper recovery in the first one and three minutes of flotation were 81.7% and 91.9% when MIBC was used as compared to 70.0% and 87.1% when X-133

was used. The corresponding concentrate grades were also higher. This indicates that MIBC is a better frother than X-133 for the composite sample.

X The tailing grade with MIBC was 0.040% Cu versus 0.051% Cu with X-133 which increased recovery.

An additional flotation test was performed with the same process conditions as Test No. 3 to confirm the finding (Test No. 8). The test data are given in Appendix D and the results are summarized in Table 12. The results for base-case test are also given in the table. The results indicate that the average results of MIBC as a frother were similar to X-133, though better recovery was obtained in one of the tests. Additional testing of MIBC should be undertaken at site.

Table 12. Flotation Test Results for MIBC and X-133 as Frothers (Flotation Time: 6 minutes)

Test No.	Process Conditions	Recovery		Grade % Cu	Tailing % Cu	Cal. Feed Grade, % Cu
		Wt.	Cu			
3	MIBC, 70 g/T SIBX stage added	9.6	93.5	5.38	0.040	0.550
8	MIBC, 70 g/T SIBX stage added	9.7	90.5	5.15	0.058	0.552
Average		9.65	92.0	5.27	0.049	0.551
2	X-133, 70 g/T SIBX stage added	11.7	92.2	4.59	0.051	0.581
1	X-133, 90 g/T SIBX	11.0	89.3	4.67	0.069	0.573

THICKENING TESTS

Thickening tests were performed on rougher flotation tailing samples with and without flocculant to determine the thickening area requirements for processing of tailings. Flotation tailing sample from Test No. 7 was thickened without flocculant and the flotation tailing sample from Test No. 8 was thickened with 20 g/T of high molecular weight and high ionic charge flocculant (Ciba 605). The test data are given in Appendix E.

The thickener area requirement to achieve 50% solids in underflow without a flocculant was very high at 55.22 m2/T/ day (i.e., 594.8 ft2/ton/day). However, when a flocculant was used, the thickener area requirement dropped to 0.08m2/T/day (0.783 ft2/ton/day). Hence a 60.7 meters diameter thickener should be sufficient to process 36,000 MTPD of tailings. The density of the solids was 52%, and at 50% solids, a 50 m diameter thickener could be used.

APPENDIX A

HEAD ANALYSES OF ORE TYPE AND COMPOSITE SAMPLE

Appendix A

Project No: 02-21
Date: 04-Oct-02

Sample Description and Preparation:

RDi Sample No: 1

Client's Identification: Sample #2, "Propylitic"

Date Received: 04-Oct-02

Sample Weight: Approximately 57-Kilograms

Sample Container: The sample was packaged inside one plastic fiber bags. The sample was delivered by Lyntek Inc.

Sample Description: Large rocks ranging in size from 8-inches to fines.

Method of Preparation: The sample in each bag were jaw crushed to pass 3/8-inch, blended and then riffle spit in-half. One half was returned bagged and set aside. The other half were blended and crushed to pass 6-mesh. The minus 6-mesh material was split into 1-kg samples and stored in plastic bags. A representative portion was further split, pulverized, split and a portion of the pulverized material submitted for chemical analyses.

Chemical Analysis:

	Cu_T %	Fe %	S %	Cu_O %
Clinent Information	0.422	2.37	1.35	
Florin Analyzed	0.41			0.02

Appendix A

Sample Description and Preparation:

Project No: 02-21
Date: 04-Oct-02

RDi Sample No: 2

Client's Identification: Sample #4, "Secondary Quartz"

Date Received:

Sample Weight: Approximately 56-Kilograms

Sample Container: The sample was packaged inside one plastic fiber bags. The sample was delivered by Lyntek Inc.

Sample Description: Large rocks ranging in size from 8-inches to fines.

Method of Preparation: The sample in each bag were jaw crushed to pass 3/8-inch, blended and then riffle spit in-half. One half was returned bagged and set aside. The other half were blended and crushed to pass 6-mesh. The minus 6-mesh material was split into 1-kg samples and stored in plastic bags. A representative portion was further split, pulverized, split and a portion of the pulverized material submitted for chemical analyses.

Chemical Analysis:

	Cu_T %	Fe %	S %	Cu_O %
Clinent Information	0.839	6.10	6.14	
Florin Analyzed	0.97			0.0368

Appendix A

Sample Description and Preparation:

Project No: 02-21
Date: 04-Oct-02

RDi Sample No: 3

Client's Identification: Sample #7, "Argylitic"

Date Received:

Sample Weight: Approximately 46-Kilograms

Sample Container: The sample was packaged inside one plastic fiber bags.
The sample was delivered by Lyntek Inc.

Sample Description: Large rocks ranging in size from 8-inches to fines.

Method of Preparation: The sample in each bag were jaw crushed to pass 3/8-inch, blended and then riffle spit in-half. One half was returned bagged and set aside. The other half were blended and crushed to pass 6-mesh. The minus 6-mesh material was split into 1-kg samples and stored in plastic bags. A representative portion was further split, pulverized, split and a portion of the pulverized material submitted for chemical analyses.

Chemical Analysis:

	Cu_T %	Fe %	S %	Cu_O %
Clinent Information	0.430	3.68	4.04	
Florin Analyzed	0.53			0.395

Appendix A

Project No: 02-21
Date: 04-Oct-02

Sample Description and Preparation:

RDI Sample No: 4

Client's Identification: Composite.

Date Received: N/A

Sample Weight: Approximately 60-Kilograms

Sample Container: See RDi Sample 1, 2 and 3 descritpions.

Sample Description: See RDi Sample 1, 2 and 3 descritpions.

Method of Preparation: After crushing the samples 1, 2, and 3 to minus 3/8-inch and splitting weighed proportion of each were combined in the ratio of 35% Sample 1, 37% Sample 2 and 27% Sample 3 were blended together to make a composite sample. The blended composite material was crushed to pass 6-mesh. The minus 6-mesh material was split into 1-kg samples and stored in plastic bags. A representative portion was further split, pulverized, split and a portion of the pulverized material submitted for chemical analyses.

Chemical Analysis:

	Cu_T %	Fe %	S %	Cu_O %
Clinent Information	0.583	4.14	3.90	
Florin Analyzed	0.600			0.029

	SiO_2 %	Fe_2O_3 %	S %	Cu ppm	Zn ppm	Pb ppm	Mo ppm
(XRF)	70.4	4.70	1.72	6,686	86	31	29

Copper, Iron and sulfur analyses by Florin Analytical Laboratory, Reno, Nevada.
Laboratory No.: 021565.
Cu_T = Total Copper, Cu_O = Oxide Copper.
XRF analyses by The Mineral Laboratory, Lakewood, Colorado, Lab no. 202787.

Appendix A

Sample Description and Preparation:

Project No: 02-21
Date: 04-Oct-02

RDi Sample No: 5

Client's Identification: Sodium Isobutil Xanthate - China

Date Received:

Sample Weight: Approximately 0.5 kg.

Sample Description: Dry powder. The samples was packaged inside a box along with the other 4 reagent samples (RDi Samples 6, 7, 8 and 9.)

Method of Preparation: The sample was stored inside a plastic bag, inside a refrigerator until needed for study.

Appendix A

Sample Description and Preparation:

Project No: 02-21
Date: 04-Oct-02

RDi Sample No: 6

Client's Identification: Sodium Isobutil Xanthate - Srbiya

Date Received:

Sample Weight: Approximately 0.5 kg.

Sample Description: Dry powder. The samples was packaged inside a box along with the other 4 reagent samples (RDi Samples 5, 7, 8 and 9.)

Method of Preparation: The sample was stored inside a plastic bag, inside a refrigerator until needed for study.

Appendix A

Project No: 02-21
Date: 04-Oct-02

Sample Description and Preparation:

RDi Sample No: 7

Client's Identification: Potassium Isobutil Xanthate - China

Date Received:

Sample Weight: Approximately 0.5 kg.

Sample Description: Dry powder. The samples was packaged inside a box along with the other 4 reagent samples (RDi Samples 5, 6, 8 and 9.)

Method of Preparation: The sample was stored inside a plastic bag, inside a refrigerator until needed for study.

Appendix A

Project No: 02-21
Date: 04-Oct-02

Sample Description and Preparation:

RDi Sample No: 8

Client's Identification: Aero 3477

Date Received:

Sample Weight: Approximately 0.5 kg.

Sample Description: Liquid. The samples was packaged inside a box along with the other 4 reagent samples (RDi Samples 5, 6, 7 and 9.)

Method of Preparation: The sample was stored inside a plastic bag, inside a refrigerator until needed for study.

Appendix A

Sample Description and Preparation:

Project No: 02-21
Date: 04-Oct-02

RDi Sample No: 9

Client's Identification: Oreprep X-133 Frother

Date Received:

Sample Weight: Approximately 0.5 kg.

Sample Description: Liquid. The samples was packaged inside a box along with the other 4 reagent samples (RDi Samples 5, 6, 7 and 8.)

Method of Preparation: The sample was stored inside a plastic bag, inside a refrigerator until needed for study.

The Mineral Lab, Inc.
2700 Youngfield Suite 105
Lakewood, CO 80215
(303) 232-8708

15th Anniversary

October 31, 2002
Lab no. 202787

Mr. E. H. Bentzen III
Resource Development, Inc
11475 West I-70 Frontage Road North
Wheat Ridge, Colorado 80033

Dear Mr. Bentzen:

Enclosed are the x-ray fluorescence (XRF) and the x-ray diffraction (XRD) results for sample, "SRK/BUL" received last week. This report will be mailed and faxed to you, as usual.

A representative portion of the sample was ground to approximately -400 mesh in a steel swing mill and then analyzed by our "XRF-powder" procedure for the standard 31 major, minor and trace elements. The relative precision/accuracy for this procedure is ~5–10% for major–minor elements and ~10–15% for trace elements (those elements listed in ppm) at levels greater than twice the detection limit in samples of average geologic composition. A replicate sample and a standard reference material ("SY3", a CANMET standard rock) were analyzed with the sample to demonstrate analytical reproducibility for your sample and analytical accuracy for a geologic standard, respectively. The accepted ("known") values for the quality control standard are listed with the XRF results.

A representative portion of the ground sample was packed into a well-type plastic holder and then scanned with the diffractometer over the range, 3-61° 2θ using Cu-Kα radiation. The results of the scan are summarized as approximate mineral weight percents on the enclosed table. Estimates of mineral concentrations were made using our XRF-determined elemental composition and the relative peak heights/areas on the XRD scan. The detection limit for an average mineral in this sample is ~1-3% and the analytical reproducibility is approximately equal to the square root of the amount. "Unidentified" accounts for that portion of the XRD scan which could not be resolved.

Thank you for the opportunity to be of continuing service to RDI.

Sincerely,

Peggy Dalheim

Peggy Dalheim

RCE DEVELOPMENT, INC
XRF-POWDER RESULTS FOR, "SRK/BUL" SAMPLE

OCTOBER 29, 2002
LAB NO. 202787

IDENT	Na2O	MgO	Al2O3	SiO2	P2O5	S	Cl	K2O	CaO	TiO2	MnO	Fe2O3	BaO
	WT %												
SRK/BUL COMP	1.95	3.59	15.1	70.3	0.11	1.71	<0.02	1.96	0.57	0.27	0.05	4.71	0.04
QUALITY CONTROL - REPLICATE (R) SAMPLE AND STANDARD REFERENCE MATERIAL (SY3) ANALYZED WITH SAMPLES													
SRK/BUL COMP(R)	1.93	3.56	14.9	70.5	0.11	1.72	<0.02	1.94	0.56	0.27	0.05	4.69	0.04
SY3-XRF	4.19	2.63	12.5	60.8	0.75	<0.05	<0.02	4.34	7.95	0.13	0.29	6.28	0.05
SY3-known	4.15	2.67	11.8	59.7	0.54	0.05	0.014?	4.20	8.26	0.15	0.32	6.45	0.05

IDENT	V	Cr	Co	Ni	W	Cu	Zn	As	Sn	Pb	Mo	Sr	U
	PPM												
SRK/BUL COMP	78	139	12	<10	<10	6717	86	669	95	31	28	109	<10
QUALITY CONTROL													
SRK/BUL COMP(R)	82	140	11	<10	<10	6655	86	675	90	31	29	114	<10
SY3-XRF	45	<10	10	12	41	19	256	<20	<50	145	<10	319	636
SY3-known	51	10	12	11	--	16	250	20	--	130	--	306	650

IDENT	Th	Nb	Zr	Rb	Y
	PPM				
SRK/BUL COMP	<10	<10	52	43	18
QUALITY CONTROL					
SRK/BUL COMP(R)	<10	<10	56	48	26
SY3-XRF	930	184	331	200	686
SY3-known	990	145	320	208	740

ANALYSIS PERFORMED BY THE MINERAL LAB, INC

esource Development, Inc
XRD Results for "SRK/BUL"

October 31, 2002
Lab no. 202787

Mineral Name	Chemical Formula	Approx. Wt %
Quartz	SiO_2	38
Mica/illite	$(K,Na,Ca)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH,F)_2$	16
Chlorite	$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$	22
Plagioclase feldspar	$(Na,Ca)Al(Si,Al)_3O_8$	17
K-feldspar	$KAlSi_3O_8$	<3
Pyrite	FeS_2	<3
Chalcopyrite	$CuFeS_2$	<2
"Unidentified"	?	<5

Analysis performed by The Mineral Lab, Inc

Florin Analytical Services, LLC

7950 Security Circle - Reno, Nevada 89506 - Phone (775) 677-2177 - FAX (775) 972-4567

Certificate of Analysis

Submitted By: Resource Development, Inc — Laboratory No.:021565

Client Number: F174

Attention: Edwin H. Bentzen III — Date: 11/09/02

Method: 4-Acid digestion, AAS analysis for total copper. 1-Molar H_2SO_4 with $Fe_2(SO_4)_3 \cdot 5H_2O$, AAS analysis for copper oxide.

Lab code:	7015	7015	7016	7016
Element:	Total Copper	Total Copper QC	Copper Oxide	Copper Oxide QC
Detection Limit:	0.01	0.01		
Units:	mg/kg	mg/kg	mg/kg	mg/kg
SRK-B-2	4060	4060	200	203
SRK-B-4	9740		368	
SRK-B-7	5280		395	
SRK/BUL Composite	6000		287	

Richard A. Grondin, QC Manager

Nevada Assembly Bill No. 519.130 requires the following statement: The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project.

APPENDIX B

BOND'S BALL-MILL WORK INDICES DETERMINATION DATA

INDIRECT METHOD OF BOND'S BALL MILL WORK INDEX DETERMINATION

The equation for calculating the energy for grinding when ball mill work index is known is:

$$E = \frac{10\ W_i}{\sqrt{X_P}} \frac{-10\ W_i}{\sqrt{X_F}}$$

Where E = energy in kwh/t
Where W_i = work index
Where X_P = 80% passing product size
Where X_F = 80% passing feed size

When two ores, one with known W_i, are ground in the mill for same time, the energy input is identical. Hence

$$\frac{10\ W_i}{\sqrt{X_P}} \frac{-10W_i}{\sqrt{X_F}} = \frac{10\ W_i*}{\sqrt{X_P*}} \frac{-10\ W_i*}{\sqrt{X_F*}}$$

Where W_i^*, X_P^* and X_F^* are for the ore with unknown work index.

X_P^* and X_F^* are obtained from batch grinding test.

The data for the composite ore with known W_i of 14.03 and the ore types are given below.

Ore Type	X_F	X_P	W_i (calculated)
Composite	1869	106	14.03 (known)
Proplitic	2796	180	18.67
Si Quartz	2881	114	13.83
Argolitic	2290	85	11.85

Appendix B
Bond Ball Mill, 100-mesh

Client: **Assarel**
Sample ID: RDi Sample #4, "Composite"

SIZE		MILL FEED			
Tyler Mesh	Microns	Weight (g)	Weight %	Retained %	Passing %
8	2,360	74.70	7.4	7.4	92.6
10	1,700	170.20	16.9	24.3	75.7
12	1,400	104.30	10.4	34.7	65.3
16	1,000	123.10	12.2	46.9	53.1
20	850	42.50	4.2	51.2	48.8
28	600	78.80	7.8	59.0	41.0
35	425	68.50	6.8	65.8	34.2
48	300	54.40	5.4	71.2	28.8
65	212	54.60	5.4	76.6	23.4
100	150	43.10	4.3	80.9	19.1
Pan		191.90	19.1	100.0	
Total		1,006.10	100.0		

Cycle #	grams / revolution
n-2	1.462
n-1	1.526
n	1.593
Average	1.527

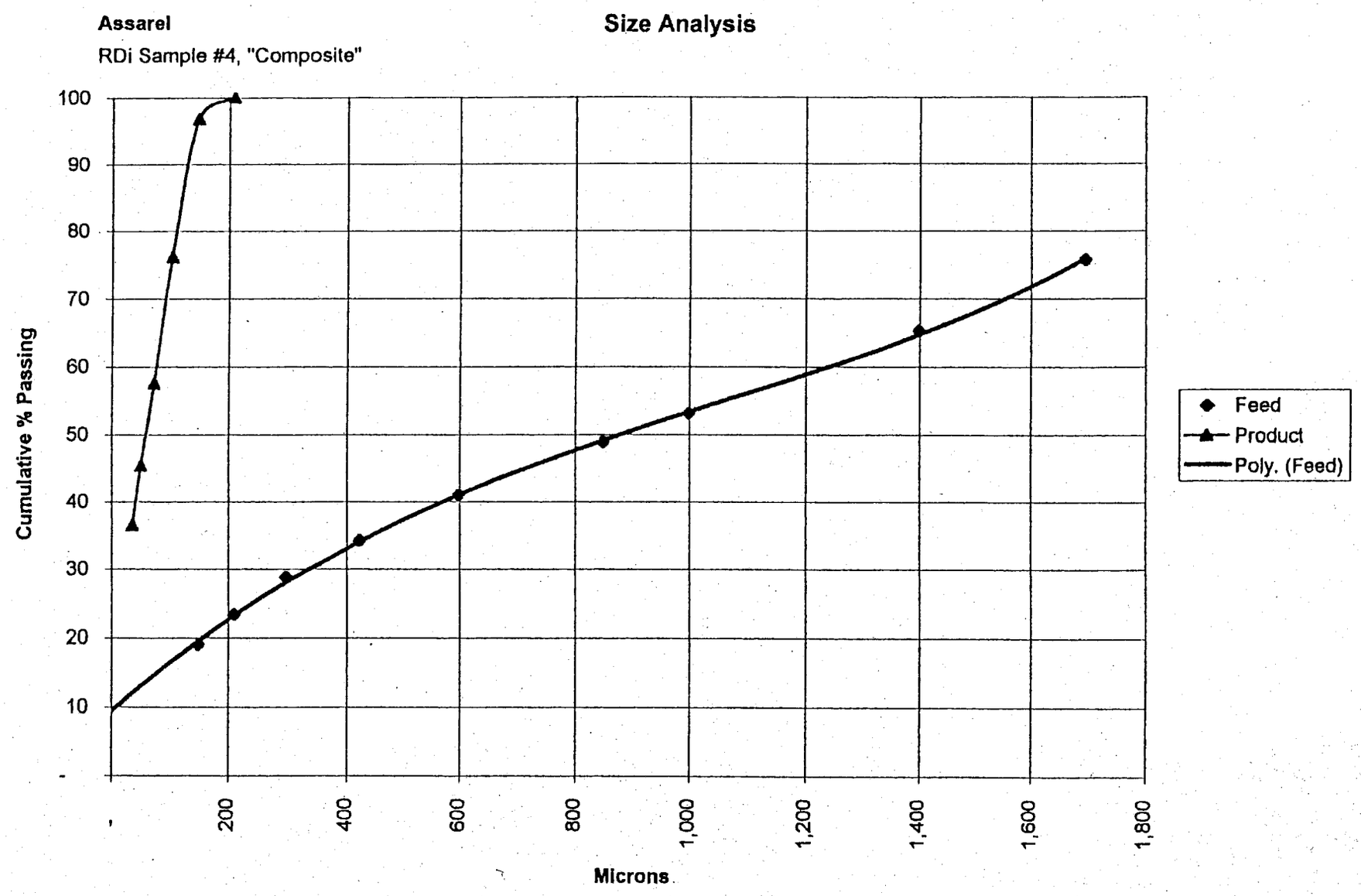
Mill Feed Weight (grams)	1013.2
Desired Mesh of Grind:	100
Desired Micron of Grind:	150
Circulating Load (%)	250
Circulating Load (grams):	289.5

SIZE		GROUND PRODUCT			
Tyler Mesh	Microns	Weight (g)	Weight %	Retained %	Passing %
65	212	-	-	-	100.0
100	150	6.50	3.2	3.2	96.8
150	106	42.70	20.8	23.9	76.1
200	75	38.10	18.5	42.5	57.5
270	53	25.10	12.2	54.7	45.3
400	38	18.20	8.9	63.6	36.4
Pan	0	74.90	36.4	100.0	-
Total		205.50	100.0		

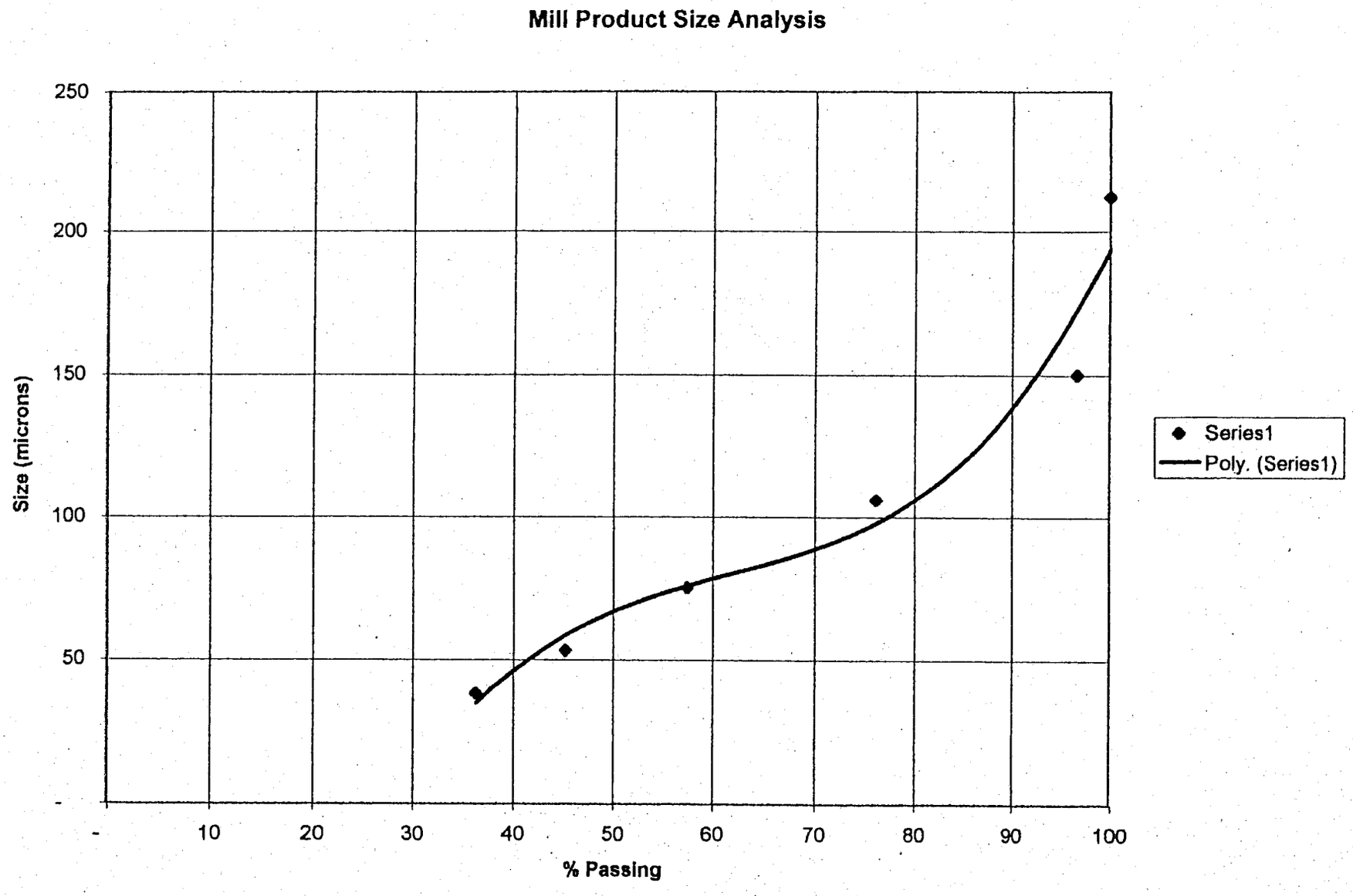
	Interpolated	Graphic
F80	1,869	1,860
P80	114	112

WORK INDEX - FROM GRAPH	13.94
WORK INDEX - INTERPOLATED	14.11
WORK INDEX - AVG	14.03

Appendix B
Bond Ball Mill, 100-mesh

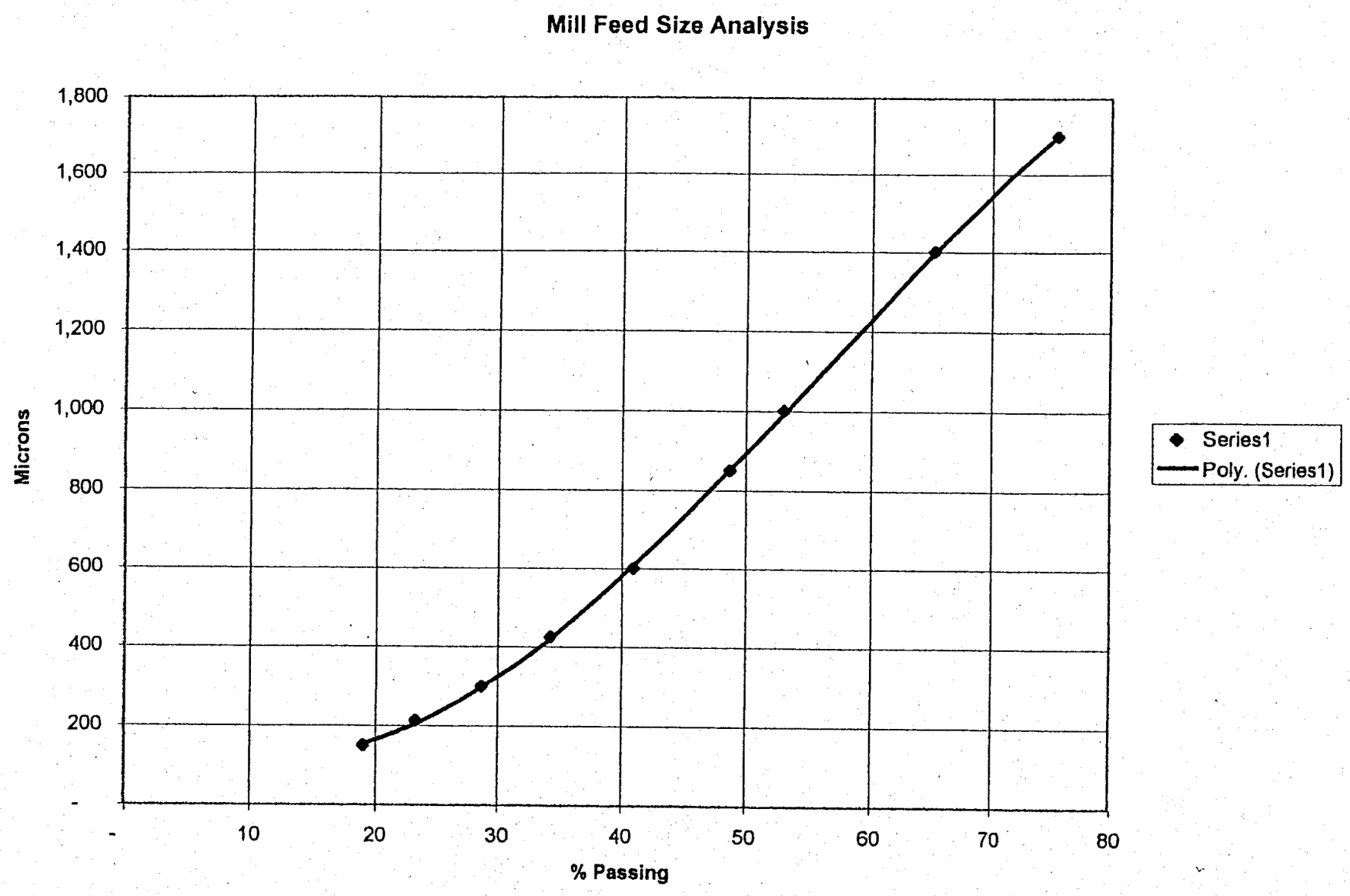


Appendix B
Bond Ball Mill, 100-mesh



pendix B

Bond Ball Mill, 100-mesh



Appendix B
Bond Ball Mill, 100-mesh

Feed

Equation Y = 14.95522687 + 0.04341801173 * X - 4.545362885E-006 * pow(X,2)

R-squared = 0.996965

Y	X
79.9991463	1860.43592

Product

Equation Y = 1.10341343 + 0.9641512743 * X - 0.002323075706 * pow(X,2)

R-squared = 0.99256

Y	X
80.0000456	112.118039

Feed	Microns	% Passing
	2360	92.6
	1700	75.7
	1400	65.3
	1000	53.1
	850	48.8
	600	41.0
	425	34.2
	300	28.8
	212	23.4
	150	19.1

Product	Microns	% Passing
	212	100.0
	150	96.8
	106	76.1
	75	57.5
	53	45.3
	38	36.4

Appendix B

Particle Size Analysis 6

Project: 02-021
Date: 05-Nov-02

Purpose: To determine the particle size distribution of the sample after crushing but before rod mill grinding.

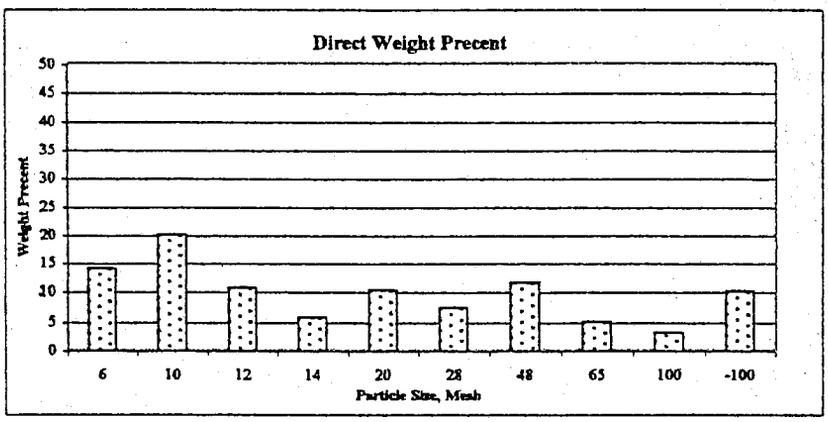
Sample: Approximately 200 grams of RDI Sample #1, Client "Sample #2, Propylitic"

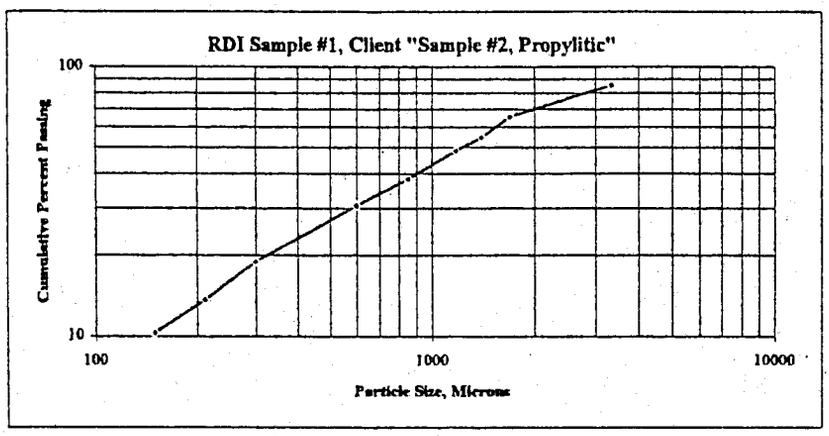
Procedure: The crushed material was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		200.8	100.0		
6	3,350	28.5	14.19	85.81	14.19
10	1,700	40.7	20.27	65.54	34.46
12	1,400	21.8	10.86	54.68	45.32
14	1,180	12.1	6.03	48.66	51.34
20	850	21.0	10.46	38.20	61.80
28	600	15.2	7.57	30.63	69.37
48	300	23.5	11.70	18.92	81.08
65	212	10.5	5.23	13.70	86.30
100	150	6.8	3.39	10.31	89.69
-100	-150	20.7	10.31	0.00	100.00

Product Size Passing 80% (P80): = 2,796 Microns





Appendix B

Particle Size Analysis 7

Project: 02-021
Date: 05-Nov-02

Purpose: To determine the particle size distribution of the sample after crushing but before rod mill grinding.

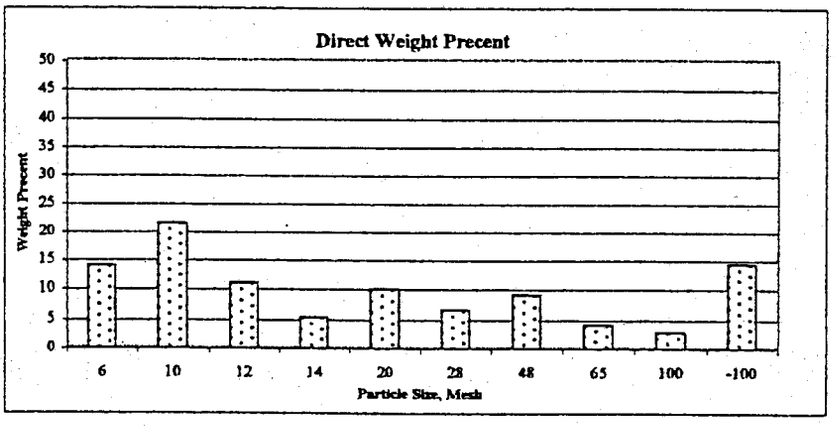
Sample: Approximately 200 grams of RDI Sample #2, Client "Sample #4, Secondary Quartz".

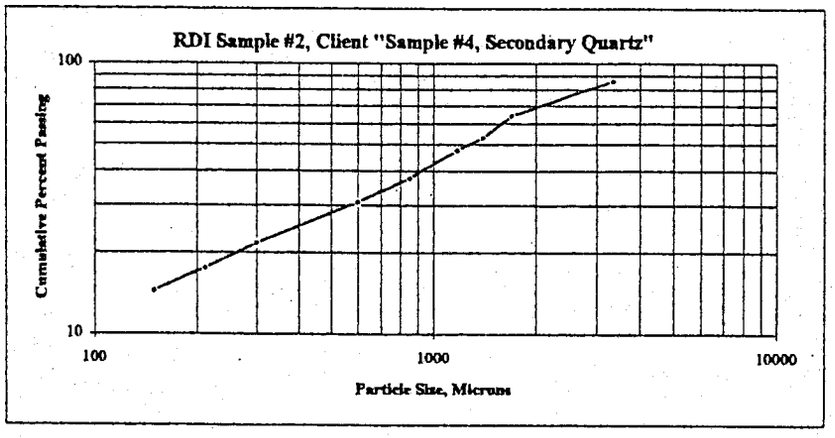
Procedure: The crushed material was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		200.7	100.0		
6	3,350	28.2	14.05	85.95	14.05
10	1,700	43.5	21.67	64.28	35.72
12	1,400	22.3	11.11	53.16	46.84
14	1,180	11.0	5.48	47.68	52.32
20	850	20.2	10.06	37.62	62.38
28	600	13.5	6.73	30.89	69.11
48	300	18.5	9.22	21.67	78.33
65	212	8.5	4.24	17.44	82.56
100	150	6.0	2.99	14.45	85.55
-100	-150	29.0	14.45	0.00	100.00

Product Size Passing 80% (P80): = 2,881 Microns





Appendix B

Particle Size Analysis 8

Project: 02-021
Date: 05-Nov-02

Purpose: To determine the particle size distribution of the sample after crushing but before rod mill grinding.

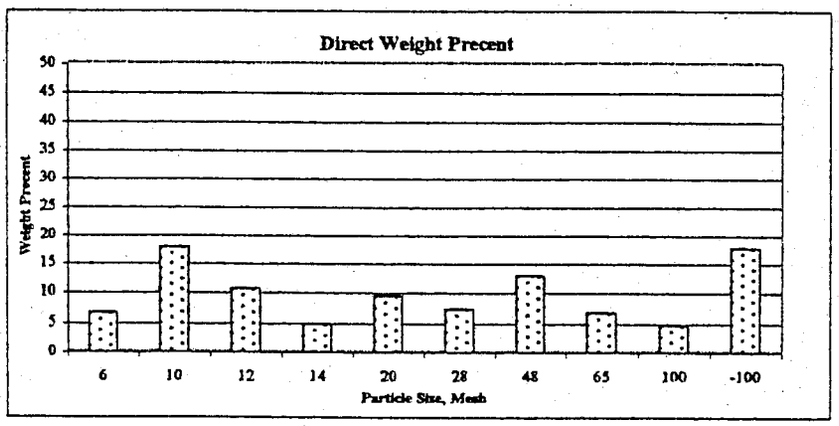
Sample: Approximately 200 grams of RDI Sample #3, Client "Sample #7, Argylite"

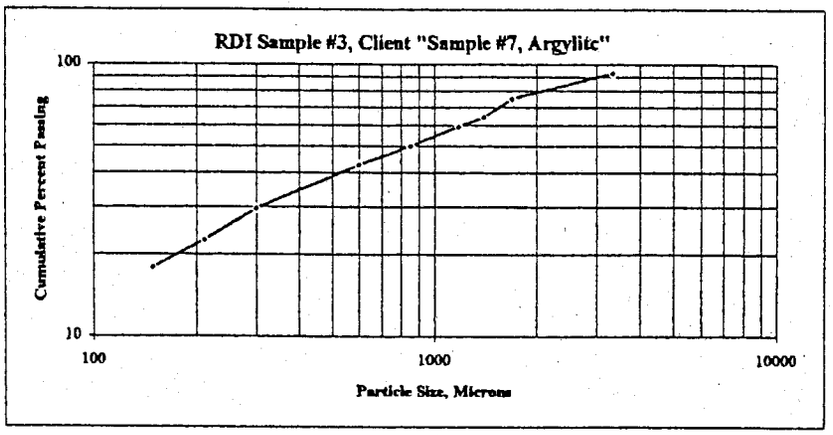
Procedure: The crushed material was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		197.4	100.0		
6	3,350	13.4	6.79	93.21	6.79
10	1,700	35.5	17.98	75.23	24.77
12	1,400	21.2	10.74	64.49	35.51
14	1,180	9.8	4.96	59.52	40.48
20	850	18.8	9.52	50.00	50.00
28	600	14.7	7.45	42.55	57.45
48	300	25.6	12.97	29.58	70.42
65	212	13.6	6.89	22.70	77.30
100	150	9.5	4.81	17.88	82.12
-100	-150	35.3	17.88	0.00	100.00

Product Size Passing 80% (P80): = 2,290 Microns





Appendix B

Particle Size Analysis 9

Project: 02-021
Date: 05-Nov-02

Purpose: To determine the particle size distribution of the sample after crushing but before rod mill grinding.

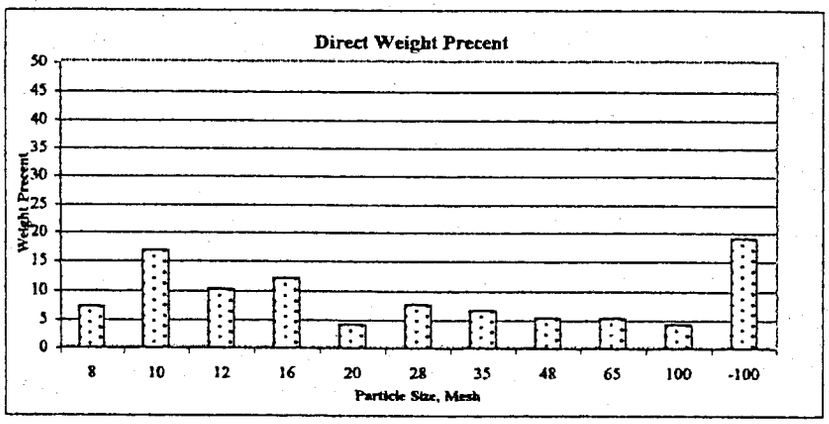
Sample: Approximately 1,000 grams of RDI Sample #4, Client "Composite"

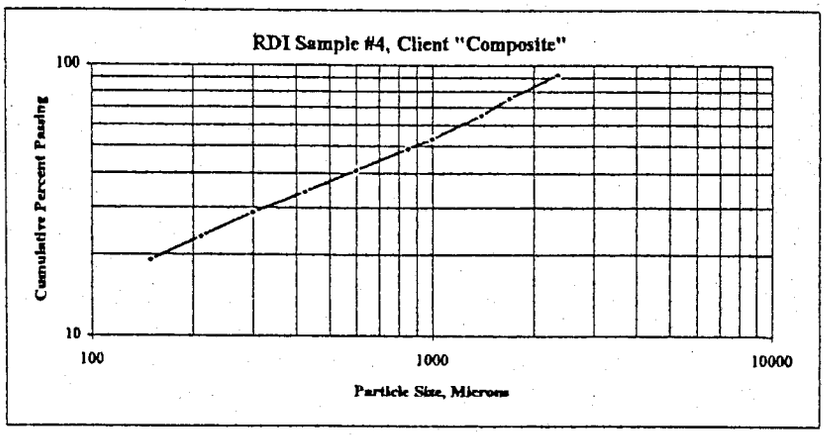
Procedure: The crushed material was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		1006.1	100.0		
8	2,360	74.7	7.42	92.58	7.42
10	1,700	170.2	16.92	75.66	24.34
12	1,400	104.3	10.37	65.29	34.71
16	1,000	123.1	12.24	53.06	46.94
20	850	42.5	4.22	48.83	51.17
28	600	78.8	7.83	41.00	59.00
35	425	68.5	6.81	34.19	65.81
48	300	54.4	5.41	28.78	71.22
65	212	54.6	5.43	23.36	76.64
100	150	43.1	4.28	19.07	80.93
-100	-150	191.9	19.07	0.00	100.00

Product Size Passing 80% (P80): = 1,860 Microns





Appendix B

Particle Size Analysis 10

Project: 02-016
Date:

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

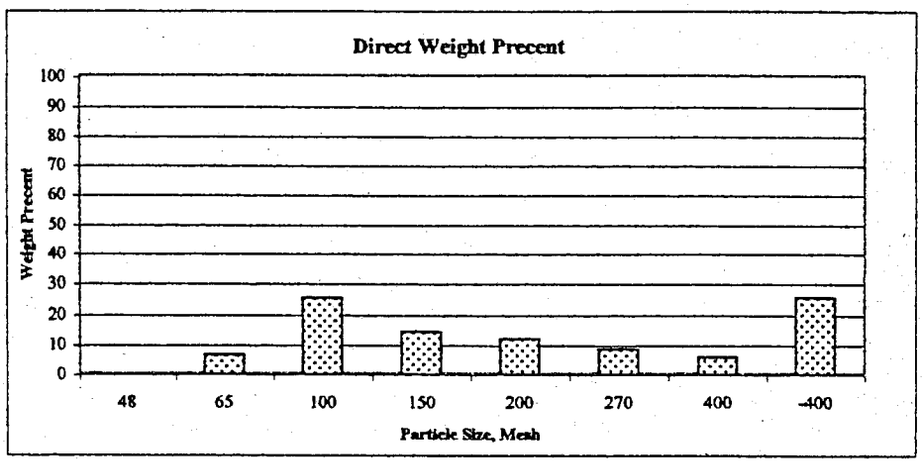
Sample: Approximately 1,000 g of RDI Sample 1, "Sample #2, Propylitic".

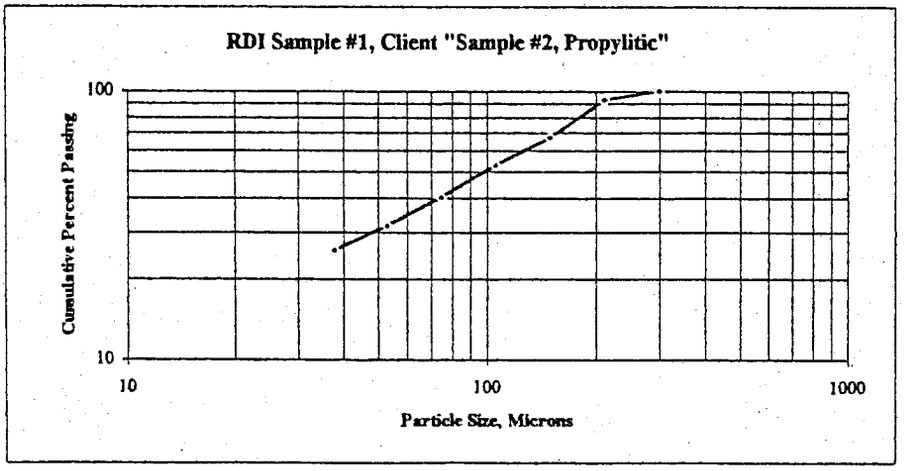
Procedure: The sample was rod mill ground at 50% solids for 25-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		999.5	100.0		
48	300	1.6	0.16	99.84	0.16
65	212	68.5	6.85	92.99	7.01
100	150	255.6	25.57	67.41	32.59
150	106	146.1	14.62	52.80	47.20
200	75	123.3	12.34	40.46	59.54
270	53	86.9	8.69	31.77	68.23
400	38	61.0	6.10	25.66	74.34
-400	-38	256.5	25.66	0.00	100.00

Product Size Passing 80% (P80): = 180 Microns





Appendix B

Particle Size Analysis 11

Project: 02-016
Date:

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

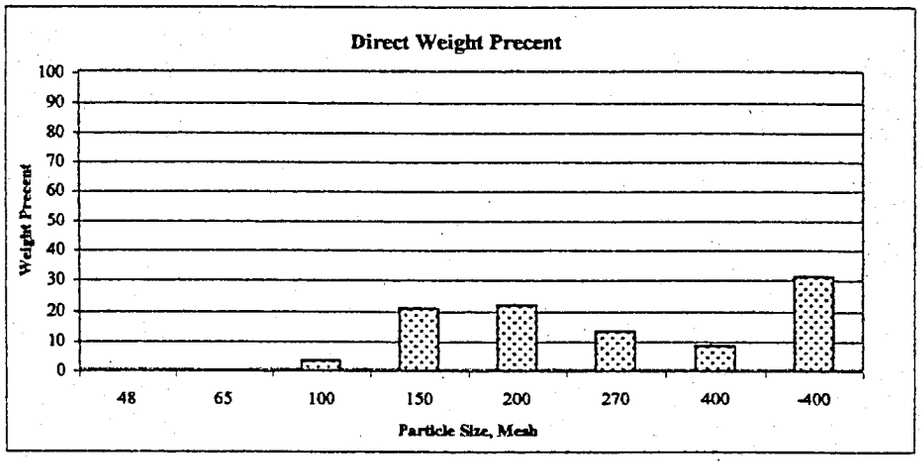
Sample: Approximately 1,000 g of RDI Sample 1, "Sample #4, Secondary Quartz".

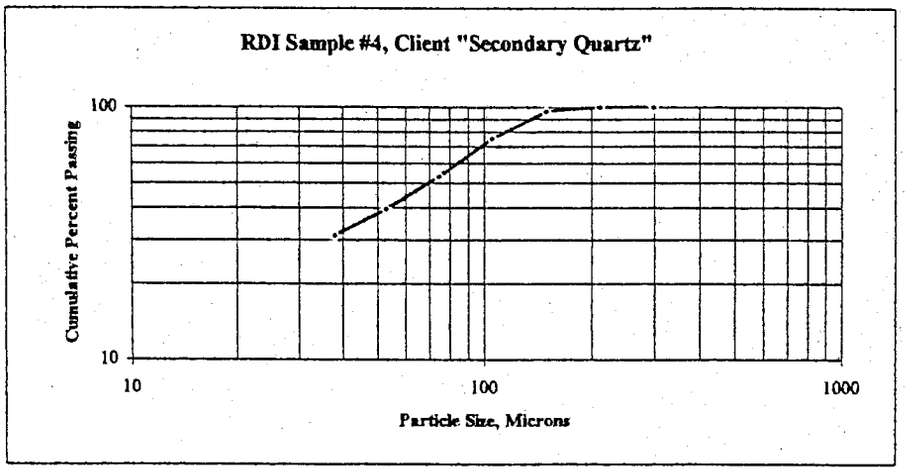
Procedure: The sample was rod mill ground at 50% solids for 25-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		1004.7	100.0		
48	300	0.1	0.01	99.99	0.01
65	212	1.1	0.11	99.88	0.12
100	150	37.0	3.68	96.20	3.80
150	106	211.2	21.02	75.18	24.82
200	75	221.0	22.00	53.18	46.82
270	53	135.4	13.48	39.70	60.30
400	38	85.8	8.54	31.16	68.84
-400	-38	313.1	31.16	0.00	100.00

Product Size Passing 80% (P80): = 114 Microns





Appendix B

Particle Size Analysis 12

Project: 02-016
Date:

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

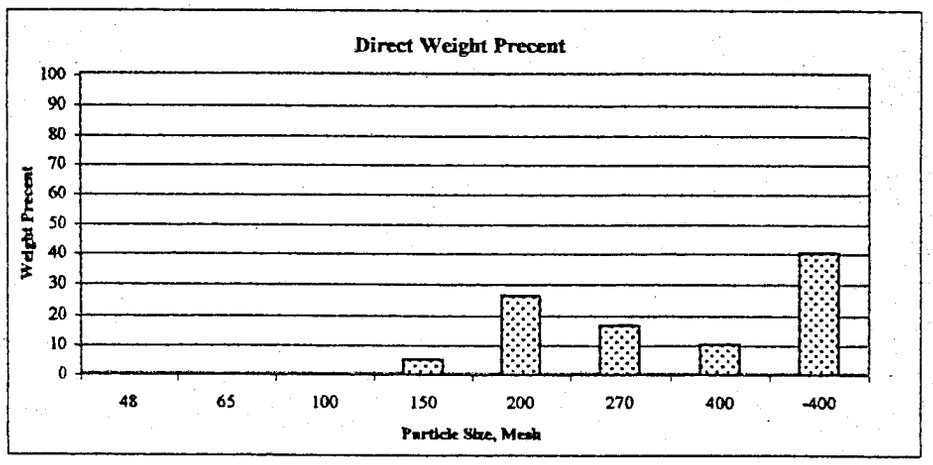
Sample: Approximately 1,000 g of RDI Sample 1, "Sample #7, Argylite".

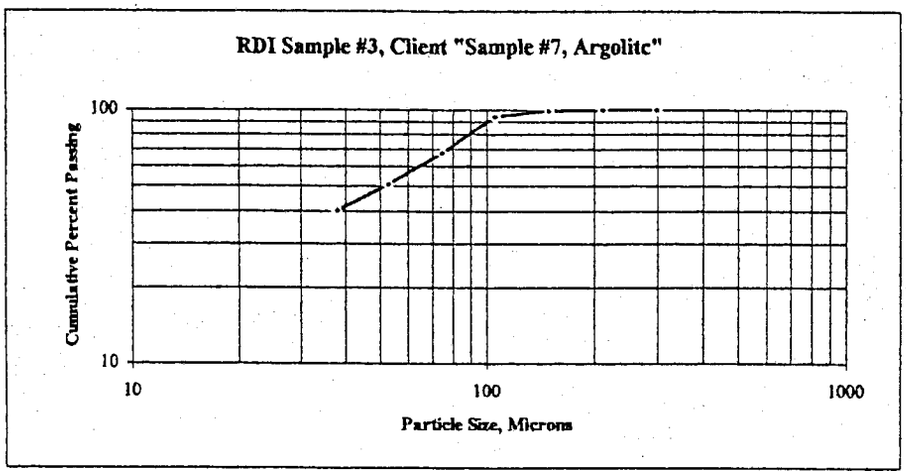
Procedure: The sample was rod mill ground at 50% solids for 25-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		980.3	100.0		
48	300	0.1	0.01	99.99	0.01
65	212	1.3	0.13	99.86	0.14
100	150	6.0	0.61	99.25	0.75
150	106	51.5	5.25	93.99	6.01
200	75	258.6	26.38	67.61	32.39
270	53	164.2	16.75	50.86	49.14
400	38	103.2	10.53	40.33	59.67
-400	-38	395.4	40.33	0.00	100.00

Product Size Passing 80% (P80): = 85 Microns



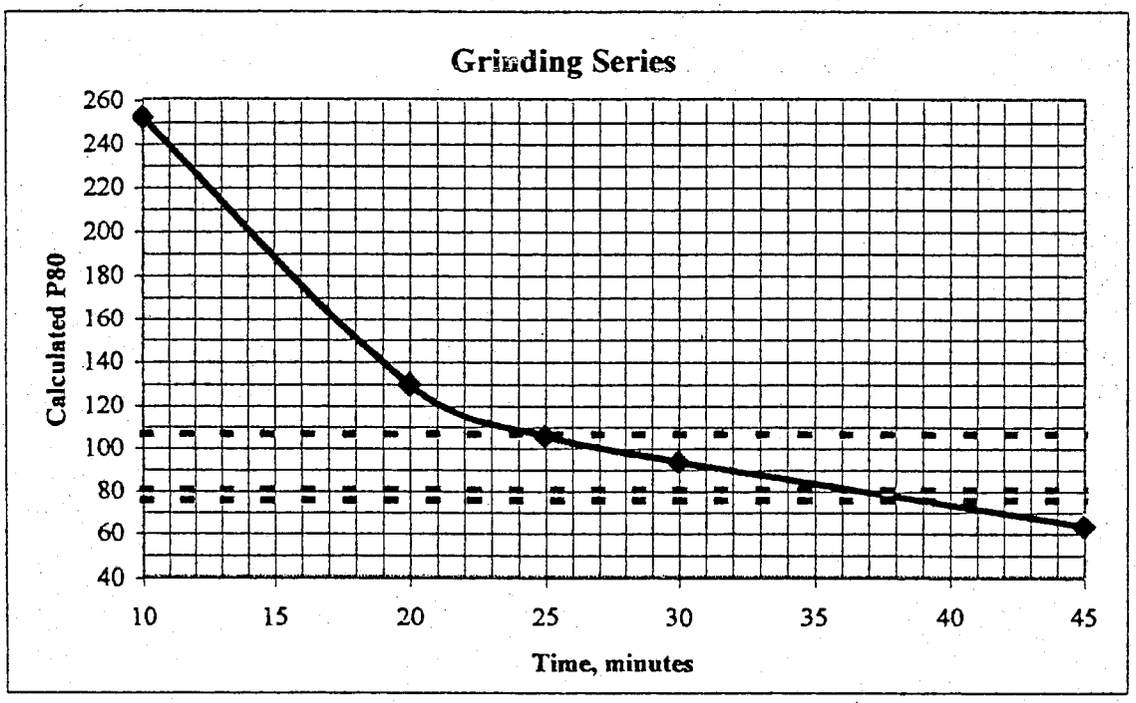


APPENDIX C

GRIND STUDY FOR COMPOSITE SAMPLE

Appendix C

Screen	Microns	Cumulative Percent Passing, Time, minutes: 10	20	25	30	45
48	300	99.6	100.0	100.0	100.0	100.00
65	212	92.4	99.6	99.9	100.0	99.95
100	150	72.0	94.1	98.5	99.3	99.78
150	106	57.3	66.3	75.4	83.2	98.96
200	75	43.8	52.7	59.6	64.9	90.14
270	53	36.4	39.2	44.1	47.3	63.51
325	45	28.4	36.4	41.0	44.2	59.33
400	38	26.5	31.6	35.7	38.3	50.72
P_{80}		252	130	106	94	63



Mesh	P80	Time
100	150	17
150	106	26
	80	35
200	75	37
270	53	55

Equation $\ln(Y) = -0.9128783183 * \ln(X) + 7.621074589$
R-squared = 0.998403

Appendix C

Particle Size Analysis 1

Project: 02-021
Date: 16-Oct-02

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

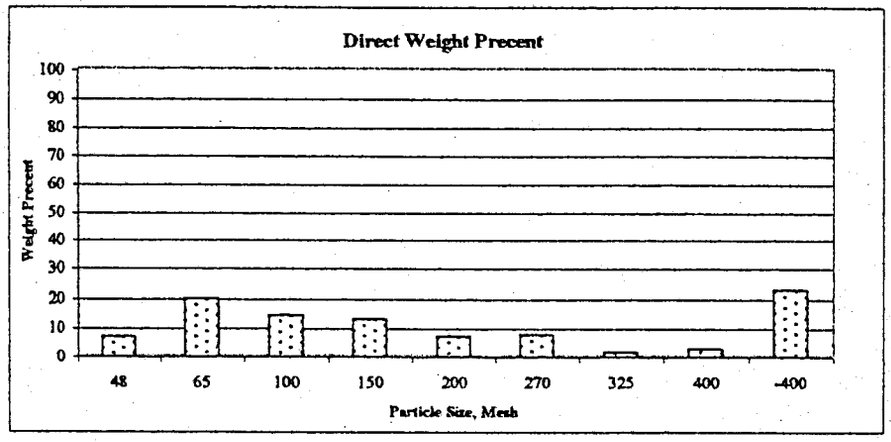
Sample: Approximately 1,000 g of RDI Sample 4, Composite.

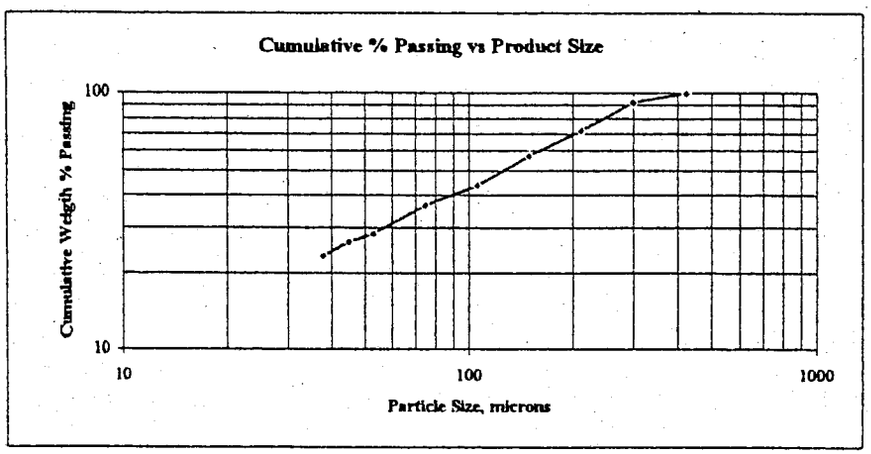
Procedure: The sample was rod mill ground at 50% solids for 10-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		997.4	100.0		
35	425	3.5	0.35	99.65	0.35
48	300	72.8	7.30	92.35	7.65
65	212	202.7	20.32	72.03	27.97
100	150	146.8	14.72	57.31	42.69
150	106	134.6	13.50	43.81	56.19
200	75	73.8	7.40	36.41	63.59
270	53	79.6	7.98	28.43	71.57
325	45	19.7	1.98	26.46	73.54
400	38	30.5	3.06	23.40	76.60
-400	-38	233.4	23.40	0.00	100.00

Product Size Passing 80% (P80): = 252 Microns





Appendix C

Particle Size Analysis 2

Project: 02-021
Date: 22-Oct-02

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

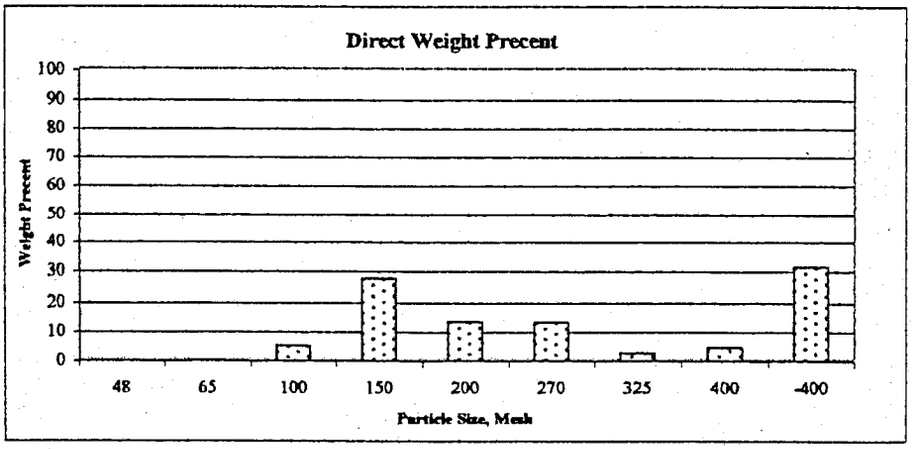
Sample: Approximately 1,000 g of RDI Sample 4, Composite.

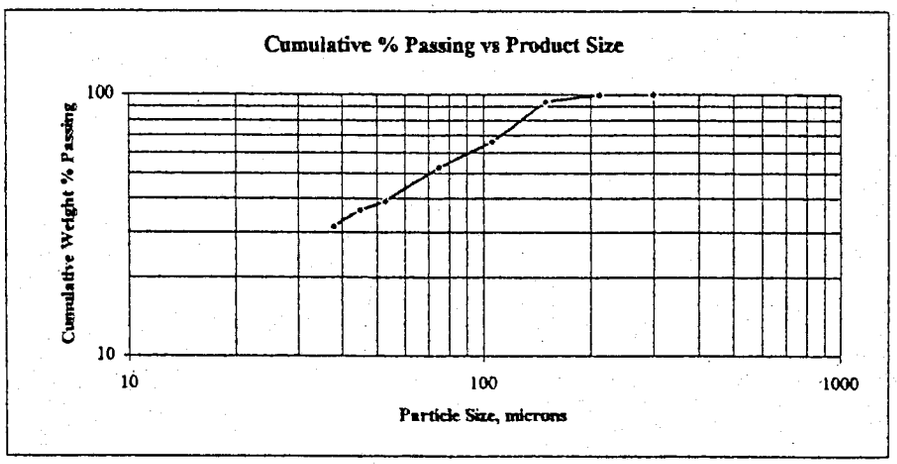
Procedure: The sample was rod mill ground at 50% solids for 20-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		997.1	100.0		
48	300	0.2	0.02	99.98	0.02
65	212	3.8	0.38	99.60	0.40
100	150	54.5	5.47	94.13	5.87
150	106	277.9	27.87	66.26	33.74
200	75	135.2	13.56	52.70	47.30
270	53	134.5	13.49	39.21	60.79
325	45	28.2	2.83	36.39	63.61
400	38	47.7	4.78	31.60	68.40
-400	-38	315.1	31.60	0.00	100.00

Product Size Passing 80% (P80): = 130 Microns





Appendix C

Particle Size Analysis 3

Project: 02-021
Date: 22-Oct-02

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

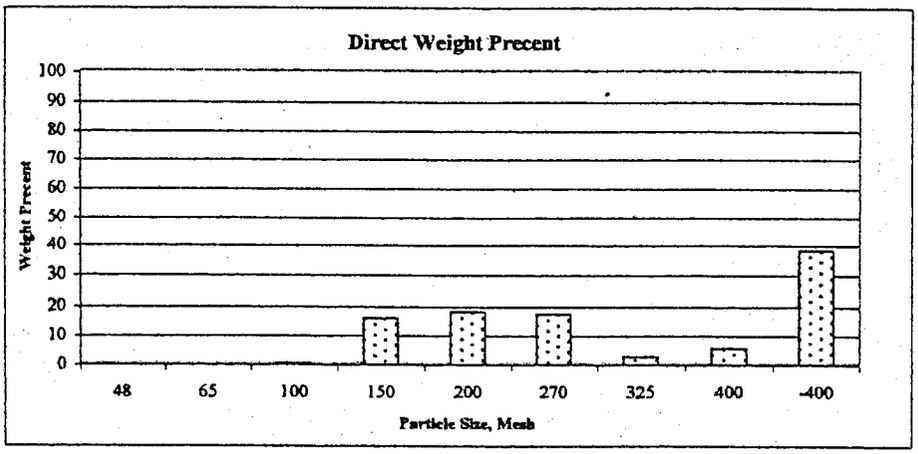
Sample: Approximately 1,000 g of RDI Sample 4, Composite.

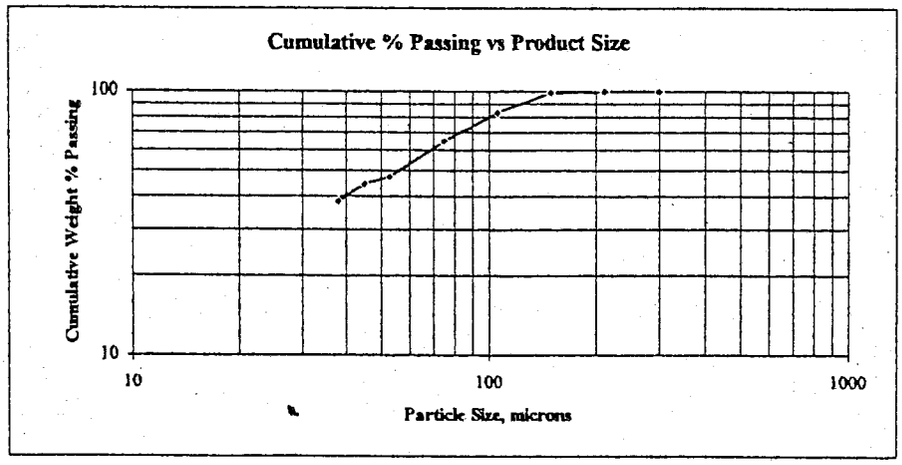
Procedure: The sample was rod mill ground at 50% solids for 30-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		1000.5	100.0		
48	300	0.1	0.01	99.99	0.01
65	212	0.4	0.04	99.95	0.05
100	150	6.7	0.67	99.28	0.72
150	106	161.1	16.10	83.18	16.82
200	75	182.9	18.28	64.90	35.10
270	53	175.6	17.55	47.35	52.65
325	45	31.0	3.10	44.25	55.75
400	38	59.1	5.91	38.34	61.66
-400	-38	383.6	38.34	0.00	100.00

Product Size Passing 80% (P80): = 94 Microns





Appendix C

Particle Size Analysis 4

Project: 02-021
Date: 24-Oct-02

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

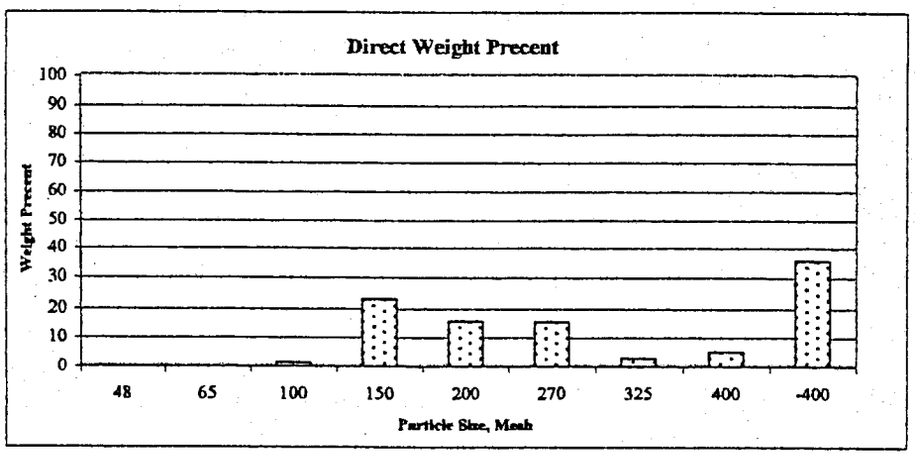
Sample: Approximately 1,000 g of RDI Sample 4, Composite.

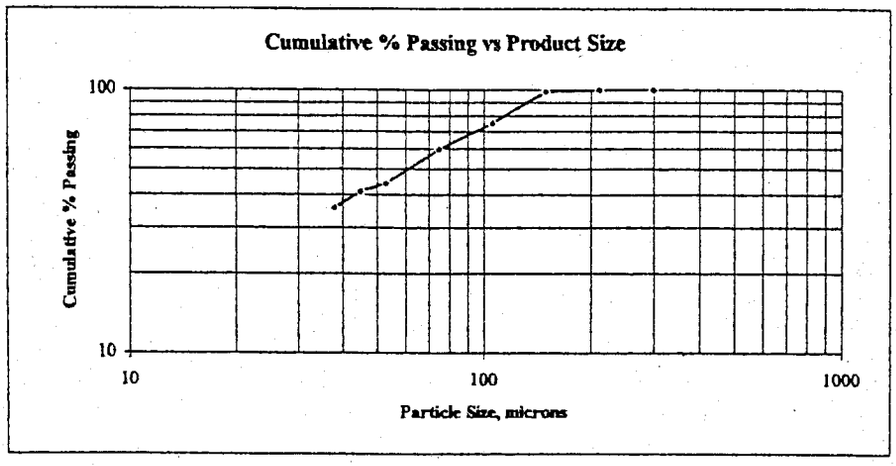
Procedure: The sample was rod mill ground at 50% solids for 25-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		1006.3	100.0		
48	300	0.0	0.00	100.00	0.00
65	212	0.7	0.07	99.93	0.07
100	150	13.9	1.38	98.55	1.45
150	106	233.2	23.17	75.38	24.62
200	75	158.3	15.73	59.64	40.36
270	53	156.9	15.59	44.05	55.95
325	45	30.8	3.06	40.99	59.01
400	38	53.2	5.29	35.71	64.29
-400	-38	359.3	35.71	0.00	100.00

Product Size Passing 80% (P80): = 106 Microns





Appendix C

Particle Size Analysis 5

Project: 02-021
Date: 23-Oct-02

Purpose: To determine the particle size distribution of the sample after rod mill grinding.

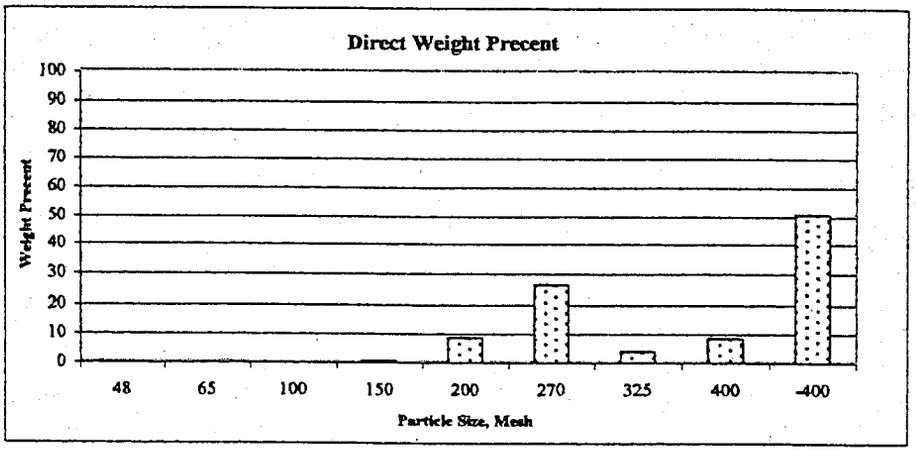
Sample: Approximately 1,000 g of RDI Sample 4, Composite.

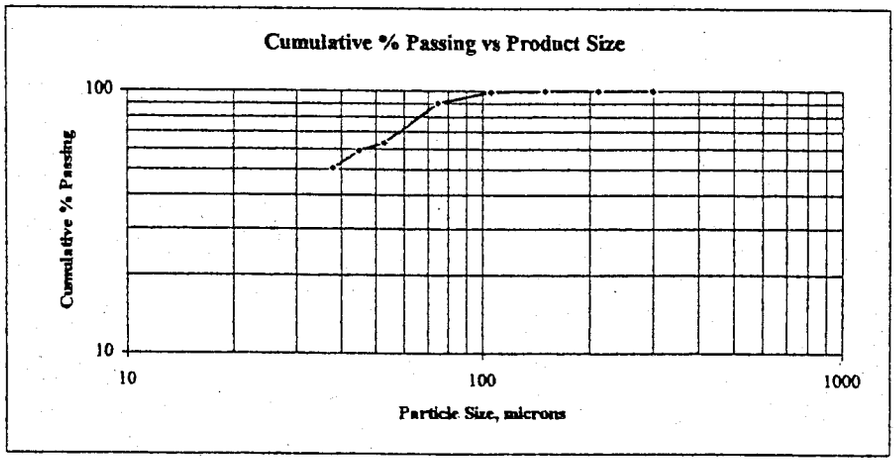
Procedure: The sample was rod mill ground at 50% solids for 45-minutes. The slurry was then wet screened at 400-mesh and dried. The plus 400-mesh fraction was dry screened (Ro-Tap 20-min) at the screen sizes shown below. The screen fractions were weighed and the particle size distribution calculated.

Results:

Product		Weight			
Mesh (Retained)	Microns	Grams	%	Cumulative Passing	Cumulative Retained
Feed (Calculated)		1000.7	100.0		
48	300	0.0	0.00	100.00	0.00
65	212	0.5	0.05	99.95	0.05
100	150	1.7	0.17	99.78	0.22
150	106	8.2	0.82	98.96	1.04
200	75	88.3	8.82	90.14	9.86
270	53	266.5	26.63	63.51	36.49
325	45	41.8	4.18	59.33	40.67
400	38	86.1	8.60	50.72	49.28
-400	-38	507.6	50.72	0.00	100.00

Product Size Passing 80% (P80): = 63 Microns





APPENDIX D

ROUGHER FLOTATION TEST RESULTS FOR COMPOSITE SAMPLE

Appendix D

Flotation Test No. 1

RDi Project No.: 02-021
Date: 25-Nov-02

Purpose: Test the results of standard reagent conditions on the recovery of copper from the sample vs. flotation time.

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed			
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477
Rod Mill Grind	25	50		6.3				
Conditioning	1	26	6.3	10.5	1360	90	12	8
Ro Flotation - 1	1	26	10.5	9.9				
Ro Flotation - 2	2	24	9.9	9.7				
Ro Flotation - 3	3	24	9.7	9.4				
Total Reagent Used, g/mt of feed					1,360	90	12	8
Solution Concentration					100%	1%	0.0040	1%

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,003.6	100.0	0.573			100.0		
Ro-Froth 1	73.2	7.3	5.50			70.0		
Ro-Froth 2	24.9	2.5	3.95			17.1		
Ro-Froth 3	11.9	1.2	1.066			2.2		
Rougher Tailing 3	893.6	89.0	0.069	0.007	0.062	10.7	21.7	10.8
Ro-Conc. 1+2 (calc)	98.1	9.8	5.11			87.1		
Ro-Conc. 1+2+3 (calc)	110.0	11.0	4.67			89.3		
Ro-Conc. 2+3 (calc)	36.8	3.7	3.02			19.3		

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
X133 was the Ore Prep reagent X133, RDi Sample 9.

Appendix D

RDi Project No.: 02-021
Date: 25-Nov-02

Flotation Test No. 2

Purpose: Test the results of lower xanthate collector on the recovery of copper from the sample vs. flotation time. (Additional collector added to third flotation stage.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed			
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477
Rod Mill Grind	25	50		8.4	1000			
Conditioning	1	26	8.4	10.3	400	40	12	8
Ro Flotation - 1	1	26	10.3	9.9				
Ro Flotation - 2	2	24	9.9	9.7				
Ro Flotation - 3	3	24	9.7	9.4		30	12	
Total Reagent Used, g/mt of feed					1,400	70	24	8
Solution Concentration					100%	1%	0.0040	1%

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	999.9	100.0	0.581			100.0		
Ro-Froth 1	73.1	7.3	5.84			73.4		
Ro-Froth 2	28.0	2.8	3.52			17.0		
Ro-Froth 3	15.8	1.6	0.672			1.8		
Rougher Tailing 3	883.0	88.3	0.051	0.011	0.041	7.8	32.3	7.1

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
X133 was the Ore Prep reagent X133, RDi Sample 9.

Ro-Conc. 1+2 (calc)	101.1	10.1	5.20	90.4
Ro-Conc. 1+2+3 (calc)	116.9	11.7	4.59	92.2
Ro-Conc. 2+3 (calc)	43.8	4.4	2.49	18.8

Appendix D

Flotation Test No. 3

RDi Project No.: 02-021
Date: 25-Nov-02

Purpose: Test the results of standard reagent conditions on the recovery of copper from the sample vs. flotation time. (Substitute MIBC for X133 as the frother.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed				
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477	MIBC
Rod Mill Grind	25	50		8.3	1000				
Conditioning	1	26	8.3	10.2	410	40		8	15
Ro Flotation - 1	1	26	10.2	9.9					
Ro Flotation - 2	2	25	9.9	9.6					
Ro Flotation - 3	3	24	9.6	9.3		30			5
Total Reagent Used, g/mt of feed					1,410	70	0	8	20
Solution Concentration					100%	1%	0.0040	1%	0.005

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,011.9	100.0	0.550			100.0		
Ro-Froth 1	63.3	6.3	7.18			81.7		
Ro-Froth 2	20.2	2.0	2.80			10.2		
Ro-Froth 3	13.1	1.3	0.684			1.6		
Rougher Tailing 3	915.3	90.5	0.040	0.010	0.030	6.5	31.5	5.2

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
MIBC was Methyl isobutyl carbinol, from U.S.A.

Ro-Conc. 1+2 (calc)	83.5	8.3	6.12	91.9
Ro-Conc. 1+2+3 (calc)	96.6	9.5	5.38	93.5
Ro-Conc. 2+3 (calc)	33.3	3.3	1.97	11.8

Appendix D

Flotation Test No. 4

RDi Project No.: 02-021
Date: 26-Nov-02

Purpose: Test the effect of pH at standard reagent conditions on the recovery of copper from the sample vs. flotation time. (Lower pH than Test 1.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed			
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477
Rod Mill Grind	25	50		7.9	900			
Conditioning	1	26	7.9	7.9		90	12	8
Ro Flotation - 1	3	26	7.9	8.1				
Ro Flotation - 2	3	24	8.1	8.1				
Total Reagent Used, g/mt of feed					900	90	12	8
Solution Concentration					100%	1%	0.0040	1%

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,005.6	100.0	0.591			100.0		
Ro-Froth 1	93.5	9.3	5.60			88.2		
Ro-Froth 2	15.5	1.5	1.28			3.3		
Rougher Tailing 2	896.6	89.2	0.056	0.013	0.044	8.5	39.1	7.6
Ro-Conc. 1+2 (calc)	109.0	10.8	4.99			91.5		

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
X133 was the Ore Prep reagent X133, RDi Sample 9.

Appendix D

Flotation Test No. 5

RDi Project No.: 02-021
Date: 26-Nov-02

Purpose: Test the effect of pH at standard reagent conditions on the recovery of copper from the sample vs. flotation time. (Higher pH than Test 1.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed			
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477
Rod Mill Grind	25	50		9.6	1600			
Conditioning	1	26	9.6	11.5	60	90	12	8
Ro Flotation - 1	3	26	11.5	11.4				
Ro Flotation - 2	3	24	11.4	11.3				
Total Reagent Used, g/mt of feed					1,660	90	12	8
Solution Concentration					100%	1%	0.0040	1%

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,002.6	100.0	0.567			100.0		
Ro-Froth 1	97.8	9.8	5.27			90.7		
Ro-Froth 2	15.6	1.6	0.92			2.5		
Rougher Tailing 2	889.2	88.7	0.043	0.011	0.033	6.8	32.4	5.7
Ro-Conc. 1+2 (calc)	113.4	11.3	4.67			93.2		

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
X133 was the Ore Prep reagent X133, RDi Sample 9.

Appendix D

Flotation Test No. 6

RDi Project No.: 02-021
Date: 26-Nov-02

Purpose: Test the effect of a finer grind at standard reagent conditions on the recovery of copper from the sample vs. flotation time. (Grind size P80 ~ 94 microns vs. P80 ~ 106 microns in standard 25 minute grind.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed			
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477
Rod Mill Grind	30	50		8.0	1000			
Conditioning	1	26	8.0	10.2	600	90	12	8
Ro Flotation - 1	1	26	10.2	10.0				
Ro Flotation - 2	2	24	10.0	9.8				
Ro Flotation - 3	3	24	9.8	9.3				
Total Reagent Used, g/mt of feed					1,600	90	12	8
Solution Concentration					100%	1%	0.0040	1%

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,005.8	100.0	0.558			100.0		
Ro-Froth 1	79.8	7.9	5.27			74.9		
Ro-Froth 2	26.0	2.6	3.14			14.5		
Ro-Froth 3	16.1	1.6	0.93			2.7		
Rougher Tailing 2	883.9	87.9	0.05	0.009	0.041	7.9	26.5	7.2
Ro-Conc. 1+2 (calc)	105.8	10.5	4.75			89.5		
Ro-Conc. 1+2+3 (calc)	121.9	12.1	4.24			92.1		
Ro-Conc. 2+3 (calc)	42.1	4.2	2.29			17.2		

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
X133 was the Ore Prep reagent X133, RDi Sample 9.

Appendix D

RDI Project No.: 02-021
Date: 18-Dec-02

Flotation Test No. 7

Purpose: To examine the effect of flotation time vs. reagent addition in the third stage of flotation. Comparison to Flotation Test 3. (Substitute MIBC for X133 as the frother.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed				
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477	MIBC
Rod Mill Grind	25	50			1000				
Conditioning	1	26	8.0	10.4	650	40		8	15
Ro Flotation - 1	1	26	10.4	10.1					
Ro Flotation - 2	2	25	10.1	9.7					
Ro Flotation - 3	3	24	9.7	9.4					
Total Reagent Used, g/mt of feed					1,650	40	0	8	15
Solution Concentration					100%	1%	0.0040	1%	0.005

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,003.1	100.0	0.570			100.0		
Ro-Froth 1	63.3	6.3	6.80			75.3		
Ro-Froth 2	22.8	2.3	3.34			13.3		
Ro-Froth 3	12.3	1.2	0.874			1.9		
Rougher Tailing 3	904.7	90.2	0.060	0.010	0.050	9.5	31.4	8.8

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
MIBC was Methyl isobutyl carbinol, from U.S.A.

Ro-Conc. 1+2 (calc)	86.1	8.6	5.88	88.6
Ro-Conc. 1+2+3 (calc)	98.4	9.8	5.26	90.5
Ro-Conc. 2+3 (calc)	35.1	3.5	2.48	15.2

Appendix D

Flotation Test No. 8

RDi Project No.: 02-021
Date: 18-Dec-02

Purpose: Repet the flotation conditions of Flotation Test 3.
(Substitute MIBC for X133 as the frother.)

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed				
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477	MIBC
Rod Mill Grind	25	50			1000				
Conditioning	1	26	7.3	10.3	570	40		8	15
Ro Flotation - 1	1	26	10.3	10.0					
Ro Flotation - 2	2	25	10.0	9.6					
Ro Flotation - 3	3	24	9.6	9.3		30			5
Total Reagent Used, g/mt of feed					1,570	70	0	8	20
Solution Concentration					100%	1%	0.0040	1%	0.005

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,001.6	100.0	0.552			100.0		
Ro-Froth 1	59.1	5.9	6.73			71.9		
Ro-Froth 2	25.2	2.5	3.55			16.2		
Ro-Froth 3	12.9	1.3	1.050			2.4		
Rougher Tailing 3	904.4	90.3	0.058	0.010	0.048	9.5	30.2	8.5

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
MIBC was Methyl isobutyl carbinol, from U.S.A.

Ro-Conc. 1+2 (calc)	84.3	8.4	5.78	88.1
Ro-Conc. 1+2+3 (calc)	97.2	9.7	5.15	90.5
Ro-Conc. 2+3 (calc)	38.1	3.8	2.70	18.6

Appendix D

RDI Project No.: 02-021
Date: 18-Dec-02

Flotation Test No. 9

Purpose: Test the results of standard reagent conditions with higher aeration (higher agitation speed) upon the recovery of copper from the sample.

Sample: Approximately 1,000 grams of the RDi Sample 4, "Composite".

Procedure:

	Conditions				Reagents, g/mt of flotation feed			
Operations	min.	Solids %	pH-Start	pH-End	$Ca(OH)_2$	SIBX	X133	3477
Rod Mill Grind	25	50		8.0	1000			
Conditioning	1	26	8.2	10.3	473	90	12	8
Ro Flotation - 1	1	26	10.3	9.9				
Ro Flotation - 2	2	22	9.9	9.7				
Total Reagent Used, g/mt of feed					1,473	90	12	8
Solution Concentration					100%	1%	0.0040	1%

Results:

Products	Weight		Chemical Analysis			Percent Distribution		
	gr.	%	Cu_T %	Cu_O %	Cu_S %	Cu_T	Cu_O	Cu_S
Feed (analyzed)	1,000.0		0.600	0.029	0.571		100.0	100
Feed (calculated)	1,008.7	100.0						
Ro-Froth 1	173.1	17.2						
Ro-Froth 2	29.7	2.9						
Rougher Tailing 2	805.9	79.9						
Ro-Conc. 1+2 (calc)	202.8	20.1						

No samples were analyzed, due to the high weight recovered to the ro-froths

Observations:

Grind in Steel Mill. Flotation in a 3.2 liter cell at 1600 RPM. Flotation in Wheat Ridge tap water.
Ca(OH)2 wa hydrated lime from Bulgaria
SIBX was the Sodium Isobutil Xanthate - Srbiya, RDi Sample 6.
3477 was the Aero Promoter 3477, RDi Sample 8.
X133 was the Ore Prep reagent X133, RDi Sample 9.

Florin Analytical Services, LLC

7950 Security Circle - Reno, Nevada 89506 - Phone (775) 677-2177 - FAX (775) 972-4567

Certificate of Analysis

Submitted By: Resource Development, Inc

Laboratory No.:021629

Client Number: F174

Attention: Mr. Deepak Malhotra

Date: 12/10/02

Method: 4-Acid digestion, AA Analysis for total copper. 1 Molar H_2SO_4 with $Fe_2(SO_4)_3 \cdot 5H_2O$ for copper oxide analysis.

Lab code:	7015	7015	7016	7016
Element:	Copper	Copper QC	Copper Oxide	Copper Oxide QC
Detection Limit:	2	2	2	2
Units:	mg/kg	mg/kg	mg/kg	mg/kg
BUI-T-1 Conc 1	55200	54800		
BUI-T-1 Conc 2	39500			
BUI-T-1 Conc 3	10660			
BUI-T-2 Conc 1	58400			
BUI-T-2 Conc 2	35200			
BUI-T-2 Conc 3	6720			
BUI-T-3 Conc 1	71800			
BUI-T-3 Conc 2	28000			
BUI-T-3 Conc 3	6840			
BUI-T-4 Conc 1	56000			
BUI-T-4 Conc 2	13000	12580		
BUI-T-5 Conc 1	52800	52600		
BUI-T-5 Conc 2	9300	9100		
BUI-Tail T-1	686		70	71
BUI-Tail T-2	512		105	
BUI-Tail T-3	396		100	
BUI-Tail T-4	562		126	
BUI-Tail T-5	432		105	

Richard A. Grondin, QC Manager

Nevada Assembly Bill No. 519.130 requires the following statement: The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials ected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed ect.

Florin Analytical Services, LLC

7950 Security Circle - Reno, Nevada 89506 - Phone (775) 677-2177 - FAX (775) 972-4567

Certificate of Analysis

Submitted By: Resource Development, Inc

Laboratory No.:021629

Client Number: F174

Attention: Mr. Deepak Malhotra

Date: 12/10/02

Method: 4-Acid digestion, AA Analysis for total copper. 1 Molar H_2SO_4 with $Fe_2(SO_4)_3 \cdot 5H_2O$ for copper oxide analysis.

Lab code:	7015	7015	7016	7016
Element:	Copper	Copper QC	Copper Oxide	Copper Oxide QC
Detection Limit:	2	2	2	2
Units:	mg/kg	mg/kg	mg/kg	mg/kg
BUI-T-1 Conc 1	55200	54800		
BUI-T-1 Conc 2	39500			
BUI-T-1 Conc 3	10660			
BUI-T-2 Conc 1	58400			
BUI-T-2 Conc 2	35200			
BUI-T-2 Conc 3	6720			
BUI-T-3 Conc 1	71800			
BUI-T-3 Conc 2	28000			
BUI-T-3 Conc 3	6840			
BUI-T-4 Conc 1	56000			
BUI-T-4 Conc 2	13000	12580		
BUI-T-5 Conc 1	52800	52600		
BUI-T-5 Conc 2	9300	9100		
BUI-Tail T-1	686		70	71
BUI-Tail T-2	512		105	
BUI-Tail T-3	396		100	
BUI-Tail T-4	562		126	
BUI-Tail T-5	432		105	

Richard A. Grondin, QC Manager

Nevada Assembly Bill No. 519.130 requires the following statement: The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project.

Florin Analytical Services, LLC

7950 Security Circle - Reno, Nevada 89506 - Phone (775) 677-2177 - FAX (775) 972-4567

Certificate of Analysis

Submitted By: Resource Development, Inc

Laboratory No.:021635

Client Number: F174

Attention: Mr. Edwin Bentzen III

Date: 12/17/02

Method: 4-Acid digestion, AA analysis for total copper. 1 Molar H_2SO_4 with $Fe_2(SO_4)_3 \cdot 5H_2O$ for copper oxide analysis.

Lab code:	7015	7015	7016	7016
Element:	Copper	Copper	Copper Oxide	Copper Oxide
Detection Limit:	0.01	0.01	1	1
Units:	%	%	mg/kg	mg/kg
BUI Test 6 Conc-1	5.27	5.18		
BUI Test 6 Conc-2	3.14			
BUI Test 6 Conc-3	0.93			
BUI Test 6 Tail	0.05		88	85

Richard A. Grondin QC Manager

Nevada Assembly Bill No. 519.130 requires the following statement: The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project.

Florin Analytical Services, LLC

7950 Security Circle - Reno, Nevada 89506 - Phone (775) 677-2177 - FAX (775) 972-4567

Certificate of Analysis

Submitted By: Resource Development, Inc — Laboratory No.:021635

Client Number: F174

Attention: Mr. Edwin Bentzen III — Date: 12/17/02

Method: 4-Acid digestion, AA analysis for total copper. 1 Molar H_2SO_4 with $Fe_2(SO_4)_3 \cdot 5H_2O$ for copper oxide analysis.

Lab code:	7015	7015	7016	7016
Element:	Copper	Copper	Copper Oxide	Copper Oxide
Detection Limit:	0.01	0.01	1	1
Units:	%	%	mg/kg	mg/kg
BUI Test 6 Conc-1	5.27	5.18		
BUI Test 6 Conc-2	3.14			
BUI Test 6 Conc-3	0.93			
BUI Test 6 Tail	0.05		88	85

Richard A.Grondin QC Manager

Nevada Assembly Bill No. 519.130 requires the following statement: The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project.

Florin Analytical Services, LLC

7950 Security Circle - Reno, Nevada 89506 - Phone (775) 677-2177 - FAX (775) 972-4567

Certificate of Analysis

Submitted By: Resource Development, Inc

Laboratory No.:021678

Client Number: F174

Attention: Mr. Edwin Bentzen III

Date: 01/07/03

Method: 4-Acid digestion, AA Analysis for total copper. 1 Molar H_2SO_4 with $Fe_2(SO_4)_3 \cdot 5H_2O$ for copper oxide analysis.

Lab code:	7015	7016
Element:	Copper	Copper
Detection Limit:	0.001	1
Units:	%	mg/kg
BUL FT-7 Conc 1	6.80	
BUL FT-8 Conc 1	6.73	
BUL FT-7 Conc 2	3.34	
BUL FT-8 Conc 2	3.55	
BUL FT-7 Conc 3	0.874	
BUL FT-8 Conc 3	1.05	
BUL FT-7 Tail	0.060	100
BUL FT-8 Tail	0.058	96

Richard A.Grondin QC Manager

Nevada Assembly Bill No. 519.130 requires the following statement: The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project.

APPENDIX E

THICKENING DATA FOR ROUGHER FLOTATION TAILING

Appendix E
Thickening Tests

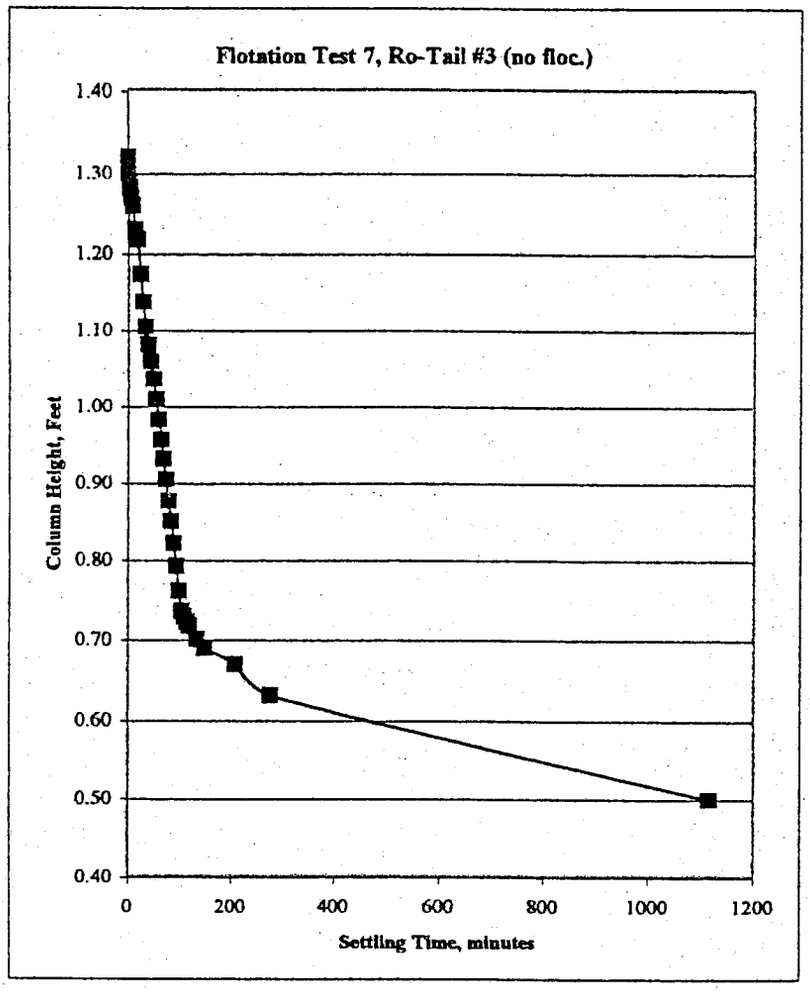
KNOWN =	WEIGHT	FEED WT % SOLIDS	SETTLED VOL	SETTLED VOL	SETTLED VOL
UNKNOWN =	% SOLIDS	WT SOLIDS	% SOLIDS	% SOLIDS	% SOLIDS
GRADUATE CYLINDER LEVEL	2000	2000	750	871	1022
GROSS WEIGHT GR.	2801.6	---	---	---	---
TARE WEIGHT GR.	462.7	---	---	---	---
NET WEIGHT GR	2338.9	---	---	---	---
SP. GR. PULP	1.17	1.17	---	---	---
SP. GR. OF SOLIDS	2.65	2.65	2.65	2.65	2.65
PERCENT SOLIDS V/V	10.3%	10.3%	27.4%	23.6%	20.1%
PERCENT SOLIDS W/W	23.3%	23.3%	50%	45%	40%
WEIGHT OF SOLIDS GR.	544.3	544.3	544.3	544.3	544.3
Initial Density (parts water to parts solids)	F	3.297			
Final Density (parts water to parts solids)	D		1.001	1.222	1.500
Cylinder, ml	2,000				
Height, ft	1.33333				
ft/ml	0.00066667				
Distance from bottom in feet			0.500	0.580	0.681

Appendix E
Thickening Tests

Initial height = 1.33333
Initial pH = 8.8

Test #7 Ro-Tail #3

Time, min	ft	ml	Dist (50 th)
0	1.3217	1983	7
2.0	1.3000	1950	20
4.0	1.2900	1935	26
5.0	1.2817	1923	31
7.0	1.2700	1905	38
10.0	1.2600	1890	44
15.0	1.2300	1845	62
20.0	1.2183	1828	69
25.0	1.1750	1763	95
30.0	1.1383	1708	117
35.0	1.1050	1658	137
40.0	1.0817	1623	151
45.0	1.0600	1590	164
50.0	1.0367	1555	178
55.0	1.0100	1515	194
60.0	0.9833	1475	210
65.0	0.9567	1435	226
70.0	0.9317	1398	241
75.0	0.9050	1358	257
80.0	0.8767	1315	274
85.0	0.8500	1275	290
90.0	0.8217	1233	307
95.0	0.7933	1190	324
100.0	0.7617	1143	343
105.0	0.7367	1105	358
110.0	0.7300	1095	362
115.0	0.7233	1085	366
120.0	0.7183	1078	369
135.0	0.7017	1053	379
150.0	0.6900	1035	386
210.0	0.6700	1005	398
278.0	0.6317	948	421
1118.0	0.5000	750	500



A = 1.333 * (F-D) / R

Minutes	Distance
4	1.2900
95	0.8217
91	0.4683

Initial Settling Rate
0.005 ft/min

50% solids

R =	0.005	Inital settling rate
F =	3.297	Initial Density
D =	1.001	Final Density
A =	594.8	Thickener Area, Ft^2/ton/24-hr

45% solids

R =	0.005	Inital settling rate
F =	3.297	Initial Density
D =	1.222	Final Density
A =	537.5	Thickener Area, Ft^2/ton/24-hr

40% solids

R =	0.005	Inital settling rate
F =	3.297	Initial Density
D =	1.500	Final Density
A =	465.5	Thickener Area, Ft^2/ton/24-hr

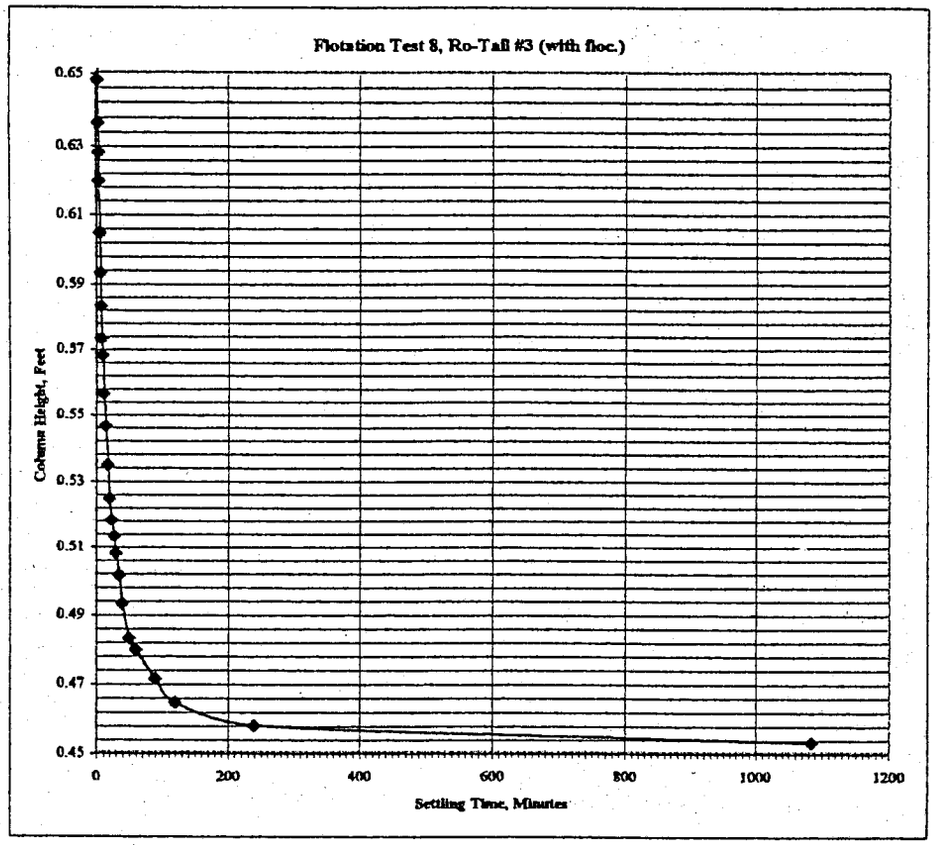
Appendix E
Thickening Tests

KNOWN =	WEIGHT	FEED WT % SOLIDS	SETTLED VOL	SETTLED VOL	SETTLED VOL
UNKNOWN =	% SOLIDS	WT SOLIDS	% SOLIDS	% SOLIDS	% SOLIDS
GRADUATE CYLINDER LEVEL	1900	1900	680	714	829
GROSS WEIGHT GR.	2672.5	---	---	---	---
TARE WEIGHT GR.	449.5	---	---	---	---
NET WEIGHT GR	2223.0	---	---	---	---
SP. GR. PULP	1.17	1.17	---	---	---
SP. GR. OF SOLIDS	2.65	2.65	2.65	2.65	2.65
PERCENT SOLIDS V/V	10.3%	10.3%	28.8%	27.4%	23.6%
PERCENT SOLIDS W/W	23.3%	23.3%	52%	50%	45%
WEIGHT OF SOLIDS GR.	518.8	518.8	518.8	518.8	518.8
FLOC STRENGTH	0.01%				
ml ADDED	100.00				
FLOC, LB/TON	0.039				
FLOC, PPM	5.26				
Cylinder, ml	2,000				
Height, ft	1.33333				
ft/ml	0.00066667				
Distance from bottom in feet			0.453	0.476	0.553

Initial height =	1.33333
Initial pH =	8.8
Floc @ lb/st	0.039

Test #8 Ro-Tail #3

Time	ft	ml	Dist (50 ft)
0:00:00	1.3083	1963	15
0:00:05	1.1933	1790	84
0:00:10	1.1200	1680	128
0:00:15	1.0517	1578	169
0:00:20	0.9867	1480	208
0:00:25	0.9383	1408	237
0:00:30	0.8967	1345	262
0:00:35	0.8650	1298	281
0:00:40	0.8383	1258	297
0:00:45	0.8167	1225	310
0:00:50	0.7950	1193	323
0:01:00	0.7800	1170	332
0:01:10	0.7583	1138	345
0:01:20	0.7417	1113	355
0:01:30	0.7283	1093	363
0:01:40	0.7167	1075	370
0:01:50	0.7033	1055	378
0:02:00	0.6967	1045	382
0:02:30	0.6733	1010	396
0:03:00	0.6617	993	403
0:03:30	0.6483	973	411
0:04:00	0.6367	955	418
0:04:30	0.6283	943	423
0:05:00	0.6200	930	428
0:06:00	0.6050	908	437
0:07:00	0.5933	890	444
0:08:00	0.5833	875	450
0:09:00	0.5733	860	456
0:10:00	0.5683	853	459
0:12:00	0.5567	835	466
0:15:00	0.5467	820	472
0:18:00	0.5350	803	479
0:21:00	0.5250	788	485
0:24:00	0.5183	778	489
0:28:00	0.5133	770	492
0:30:00	0.5083	763	495
0:35:00	0.5017	753	499
0:40:00	0.4933	740	504
0:50:00	0.4833	725	510
1:00:00	0.4800	720	512
1:30:00	0.4717	708	517
2:00:00	0.4650	698	521
4:00:00	0.4583	688	525
18:05:10	0.4533	680	528



% Solids Target	Distance Ft
52%	0.453
50%	0.476
45%	0.553

	52% solids		50% solids		45% solids	
	Metric	SI	Metric	SI	Metric	SI
tc	0.0507	0.0507	0.0382	0.0382	0.0090	0.0090
Co	1.1700	0.0366	1.1700	0.0366	1.1700	0.0366
Ho	0.4064	1.3333	0.4064	1.3333	0.4064	1.3333

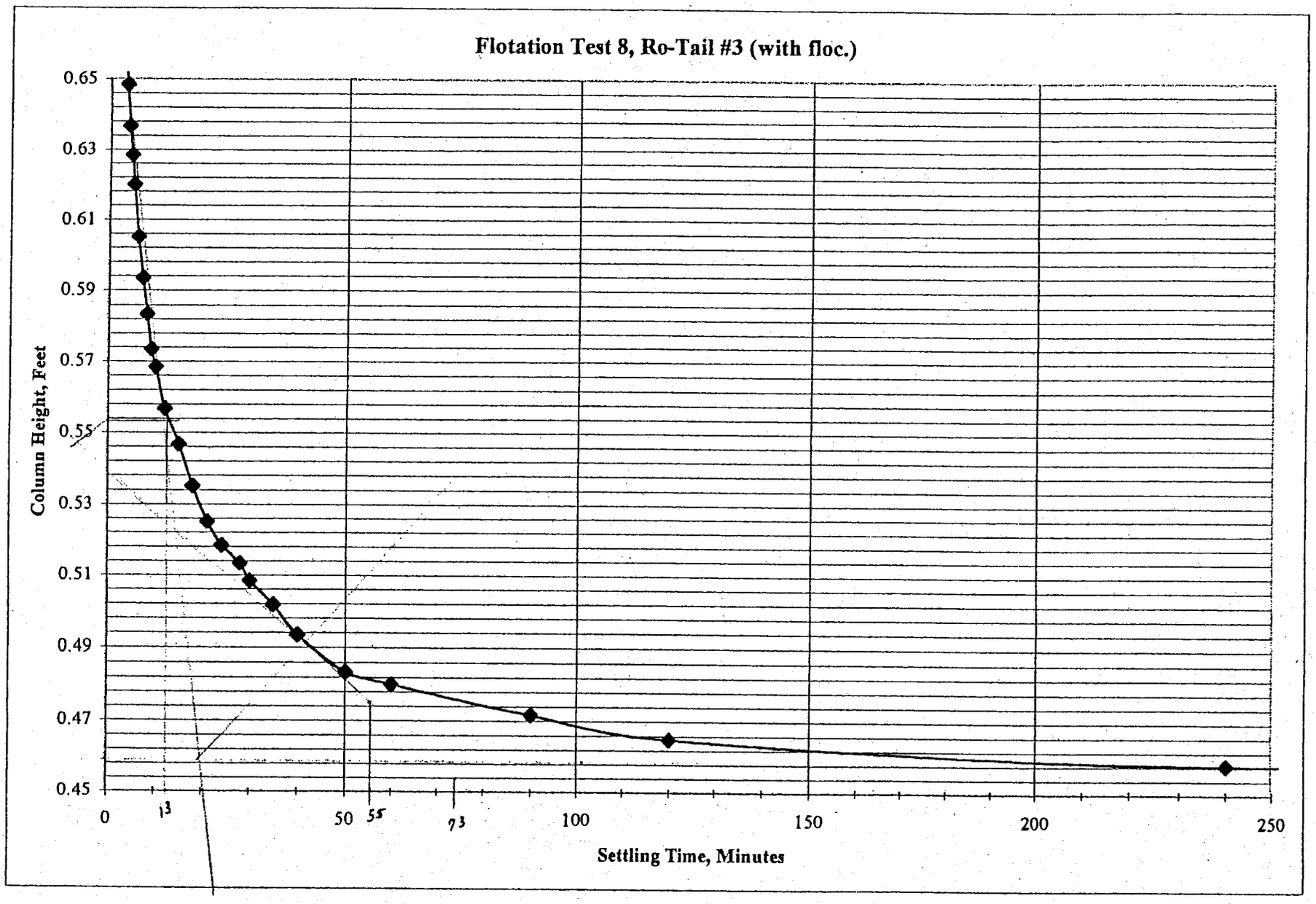
$$UA = t_c / H_o * C_o$$

t_c	=	Critical Time
C_o	=	Initial Solids Concentration
H_o	=	Initial Height of Pulp Test Column
UA	=	Unit Area

	m²/h/day	ft²/h/day	m²/h/day	ft²/h/day	m²/h/day	ft²/h/day
UA	0.107	1.040	0.080	0.783	0.019	0.185

MT/day	ST/day
36,000	39,600

	meters	feet	meters	feet	meters	feet
Diameter	69.9	229.0	60.7	198.8	29.5	96.6


Flotation Test 8, Ro-Tail #3 (with floc.)
Column Height, Feet
0.65
0.63
0.61
0.59
0.57
0.55
0.53
0.51
0.49
0.47
0.45
0
13
50
55
73
100
150
200
250
Settling Time, Minutes

ASSAREL MEDET LABORATORY RESULTS

Tests with ore - prophylites

9/26/02

pH - 10-10,5

№		Production		Cu -0,461			S - 3,65			Fe -4,51			reagents - gr/t			% solid	Size -0.08
		gr	%	grade	metal	recovery	grade	metal	recovery	grade	metal	recovery	kst	X 133	3477		
1.	Concentrate	171.2	21.40	1.80	38.520	86.42	12.88	275.63	75.79	13.26	283.764	58.51	90	10	8	27	60
	Tailing	628.8	78.60	0.077	6.052	13.58	1.12	88.03	24.21	2.56	201.216	41.49					
		800.0	100.00	0.446	44.572	100.00	3.64	363.66	100.00	4.850	484.980	100.00					
2.	Concentrate	185.0	23.13	1.71	39.544	86.40	11.92	275.65	77.02	12.05	278.656	58.42	90	10	8	27	60
	Tailing	615.0	76.88	0.081	6.227	13.60	1.07	82.26	22.98	2.58	198.338	41.58					
		800.0	100.00	0.458	45.771	100.00	3.58	357.91	100.00	4.770	476.994	100.00					
3.	Concentrate	170.9	18.68	1.94	36.235	83.66	15.01	280.35	80.22	13.02	243.182	52.09	90	10	8	30	50
	Tailing	744.1	81.32	0.087	7.075	16.34	0.85	69.12	19.78	2.75	223.637	47.91					
		915.0	100.00	0.433	43.310	100.00	3.49	349.47	100.00	4.668	466.819	100.00					
4.	Concentrate	178.4	19.50	1.88	36.655	84.74	14.72	287.00	79.84	12.48	243.326	51.73	90	10	8	30	50
	Tailing	736.6	80.50	0.082	6.601	15.26	0.9	72.45	20.16	2.82	227.018	48.27					
		915.0	100.00	0.433	43.256	100.00	3.59	359.45	100.00	4.703	470.344	100.00					
5.	Concentrate	240.4	21.66	1.88	40.716	87.68	14.13	306.02	87.27	14.81	320.750	66.96	90	10	8	35	50
	Tailing	869.6	78.34	0.073	5.719	12.32	0.57	44.66	12.73	2.02	158.252	33.04					
		1110.0	100.00	0.464	46.435	100.00	3.51	350.68	100.00	4.790	479.001	100.00					
6.	Concentrate	250.7	22.59	1.76	39.751	86.96	13.80	311.68	88.37	13.44	303.550	66.90	90	10	8	35	50
	Tailing	859.3	77.41	0.077	5.961	13.04	0.53	41.03	11.63	1.94	150.184	33.10					
		1110.0	100.00	0.457	45.712	100.00	3.53	352.71	100.00	4.537	453.734	100.00					
7.	Concentrate	299.2	22.67	1.79	40.573	86.06	13.48	305.55	92.08	12.94	293.307	64.80	90	10	8	40	50
	Tailing	1020.8	77.33	0.085	6.573	13.94	0.34	26.29	7.92	2.06	159.307	35.20					
		1320.0	100.00	0.471	47.147	100.00	3.318	331.84	100.00	4.526	452.613	100.00					
8.	Concentrate	310.0	23.48	1.73	40.629	86.34	13.16	309.06	92.03	12.54	294.500	65.25	90	10	8	40	50
	Tailing	1010.0	76.52	0.084	6.427	13.66	0.35	26.78	7.97	2.05	156.856	34.75					
		1320.0	100.00	0.471	47.056	100.00	3.358	335.84	100.00	4.514	451.356	100.00					
9.	Concentrate	182.5	19.95	2.06	41.087	88.00	13.76	274.45	81.27	13.24	264.077	54.99	90	10	8	30	65
	Tailing	732.5	80.05	0.07	5.604	12.00	0.79	63.24	18.73	2.7	216.148	45.01					
		915.0	100.00	0.467	46.691	100.00	3.377	337.69	100.00	4.802	480.224	100.00					
10.	Concentrate	170.0	18.58	2.22	41.246	88.17	14.42	267.91	79.66	13.74	255.279	54.57	90	10	8	30	65
	Tailing	745.0	81.42	0.068	5.537	11.83	0.84	68.39	20.34	2.61	212.508	45.43					
		915.0	100.00	0.468	46.783	100.00	3.363	336.31	100.00	4.678	467.787	100.00					
11.	Concentrate	216.5	19.50	2.06	40.179	89.27	7.86	153.31	45.73	9.92	193.485	40.17	90	10	8	35	65
	Tailing	893.5	80.50	0.060	4.830	10.73	2.260	181.92	54.27	3.58	288.174	59.83					
		1110.0	100.00	0.450	45.009	100.00	3.352	335.23	100.00	4.817	481.659	100.00					
12.	Concentrate	202.0	18.20	2.17	39.490	89.11	8.56	155.78	45.51	10.96	199.452	39.98	90	10	8	35	65
	Tailing	908.0	81.80	0.059	4.826	10.89	2.28	186.51	54.49	3.66	299.395	60.02					
		1110.0	100.00	0.443	44.316	100.00	3.423	342.28	100.00	4.988	498.847	100.00					
13.	Concentrate	252.0	19.09	2.09	39.900	88.99	8.69	165.90	45.46	8.55	163.227	34.09	90	10	8	40	65
	Tailing	1068.0	80.91	0.061	4.935	11.01	2.46	199.04	54.54	3.9	315.545	65.91					
		1320.0	100.00	0.448	44.835	100.00	3.649	364.94	100.00	4.788	478.773	100.00					
14.	Concentrate	238.5	18.07	2.23	40.292	89.13	9.66	174.54	46.21	9.05	163.517	34.14	90	10	8	40	65
	Tailing	1081.5	81.93	0.06	4.916	10.87	2.48	203.19	53.79	3.85	315.438	65.86					
		1320.0	100.00	0.452	45.208	100.00	3.777	377.73	100.00	4.790	478.955	100.00					

Screen analyses for specifying the milling

size mm	27% solid in milling-8 min.			27% solid in milling-10 min.			30% solid in milling.-9.5min.			30% тsolid in milling-14min.		
	Production			Production			Production			Production		
	gr.	%	amount	gr.	%	amount	gr.	%	amount	gr.	%	amount
2.0	12.20	1.53	1.53	10.40	1.30	1.30	13.00	1.42	1.42	11.00	1.20	1.20
1.0	20.70	2.59	4.11	15.20	1.90	3.20	19.50	2.13	3.55	16.50	1.80	3.01
0.4	14.70	1.84	5.95	10.50	1.31	4.51	14.70	1.61	5.16	13.50	1.48	4.48
0.2	74.00	9.25	15.20	65.50	8.19	12.70	87.20	9.53	14.69	80.30	8.78	13.26
0.1	179.70	22.46	37.66	158.00	19.75	32.45	196.70	21.50	36.19	148.80	16.26	29.52
0.08	48.70	6.09	43.75	36.40	4.55	37.00	82.20	8.98	45.17	22.70	2.48	32.00
-0.08	450.00	56.25	100.00	504.00	63.00	100.00	501.70	54.83	100.00	622.20	68.00	100.00
	800.00	100.00		800.00	100.00		915.00	100.00		915.00	100.00	

size mm	35% solid in milling - 12 min.			35% solid in milling- 16 min			40% solid in milling-11 min.			40% solid in milling-15 min		
	Production			Production			Production			Production		
	gr.	%	amount	gr.	%	amount	gr.	%	amount	gr.	%	amount
2.0	10.50	0.95	0.95	8.40	0.76	0.76	13.20	1.00	1.00	8.20	0.62	0.62
1.0	19.00	1.71	2.66	16.50	1.49	2.24	18.80	1.42	2.42	14.50	1.10	1.72
0.4	17.50	1.58	4.23	13.80	1.24	3.49	21.50	1.63	4.05	15.70	1.19	2.91
0.2	112.20	10.11	14.34	80.20	7.23	10.71	155.80	11.80	15.86	118.50	8.98	11.89
0.1	250.20	22.54	36.88	208.50	18.78	29.50	345.00	26.14	41.99	293.50	22.23	34.12
0.08	92.50	8.33	45.22	38.90	3.50	33.00	145.30	11.01	53.00	91.20	6.91	41.03
-0.08	608.10	54.78	100.00	743.70	67.00	100.00	620.40	47.00	100.00	778.40	58.97	100.00
	1,110.00	100.00		1,110.00	100.00		1,320.00	100.00		1,320.00	100.00	

Lime - fed in the milling

Reagents - fed at the beginning of the flotation process

Tests with ore - quartzites

10/2/02

pH - 10-10,5

№		Production		Cu -0,472			S - 2,38			Fe - 2,89			reagents - gr/t				Size
		gr	%	grade	metal	recovery	grade	metal	recovery	grade	metal	recovery	kst	X 133	3477	%solid	-0.08
1.	Concentrate	118.0	14.75	3.01	44.398	90.92	13.89	204.88	90.92	12.57	185.408	62.95	90	10	8	27	60
	Tailing	682.0	85.25	0.052	4.433	9.08	0.24	20.46	9.08	1.28	109.120	37.05					
		800.0	100.00	0.488	48.831	100.00	2.25	225.34	100.00	2.945	294.528	100.00					
2.	Concentrate	120.0	15.00	2.94	44.100	91.37	14.23	213.45	91.28	12.47	187.050	62.86	90	10	8	27	60
	Tailing	680.0	85.00	0.049	4.165	8.63	0.24	20.40	8.72	1.3	110.500	37.14					
		800.0	100.00	0.483	48.265	100.00	2.34	233.85	100.00	2.976	297.550	100.00					
3.	Concentrate	171.0	18.69	2.35	43.918	91.22	9.77	182.59	85.53	10.34	193.239	68.56	90	10	8	30	50
	Tailing	744.0	81.31	0.052	4.228	8.78	0.38	30.90	14.47	1.09	88.630	31.44					
		915.0	100.00	0.481	48.146	100.00	2.13	213.49	100.00	2.819	281.869	100.00					
4.	Concentrate	121.5	13.28	3.28	43.554	90.45	13.29	176.47	83.92	13.58	180.325	68.15	90	10	8	30	50
	Tailing	793.5	86.72	0.053	4.596	9.55	0.39	33.82	16.08	0.972	84.293	31.85					
		915.0	100.00	0.482	48.150	100.00	2.10	210.30	100.00	2.646	264.618	100.00					
5.	Concentrate	227.5	20.50	2.05	42.016	88.16	10.04	205.77	89.30	9.36	191.838	72.92	90	10	8	35	50
	Tailing	882.5	79.50	0.071	5.645	11.84	0.31	24.65	10.70	0.896	71.236	27.08					
		1110.0	100.00	0.477	47.661	100.00	2.30	230.42	100.00	2.631	263.074	100.00					
6.	Concentrate	240.0	21.62	1.92	41.514	88.47	9.04	195.46	87.39	9.01	194.811	72.43	90	10	8	35	50
	Tailing	870.0	78.38	0.069	5.408	11.53	0.36	28.22	12.61	0.946	74.146	27.57					
		1110.0	100.00	0.469	46.922	100.00	2.24	223.68	100.00	2.690	268.957	100.00					
7.	Concentrate	371.2	28.12	1.61	45.275	91.17	8.13	228.63	90.86	6.64	186.725	74.98	90	10	8	40	50
	Tailing	948.8	71.88	0.061	4.385	8.83	0.32	23.00	9.14	0.867	62.319	25.02					
		1320.0	100.00	0.497	49.660	100.00	2.516	251.63	100.00	2.490	249.044	100.00					
8.	Concentrate	312.0	23.64	1.91	45.145	91.92	8.84	208.95	90.42	8.17	193.109	75.36	90	10	8	40	50
	Tailing	1008.0	76.36	0.052	3.971	8.08	0.29	22.15	9.58	0.827	63.153	24.64					
		1320.0	100.00	0.491	49.116	100.00	2.311	231.09	100.00	2.563	256.262	100.00					
9.	Concentrate	139.0	15.19	2.78	42.232	89.09	10.27	156.01	71.87	10.60	161.027	55.38	90	10	8	30	65
	Tailing	776.0	84.81	0.061	5.173	10.91	0.72	61.06	28.13	1.53	129.757	44.62					
		915.0	100.00	0.474	47.405	100.00	2.171	217.08	100.00	2.908	290.785	100.00					
10.	Concentrate	153.2	16.74	2.61	43.700	89.13	9.65	161.57	73.21	9.02	151.023	54.08	90	10	8	30	65
	Tailing	761.8	83.26	0.064	5.328	10.87	0.71	59.11	26.79	1.54	128.216	45.92					
		915.0	100.00	0.490	49.028	100.00	2.207	220.68	100.00	2.792	279.239	100.00					
11.	Concentrate	163.2	14.70	3.02	44.402	90.13	13.47	198.05	89.58	12.67	186.283	63.97	90	10	8	35	65
	Tailing	946.8	85.30	0.057	4.862	9.87	0.27	23.03	10.42	1.23	104.916	36.03					
		1110.0	100.00	0.493	49.264	100.00	2.211	221.08	100.00	2.912	291.199	100.00					
12.	Concentrate	250.5	22.57	1.87	42.201	90.38	9.14	206.27	93.67	8.07	182.120	64.58	90	10	8	35	65
	Tailing	859.5	77.43	0.058	4.491	9.62	0.18	13.94	6.33	1.29	99.888	35.42					
		1110.0	100.00	0.467	46.692	100.00	2.202	220.21	100.00	2.820	282.008	100.00					
13.	Concentrate	330.0	25.00	1.81	45.250	93.49	8.37	209.25	90.00	8.32	208.000	79.53	90	10	8	40	65
	Tailing	990.0	75.00	0.042	3.150	6.51	0.31	23.25	10.00	0.714	53.550	20.47					
		1320.0	100.00	0.484	48.400	100.00	2.325	232.50	100.00	2.616	261.550	100.00					
14.	Concentrate	370.5	28.07	1.59	44.628	93.38	6.97	195.64	89.18	7.46	209.389	80.55	90	10	8	40	65
	Tailing	949.5	71.93	0.044	3.165	6.62	0.33	23.74	10.82	0.703	50.568	19.45					
		1320.0	100.00	0.478	47.793	100.00	2.194	219.37	100.00	2.600	259.957	100.00					

Screen analyses for sp[illegible]ying the milling

sizes mm	27% solid in milling -7 min			27% solid in milling -10 min			30% solid in milling -6 min			30% solid in milling -10 min.		
	Production			Production			Production			Production		
	gr	%	amount	gr	%	amount	gr	%	amount	gr	%	amount
2.0	18.20	2.28	2.28	9.40	1.18	1.18	16.00	1.75	1.75	9.50	1.04	1.04
1.0	25.70	3.21	5.49	13.70	1.71	2.89	17.80	1.95	3.69	12.00	1.31	2.35
0.4	21.20	2.65	8.14	10.80	1.35	4.24	14.20	1.55	5.25	8.70	0.95	3.30
0.2	95.50	11.94	20.08	58.70	7.34	11.58	85.30	9.32	14.57	64.20	7.02	10.32
0.1	191.70	23.96	44.04	150.90	18.86	30.44	270.60	29.57	44.14	217.00	23.72	34.03
0.08	63.40	7.93	51.96	53.80	6.73	37.16	69.90	7.64	51.78	62.00	6.78	40.81
-0.08	384.30	48.04	100.00	502.70	62.84	100.00	441.20	48.22	100.00	541.60	59.19	100.00
	800.00	100.00		800.00	100.00		915.00	100.00		915.00	100.00	

sizes mm	35% solid in milling- 8 min.			35%solid in milling- 14 min.			40%solid in milling-10 min.			40%solid in milling-17 min.		
	Production			Production			Production			Production		
	gr.	%	amount	gr.	%	сум	gr.	%	amount	gr.	%	сум
2.0	16.70	1.50	1.50	5.50	0.50	0.50	24.00	1.82	1.82	3.30	0.25	0.25
1.0	16.70	1.50	3.01	6.70	0.60	1.10	30.00	2.27	4.09	5.30	0.40	0.65
0.4	17.80	1.60	4.61	7.80	0.70	1.80	15.70	1.19	5.28	6.60	0.50	1.15
0.2	75.50	6.80	11.41	51.10	4.60	6.41	100.40	7.61	12.89	46.20	3.50	4.65
0.1	357.40	32.20	43.61	255.30	23.00	29.41	399.30	30.25	43.14	273.90	20.75	25.40
0.08	98.60	8.88	52.50	74.40	6.70	36.11	147.20	11.15	54.29	97.00	7.35	32.75
-0.08	527.30	47.50	100.00	709.20	63.89	100.00	603.40	45.71	100.00	887.70	67.25	100.00
	1,110.00	100.00		1,110.00	100.00		1,320.00	100.00		1,320.00	100.00	

Lime - fed in the milling

Reagents - fed at the beginning of the flotation process

Tests with ore - argilytes

7/31/02

pH - 10-10,5

№		Production		Cu -0,490			S - 5,06			Fe -4,89			reagents - gr/t				Size
		gr.	%	grade	metal	recovery	grade	metal	recovery	grade	metal	recovery	kst	X 133	3477	%solid	-0.08
1.	Concentrate	247.5	30.94	1.32	40.838	88.74	16.36	506.14	96.45	13.20	408.375	89.62	90	10	8	27	60
	Tailing	552.5	69.06	0.075	5.180	11.26	0.27	18.65	3.55	0.685	47.308	10.38					
		800.0	100.00	0.460	46.017	100.00	5.25	524.78	100.00	4.557	455.683	100.00					
2.	Concentrate	202.0	25.25	1.62	40.905	88.23	20.04	506.01	95.76	16.22	409.555	89.03	90	10	8	27	60
	Tailing	598.0	74.75	0.073	5.457	11.77	0.3	22.43	4.24	0.675	50.456	10.97					
		800.0	100.00	0.464	46.362	100.00	5.28	528.44	100.00	4.600	460.011	100.00					
3.	Concentrate	244.5	26.72	1.60	42.754	87.41	18.93	505.83	90.91	15.92	425.403	88.99	90	10	8	30	50
	Tailing	670.5	73.28	0.084	6.155	12.59	0.69	50.56	9.09	0.718	52.614	11.01					
		915.0	100.00	0.489	48.910	100.00	5.56	556.40	100.00	4.780	478.017	100.00					
4.	Concentrate	201.2	21.99	1.95	42.879	87.02	22.33	491.02	90.90	18.94	416.473	88.42	90	10	8	30	50
	Tailing	713.8	78.01	0.082	6.397	12.98	0.63	49.15	9.10	0.699	54.530	11.58					
		915.0	100.00	0.493	49.276	100.00	5.40	540.16	100.00	4.710	471.003	100.00					
5.	Concentrate	288.0	25.95	1.52	39.438	84.19	16.56	429.66	86.70	15.74	408.389	88.99	90	10	8	35	50
	Tailing	822.0	74.05	0.100	7.405	15.81	0.890	65.91	13.30	0.682	50.505	11.01					
		1110.0	100.00	0.468	46.843	100.00	4.96	495.57	100.00	4.589	458.894	100.00					
6.	Concentrate	272.0	24.50	1.62	39.697	84.16	16.89	413.88	86.44	16.69	408.980	88.28	90	10	8	35	50
	Tailing	838.0	75.50	0.099	7.474	15.84	0.86	64.93	13.56	0.719	54.281	11.72					
		1110.0	100.00	0.472	47.171	100.00	4.79	478.81	100.00	4.633	463.261	100.00					
7.	Concentrate	385.5	29.20	1.43	41.763	83.57	14.41	420.84	86.53	14.11	412.076	84.96	90	10	8	40	50
	Tailing	934.5	70.80	0.116	8.212	16.43	0.925	65.49	13.47	1.03	72.919	15.04					
		1320.0	100.00	0.500	49.975	100.00	4.863	486.32	100.00	4.850	484.995	100.00					
8.	Concentrate	384.7	29.14	1.41	41.093	83.69	14.60	425.50	86.72	14.24	415.010	84.55	90	10	8	40	50
	Tailing	935.3	70.86	0.113	8.007	16.31	0.92	65.19	13.28	1.07	75.816	15.45					
		1320.0	100.00	0.491	49.100	100.00	4.907	490.69	100.00	4.908	490.826	100.00					
9.	Concentrate	308.2	33.68	1.28	43.114	89.53	13.78	464.15	89.28	13.90	468.195	90.66	90	10	8	30	65
	Tailing	606.8	66.32	0.076	5.040	10.47	0.84	55.71	10.72	0.727	48.212	9.34					
		915.0	100.00	0.482	48.154	100.00	5.199	519.86	100.00	5.164	516.407	100.00					
10.	Concentrate	297.8	32.55	1.38	44.914	91.11	14.17	461.18	88.83	14.03	456.627	90.36	90	10	8	30	65
	Tailing	617.2	67.45	0.065	4.384	8.89	0.86	58.01	11.17	0.722	48.701	9.64					
		915.0	100.00	0.493	49.299	100.00	5.192	519.19	100.00	5.053	505.328	100.00					
11.	Concentrate	349.4	31.48	1.40	44.068	89.68	14.76	464.61	96.72	14.23	447.925	89.82	90	10	8	35	65
	Tailing	760.6	68.52	0.074	5.071	10.32	0.230	15.76	3.28	0.741	50.775	10.18					
		1110.0	100.00	0.491	49.139	100.00	4.804	480.37	100.00	4.987	498.700	100.00					
12.	Concentrate	352.2	31.73	1.41	44.739	90.10	14.55	461.67	96.57	14.10	447.389	89.73	90	10	8	35	65
	Tailing	757.8	68.27	0.072	4.915	9.90	0.24	16.38	3.43	0.75	51.203	10.27					
		1110.0	100.00	0.497	49.654	100.00	4.781	478.05	100.00	4.986	498.592	100.00					
13.	Concentrate	411.7	31.19	1.39	43.353	89.11	14.52	452.87	95.36	13.95	435.092	88.74	90	10	8	40	65
	Tailing	908.3	68.81	0.077	5.298	10.89	0.32	22.02	4.64	0.802	55.186	11.26					
		1320.0	100.00	0.487	48.652	100.00	4.749	474.89	100.00	4.903	490.278	100.00					
14.	Concentrate	440.7	33.39	1.28	42.735	89.78	13.68	456.73	95.67	12.61	421.002	89.13	90	10	8	40	65
	Tailing	879.3	66.61	0.073	4.863	10.22	0.31	20.65	4.33	0.771	51.359	10.87					

		1320.0	100.00	0.476	47.597	100.00	[illegible]774	477.38	100.00	4.724	472.361	100.00				

Screen analyses for specifying the milling

size mm	27%solid in milling-7 min			27%solid in milling-7 min			30%solid in milling-4 min			30%solid in milling-7 min		
	Production			Production			Production			Production		
	gr.	%	сум.	gr.	%	сум	gr.	%	сум.	gr.	%	сум
2.0	5.80	0.73	0.73	2.70	0.34	0.34	9.80	1.07	1.07	6.20	0.68	0.68
1.0	10.20	1.28	2.00	5.70	0.71	1.05	20.20	2.21	3.28	10.70	1.17	1.85
0.4	8.80	1.10	3.10	5.50	0.69	1.74	22.00	2.40	5.68	11.00	1.20	3.05
0.2	69.00	8.63	11.73	43.00	5.38	7.11	112.20	12.26	17.95	77.80	8.50	11.55
0.1	184.00	23.00	34.73	160.00	20.00	27.11	242.00	26.45	44.39	187.00	20.44	31.99
0.08	76.90	9.61	44.34	63.50	7.94	35.05	92.50	10.11	54.50	69.00	7.54	39.53
-0.08	445.30	55.66	100.00	519.60	64.95	100.00	416.30	45.50	100.00	553.30	60.47	100.00
	800.00	100.00		800.00	100.00		915.00	100.00		915.00	100.00	

size mm	35%solid in milling- 3 min			35%solid in milling- 8 min			40%solid in milling-5.5 min			40%solid in milling-9 min		
	Production			Production			Production			Production		
	gr.	%	amoun	gr.	%	сум	gr.	%	сум.	gr.	%	сум
2.0	15.80	1.42	1.42	5.20	0.47	0.47	10.70	0.81	0.81	4.70	0.36	0.36
1.0	32.20	2.90	4.32	11.20	1.01	1.48	23.50	1.78	2.59	12.50	0.95	1.30
0.4	40.00	3.60	7.93	15.00	1.35	2.83	34.00	2.58	5.17	22.50	1.70	3.01
0.2	167.40	15.08	23.01	102.20	9.21	12.04	195.00	14.77	19.94	147.00	11.14	14.14
0.1	321.80	28.99	52.00	261.00	23.51	35.55	355.00	26.89	46.83	316.00	23.94	38.08
0.08	84.80	7.64	59.64	51.70	4.66	40.21	95.80	7.26	54.09	70.00	5.30	43.39
-0.08	448.00	40.36	100.00	663.70	59.79	100.00	606.00	45.91	100.00	747.30	56.61	100.00
	1,110.00	100.00		1,110.00	100.00		1,320.00	100.00		1,320.00	100.00	

Lime - fed in the milling

Reagents - fed at the beginning of the flotation process

10/8/02

Tests with ore - blended ore

pH - 10-10,5

№		Production		СИ -0,470			S - 3,65			Fe - 3,58			reagents - gr./t			% solid	size -0.08
		gr.	%	grade	metal	recovery	grade	metal	recovery	grade	metal	recovery	kst	X 133	3477		
1.	Concentrate	157.5	19.69	2.21	43.509	89.29	15.83	311.65	85.84	13.04	256.725	70.46	90	10	8	27	60
	Tailing	642.5	80.31	0.065	5.220	10.71	0.64	51.40	14.16	1.34	107.619	29.54					
		800.0	100.00	0.487	48.730	100.00	3.63	363.05	100.00	3.643	364.344	100.00					
2.	Concentrate	166.0	20.75	2.08	43.160	89.93	15.22	315.82	85.42	12.44	258.130	70.24	90	10	8	27	60
	Tailing	634.0	79.25	0.061	4.834	10.07	0.68	53.89	14.58	1.38	109.365	29.76					
		800.0	100.00	0.480	47.994	100.00	3.70	369.71	100.00	3.675	367.495	100.00					
3.	Concentrate	194.5	21.26	2.02	42.939	88.77	16.36	347.76	91.70	13.36	283.991	77.79	90	10	8	30	50
	Tailing	720.5	78.74	0.069	5.433	11.23	0.4	31.50	8.30	1.03	81.105	22.21					
		915.0	100.00	0.484	48.372	100.00	3.79	379.26	100.00	3.651	365.097	100.00					
4.	Concentrate	191.0	20.87	2.06	43.001	89.02	16.52	344.84	91.98	13.50	281.803	77.91	90	10	8	30	50
	Tailing	724.0	79.13	0.067	5.301	10.98	0.38	30.07	8.02	1.01	79.917	22.09					
		915.0	100.00	0.483	48.303	100.00	3.75	374.91	100.00	3.617	361.720	100.00					
5.	Concentrate	240.0	21.62	1.91	41.297	86.68	14.66	316.97	87.84	12.70	274.595	75.61	90	10	8	35	50
	Tailing	870.0	78.38	0.081	6.349	13.32	0.560	43.89	12.16	1.13	88.568	24.39					
		1110.0	100.00	0.476	47.646	100.00	3.61	360.86	100.00	3.632	363.162	100.00					
6.	Concentrate	260.5	23.47	1.70	39.896	86.27	13.46	315.89	87.49	12.41	291.244	76.33	90	10	8	35	50
	Tailing	849.5	76.53	0.083	6.352	13.73	0.59	45.15	12.51	1.18	90.307	23.67					
		1110.0	100.00	0.462	46.249	100.00	3.61	361.04	100.00	3.816	381.551	100.00					
7.	Concentrate	360.1	27.28	1.51	41.193	88.45	12.35	336.91	92.79	11.44	312.087	78.58	90	10	8	40	50
	Tailing	959.9	72.72	0.074	5.381	11.55	0.36	26.18	7.21	1.17	85.082	21.42					
		1320.0	100.00	0.466	46.575	100.00	3.631	363.09	100.00	3.972	397.169	100.00					
8.	Concentrate	335.7	25.43	1.67	42.471	88.23	12.99	330.36	92.68	12.17	309.505	78.45	90	10	8	40	50
	Tailing	984.3	74.57	0.076	5.667	11.77	0.35	26.10	7.32	1.14	85.008	21.55					
		1320.0	100.00	0.481	48.138	100.00	3.565	356.46	100.00	3.945	394.513	100.00					
9.	Concentrate	206.2	22.54	1.95	43.944	90.15	14.72	331.72	91.85	12.42	279.891	78.63	90	10	8	30	65
	Tailing	708.8	77.46	0.062	4.803	9.85	0.38	29.44	8.15	0.982	76.070	21.37					
		915.0	100.00	0.487	48.747	100.00	3.612	361.16	100.00	3.560	355.961	100.00					
10.	Concentrate	194.5	21.26	2.01	42.726	90.04	15.45	328.42	91.45	13.42	285.267	78.49	90	10	8	30	65
	Tailing	720.5	78.74	0.06	4.725	9.96	0.39	30.71	8.55	0.993	78.192	21.51					
		915.0	100.00	0.475	47.451	100.00	3.591	359.13	100.00	3.635	363.459	100.00					
11.	Concentrate	341.2	30.74	1.42	43.649	90.13	10.97	337.20	92.76	9.02	277.263	78.91	90	10	8	35	65
	Tailing	768.8	69.26	0.069	4.779	9.87	0.38	26.32	7.24	1.07	74.110	21.09					
		1110.0	100.00	0.484	48.428	100.00	3.635	363.52	100.00	3.514	351.373	100.00					
12.	Concentrate	352.2	31.73	1.38	43.787	89.78	10.28	326.18	92.27	8.86	281.125	79.07	90	10	8	35	65
	Tailing	757.8	68.27	0.073	4.984	10.22	0.40	27.31	7.73	1.09	74.415	20.93					
		1110.0	100.00	0.488	48.771	100.00	3.535	353.49	100.00	3.555	355.540	100.00					
13.	Concentrate	373.0	28.26	1.50	42.386	90.23	11.83	334.29	93.39	10.84	306.312	81.13	90	10	8	40	65
	Tailing	947.0	71.74	0.064	4.592	9.77	0.33	23.68	6.61	0.993	71.240	18.87					
		1320.0	100.00	0.470	46.978	100.00	3.580	357.96	100.00	3.776	377.552	100.00					
14.	Concentrate	389.2	29.48	1.41	41.574	90.07	11.36	334.95	93.32	10.30	303.694	81.52	90	10	8	40	65
	Tailing	930.8	70.52	0.065	4.583	9.93	0.34	23.98	6.68	0.976	68.823	18.48					
		1320.0	100.00	0.462	46.157	100.00	3.589	358.92	100.00	3.725	372.517	100.00					

Screen analyses for specifying the milling

size mm	27%solid in milling-8 min			30%solid in milling-5 min			30%solid in milling9 min		
	Production			Production			Production		
	gr.	%	amount	gr.	%	amount	gr.	%	amount
2.0	8.70	1.09	1.09	9.40	1.03	1.03	8.40	0.92	0.92
1.0	11.00	1.38	2.46	16.40	1.79	2.82	13.90	1.52	2.44
0.4	8.20	1.03	3.49	14.90	1.63	4.45	12.20	1.33	3.77
0.2	48.70	6.09	9.58	88.60	9.68	14.13	73.80	8.07	11.84
0.1	188.70	23.59	33.16	266.80	29.16	43.29	215.70	23.57	35.41
0.08	49.20	6.15	39.31	84.50	9.23	52.52	53.00	5.79	41.20
-0.08	485.50	60.69	100.00	434.40	47.48	100.00	538.00	58.80	100.00
	800.00	100.00		915.00	100.00		915.00	100.00	

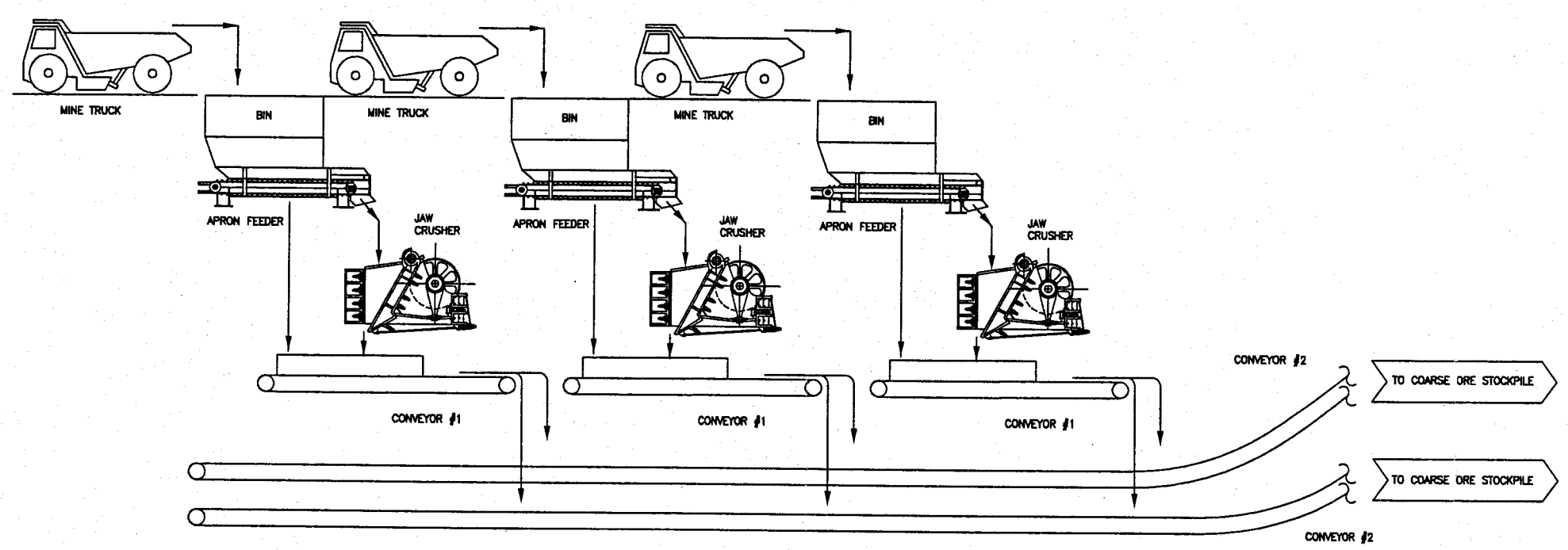
size mm	35%solid in milling-6 min			35%solid in milling- 11 min			40%solid in milling-8 min			40%solid in milling-13 min		
	Production			Production			Production			Production		
	gr.	%	amount	gr.	%	сум	gr.	%	amount	gr.	%	сум
2.0	10.80	0.97	0.97	9.00	0.81	0.81	7.80	0.59	0.59	5.50	0.42	0.42
1.0	15.50	1.40	2.37	14.00	1.26	2.07	14.30	1.08	1.67	9.60	0.73	1.14
0.4	16.00	1.44	3.81	14.20	1.28	3.35	17.00	1.29	2.96	13.20	1.00	2.14
0.2	101.40	9.14	12.95	89.30	8.05	11.40	146.80	11.12	14.08	118.40	8.97	11.11
0.1	273.80	24.67	37.61	197.40	17.78	29.18	365.70	27.70	41.79	295.90	22.42	33.53
0.08	164.00	14.77	52.39	93.00	8.38	37.56	173.60	13.15	54.94	102.30	7.75	41.28
-0.08	528.50	47.61	100.00	693.10	62.44	100.00	594.80	45.06	100.00	775.10	58.72	100.00
	1,110.00	100.00		1,110.00	100.00		1,320.00	100.00		1,320.00	100.00	

Lime - fed in the milling

Reagents - fed at the begining of the flotation process

APPENDIX C

Drawings



NOTE:
ONE JAW CRUSHER IS WORKING WITH BLEND OF THREE ORES.

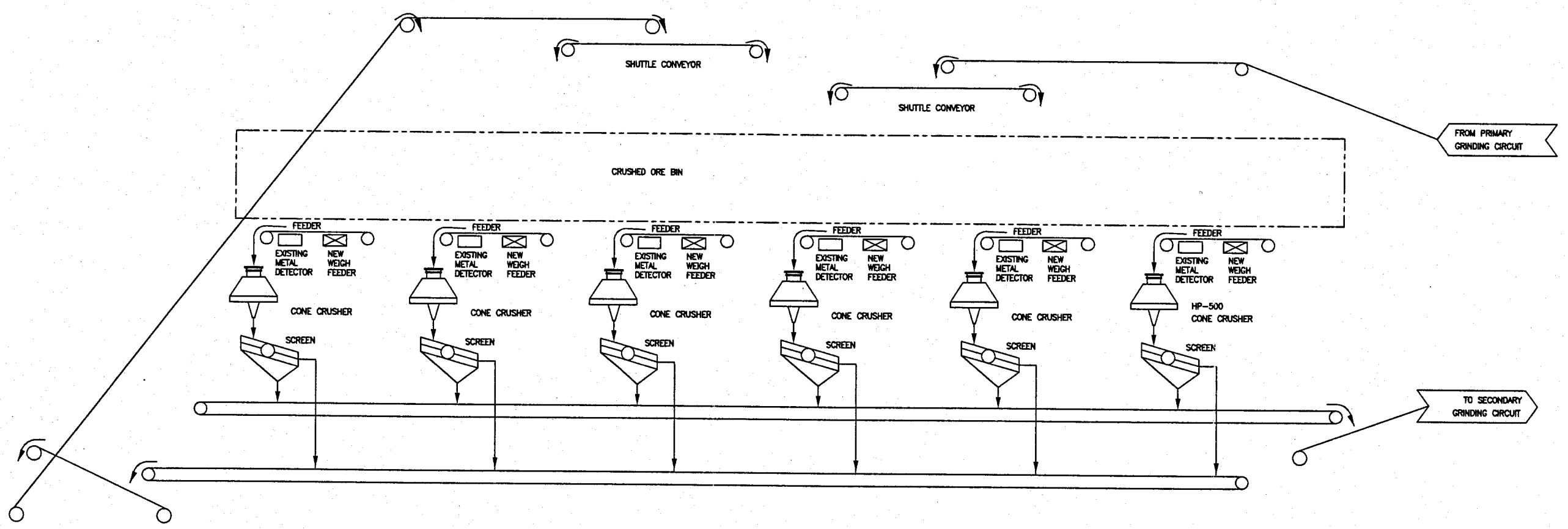
NO	REVISIONS	BY	DATE
C	GENERAL REVISION	ID	01-09-03
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

PRIMARY AND SECONDARY
CRUSHING CIRCUIT (1 OF 2)

LYNTEK
INCORPORATED

CAD-OP	ID	02-13-02	010903.1300
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-F-01 / C
SCALE:	( ) NONE		



NO	REVISIONS	BY	DATE
D	Add shuttle conv., screens	HJB	04-17-03
C	GENERAL REVISION	ID	01-09-03
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

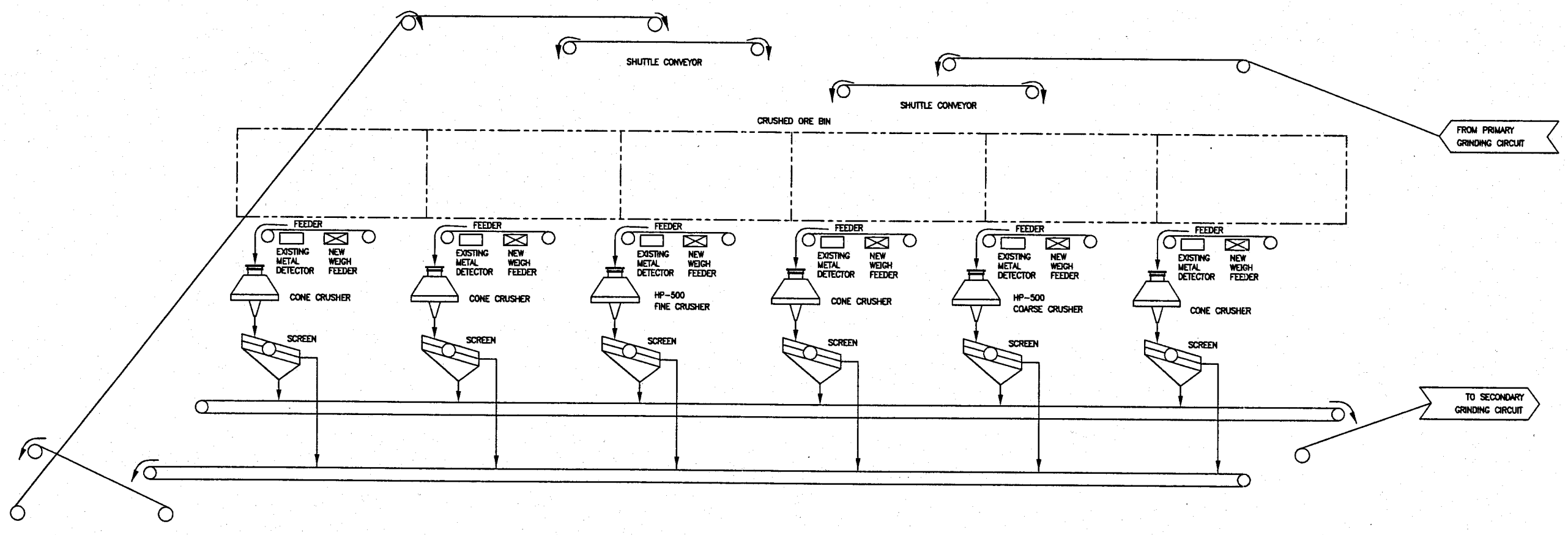
PRIMARY AND SECONDARY (ALT. 1)
CRUSHING CIRCUIT (2 OF 2)

LYNTEK INCORPORATED

CAD-OP	ID	02-13-02
CKD.		
P.M.		
CLIENT		
SCALE:	( ) NONE	

041703.1006

DRAWING NO. 02003-F01-1 REV. D



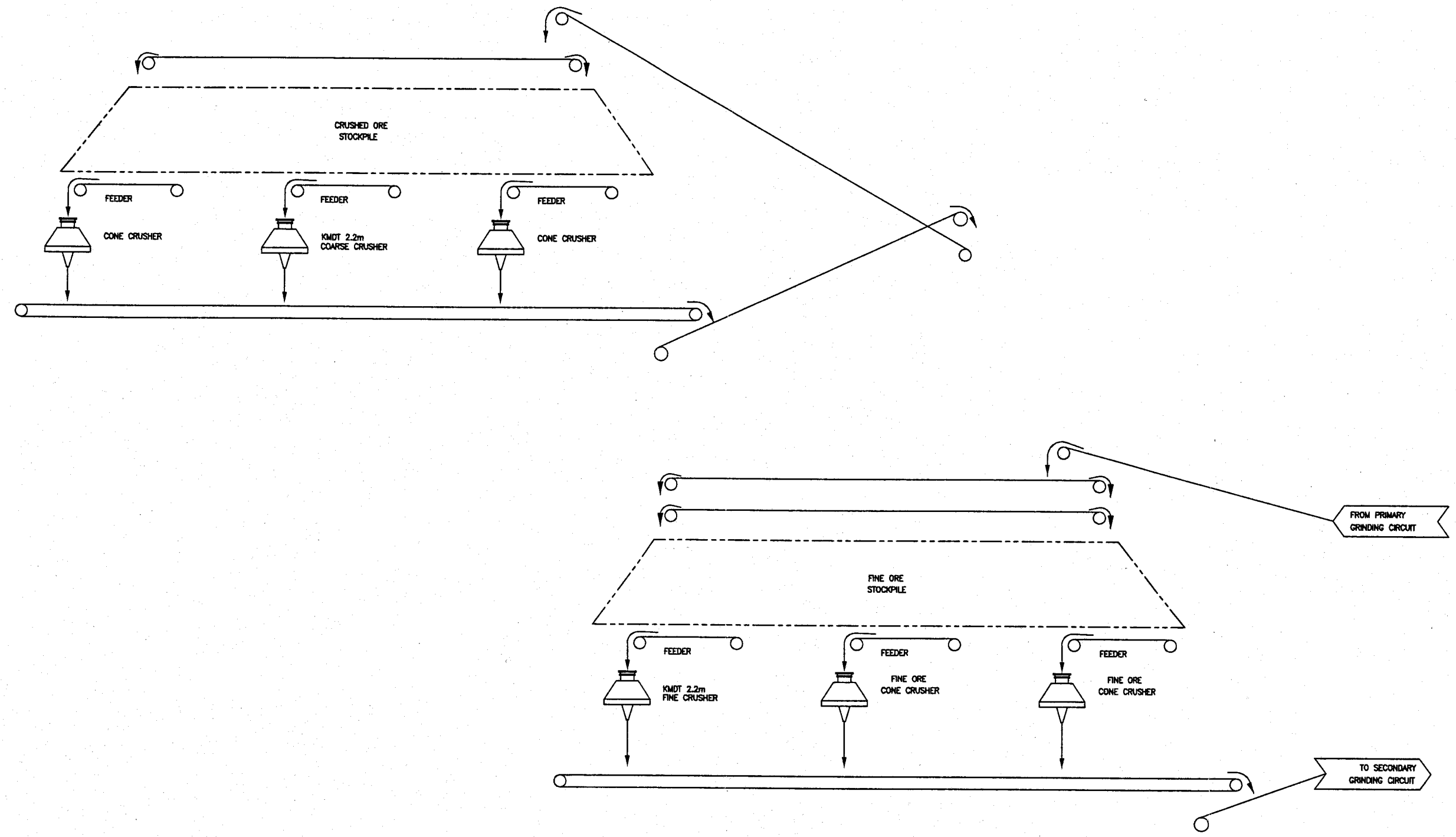
NO	REVISIONS	BY	DATE
D	Add shuttle convey., screens	HJB	4-17-03
C	GENERAL REVISION	ID	01-09-03
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

PRIMARY AND SECONDARY (ALT. 2)
CRUSHING CIRCUIT (2 OF 2)

LYNTEK INCORPORATED

CAD-OP	ID	02-13-02	041703.1117
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			
SCALE:	( ) NONE		02003-F01-2 / D



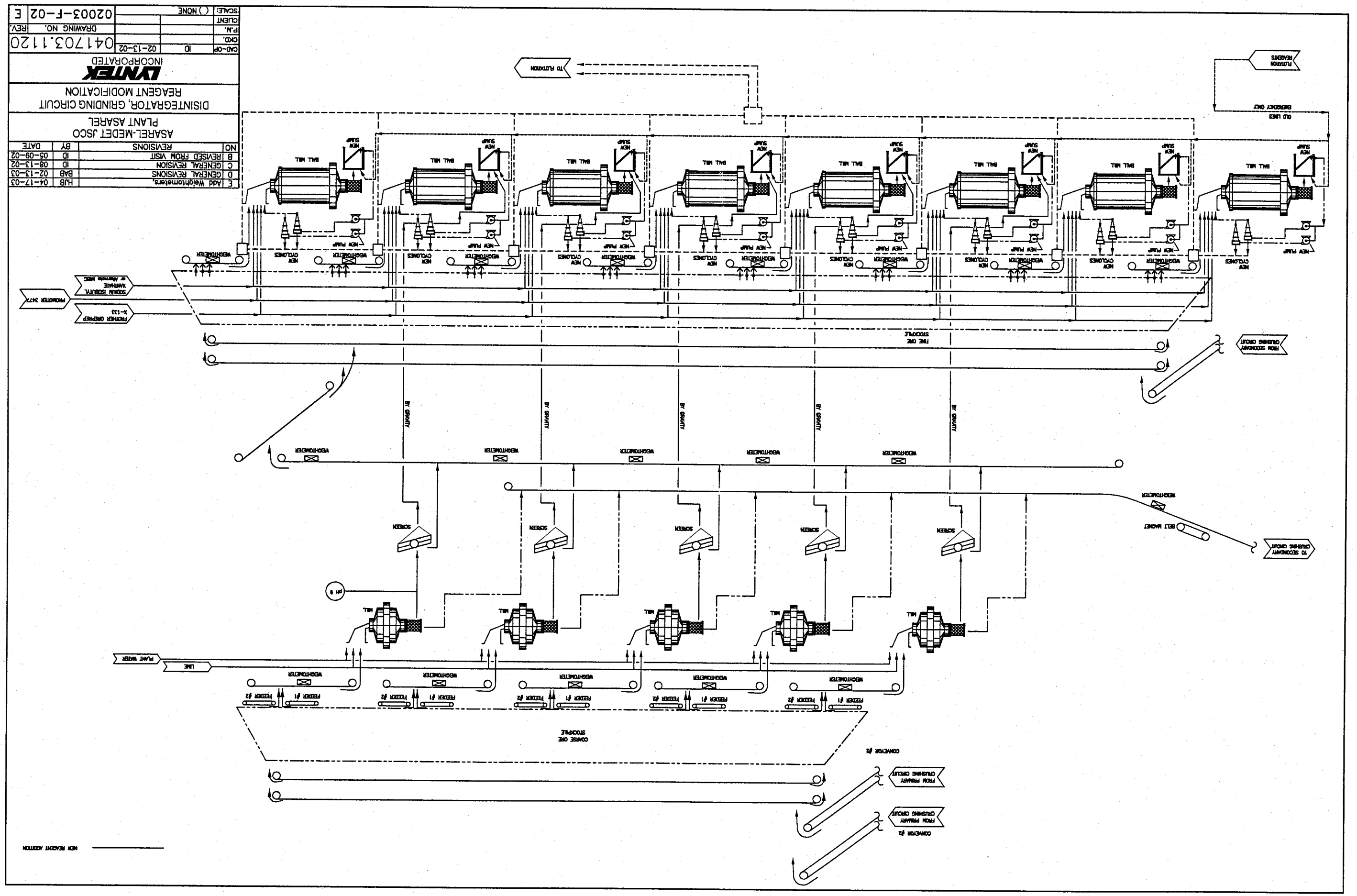
NO	REVISIONS	BY	DATE
C	GENERAL REVISION	ID	01-09-03
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

PRIMARY AND SECONDARY (ALT-3)
CRUSHING CIRCUIT (2 OF 2)

LYNTEK
INCORPORATED

CAD-OP	ID	02-13-02	010703.1400
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-F01-3 C
SCALE:	( ) NONE		



NO	REVISIONS	BY	DATE
E	Add Weightometers.	HJB	04-17-03
B	REVISED FROM VISIT	ID	05-09-02
C	GENERAL REVISION	ID	08-13-02
D	GENERAL REVISIONS	BAB	02-13-03

ASARELMEDET JSCO
PLANT ASARAL

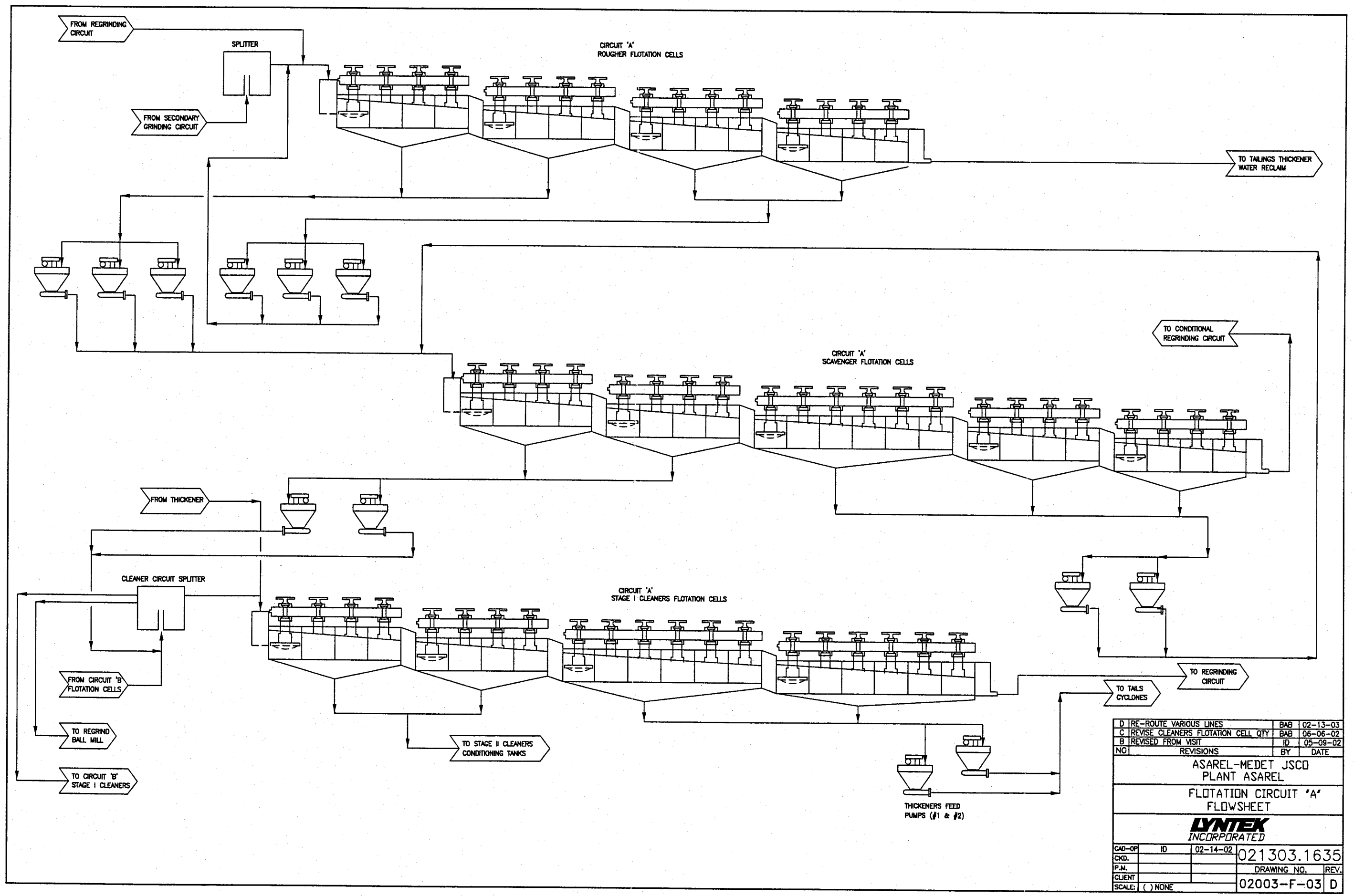
DISINTEGRATOR, GRINDING CIRCUIT
REAGENT MODIFICATION

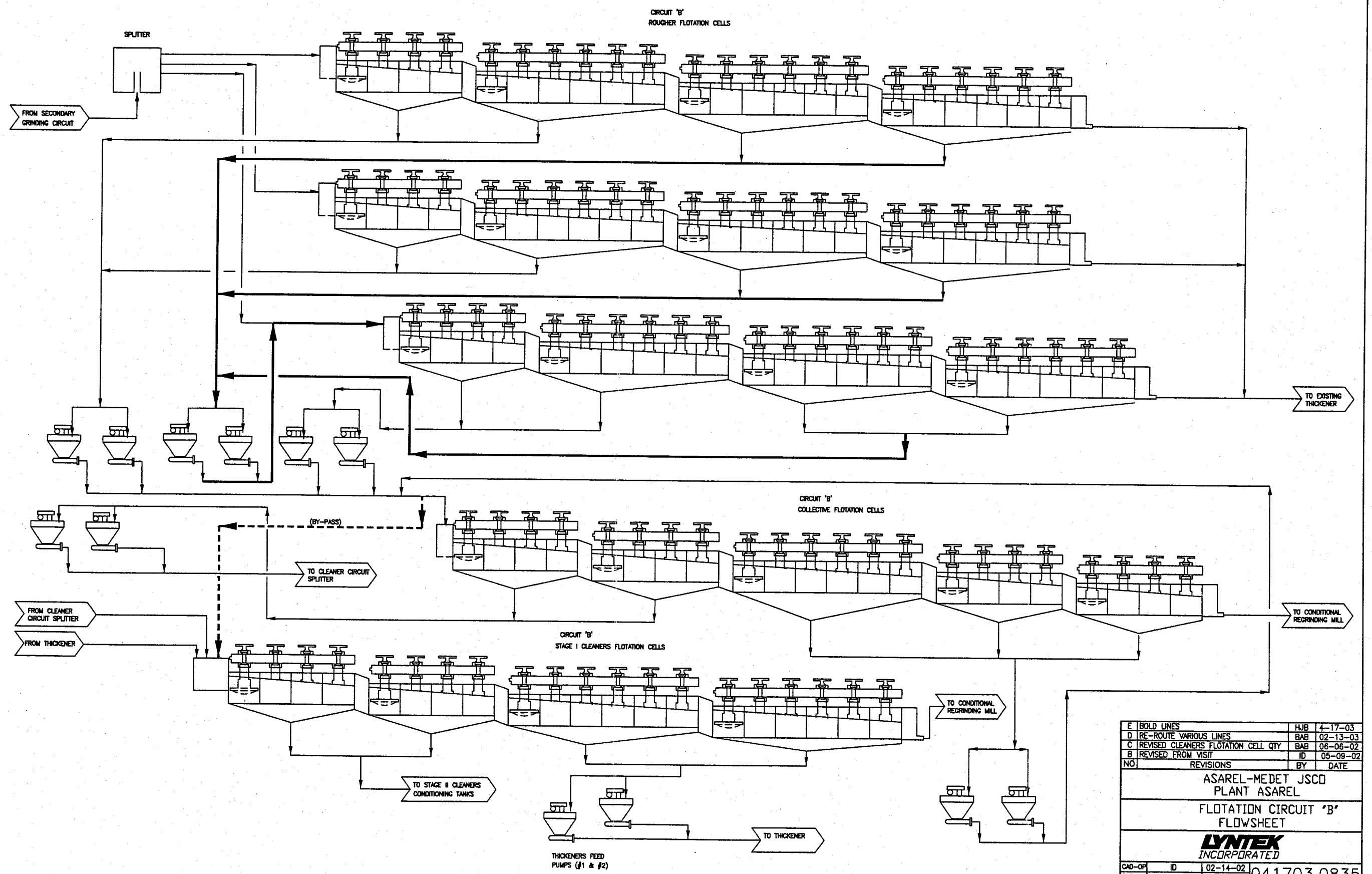
LYNTEX
INCORPORATED

CAD-OP	ID	02-13-02	
CKD.			
P.M.			
CLIENT			
SCALE:	( ) NONE		

04170 3.1120
DRAWING NO.

02003-F-02
REV. E


FROM REGRINDING CIRCUIT
SPLITTER
FROM SECONDARY GRINDING CIRCUIT
CIRCUIT 'A' ROUGHER FLOTATION CELLS
TO TAILINGS THICKENER WATER RECLAIM
TO CONDITIONAL REGRINDING CIRCUIT
CIRCUIT 'A' SCAVENGER FLOTATION CELLS
FROM THICKENER
CLEANER CIRCUIT SPLITTER
CIRCUIT 'A' STAGE I CLEANERS FLOTATION CELLS
FROM CIRCUIT 'B' FLOTATION CELLS
TO REGRIND BALL MILL
TO CIRCUIT 'B' STAGE I CLEANERS
TO STAGE II CLEANERS CONDITIONING TANKS
TO REGRINDING CIRCUIT
TO TAILS CYCLONES
THICKENERS FEED PUMPS (#1 & #2)
D RE-ROUTE VARIOUS LINES BAB 02-13-03
C REVISE CLEANERS FLOTATION CELL QTY BAB 06-06-02
B REVISED FROM VISIT ID 05-09-02
NO REVISIONS BY DATE
ASAREL-MEDET JSCO
PLANT ASAREL
FLOTATION CIRCUIT 'A'
FLOWSHEET
LYNTEK INCORPORATED
CAD-OP ID 02-14-02
CKD.
P.M.
CLIENT
SCALE: ( ) NONE
021303.1635
DRAWING NO.
REV.
02003-F-03
D



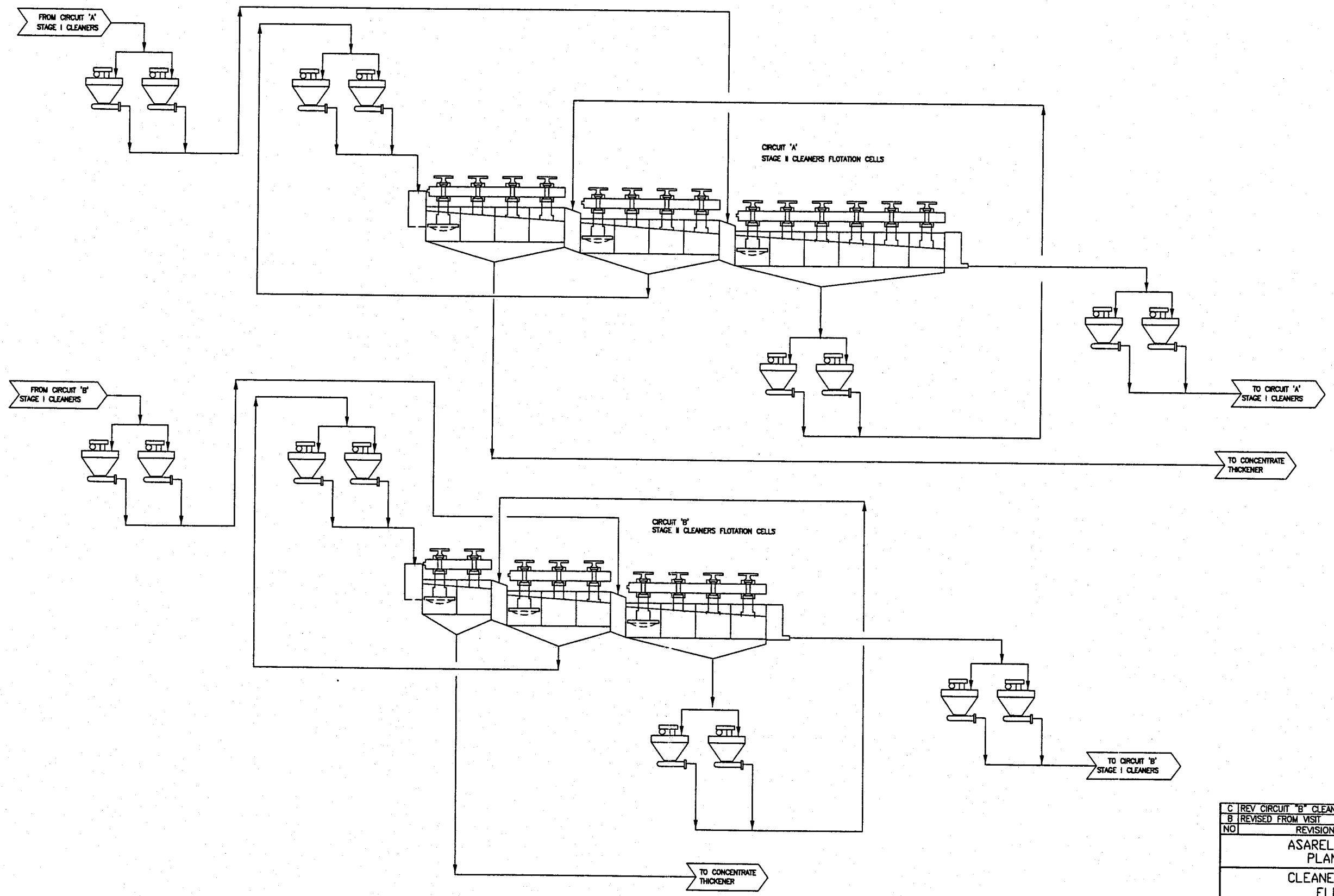
NO	REVISIONS	BY	DATE
E	BOLD LINES	HJB	4-17-03
D	RE-ROUTE VARIOUS LINES	BAB	02-13-03
C	REVISED CLEANERS FLOTATION CELL QTY	BAB	06-06-02
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

FLOTATION CIRCUIT 'B'
FLOWSHEET

LYNTEK INCORPORATED

CAD-OP	ID	02-14-02	041703.0835
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-F-04 / E
SCALE:	( ) NONE		



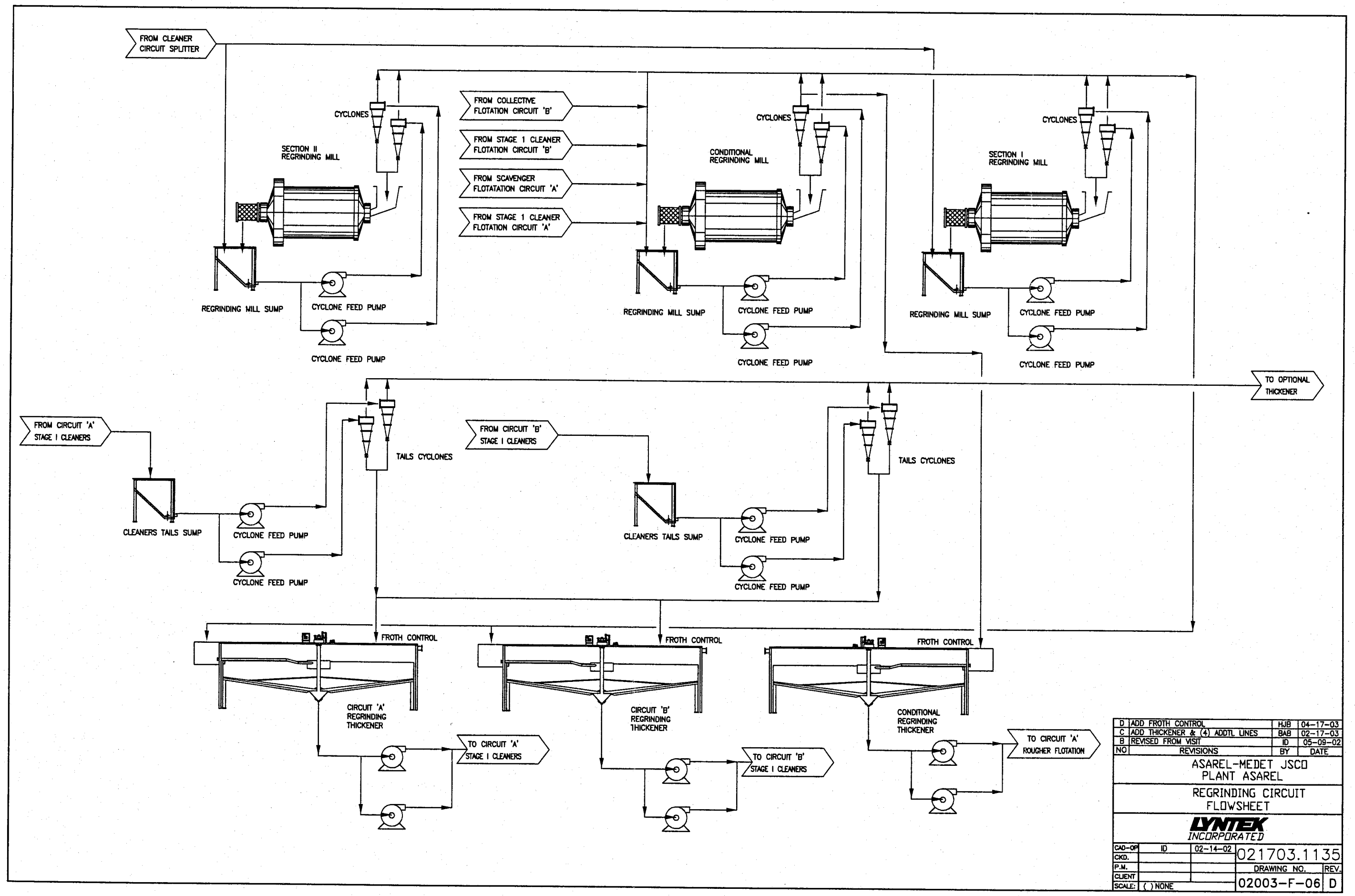
NO	REVISIONS	BY	DATE
C	REV CIRCUIT "B" CLEANERS CELL QTY'S	BAB	06-06-02
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

CLEANERS FLOTATION
FLOWSHEET

LYNTEK
INCORPORATED

CAD-OP	ID	02-14-02	060602.1840
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-F-05 / C
SCALE:	( ) NONE		



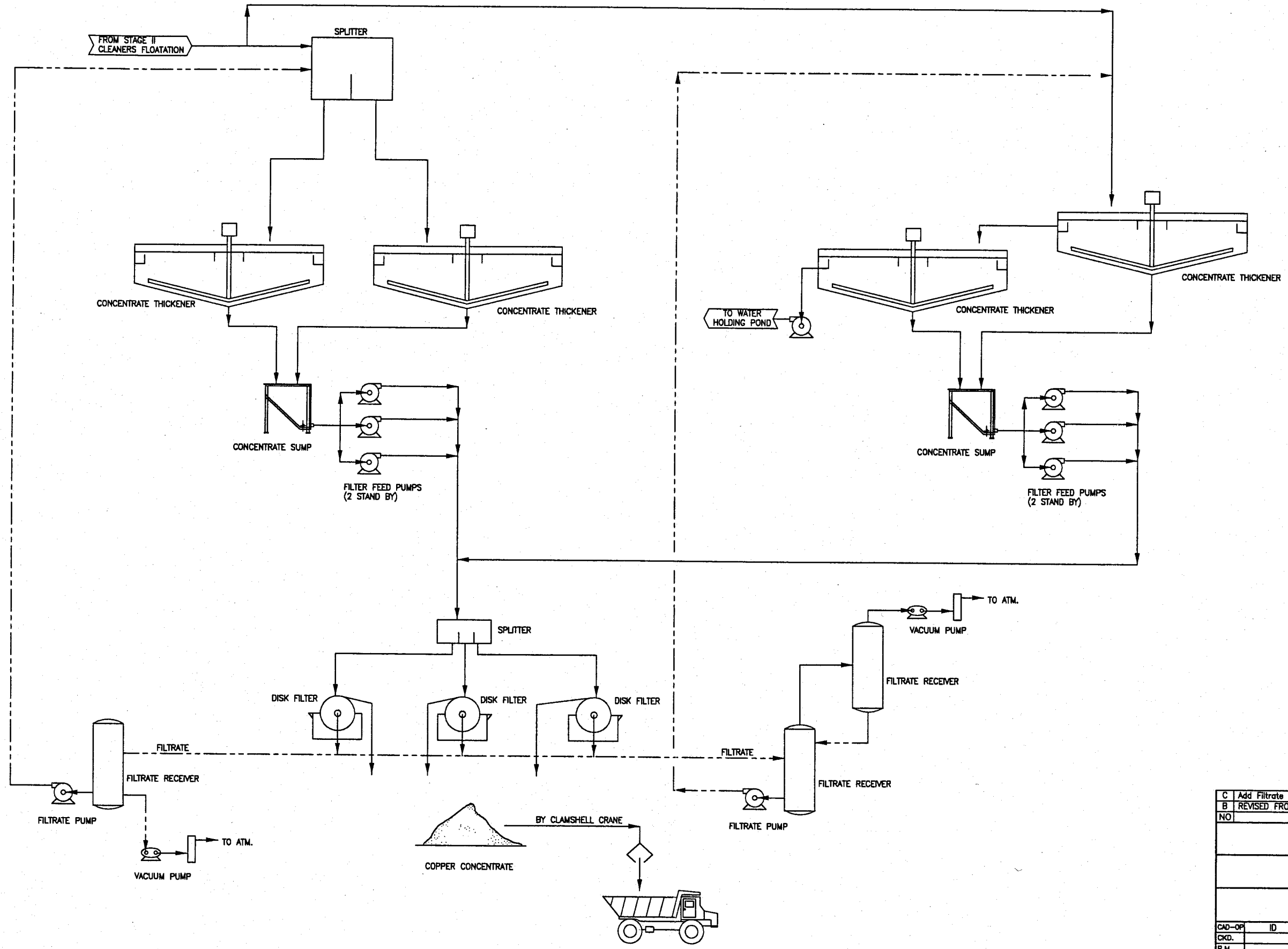
NO	REVISIONS	BY	DATE
D	ADD FROTH CONTROL	HJB	04-17-03
C	ADD THICKENER & (4) ADDTL LINES	BAB	02-17-03
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

REGRINDING CIRCUIT FLOWSHEET

LYNTEK INCORPORATED

CAD-OP	ID	02-14-02	021703.1135
CKD.			
P.M.			DRAWING NO. / REV.
CLIENT			
SCALE:	( ) NONE		02003-F-06 / D



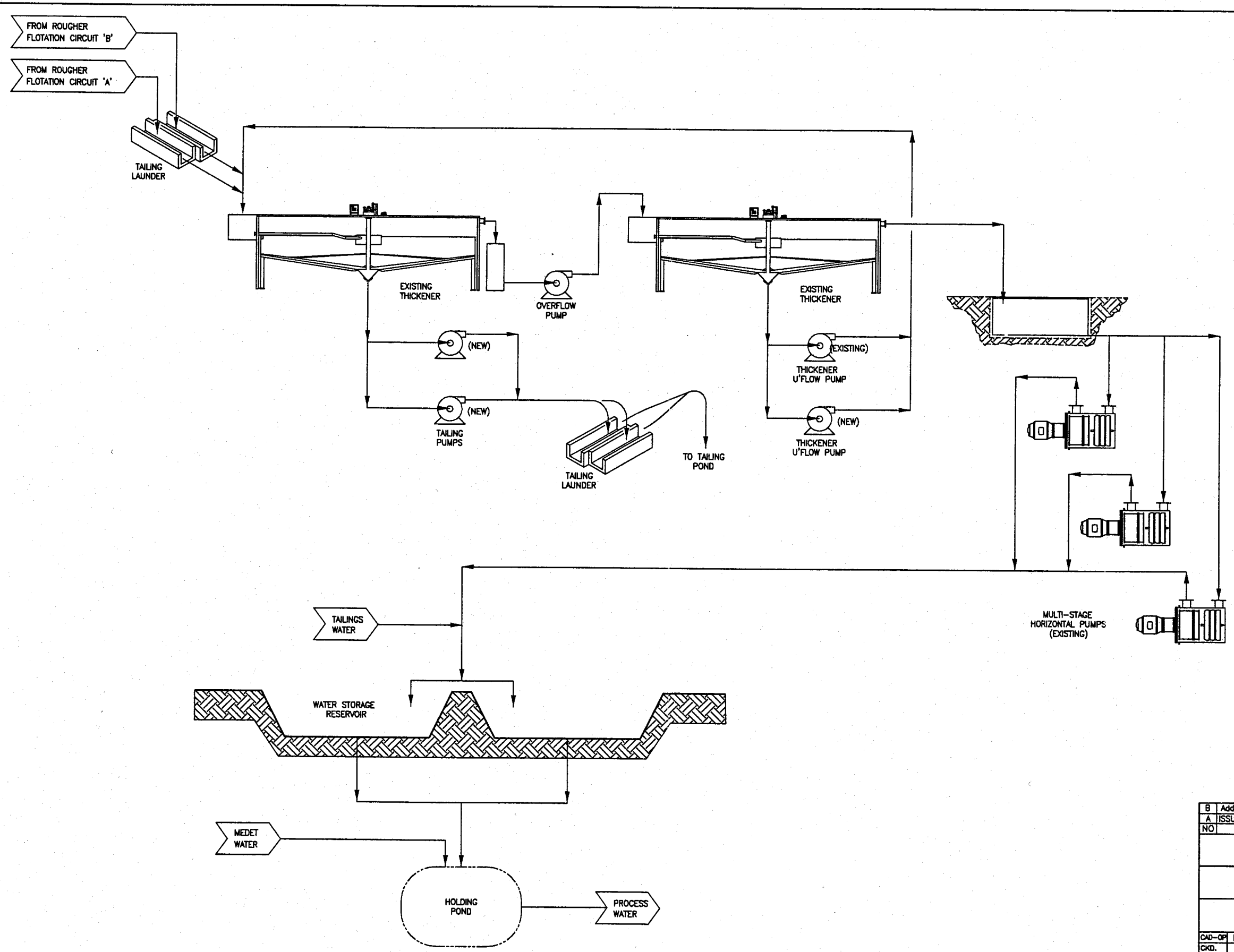
NO	REVISIONS	BY	DATE
C	Add Filtrate Reciever, Remove Filter	HJB	4-17-03
B	REVISED FROM VISIT	ID	05-09-02

ASAREL-MEDET JSCO
PLANT ASAREL

FLOWSHEET
CONCENTRATE FILTRATION

LYNTEK INCORPORATED

CAD-OP	ID	02-14-02	050902.1430
CKD.			
P.M.			DRAWING NO. / REV.
CLIENT			02003-F-07 / C
SCALE:	( ) NONE		



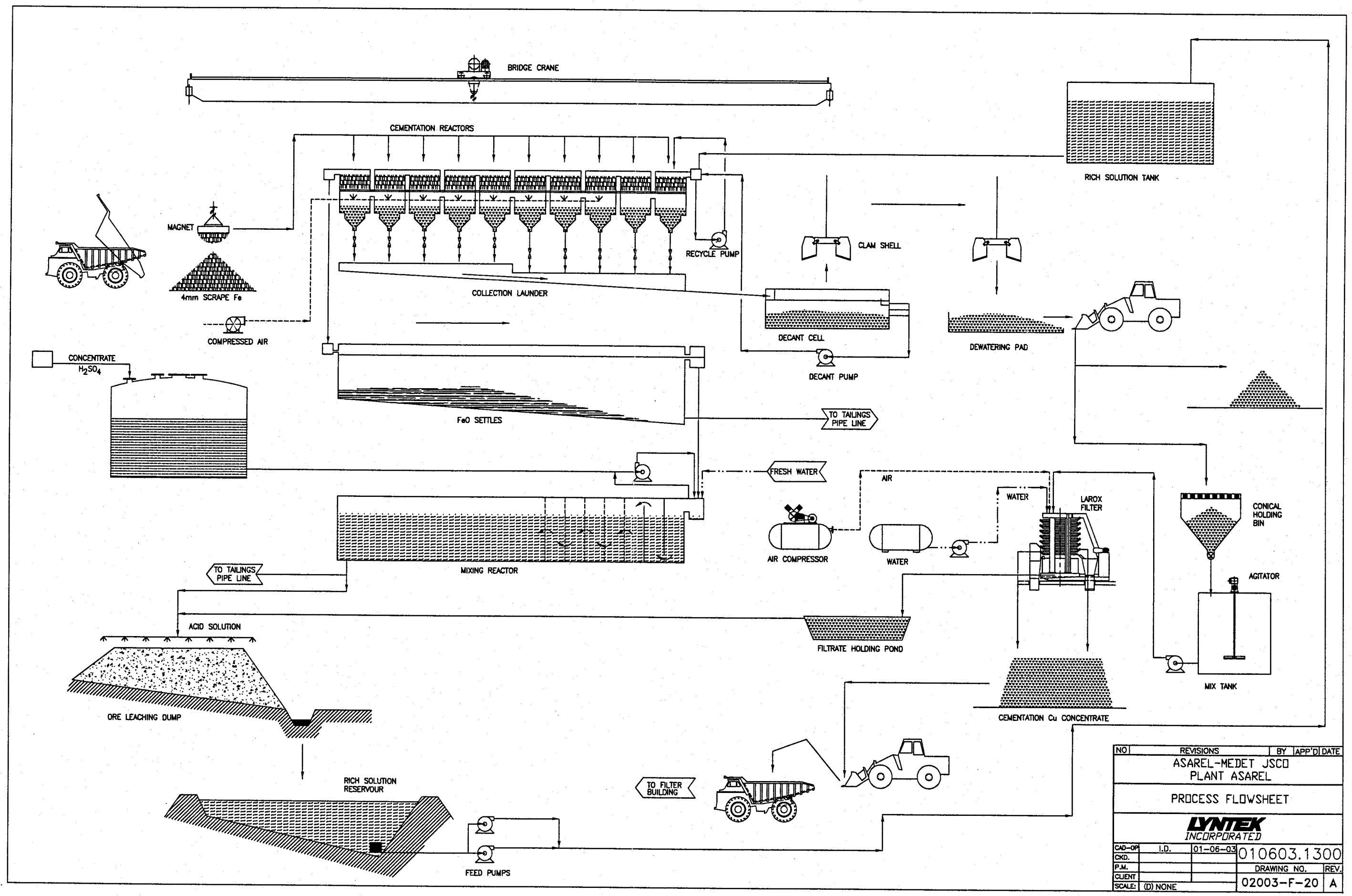
NO	REVISIONS	BY	DATE
B	Add Pumps, Launders	HJB	4-16-03
A	ISSUED FOR REVIEW	BAB	02-17-03

ASAREL-MEDET JSCO
PLANT ASAREL

TAILING THICKENING WATER RECLAIM FLOWSHEET

LYNTEK INCORPORATED

CAD-OP	B.BINGEMER	02-17-03	041603.1555
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-F-08 / B
SCALE:	( ) NONE		



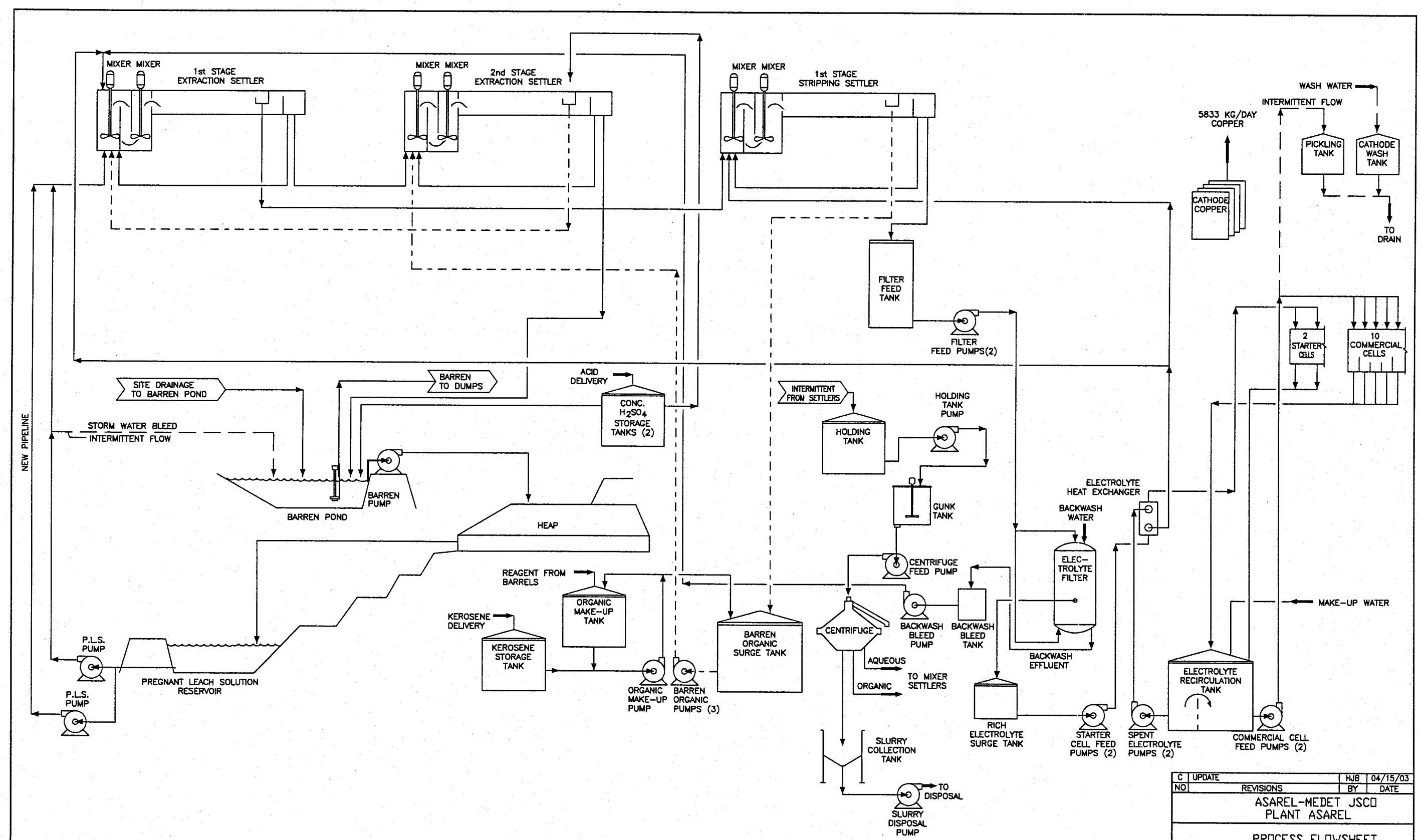
NO	REVISIONS	BY	APP'D	DATE

ASAREL-MEDET JSCO
PLANT ASAREL

PROCESS FLOWSHEET

LYNTEK INCORPORATED

CAD-OP	I.D.	01-06-03	010603.1300
CKD.			
P.M.			DRAWING NO. / REV.
CLIENT			02003-F-20 / A
SCALE:	(D) NONE		



* PREGNANT LEACH SOLUTION FROM RESERVOIR WILL BE GRAVITY FLOW, SITE DEVELOPMENT PERMITTING.

— — — ORGANIC FLOW

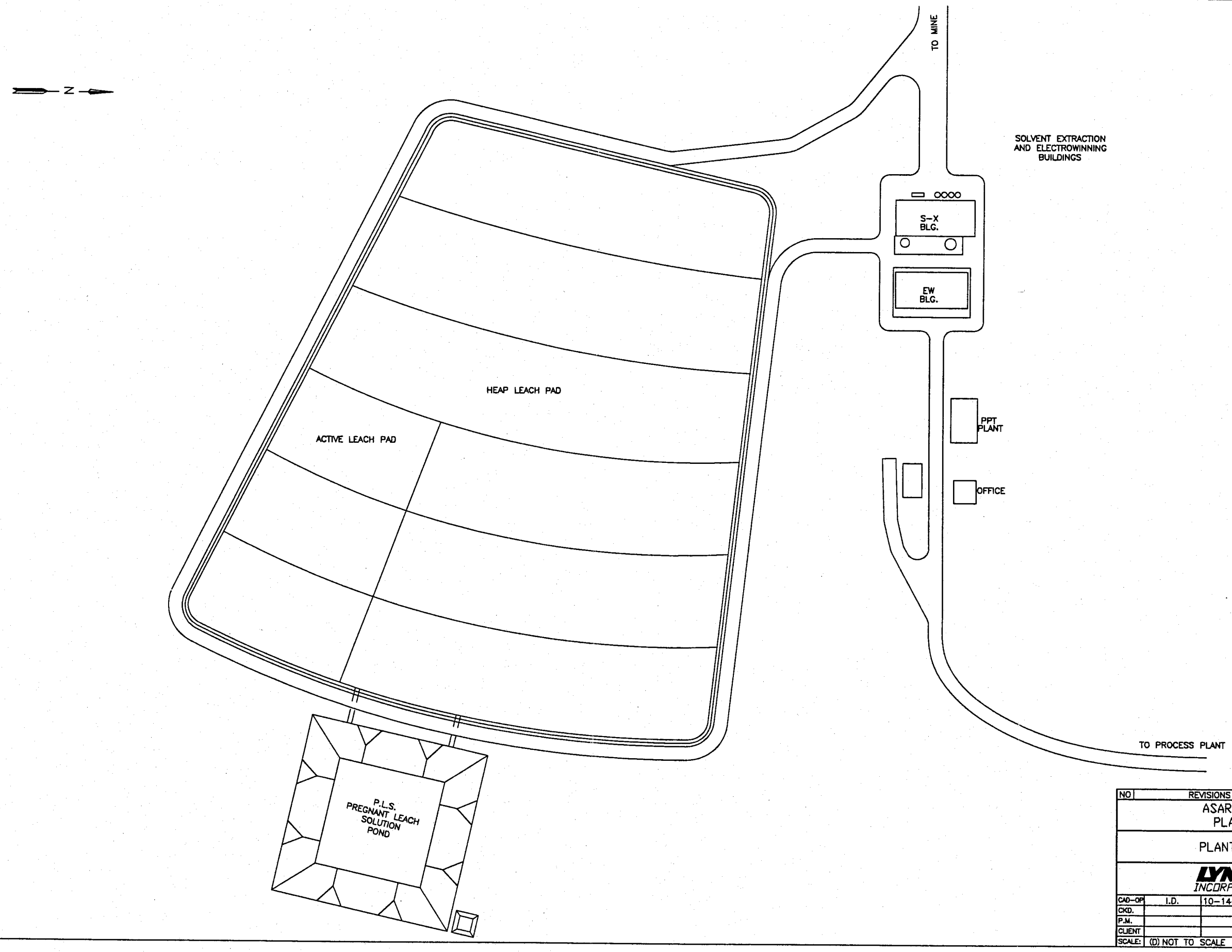
NO	REVISIONS	BY	DATE
C	UPDATE	HJB	04/15/03

ASAREL-MEDET JSCO
PLANT ASAREL

PROCESS FLOWSHEET

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	041503.0747
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			
SCALE:	(D) NONE		02003-F-30 / C



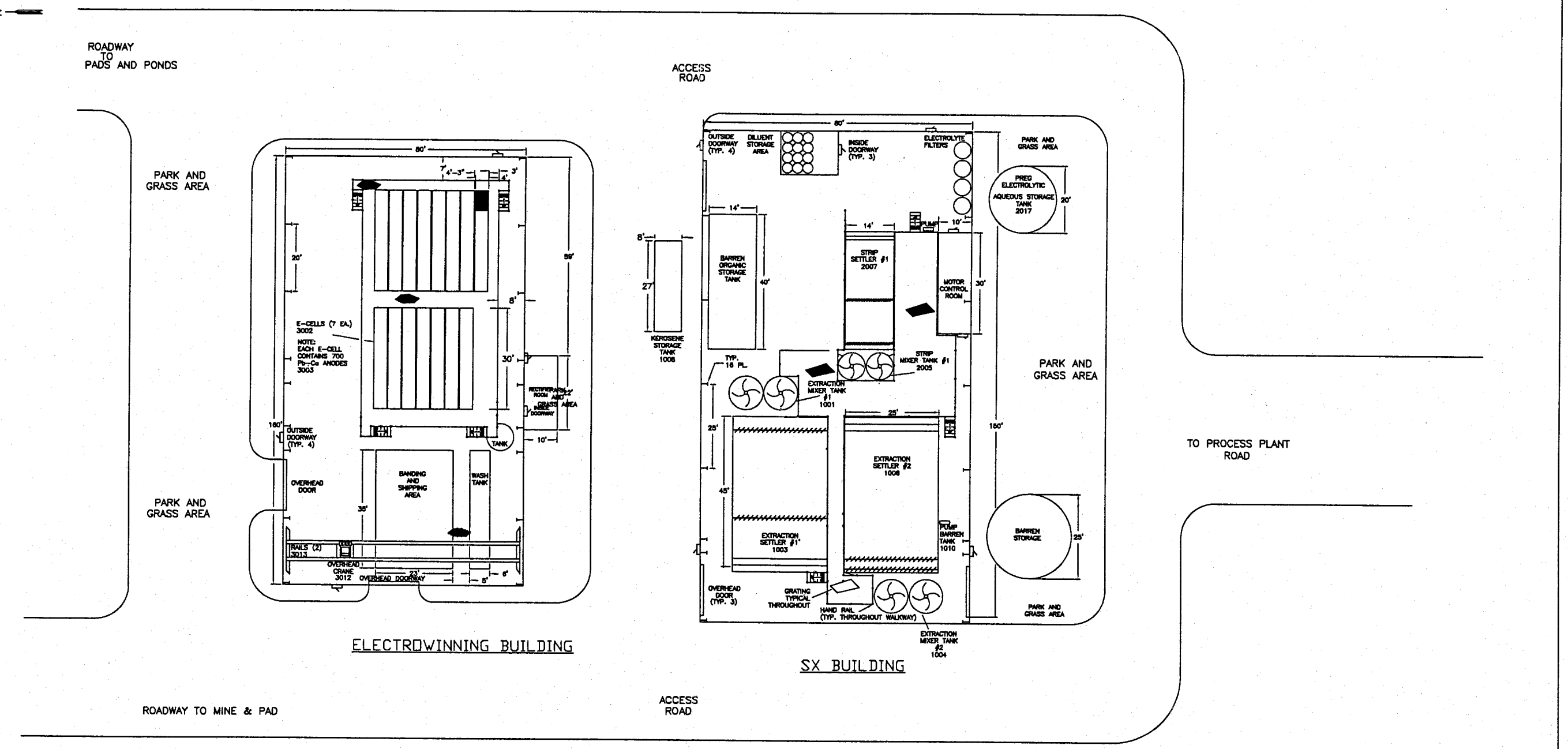
NO	REVISIONS	BY	APP'D	DATE

ASAREL-MEDET JSCO
PLANT ASAREL

PLANT ARRANGEMENT

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	010603.1600
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-G-01 / B
SCALE:	(D) NOT TO SCALE		



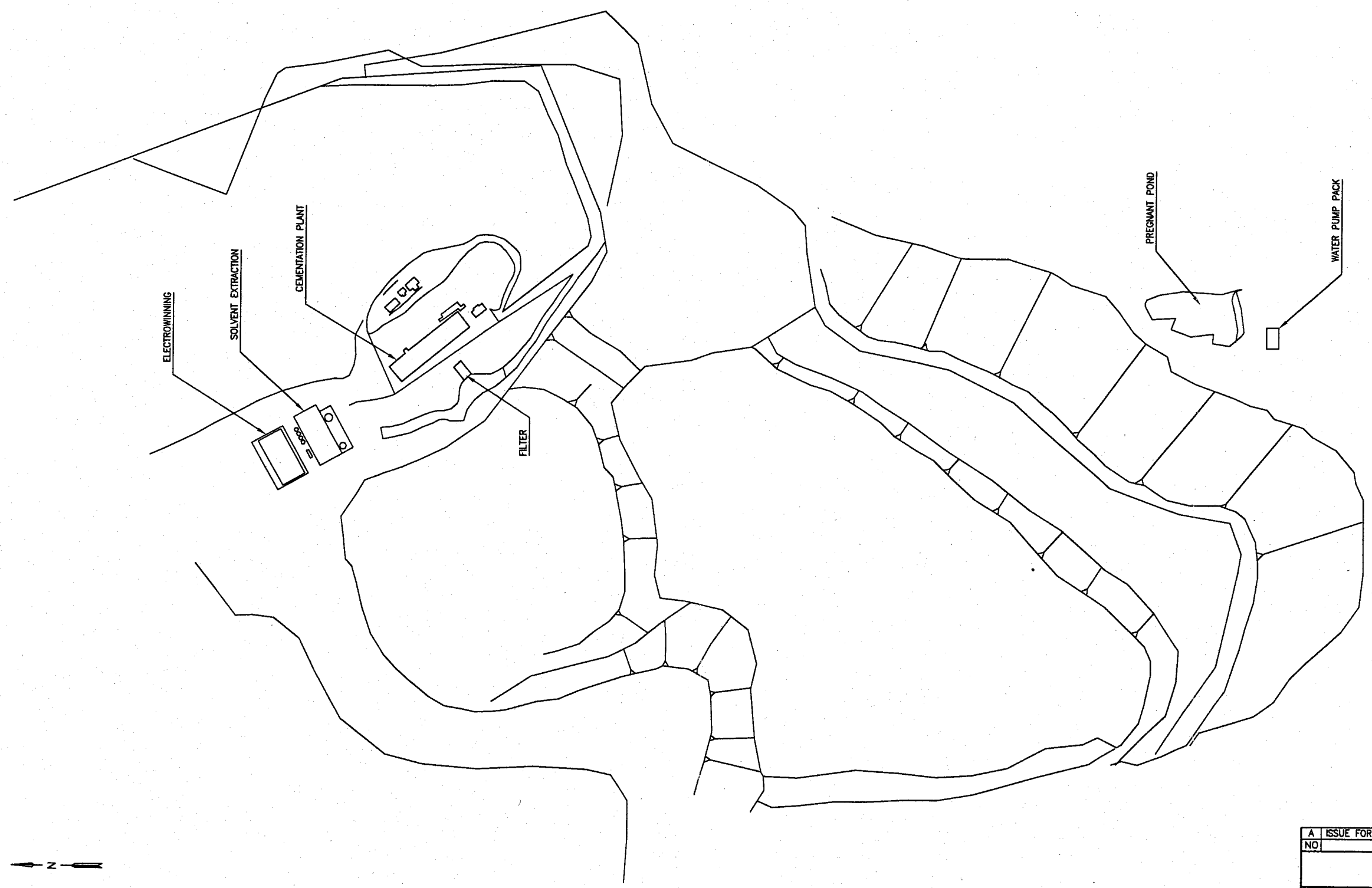
NO	REVISIONS	BY	APP'D	DATE
C	Remove Strip Settler #1, swap Bldgs	HJB		4-17-03

ASAREL-MEDET JSCO
PLANT ASAREL

BUILDING LAYOUT

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	041703.0722
CKD.			
P.M.			DRAWING NO. / REV.
CLIENT			02003-G-02 / C
SCALE:	(D) 1"=30'-0"		



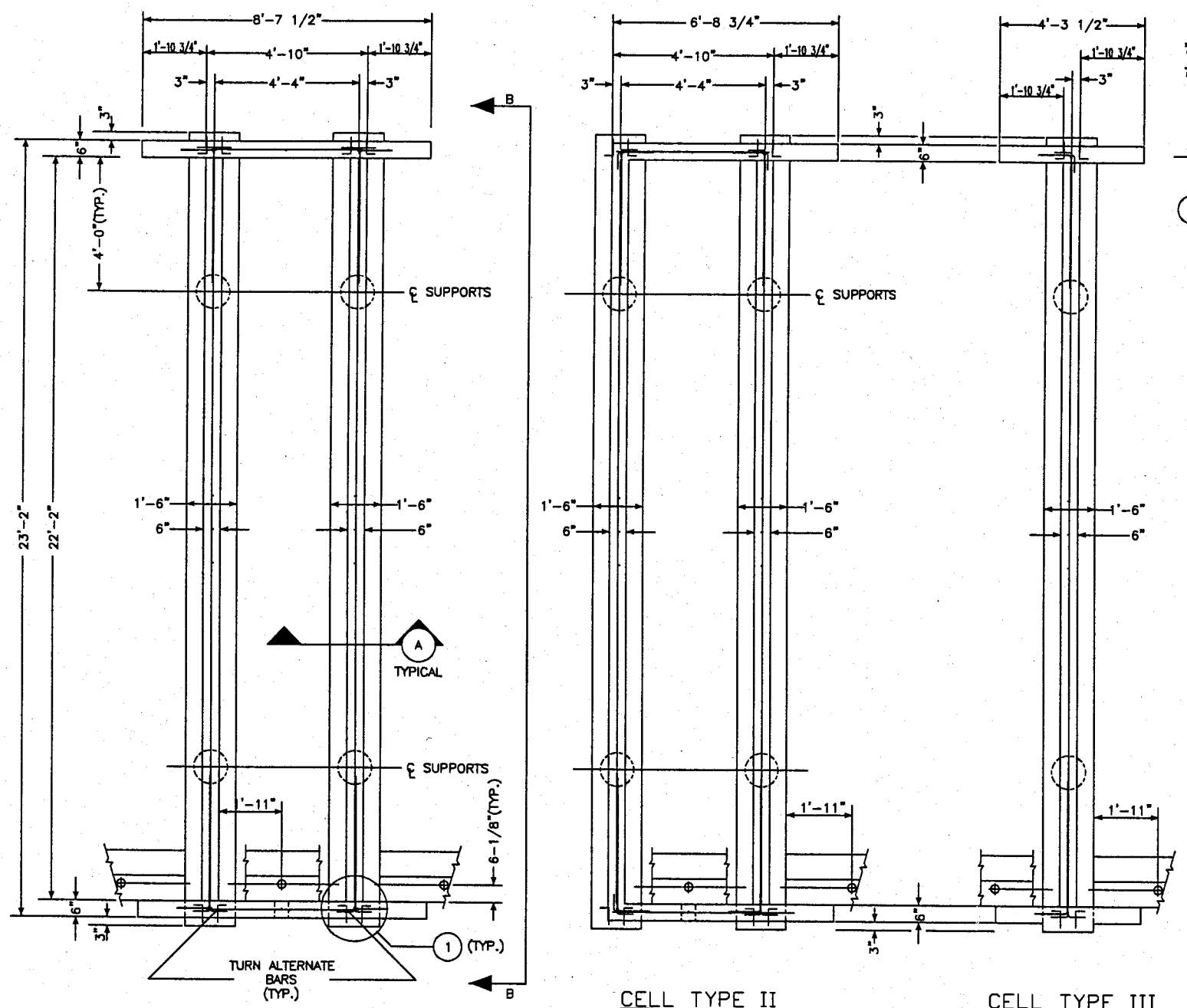
NO	REVISIONS	BY	DATE
A	ISSUE FOR REVIEW	HJB	4-16-03

ASAREL-MEDET JSCO
PLANT ASAREL

SITE PLAN

LYNTEK INCORPORATED

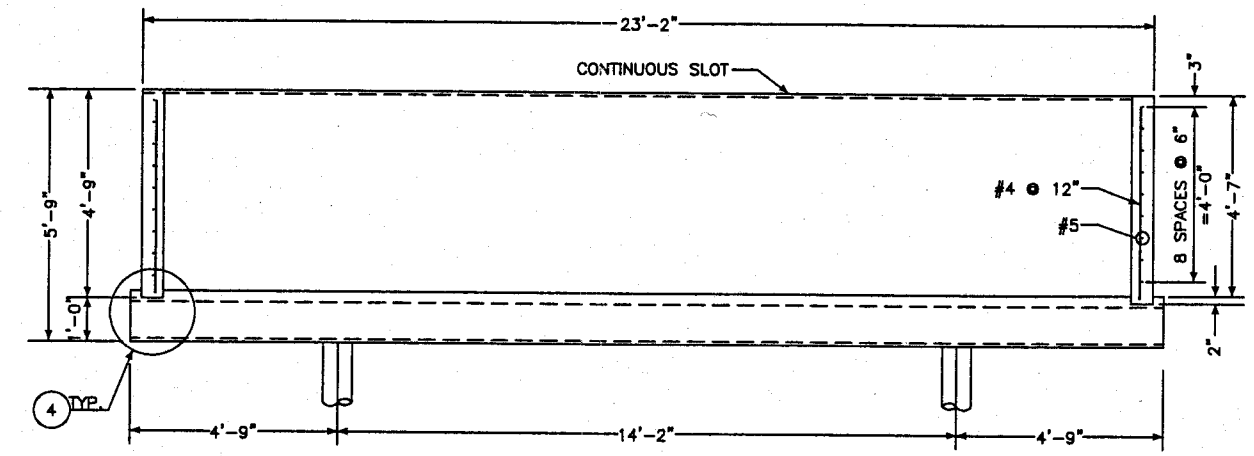
CAD-OP	HJB	4-14-03	041603.1442
CKD.			DRAWING NO. / REV.
P.M.			02003-G-03 / A
CLIENT			
SCALE:	( )		



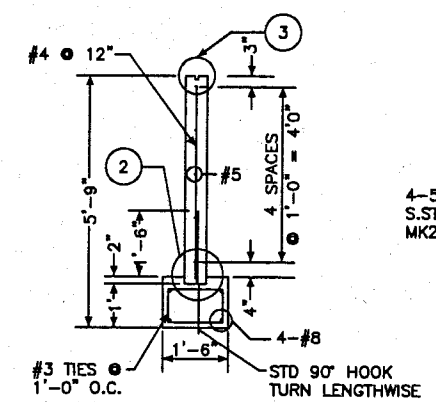
CELL TYPE I
CELL TYPE IA
SCALE: 1/4"=1'-0"

CELL TYPE II
CELL TYPE IIA
SCALE: 1/4"=1'-0"

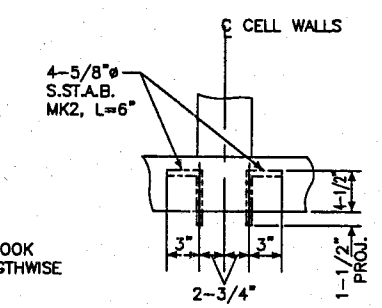
CELL TYPE III
SCALE: 1/4"=1'-0"



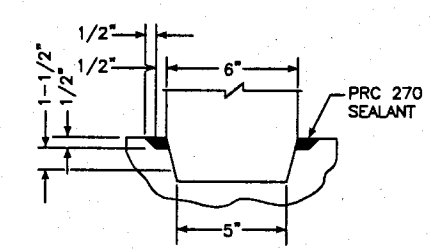
VIEW B-B
SCALE: 1/4"=1'-0"



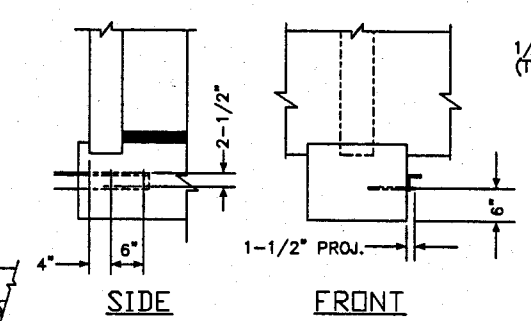
SECTION A
SCALE: 1/4"=1'-0"



DETAIL 1
SCALE: 3/4"=1'-0"

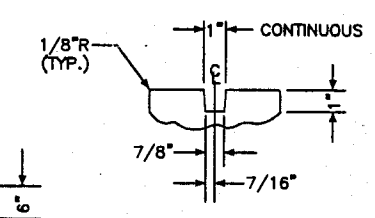


DETAIL 2
SCALE: 1 1/2"=1'-0"



SIDE
FRONT

DETAIL 4
SCALE: 3/8"=1'-0"



DETAIL 3
SCALE: 1 1/2"=1'-0"

NOTES:

1. CLEAN SURFACES OF GROOVE & WALL WHERE SEALANT WILL BE APPLIED SO THAT THERE IS NO LOOSE AGGREGATE DEBRIS OR FORM RELEASE AGENTS.
2. APPLY ONE COAT OF PRC* PRIMER #26 TO SURFACES TO BE SEALED.
3. AFTER PRIMER HAS DRIED, FILL GROOVE WITH PRC* RUBBER CALK 270 SEALANT. FIRMLY PRESS SEALANT INTO GROOVE TO ASSURE COMPLETE WETTING OF THE BONDING SURFACE.

PRC*– PRODUCTS RESEARCH & CHEMICAL CORPORATION

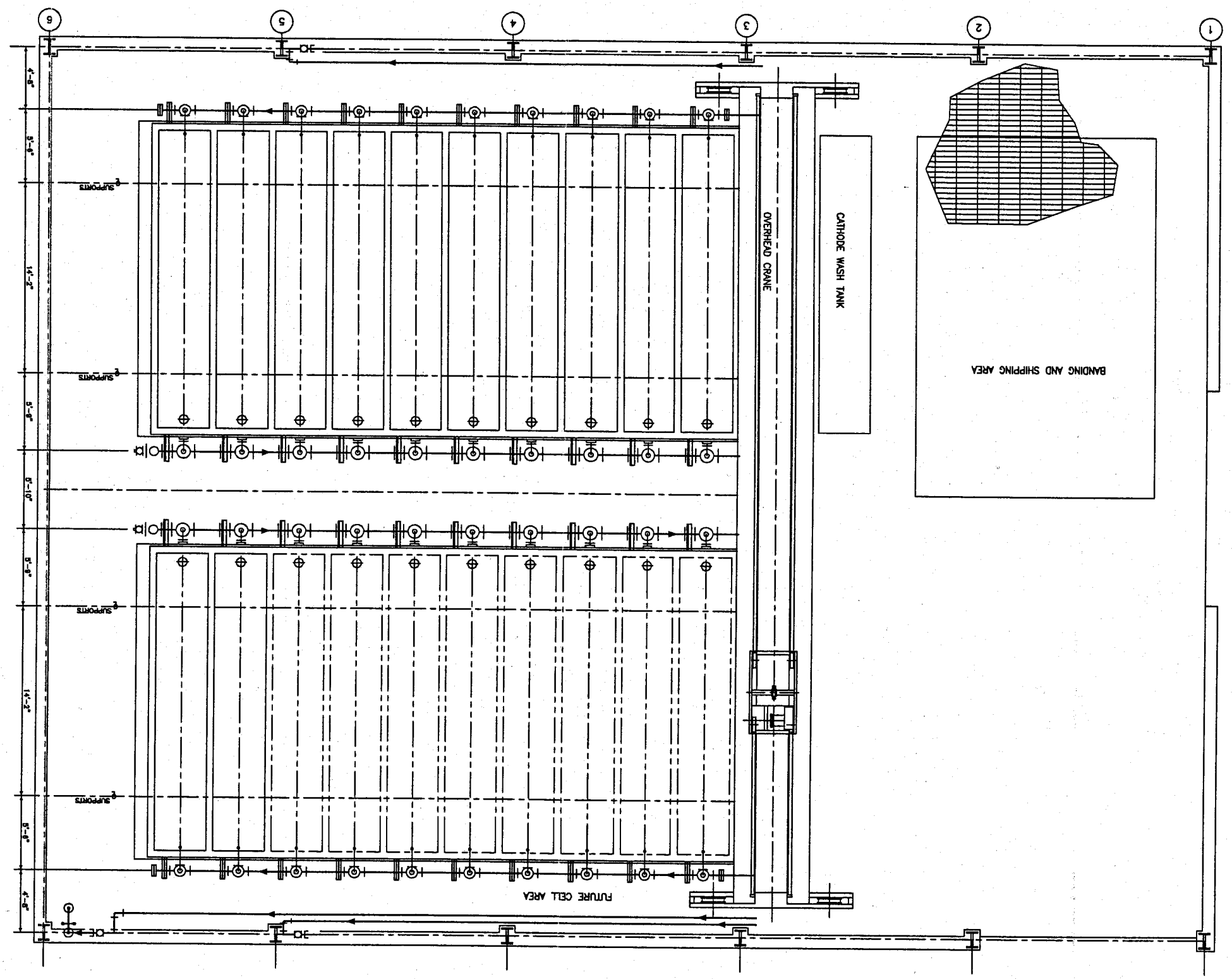
NO	REVISIONS	BY	APP'D	DATE

ASAREL-MEDET JSCO
PLANT ASAREL

CELLS DETAILS

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	101402.1034
CKD.			
P.M.			DRAWING NO. / REV.
CLIENT			
SCALE:	(D) 1/4"=1'-0"		02003-M-01 / A



NO	REVISIONS	BY	DATE
B	GENERAL REVS	KJB	4-17-03

ASARCL-MEDCET JSCD
PLANT ASARCL

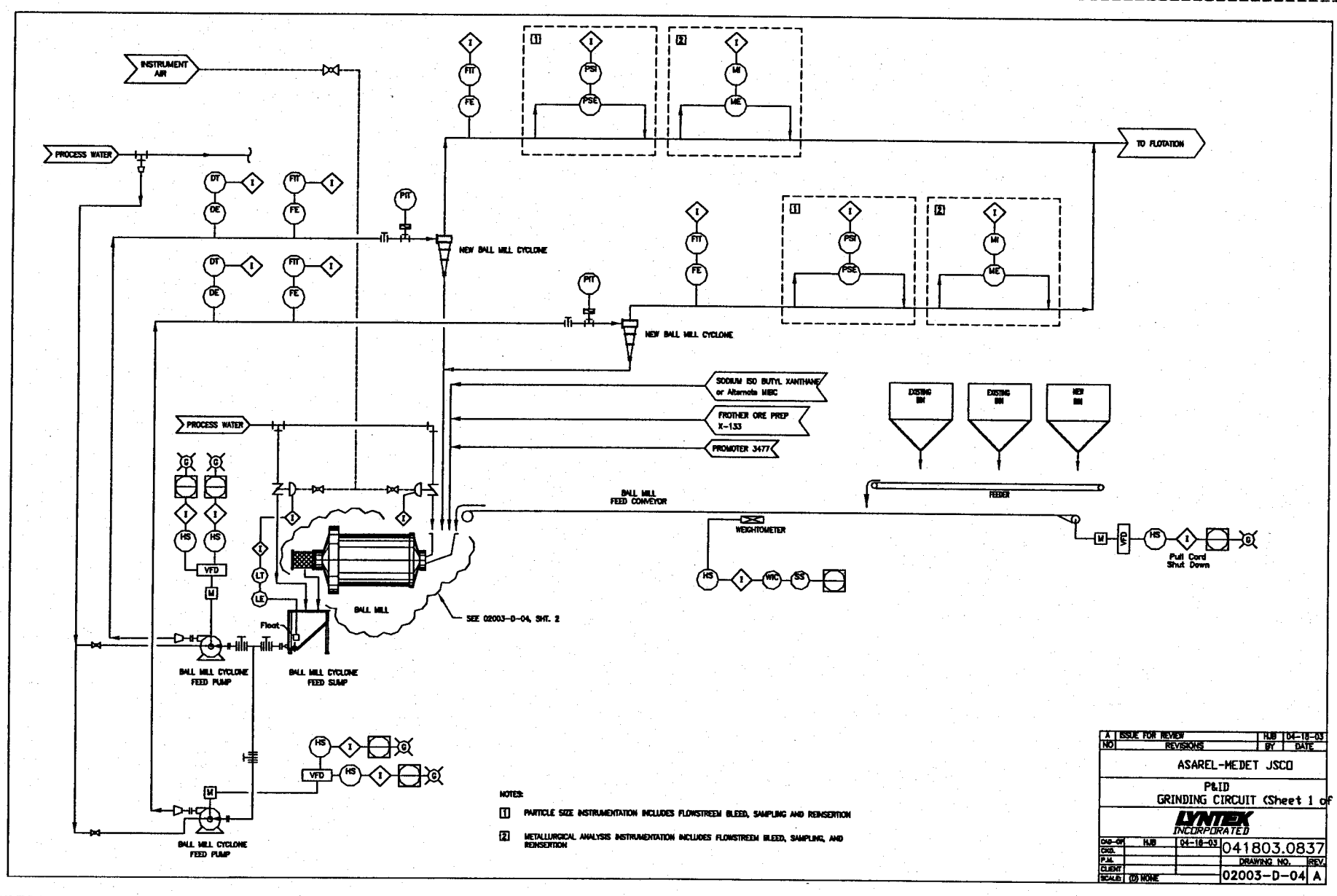
TYPICAL CELLS PIPING

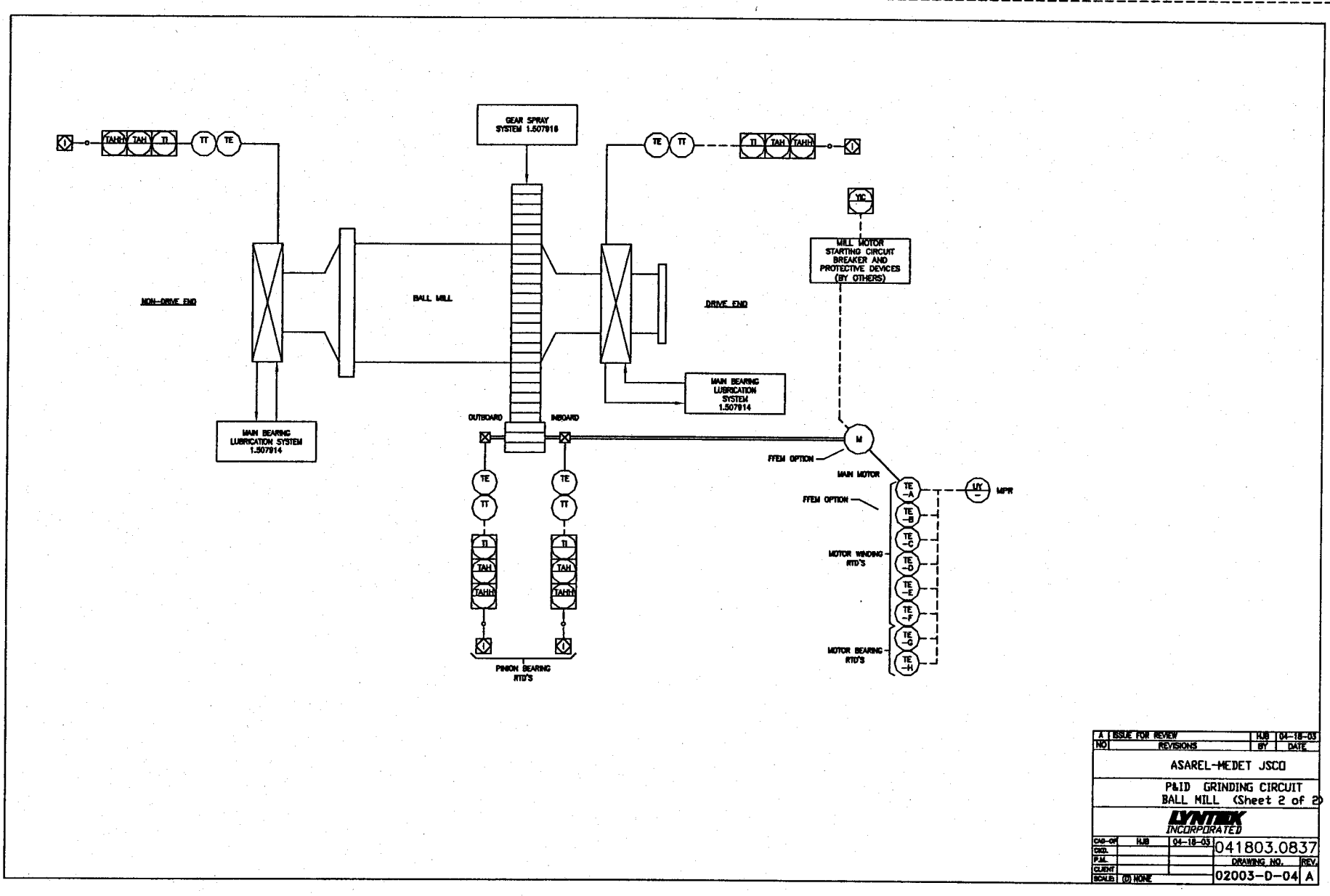
LYNTEK INCORPORATED

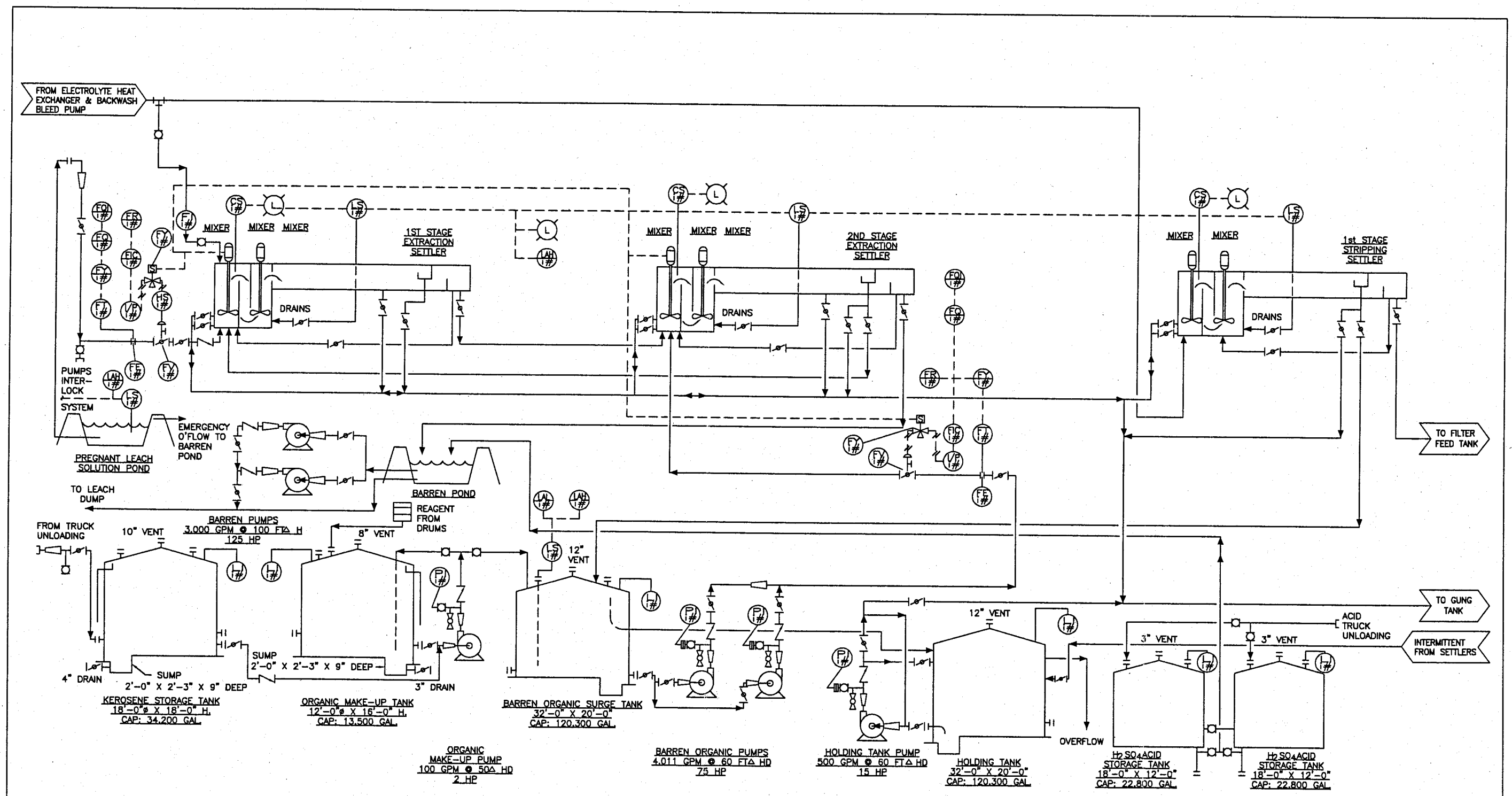
CAD-OP	L.D.	10-14-02
CHD.		
CLIENT		
P.M.		
SCALE:	(D) 1/8"=1'-0"	

041703.1220

DRAWING NO. 02003-P-01 REV. B


INSTRUMENT AIR
PROCESS WATER
TO FLOTATION
NEW BALL MILL CYCLONE
NEW BALL MILL CYCLONE
SODIUM ISO BUTYL XANTHATE or Alternate MIBC
FROTHER ORE PREP X-133
PROMOTER 3477
EXISTING BIN
EXISTING BIN
NEW BIN
FEEDER
BALL MILL FEED CONVEYOR
WEIGHTOMETER
Pull Cord Shut Down
BALL MILL
SEE 02003-D-04, SHT. 2
Float
BALL MILL CYCLONE FEED PUMP
BALL MILL CYCLONE FEED SUMP
BALL MILL CYCLONE FEED PUMP
NOTES:
1 PARTICLE SIZE INSTRUMENTATION INCLUDES FLOWSTREEM BLEED, SAMPLING AND REINSERTION
2 METALLURGICAL ANALYSIS INSTRUMENTATION INCLUDES FLOWSTREEM BLEED, SAMPLING, AND REINSERTION
A ISSUE FOR REVIEW HJB 04-18-03
NO REVISIONS BY DATE
ASAREL-MEDET JSCO
P&ID
GRINDING CIRCUIT (Sheet 1 of 2)
LYNTEK INCORPORATED
041803.0837
02003-D-04 A


GEAR SPRAY SYSTEM 1.507916
NON-DRIVE END
BALL MILL
DRIVE END
MILL MOTOR STARTING CIRCUIT BREAKER AND PROTECTIVE DEVICES (BY OTHERS)
MAIN BEARING LUBRICATION SYSTEM 1.507914
MAIN BEARING LUBRICATION SYSTEM 1.507914
OUTBOARD
INBOARD
FFEM OPTION
MAIN MOTOR
FFEM OPTION
MPR
MOTOR WINDING RTD'S
MOTOR BEARING RTD'S
PINION BEARING RTD'S
A ISSUE FOR REVIEW HJB 04-18-03
NO REVISIONS BY DATE
ASAREL-MEDET JSCO
P&ID GRINDING CIRCUIT
BALL MILL (Sheet 2 of 2)
LYNTEK INCORPORATED
041803.0837
02003-D-04 A



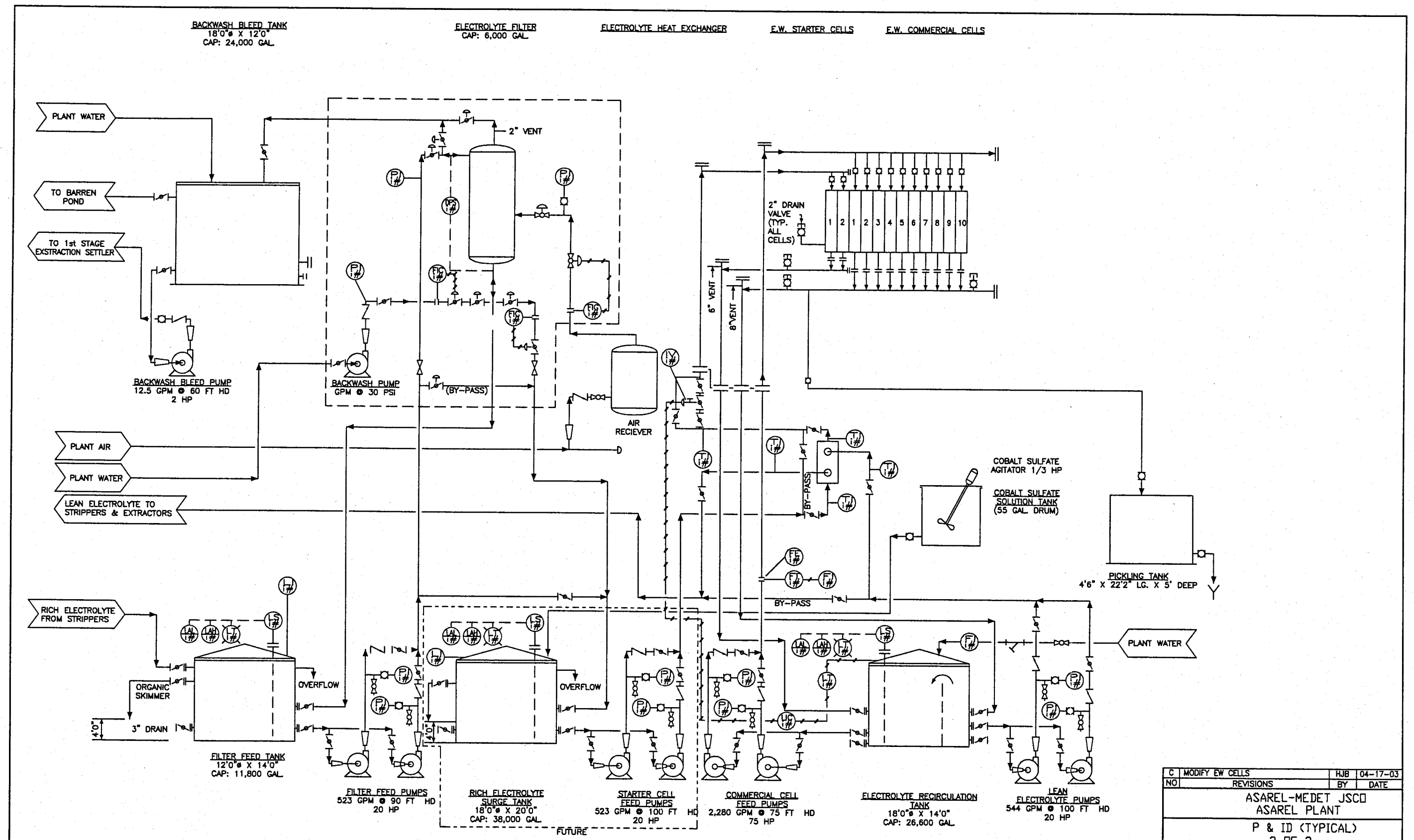
NO	REVISIONS	BY	APP'D	DATE

ASAREL-MEDET JSCO
PLANT ASAREL

P & I DIAGRAM (TYPICAL)
1 OF 3

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	010703.0900
CKD.			DRAWING NO. / REV.
P.N.			
CLIENT			02003-D-01 / B
SCALE:	(D) NONE		



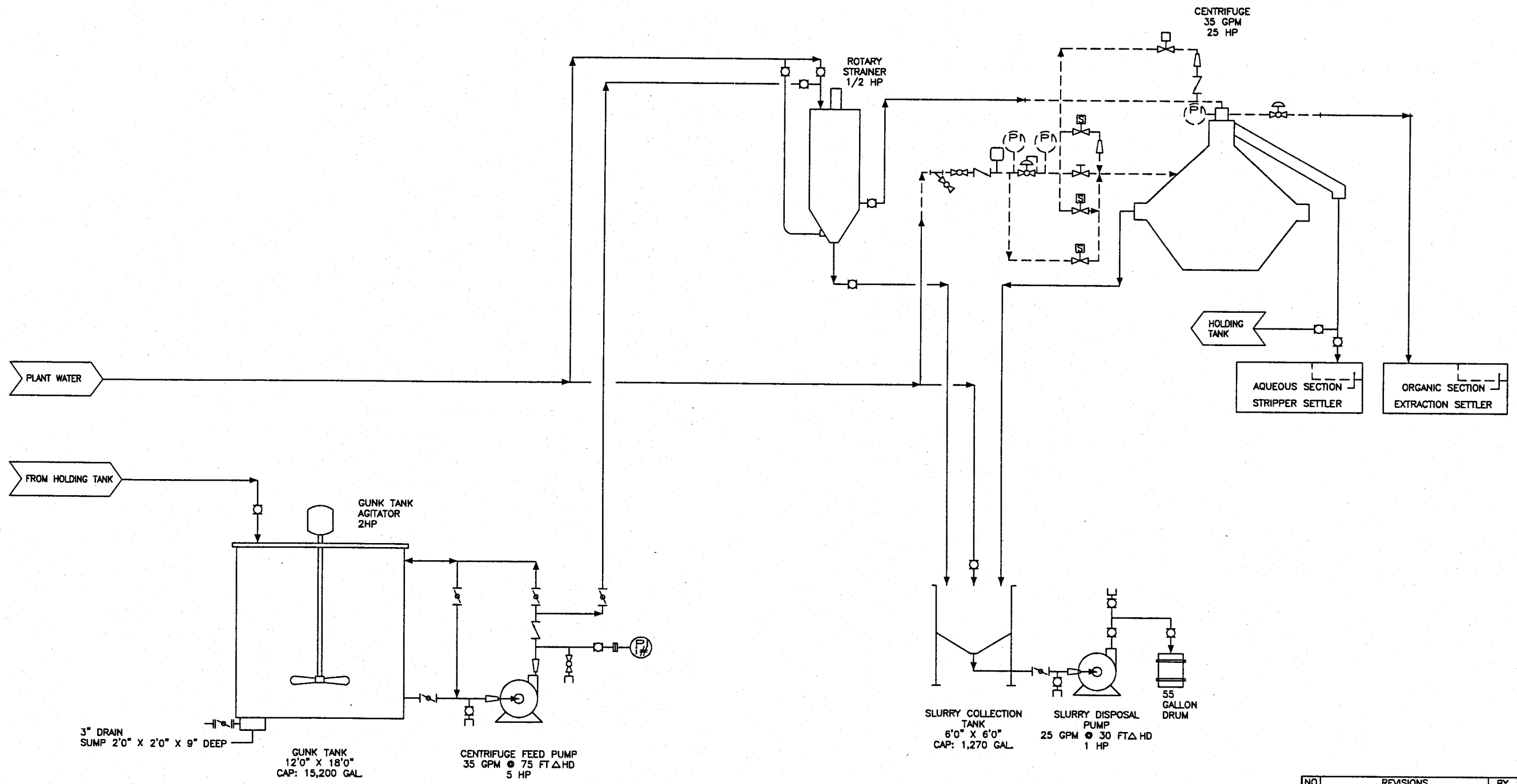
NO	REVISIONS	BY	DATE
C	MODIFY EW CELLS	HJB	04-17-03

ASAREL-MEDET JSCO
ASAREL PLANT

P & ID (TYPICAL)
2 OF 3

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	041703.1211
CKD.			DRAWING NO. / REV.
P.M.			
CLIENT			02003-D-02 / C
SCALE:	(D) NONE		



NO	REVISIONS	BY	APP'D	DATE

ASAREL-MEDET JSCO
ASAREL PLANT

P & I DIAGRAM (TYPICAL)
3 OF 3

LYNTEK INCORPORATED

CAD-OP	I.D.	10-14-02	101402.0335
CKD.			
P.M.			DRAWING NO. / REV.
CLIENT			02003-D-03 / A
SCALE:	(D) NONE		

Appendix D

U.S. Vendor Listing

Equipment Type	Manufacturer Name	Manufacturer Contact Information	Representative	Representative Contact Information
Agitators	Sharpe	Sharpe Mixers P.O. Box 3906 Seattle, WA 98124	Fluid Equipment, L. L. C.	Jack Kusmick Email: feco.jak@worldnet.att.net Phone: 303.430.9069 Fax: 303.430.1001 Address: P.O. Box 1025 Westminster, CO 80036-1025
	Denver Equipment via Metso via Pumps Plus	e (800) 237-8815 Fax (800) 767	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	Philadelphia Mixers Corp. (via Camber Process Equipment Co.)	n/a	Camber Equipment Co.	Mike Jensen Email: camber@mho.net Phone: 303.766.8320 Fax: 303.766.7963 Address: P.O. Box 460117, Aurora, CO 80046-0117
Crushers	Cedar Rapids	4388 Santa Fe Road	Power Equipment	Darren Brown Email dbrown@power-equip.com Phone (303) 288-6801 Fax (303) 288-6809 500 E. 62nd Ave., Denver, CO 80216
	Norgberg Via Metso	Bill Brewer Email: Bill.Breuer@metso.com Phone:303.792.0393 Fax: 303.792.0394 Address: 8100 South Akron Street, Suite 315 Englewood, CO 80112	same	same
	KuKan Crushers	n/a	Camber Equipment Co.	Mike Jensen Email: camber@mho.net Phone: 303.766.8320 Fax: 303.766.7963 Address: P.O. Box 460117, Aurora, CO 80046-0117
	FFE Minerals USA	Telephone: 1-805-544-9155	same	same
	Telsmith	Telefax: 1-805-546-8105	same	same
Pumps	Warman via Canmac Engineering Sales, Inc.	Jim McGuigan Email canmaceng@aol.com Phone (303) 278-9224 Fax (303) 279-2804, 2885 Braun Court, Golden, Colorado 8040l-2885	same	same
		n/a	Fluid Equipment, L. L. C.	Jack Kusmick Email: feco.jak@worldnet.att.net Phone: 303.430.9069 Fax: 303.430.1001 Address: P.O. Box 1025 Westminster, CO 80036-1025
	Denver Equipment Via Metso via Pumps Plus	Les Apodaca Email: Leslie.Apodaca@metso.com	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	Tyler Equipment Corp. (via Camber Process Equipment Co.)	n/a	Camber Equipment Co.	Mike Jensen Email: camber@mho.net Phone: 303.766.8320 Fax: 303.766.7963 Address: P.O. Box 460117, Aurora, CO 80046-0117

	Norgberg Via Metso	Bill Brewer Email: Bill.Breuer@metso.com Phone:303.792.0393 Fax: 303.792.0394 Address: 8100 South Akron Street, Suite 315 Englewood, CO 80112	same	same
	Sandvick Tamrock (formerly Svedala, formerly Allis Chalmers)	Gerry Szpak, Regional District Sales Rep. Email gerry.szpak@sandvik.com Phone (480) 460-7103 Fax (480) 460-7102 Mobile 404.435.7403 Address: 6181 S. Bradshaw Wy., Chandler AZ 85249	same	same
Thickeners	**EIMCO**	Frank Traczyk Email: Frank.Traczyk@eimcoprocess.com Phone: 801.526.2406 Fax: 801.526.2923 Address: P.O. Box 300, Salt Lake City, UT 84010	same	same
	Denver Equipment Via Pumps Plus	Les Apodaca Email: Leslie.Apodaca@metso.com	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	Outokumpu	W. Matthew Parry Email: matt.parry@outokumpu.com Phone: 303.792.3110 Fax: 303.799.6892 Address: 109 Inverness Dr. East, Suite F, Englewood CO 80112	same	same
	Quinn Process Equipment Co.	Richard Quinn 3000 Brighton Blvd. Denver, Colorado 80204	Richard Quinn	
Filters	**Metso via Pumps Plus**	Rene Trudel Email: Rene.Trudel@metso.com	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	EIMCO	Craig McDonald Email: Craig.McDonald@eimcoprocess.com Phone: 801.526.2406 Fax: 801.526.2923 Address: P.O. Box 300, Salt Lake City, UT 84010	same	same
	Outokumpu	W. Matthew Parry Email: matt.parry@outokumpu.com Phone: 303.792.3110 Fax: 303.799.6892 Address: 109 Inverness Dr. East, Suite F, Englewood CO 80112	same	same
	Metso via Pumps Plus	Rene Trudel Email: Rene.Trudel@metso.com	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	EIMCO	Craig McDonald Email: Craig.McDonald@eimcoprocess.com Phone: 801.526.2406 Fax: 801.526.2923 Address: P.O. Box 300, Salt Lake City, UT 84010	same	same
	Outokumpu Technology Inc.	W. Matthew Parry Email: matt.parry@outokumpu.com Phone: 303.792.3110 Fax: 303.799.6892 Address: 109 Inverness Dr. East, Suite F, Englewood CO 80112	same	same

Mills	Metso via Pumps Plus	Brenda Wolfe Email: Brenda.Wolfe@metso.com	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
Hydrocyclone	Krebs Engineers (via Pumps Plus Inc.)	Joel Morales Email: jmorales@krebs.com Phone:520.744.8200 Fax: 520.744.5104/8300 Address: 5505 West Gillette Road Tuscon AZ 85743	Pumps Plus Inc.	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	Warman via Canmac Engineering Sales, Inc.	Jim McGuigan Email canmaceng@aol.com Phone (303) 278-9224 Fax (303) 279-2804, 2885 Braun Court, Golden, Colorado 80401-2885	same	same
	FFE Minerals USA	Michael Schreder Email: michael.schreder@ffeminerals.com Phone: 610.264.6929 Fax: 610.264.6802 Address: 3235 Schoenersville Rd., Bethlehem, PA 18016-0810	same	same
	Metso Minerals Inc. (Svedala) Western Region	Bill Brewer Email: Bill.Breuer@metso.com Phone:303.792.0393 Fax: 303.792.0394 Address: 8100 South Akron Street, Suite 315 Englewood, CO 80112	same	same
Conveyors	Metso via Pumps Plus	Les Apodaca Email: Leslie.Apodaca@metso.com	Allis Chamers	Greg LaRocque/Jim Thompson Email: Gelarocque@aol.com or pumpsplus@aol.com Phone: 303.451.7677 Fax: 303.452.2435 Address: Colorado Tech Center, 609 South Taylor Avenue, Unit B, Louisville, CO 80027
	Conveyor Engineering. Inc.	2909 Elder St. (83705) P.O. Box 15989 Boise, Idaho 83715	Matt Russell, P. E.	(208) 342-2653
	Conveying Industries, Inc.	P.O. Box 15989	P.O. Box 15989	303.373.2035
	Telsmith	Boise, Idaho 83715	Conveyor Special MidWest	n/a
OnStream Unit	Thermogammametr	Thomas R. Strombotne Email: tstrombo@thermogammametrics.com Phone: (858) 458-1700 ext 243 Fax: (858) 452-9250 Address: 5788 Pacific Center Blvd San Diego, CA 92121	Thermogammametrics	Thomas R. Strombotne Email: tstrombo@thermogammametrics.com Phone: (858) 458-1700 ext 243 Fax: (858) 452-9250 Address: 5788 Pacific Center Blvd San Diego, CA 92121
	Outokumpu Technology Inc.	W. Matthew Parry Email: matt.parry@outokumpu.com Phone: 303.792.3110 Fax: 303.799.6892 Address: 109 Inverness Dr. East, Suite F, Englewood CO 80112	Outokumpu Technology Inc.	W. Matthew Parry Email: matt.parry@outokumpu.com Phone: 303.792.3110 Fax: 303.799.6892 Address: 109 Inverness Dr. East, Suite F, Englewood CO 80112