



ALEXCO

Mill Development and Operations Plan

Quartz Mining Licence QML-0009

November 2009

BELLEKENO PROJECT



ACCESS
CONSULTING GROUP

Table of Contents

1.0	INTRODUCTION.....	1
1.1	Flame and Moth Site History	1
2.0	MILL CONSTRUCTION.....	5
2.1	Mill Site Construction Schedule.....	7
2.1.1	Mill Building Construction Plans	1
3.0	MINERALOGICAL PROCESSING AND METALLURGICAL TESTING.....	1
3.1	Test Work Review	1
3.1.1	Background	1
3.1.2	Test Work Programs	1
3.1.3	Test Samples	3
3.1.4	Mineralogical Study	6
3.1.5	Grindability Tests.....	7
3.1.6	Flotation.....	8
3.1.7	Thickening Test.....	30
3.1.8	Filtration Test.....	31
3.1.9	Characterization of Flotation Tailings	31
3.2	Flowsheet Development	36
3.2.1	Design Criteria.....	37
3.3	Process Description	39
3.3.1	ROM Ore Crushing, Ore Storage, and Reclaim	39
3.3.2	Primary Grinding Circuit	40
3.3.3	Classification	41
3.3.4	Silver-Lead Flotation	41
3.3.5	Zinc Flotation.....	44
3.3.6	Lead and Zinc Concentrates Dewatering And Loadout.....	47
3.3.7	High Pyrite and Low Pyrite Tailings Dewatering and Handling	49
3.4	Plant Services	51
3.4.1	Water Supply.....	51
3.4.2	Air Supply	52
3.4.3	Instrumentation and Process Control	53
3.4.4	Quality Control.....	53
3.5	Metal Production Projection	53

3.5.1	Concentrate Dewatering.....	55
3.5.2	Tailings and Pyrite Concentrate Dewatering and Handling.....	55
4.0	REAGENT HANDLING AND STORAGE	56
5.0	TAILINGS PROCESS OPERATIONS	59
6.0	DRY STACK TAILINGS FACILITY OPERATIONS.....	59
7.0	ANCILLARY FACILITIES.....	60
7.1	Water Supply and Distribution	60
7.1.1	Mill Fresh Water Supply System	60
7.1.2	Note regarding potential Groundwater sources.....	60
7.1.3	Process Water Supply System.....	61
7.2	Assay Laboratory	61
7.3	Electrical Substation and Stand-by Generators	61
7.4	Fuel Storage and Handling	62
7.5	Temporary Construction Facilities	62
8.0	KENO CITY SOCIOECONOMIC CONSIDERATIONS.....	62
8.1	Potential Effects	62
8.2	Consultation and Mitigation	63
8.3	Keno City Socio-Economic Mitigation Plan	63
8.3.1	Communication Protocol	63
8.3.2	Access Management and Traffic.....	64
8.3.3	Predicted Noise Impact and Mitigations	68
8.3.4	Dust abatement.....	70
8.3.5	Light Pollution and Visual Impact	72

List of Tables

Table 3-1	Historical Operation Concentrate Data	1
Table 3-3	Head Assay – 1996 Test Work.....	3
Table 3-4	Specific Gravities of Composites – 1996 Test Work.....	3
Table 3-5	Head Assay – 2007 Test Work.....	4
Table 3-6	Head Assay – 2009/2009 Test Work.....	5
Table 3-7	Grindability Test Results	7
Table 3-8	Reagent Dosage Test Results – 2008/2009 Test Work	11

Table 3-9	Regrind Test Results – 1996 Test Program	14
Table 3-10	Pyrite Rejection Test Results – 2008/2009 Test Work	17
Table 3-11	Locked Cycle Test Results – 2008/2009 PRA Test Work.....	19
Table 3-12	Locked Cycle Test Results – 2007 SGS Test Work.....	23
Table 3-13	Locked Cycle Test Results – 1996 PRA Test Work.....	24
Table 3-14	Lead-Silver and Zinc Concentrate Assay – 2008/2009 Test Work	26
Table 3-15	Summary of Variability Test – Zone Composites	27
Table 3-16	Summary of Level Testing, SW Zone – 2008/2009 Test Work.....	28
Table 3-17	Summary of Level Testing, East Zone – 2008/2009 Test Work	29
Table 3-18	Tailings Production Test Results – 2008/2009 Test Work	29
Table 3-19	Settling Test Results – 1996 Test Work	30
Table 3-20	Settling Test Results – 2008/2009 Test Work.....	30
Table 3-21	LCT1 Bulk Tailings Assay – 2008/2009 Test Work	32
Table 3-22	Tailings Water Assay	33
Table 3-23	ABA Tests on LCT1 Tailings – 2008/2009 Test Work.....	33
Table 3-24	ABA Tests on LCT1 Tailings – 2007 Test Work.....	34
Table 3-25	NAG Test – 2007 Test Work.....	35
Table 3-26	TCLP Leachates Assay – 2008/2009 Test Work.....	36
Table 3-27	Process Design Criteria	38
Table 3-29	Metal Production Projection.....	54
Table 4-1	Summary of Reagents – Bellekeno Plant.....	58
Table 8-1	Estimated Daily Traffic Count – Construction Phase	67
Table 8-2	Estimated Daily Traffic Count – Operations Phase.....	67

List of Figures

Figure 1-1	Mill Site Location	2
Figure 1-2	Mill Water Sources.....	3
Figure 1-3	Mill Building General Arrangement Operating Floor Plan	4
Figure 2-1	Mill Site General Arrangement	6
Figure 2-2	Mill Site Construction Schedule.....	8
Figure 3-1	Lead and Zinc Recovery at Lead-Silver Rougher Flotation vs. Mass Pull – 2007 Test Work.....	8

Figure 3-2 Lead-Silver Rougher Concentrate Metallurgical Performance vs. Primary Grind Size – 2008/2009 Test Work.....	9
Figure 3-3 Zinc Recovery vs. Primary Grind Size – 2008/2009 Test Work	9
Figure 3-4 Effect of Collectors on Lead, Zinc, and Silver Recovery at Lead-Silver Rougher Flotation – 2007 Test Work.....	10
Figure 3-5 Effect of Regrind on Lead-Silver Rougher Flotation – 2008/2009 Test Work	13
Figure 3-6 Effect of Reagent Dosage on Zinc Flotation – 2008/2009 Test Work.....	16
Figure 3-7 Locked Cycle Test Flowsheet (LCT 1) – 2008/2009 Test Work.....	21
Figure 3-8 Locked Cycle Test Flowsheet (LCT 2) – 2008/2009 Test Work.....	22
Figure 3-9 Locked Cycle Test Flowsheet – SGS.....	23
Figure 8-1 Keno City Bypass	65

List of Appendices

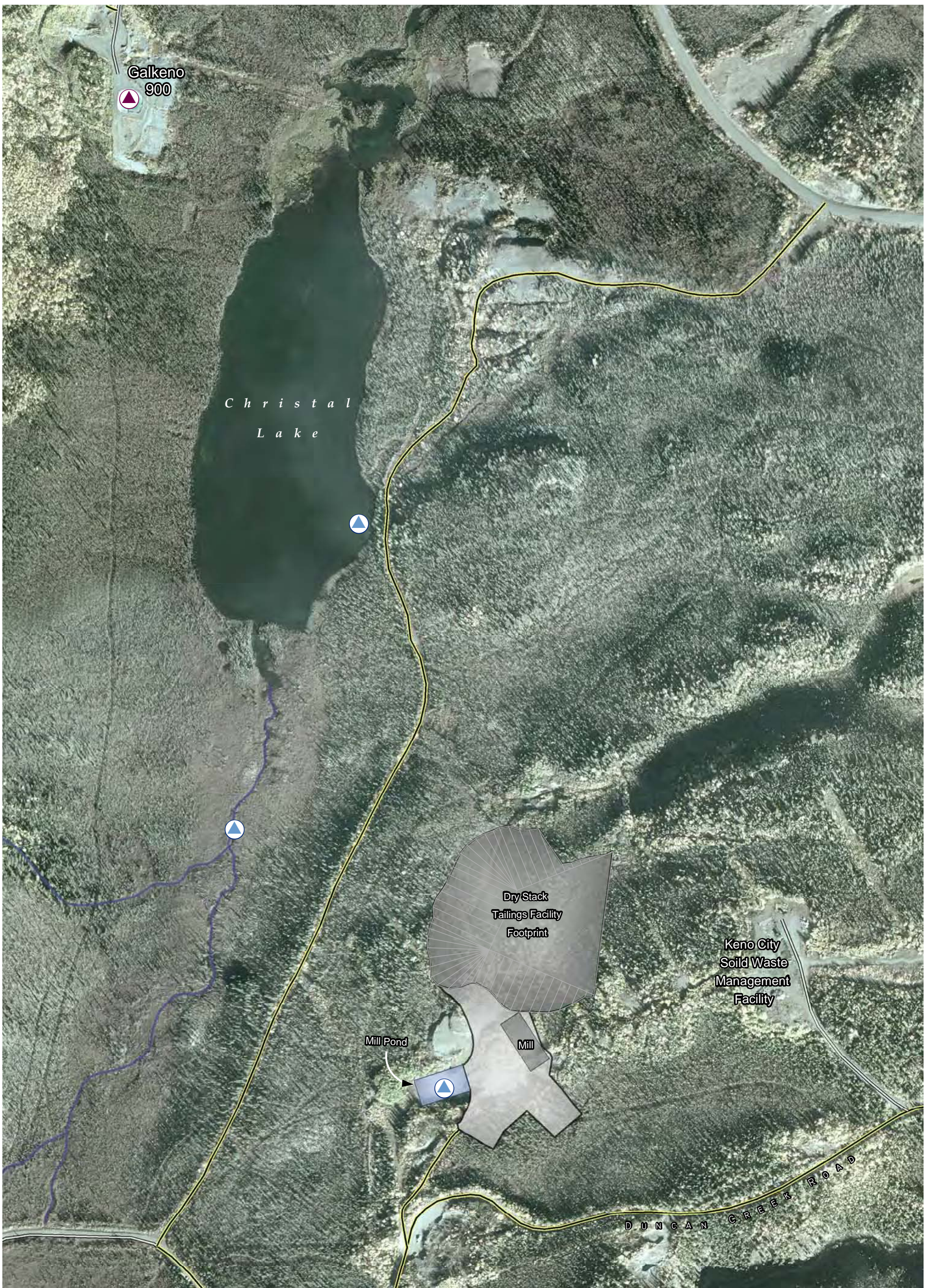
Appendix A	Project Drawings
Appendix B	Design Criteria
	i) Civil Design Criteria
	ii) Mechanical Design Criteria
	iii) Piping Design Criteria
	iv) Building Services Design Criteria
	v) Structural Design Criteria
	vi) Instrumentation Design Criteria

1.0 INTRODUCTION

As a condition of Section 15.1 of Quartz Mining Licence QML-0009, this plan is submitted for approval as the Mill Development and Operation plan for the Bellekeno Mine Project.

1.1 Flame and Moth Site History

The Flame and Moth mill site is located approximately 1.1 km from the center of Keno City and is within the upper Christal Creek drainage. The Flame and Moth pit is centered on a north east striking, southeast dipping vein fault which was a historic producer. The UKHM 1996 Mine Reopening – Operating Plan indicates that about 1,600 tons of ore were extracted from a small underground development during the 1950s and a small pit developed later to recover the crown pillar. Another UKHM document entitled Keno Hill – Galena Hill Ore Production 1913 -1982 indicates that this open pit production amounted to 1,590 tonnes and contained approximately 30,000 ounces of silver. As a past producing mine, the Flame and Moth pit is also a previously impacted site, which Alexco and other stakeholders view as favorable with regard to minimizing environmental impact of the project. Figure 1-1 shows the mill site location and Figure 1-2 shows the DSTF and ancillary facilities and makeup water sources. Figure 1-3 presents the current mill building configuration design and floor plan.



Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13 and 14 2006.

1:4,000 (when printed on 11 x17 inch paper)



Primary Water Source



Alternate Water Source



Watercourse

Local Road

Haul Road

Contours

**BELLEKENO MINE PROJECT
TYPE A WATER LICENSE APPLICATION**

**FIGURE 2-10
MILL WATER SOURCES**

Drawn By: MD

AUGUST 2009

Verified by: EA

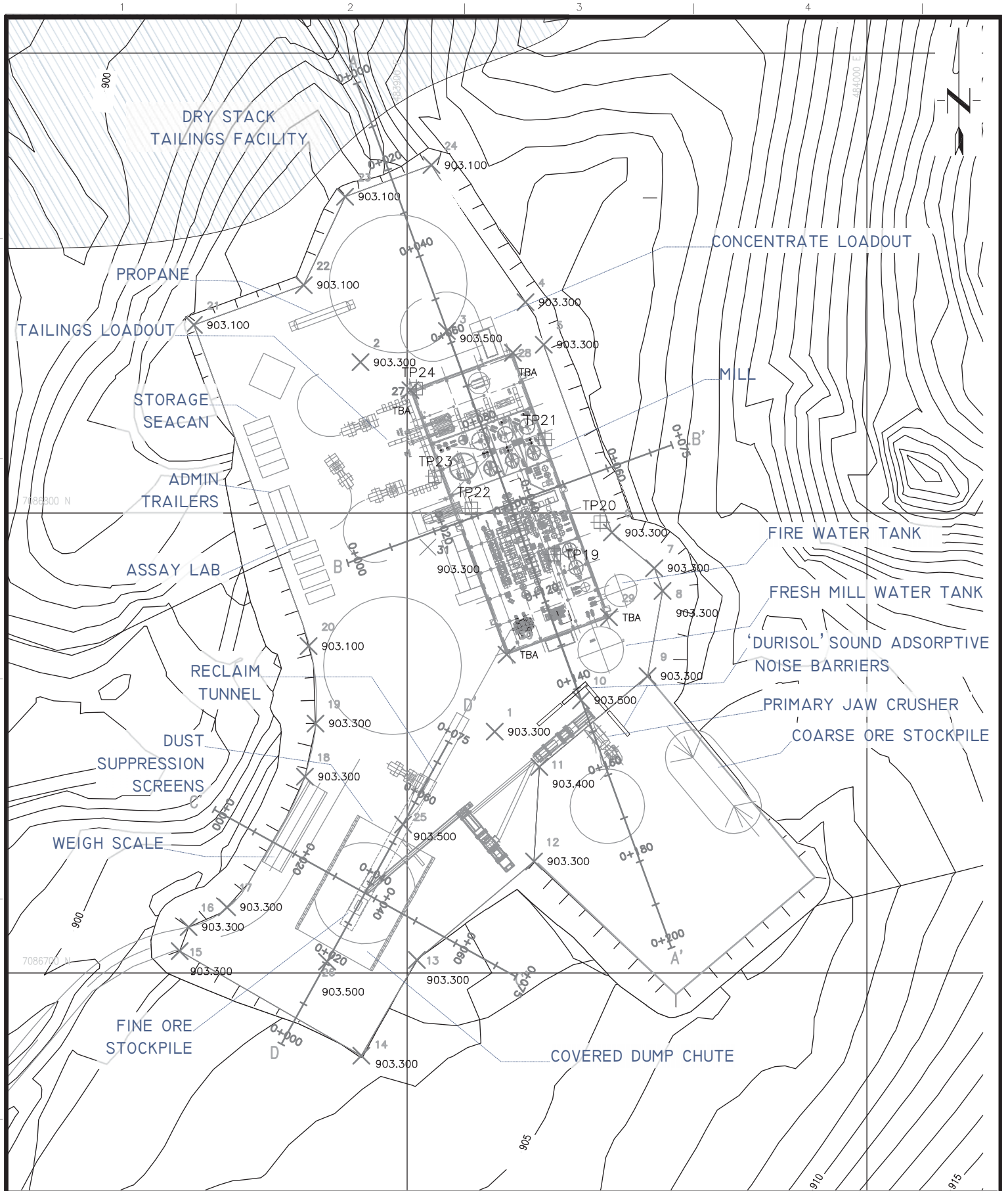
D:\Project\AllProjects\ALEX-05-01\Bellekeno\GIS\mxd
WUL_MLU_Applications\WUL_Aug_09\Fig_2_9_Mill_Site_Location.mxd



2.0 MILL CONSTRUCTION

The overall general arrangement for the mill site is provided in Figure 2-1. Some of the drawings or figures in supporting documentation are earlier versions and may show slightly differing arrangements for final layout mine components, pending final detailed engineering designs. These will be updated in due course and a final site as built will be provided to Yukon Government.

Mill site development to date has consisted of construction preparatory earthworks, leveling and minor clearing, and construction of concrete foundations for the mill building. These activities were authorized under MLU LQ00240. General details on mill site construction such as construction surface water management and details on construction of preparatory earthworks and concrete foundations were presented in the Construction Site Plan, which was approved as part of QML-0009.



ALEXCO KENO HILL MINING CORP.
 BELLEKENO PROJECT
 PLANT SITE LAYOUT

JULY 2009

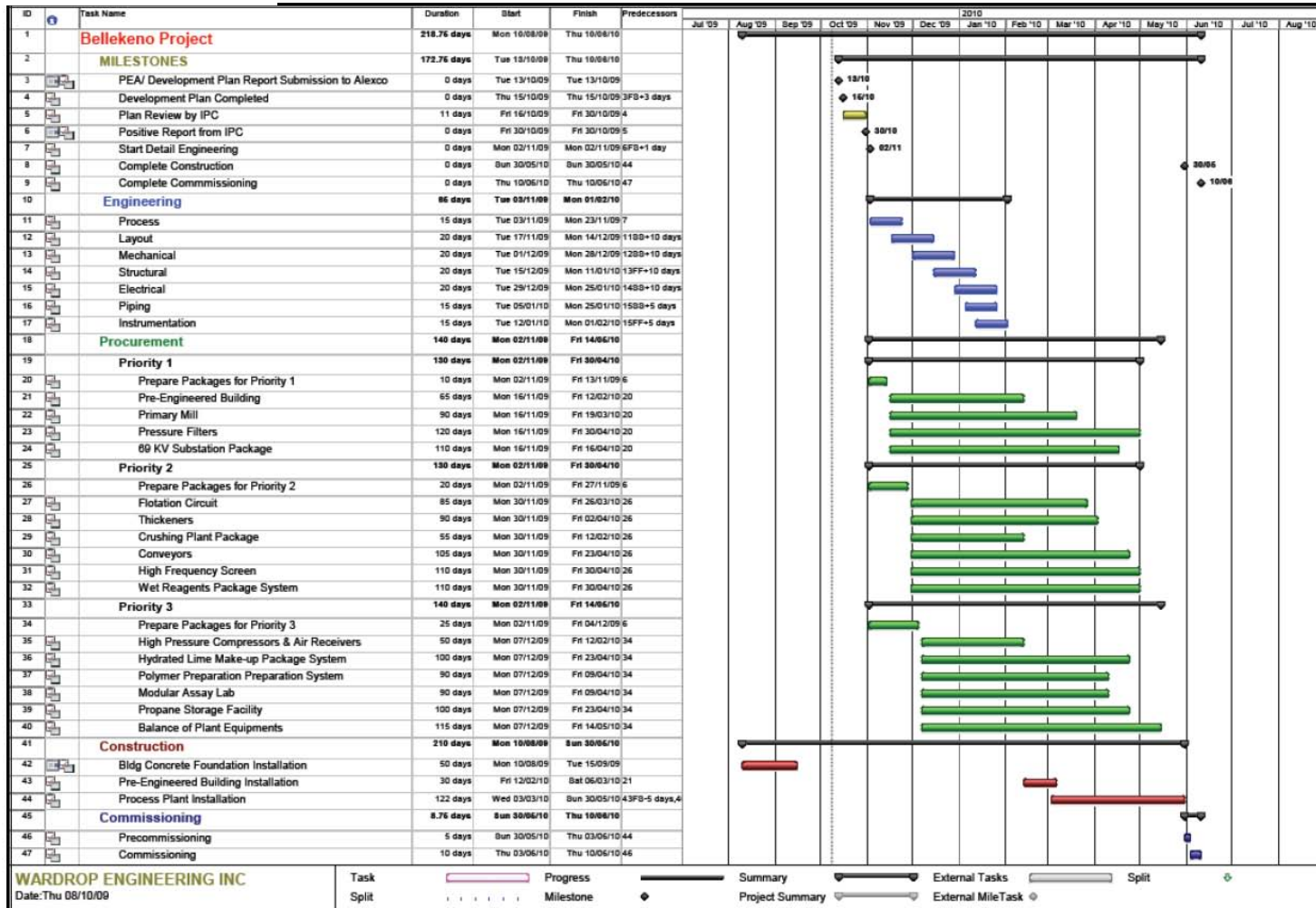
FIGURE 4-3

2.1 Mill Site Construction Schedule

In order to achieve commercial ore production by the second half of 2010, construction of the mill building and ancillary facilities will commence during February, 2010. All aspects of mill construction and ancillary facilities are anticipated to be complete by June 2010. See detailed mill site development schedule in Figure 2-2 below.

ALEXCO KENO HILL MINING CORP. BELLEKENO PROJECT
 QUARTZ MINING LICENCE MILL DEVELOPMENT AND OPERATIONS PLAN

Figure 2-2 Mill Site Construction Schedule



2.1.1 Mill Building Construction Plans

The mill building will be constructed according to Wardrop Engineering Inc., designs as depicted on Drawing numbers E00-10-001, E00-10-002, E00-10-003, E00-10-004 in Appendix A for Mill building General Arrangement drawings. Civil and Mechanical design criteria are found in Appendix B. Professional Engineer stamped Issued for Construction mill and mill site drawings will be submitted once they are complete.

3.0 MINERALOGICAL PROCESSING AND METALLURGICAL TESTING

3.1 Test Work Review

3.1.1 Background

Although there is a long history of operation with the processing of ores from different mines at the Elsa Mill, including that of the Bellekeno deposit, historical test work related to Bellekeno mineralization prior to 1996 could not be located. An earlier Feasibility Study by Rescan Engineering Ltd. (Rescan) summarized historical operation data. The Elsa Mill operated between 1949 and 1989 to process various ores from many different mines in the Keno Hill District. Mineralogy of mill feeds varied substantially due to different styles of mineralization throughout the district. Before the closure of the Hector-Calumet Mine in October 1972, the Elsa Mill produced both a silver-lead concentrate and a zinc concentrate. In the later operation period, the mill produced silver-lead concentrate only due to much lower zinc feed grades and lower metal prices.

3.1.2 Test Work Programs

The historical operation concentrate data are summarized in Table 3-1.

Table 3-1 Historical Operation Concentrate Data

Period	Concentrate	Assay			Distribution		
		Ag (oz/t)	Pb (%)	Zn (%)	Ag (%)	Pb (%)	Zn (%)
1950s	Silver-Lead	304	71.3	3.6	89	93	5
	Zinc	13	0.8	56.3	5	1	88

1970s	Silver-Lead	545	60.6	7.3	92	88	37
	Zinc	46	1.4	48.9	1	-	38
1980s	Silver-Lead	229	42	4.2	85	75	40
	Zinc	-	-	-	-	-	-

An earlier Rescan Feasibility Study (October 1996) listed six metallurgical test work reports:

- Microscopic Examination of Zinc Concentrate, SGS-Lakefield Research Ltd. (SGS), 1973
- Investigation of Recovery of Lead and Silver from 'Shamrock' Ore Sample, SGS, 1975
- Investigation of Recovery of Lead and Silver from UKHM Ore Sample, SGS, 1976
- Investigation of the Filtration Characteristics of a Lead-Silver Concentrate from UKHM, SGS, 1978
- Investigation of Recovery of Silver from UKHM, SGS, 1979
- Metallurgical Testing on the Bellekeno and Silver King Ores, Process Research Associates Ltd., 1996.

Two of the above reports, prepared in 1979 and 1996, were available for the review.

The 1996 test work by PRA was used as the basis for the Rescan Feasibility Study. The test program focused on a blend composite sample consisting of 85% Bellekeno and 15% Silver King ore. The testing also investigated the metallurgical responses of individual Bellekeno and Silver King samples.

The most recent test program was conducted by SGS in 2007 and by Inspectorate-PRA (PRA) in 2008/2009. The SGS tests evaluated the metallurgical performance of a composite representing Bellekeno mineralization. Process mineralogical examination was also performed on a head sample using the QEMSCAN™ technique. The 2008/2009 testing program by PRA focused on confirming previous findings and investigating the effect of mineralogical variation on metallurgical performance.

Since the mineralization for the currently proposed process plant may differ from the samples used for the test work prior to 1986, the review focuses on the 1996, 2007, and 2008/2009 test programs only.

3.1.3 Test Samples

3.1.3.1 1996 Test Samples

In 1996, three samples – Bellekeno (BK), Silver King (SK), and BK/SK (85%/15%) composites – were generated for metallurgical testing. The blended BK/SK composite was used for preliminary process condition optimization tests. The head assays on the composites are shown in

Table 3-2.

Table 3-2 Head Assay – 1996 Test Work

Sample	Au (g/t)	Ag (g/t)	Cu (%)	Fe (%)	Pb (%)	Zn (%)	S (%)	C (%)
BK Comp	0.40	990	0.092	6.81	14.6	6.48	7.19	0.11
SK Comp	0.70	1,219	0.048	4.27	4.46	0.041	4.84	0.74
BK/SK Comp	0.55	1,119	0.084	5.86	13.6	4.51	6.32	0.25

As shown in Table 3-3, the program also determined the specific gravity for the head samples.

Table 3-3 Specific Gravities of Composites – 1996 Test Work

Sample	Specific Gravity
BK Composite	3.57
SK Composite	2.81
BK Waste	2.66
SK Waste	2.75

3.1.3.2 2007 Test Samples

The 2007 composite sample was produced from 31 drill core samples from the 2006-2007 Alexco core drilling at the Bellekeno deposit. Chemical analysis on the master sample is provided in Table 3-4. Compared to the 1996 samples, the sample contained a significantly high amount of zinc.

Table 3-4 Head Assay – 2007 Test Work

Sample	Au (g/t)	Ag (g/t)	Cu (%)	Fe (%)	Pb (%)	Zn (%)	S (%)	S ² (%)
BK Comp	0.96	1,152	-	12.7	11.8	11.2	9.69	9.62
BK Comp (dup)	1.15	1,210						

3.1.3.3 2008/2009 Test Samples

The drill core and assay rejection samples used in the 2008-2009 testing program were collected by Alexco under the supervision of Stan Dodd, QP, from SW zone and East zone of Bellekeno deposit and adjacent Onek deposit. No metallurgical tests had been conducted on the Onek samples because the mineralization will be mined separately.

Half drill core samples were collected from the Bellekeno East and Southwest zones in 2008 for metallurgical testing. Samples were available mainly from drilling done in 2007.

Sample selection criteria focused on the following:

- Constructing composites that would approach the average grade of the resource and;
- Selecting drill holes that would spatially represent each resource zone.

In addition to core samples, coarse assay rejects and a bulk sample from the East zone were made available to supplement core samples, if extra material was required.

The individual drill core samples were grounded into nine level composites according to mineralogical zones, drill holes, and elevations. The level composite samples were further composed into two zone composite samples: SW zone and East zone. A master composite, consisting 68% of the SW zone composite and 32% of the East zone composite, was generated for metallurgical performance confirmation tests. All the composites were generated from drill core samples. Assay reject samples were primary

used for generating bulk tailings for back fill testing. The assay results for the composites are presented in Table 3-5.

Table 3-5 Head Assay – 2009/2009 Test Work

Element	Au (g/t)	Ag (g/t)	Pb (%)	Zn (%)	Fe (%)	S (T) (%)
Master Comp	0.40	968.8	14.20	0.53	13.54	9.6
East Zone Comp	0.39	328.8	2.53	16.12	18.77	10.3
SW Zone Comp	0.48	1,375.4	25.41	9.21	9.22	9.1
Onek Composite	0.51	183.2	1.26	22.36	19.12	12.6
SW Zone-SW-1*		2,187.4	33.31	6.42		9.78
SW Zone-SW-2*		148.4	2.27	1.17		1.26
SW Zone-SW-3*		1,528.1	27.75	7.02		8.75
SW Zone-SW-4*		892.1	12.72	12.56		10.90
East-SW-1*		133.1	1.08	32.52		21.13
East-SW-2*		188.9	2.81	10.07		7.15
East-NE-1*		130.5	0.20	9.85		6.87
East-NE-2*		568.7	3.77	9.34		6.93

* calculated head from metallurgical balance

S (T) = total sulphur.

There was no core drilling on the 99 zone from 2006-2008 and as a result there was no material available for a composite. Historical drilling and chip sample data indicate the mineralized material in the 99 zone is geochemically similar (high silver/high lead relative to zinc) to the Southwest zone. This was confirmed in the 2009 drilling and resulting resource estimate where the lead/zinc ratios for both areas are essentially identical.

The 2009 drilling does show some variable oxidation occurring in the 99 and East zones, mainly above the 625 level, relative to the Southwest zone. There is no indication from the historical records of any metallurgical issues relating to oxidation at the Elsa mill for ore mined between the 625 and 400 levels in the 99 zone. The combined resource tonnes occurring in these upper levels represent <10% of the total indicated geologic resource tonnage at a \$185/tonne cutoff.

3.1.4 Mineralogical Study

3.1.4.1 2007 Test Samples

In 2007, SGS conducted mineralogical study using QEMSCAN™ technology. The mineralogical examination indicated that lead occurred as galena (PbS) and zinc as sphalerite ((Zn, Fe)S). Pyrite was identified as a minor sulphide (3.8% of total mass) and trace sulphide minerals included chalcopyrite, bornite, chalcocite, tetrahedrite, and arsenopyrite. Non-sulphide minerals were mainly quartz (30.5% of total mass) and manganese-bearing siderite (27.6% of total mass). Other non-sulphide minerals identified include micas, feldspars, chlorites, and clays.

Both sphalerite and galena liberated at a relative coarse grind size. At a grind size of P80 170 µm, 96.5% of the sphalerite and 95.4% of galena were present as liberated phases. It appears that some of the sphalerite and galena associated closely with siderite.

3.1.4.2 2008/2009 Test Samples

In the 2008/2009 program, PRA also conducted microscope examination on the SW composite and the East composite. The results are summarized in this section.

SW Composite

The composite contains a broad variety of minerals. Predominant minerals are galena occurring together with subordinate gangues and sphalerite. Other sulphides do not exceed accessory or trace amounts. Proustite-pyrargyrite is the only specific silver mineral. It forms small inclusions in galena. Tennantite-tetrahedrite or even sphalerite may be additional silver carriers. Native gold has been found twice as minute inclusions of less than five microns in chalcopyrite.

The iron content of the material can be attributed to various minerals: pyrite, marcasite and arsenopyrite are the most obvious iron carriers, while marmatitic sphalerite also contributes a significant amount of iron.

The textures of the minerals are generally very coarse. Fine-grained or complex locking textures are not very common. Mineral liberation may be easily achieved.

East Composite

The sample is composed of predominant gangue, mainly represented by carbonates including siderite. Sphalerite and subordinate pyrite are other main constituents. Galena is a frequent accessory. Chalcopyrite is the most common trace sulphide. Tennantite-tetrahedrite is present in association with polybasite-pearceite and native silver. The high iron content of the composite sample is caused by an assemblage of siderite, marmatitic sphalerite and pyrite.

A part of the material underwent a distinct supergene alteration which is reflected by the presence of secondary minerals.

As the textures of the minerals are generally rather coarse, mineral liberation will not present any problem. Marmatitic sphalerite will lead to substantial amounts of iron in the zinc concentrate.

3.1.5 Grindability Tests

All the three test programs determined sample hardness. The test results are summarized in Table 3-6.

Table 3-6 Grindability Test Results

Test Program	Sample	Bond Ball Mill Work Index (kWh/t)	Bond Rod Mill Work Index (kWh/t)	Bond Abrasion Index (g)
1996	BK Comp	9.3#	-	-
	SK Comp	10.3#	-	-

2007	Bellekeno Comp	9.5*	-	-
2008/2009	Master Comp	-	8.7	0.438
	East Zone Comp	8.7*	-	-
	SW Zone Comp	9.0*	-	-
	Onek Comp	8.5*	-	-

* at a closing mesh size of 106 µm; # at a closing mesh size of 150 µm.

These results indicate that the hardness of the samples to grinding resistance to ball mill and rod mill was within soft to medium-soft range.

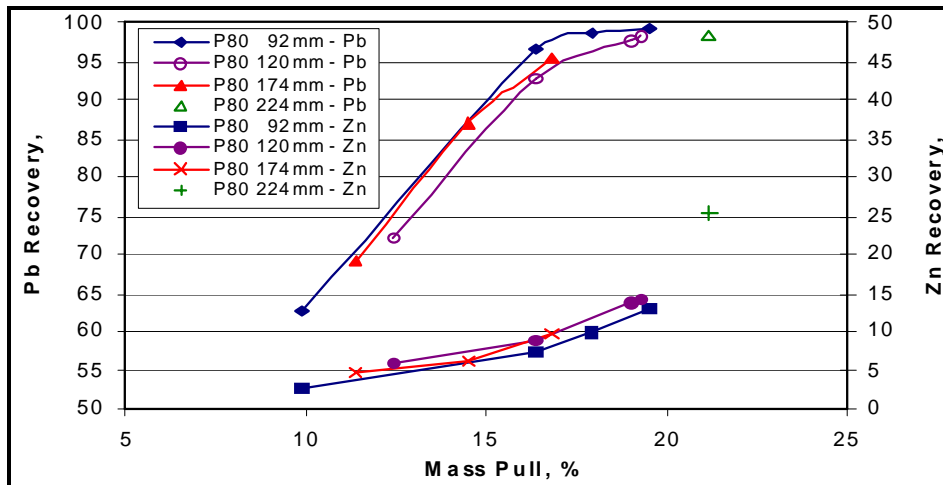
3.1.6 Flotation

3.1.6.1 Bench Open Cycle Tests

Primary Grind Size

The 2007 test work investigated the effect of primary grind size on metallurgical performance. The relationship between lead and zinc recoveries and mass recovery at the lead-silver rougher flotation stage are summarized in Figure 3-1. Although finer primary grind size would slightly improve lead and zinc metallurgical performance, the effect of primary grind size was not significant. SGS used 80% passing 175 µm as the primary grind size for the locked cycle tests.

Figure 3-1 Lead and Zinc Recovery at Lead-Silver Rougher Flotation vs. Mass Pull – 2007 Test Work



For zinc flotation, SGS indicated that zinc rougher flotation recovery was not affected by primary grind size (up to 80% passing 174 μm).

In the 2008/2009 test program, primary grind sizes varied from 80% passing 79 μm to 144 μm . As shown in Figure 3-2, it appears that lead metallurgical performance is not sensitive to the primary grind sizes tested, although the highest lead and silver recoveries are produced at the finest primary grind size.

The test results seem to show that zinc recovery increases with primary grinding fineness, except for the finest grind size.

Figure 3-2 Lead-Silver Rougher Concentrate Metallurgical Performance vs. Primary Grind Size – 2008/2009 Test Work

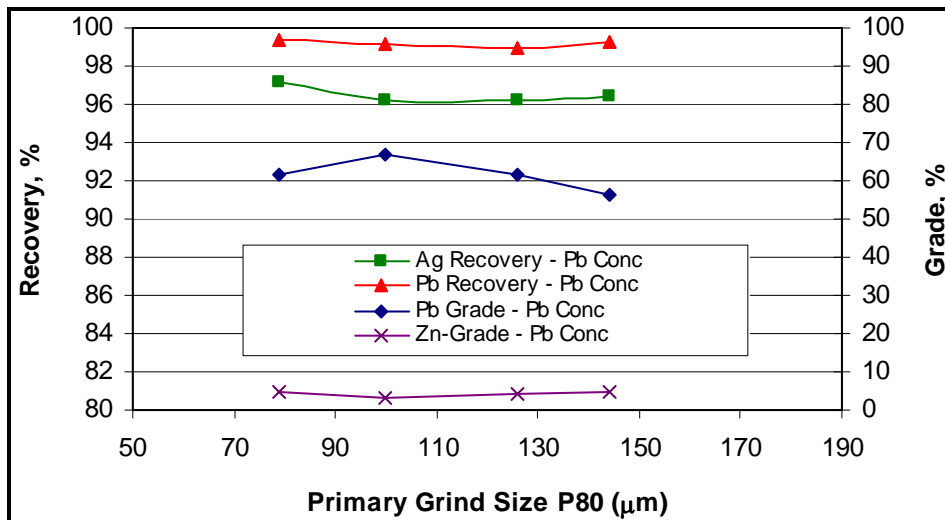
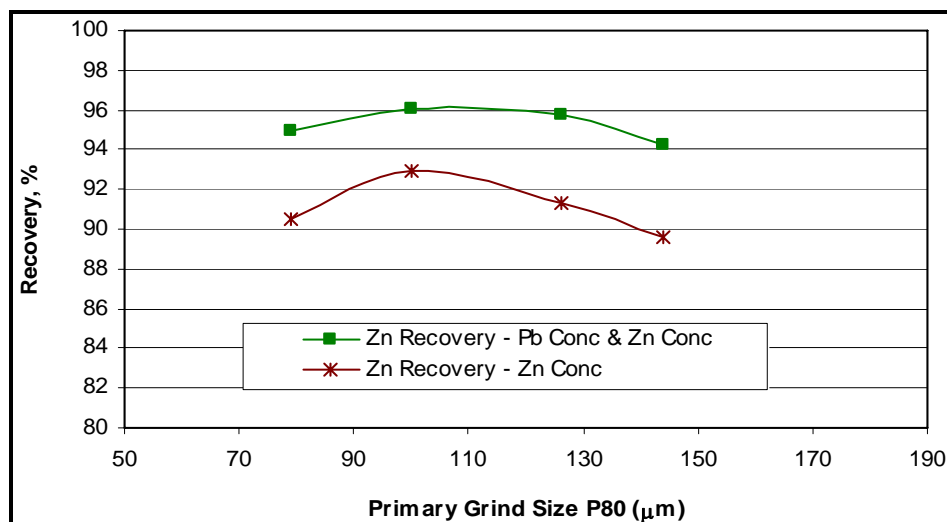


Figure 3-3 Zinc Recovery vs. Primary Grind Size – 2008/2009 Test Work

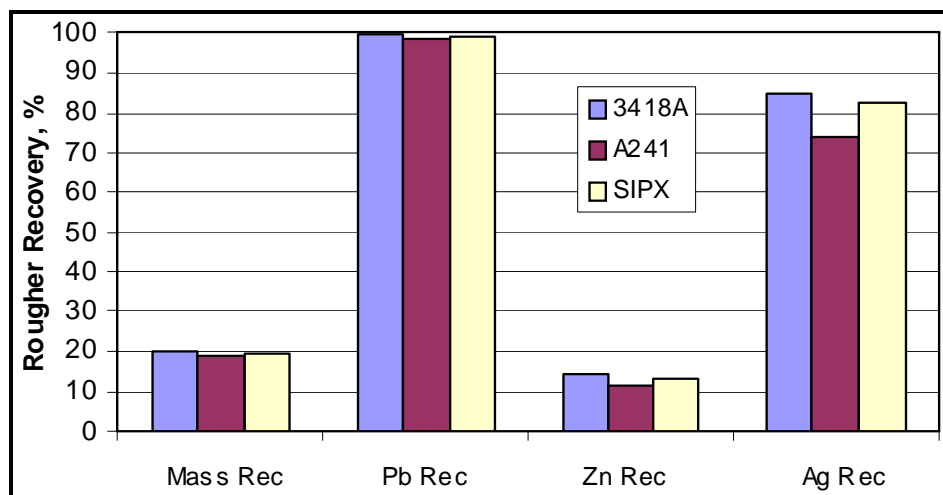


In the 1996 test work, no primary grind size was optimized. All tests were conducted at a relatively coarse primary grind size, targeting 45% passing 74 µm.

Collector – Lead-Silver Flotation

The 2007 test program investigated the effect of mineral collectors on lead-silver flotation. The tested collectors included 3418A, A241, and sodium isopropyl xanthate (SIPX). The tests were conducted at the primary grind size of 80% passing 92 µm using 400 g/t soda ash (Na_2CO_3) to control pH and 200 g/t ZnSO_4 and sodium cyanide (NaCN) complex (150 g/t ZnSO_4 and 50 g/t NaCN) to suppress zinc minerals. The test results are summarized in Figure 3-4.

Figure 3-4 Effect of Collectors on Lead, Zinc, and Silver Recovery at Lead-Silver Rougher Flotation – 2007 Test Work



The collector screening tests generated very similar metallurgical responses for lead and zinc. However, it appears that silver did not respond well to A241 compared to 3418A and SIPX. SGS selected SIPX as lead-silver mineral collector for further testing because the reagent is inexpensive compared to the other two reagents.

The test program in 1996 employed 3418A alone or 3418A in conjunction with sodium ethyl xanthate (SEX) as lead-silver mineral collectors. The test results showed no benefit to lead-silver recovery by using the combined collector regime.

The 2008/2009 test program used A242 and potassium ethyl xanthate (PEX) as lead-silver mineral collectors. No further collector optimization was conducted; however, the tests investigated the effect of reagent dosages on the effect of metal recoveries and concentrate grades. The test results obtained at a primary grind size of 80% passing 150 µm with 10 minutes of regrinding on lead-silver and zinc rougher concentrates are shown in Table 3-7.

Table 3-7 Reagent Dosage Test Results – 2008/2009 Test Work

Test ID	Reagent Dosages (g/t)				Concentrate Grades		Recovery (%)		
	Pb Flotation		Zn Flotation		Pb Cleaner Conc. (Pb %)	Zn Cleaner Conc. (Zn %)	Pb Ro. Conc.		Zn Ro. Conc.
	PEX	A242	SIPX	CuSO ₄			Ag	Pb	Zn
F8	35	20	80	550	69.8*	67.5	96.3	99.3	88.8

F9	35	20	110	250	78.6	67.5	92.5	98.9	90.0
F11	50	25	110	550	73.5	58.6	94.9	99.3	89.2
F12	50	25	120	500	73.9	59.6	96.1	99.2	88.4

* one-stage lead cleaning.

Collector – Zinc Flotation

All the test programs employed conventional collectors for zinc flotation. The 1996 test program used PAX for zinc flotation, while the 2007 test program and the 2008/2009 test program employed SIPX. It appears that zinc flotation responded well and similarly to the reagents. As shown in Table 3-7, a reduction in SIPX dosage may improve the zinc grade of the final concentrate.

Zinc Mineral Suppressants

The 2008/2009 test program used zinc sulphate ($ZnSO_4$) alone as zinc mineral depressant in conjunction with A242 and PEX as collectors. The test results indicated that the zinc minerals were well suppressed during lead-silver flotation. As shown in Figure 3-3, over approximately 90% of the zinc was recovered into the zinc rougher concentrate. Only less than 10% of the zinc reported to the lead-silver rougher concentrate. Total zinc sulphate consumption was approximately 1,100 g/t.

The 2007 test program investigated the effect of two zinc mineral suppression regimes on lead-silver rougher flotation. One was zinc sulphate ($ZnSO_4$, 150 g/t) alone and the other was zinc sulphate in conjunction with NaCN (150 g/t $ZnSO_4$ + 50 g/t NaCN).

The test results indicated over 25% of the zinc reported to lead-silver rougher flotation concentrate when using $ZnSO_4$ alone, compared to approximately 10% of the zinc in the lead-silver rougher concentrate with adding the $ZnSO_4$ /NaCN complex. According to the test results, SGS employed the $ZnSO_4$ /NaCN complex for further testing.

The 1996 test program used a combination of $ZnSO_4$ / Na_2SO_3 for zinc mineral suppression during lead-silver flotation. The test results indicated that the suppression regime could

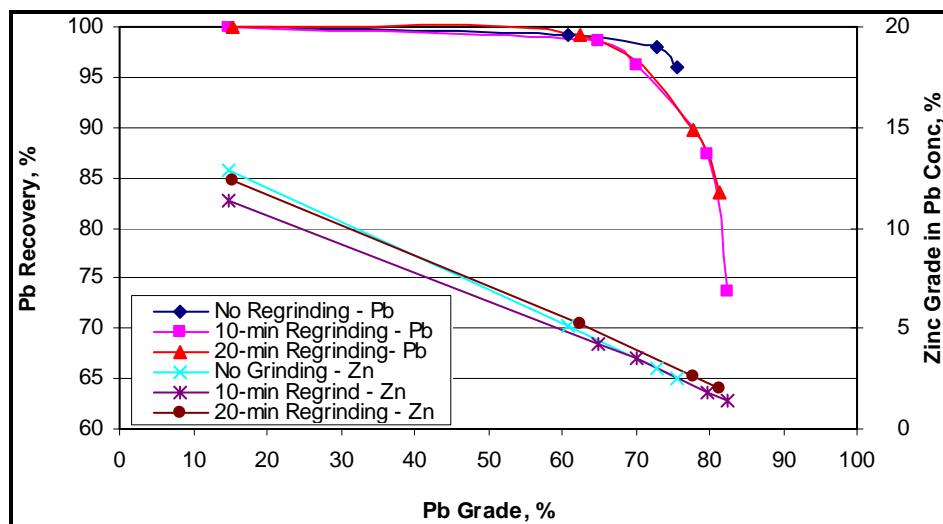
effectively depress the flotation of zinc minerals. The reagent dosage was 500 grams per ton.

These test results indicate that the zinc in the mineral samples can be effectively suppressed by using cyanide-free zinc suppressing regimes.

Regrind – Lead-Silver Cleaner Flotation

All the test programs investigated the effect of regrind particle size on lead-silver cleaner flotation. The 2008/2009 test program (Tests F5, F7, and F10) appears to indicate that regrinding on lead-silver rougher flotation concentrate did not benefit for the zinc rejection in lead-silver cleaner flotation. The test results are plotted in Figure 3-5. Further tests showed similar lead-silver cleaner flotation performances if bypassing the first lead-silver concentrate to the cleaner circuit and regrinding the second rougher concentrate and lead-silver rougher/scavenger concentrate only, in comparison with regrinding all the lead-silver rougher concentrates.

Figure 3-5 Effect of Regrind on Lead-Silver Rougher Flotation – 2008/2009 Test Work



The 2007 test program appeared to show that re-grinding lead-silver rougher concentrate down to 80% passing 15 µm did not significantly improve the metallurgical performance, compared to a re-grind particle size of 80% passing 32 µm.

The 1996 test program also studied the effect of re-grind size on the metallurgical response of lead-silver rougher flotation. The re-grinding test results of the lead-silver flotation circuit are presented in Table 3-8. The results clearly show that re-grinding of the lead-silver rougher concentrate substantially improves lead and silver recoveries and concentrate quality. Mineralogical examinations indicated that 92% of the zinc minerals in the lead-silver cleaner scavenger concentrate were associated with other minerals when without re-grinding (Test 7).

The particle size of the lead-silver cleaner concentrate from Test 8 was 96.8% passing 37 µm; this might not be the optimum re-grind size for lead and zinc mineral liberation.

Table 3-8 Re-grind Test Results – 1996 Test Program

Test	Product	Mass Recovery (%)	Grade		Recovery		
			Pb (%)	Zn (%)	Pb (%)	Zn (%)	Ag (%)
Test 7 without re-grind	1st Cl. Conc.	11.1	58.6	6.5	55.8	17.7	68.7
	1st Cl. + Sc.	17.4	60.9	5.9	90.8	25.2	91.3

Test	Product	Mass Recovery (%)	Grade		Recovery		
			Pb (%)	Zn (%)	Pb (%)	Zn (%)	Ag (%)
	Conc.						
	Pb Rougher Conc.	19.2	58.8	5.6	96.9	26.4	96.4
Test 6 with regrind	1st Cl. Conc.	16.2	72.0	1.9	93.7	7.0	93.7
	1st Cl. + Sc. Conc.	18.5	65.1	3.0	95.6	12.8	95.6
	Pb Rougher Conc.	22.6	54.4	3.5	97.0	18.6	97.0
Test 8 with regrind	2nd Cl. Conc.	14.9	74.8	1.0	87.5	3.1	90.6
	1st Cl. Conc.	15.9	72.3	1.4	90.3	4.7	92.4
	Pb Rougher Conc.	19.3	63.5	2.8	96.0	11.3	95.6
Test 9 with regrind	2nd Cl. Conc.	19.0	71.4	1.8	91.4	6.1	93.3
	1st Cl. Conc.	20.5	68.4	2.7	94.2	9.8	94.9
	Pb Rougher Conc.	24.9	58.2	6.1	97.4	26.6	96.8

Regrind – Zinc Cleaner Flotation

All three test programs investigated the effect of regrinding on zinc cleaner flotation. The results from the SGS test work appeared to show that the regrinding of rougher concentrate would improve zinc concentrate grade and over-grinding (finer than 80% passing 65 µm) might cause a detrimental effect on zinc recovery.

However, the PRA test results obtained from the 1996 test program concluded that regrinding zinc rougher concentrate from 35% passing 74 µm to 99.6% passing 74 µm did

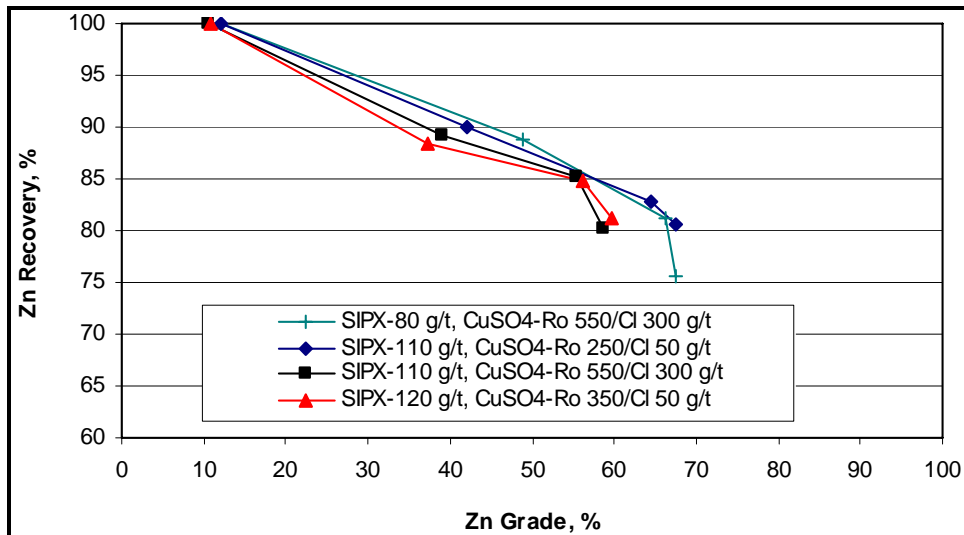
not improve zinc flotation. Again, the 2008/2009 test work indicated that regrinding zinc rougher concentrate down to 90% passing 33 µm did not play a positive impact on the upgrading of the zinc rougher concentrates.

Zinc Mineral Activation

As the common way in the mining industry, all the three test programs used copper sulphate (CuSO₄) as a zinc mineral activator in zinc flotation circuit. The SGS tests used 700 g/t CuSO₄ (grams per tonne of flotation feed) for all the tests. The 1996 PRA tests employed slightly lower dosages, ranging from 400 to 600 g/t CuSO₄. It concluded that the lower dosage did not cause a decrease in zinc recovery.

The 2008/2009 testing compared the effect of different CuSO₄ dosages on zinc flotation. As shown in Figure 3-6, the test results were inconsistent. However, it appears that reducing copper sulphate dosage at the zinc rougher flotation from 550 g/t to 250 g/t did not have a detrimental influence on zinc flotation. Also a reduction in copper sulphate dosage in the first zinc circuit from 300 g/t to 50 g/t did not significantly affect on the zinc recovery to the final zinc concentrate.

Figure 3-6 Effect of Reagent Dosage on Zinc Flotation – 2008/2009 Test Work



Pyrite Rejection Flotation

To reduce potential acid consumption and simplify pyrite rejection flotation, the 2008/2009 test work explored to reject pyrite and other sulphide minerals to the zinc cleaner scavenger tailings which will be used for underground backfilling.

The test results, as shown in Table 3-9, indicate that the zinc cleaner flotation tailings would contain a much higher sulphide minerals compared with the zinc rougher scavenger tailings. Acid-Base Accounting tests on two tailings samples from locked cycle tests (LCT1, Cycle 5) indicate that the zinc rougher scavenger tailings is not likely acid-generating, while the zinc cleaner scavenger tailings may pose some acid generation potential.

Table 3-9 Pyrite Rejection Test Results – 2008/2009 Test Work

Test ID	Zn Ro-Sc. Dosages (g/t)				Zn Cl. Sc. Tail		Zn Ro. Sc. Tail	
	Ro. pH	Sc. pH	SIPX/PAX	CuSO ₄	Fe	S (T)	Fe	S (T)
F11	7.7	7.5	110	550	18.9	-	16.6	-
F13	10	10	90*	350	22.0	9.0	15.2	0.5
LCT1 [#]	11	11	110	350	22.4	4.9	16.5	0.7

* PAX

[#] Cycle 5.

S (T) = total sulphur.

Flash Flotation

In 1996, PRA performed an exploratory test to investigate the metallurgical response of the BK/SK composite to flash flotation. The results obtained were encouraging; flash flotation produced a 65% Pb lead-silver concentrate recovering 26% of the silver and 14% of the lead.

Other Flotation Tests

The 1996 test program also conducted tests on the BK and SK composites separately using the flowsheet developed from the BK/SK composite. The BK composite responded well to the flowsheet. However, the concentrate grade from the SK composite was inferior compared to the BK composite.

The suppression of graphite was also tested in 1996. Carboxymethyl cellulose (CMC) was used to depress graphite carbon. It appears that the addition of CMC could not effectively reject the graphite carbon.

3.1.6.2 Bench Locked Cycle Tests

2008/2009 Test Work

The 2008/2009 testing program performed three locked cycle tests on the Master composite and the East composite. Two different flowsheets were tested on the Master composite.

The LCT 1 test employed three stages of lead-silver rougher flotation and two stages of lead-silver cleaner flotation. The first lead-silver rougher flotation concentrate bypassed to the first cleaner flotation without regrinding. The zinc circuit used two stages of rougher flotation followed by rougher scavenger flotation. The zinc rougher concentrates were reground prior to three stages of cleaner flotation. The flowsheet produced two tailings, the low sulphide tailings and high sulphide tailings. The flowsheet is schematically shown in Figure 3-7

As

shown

in

Figure 3-8, an alternative flowsheet was also tested on the Master composite (Test LCT 2). The flowsheet is similar to the one used in the LCT 1 test; however, no regrinding was performed in the test. The first lead-silver rougher flotation concentrate was directly sent to the second cleaner flotation. The lead-silver cleaner scavenger stage was also eliminated. The zinc flotation used PAX as collector, compared to SIPX in the LCT 1 test.

The test results show that the Master composite responded well to both the flowsheets. The test results are tabulated in Table 3-10. On average, approximately 98.5% of the lead-silver was recovered into the lead-silver concentrate grading at 72% Pb. The concentrate also recovered approximately over 94% of the silver.

There are some differences in the zinc metallurgical performance between the two flowsheets. The LCT 1 test appeared to produce a higher zinc grade concentrate with a higher zinc recovery, compared to the LCT 2 test.

Another locked-cycle test (LC3) was conducted on the East zone material to assess the metallurgical response of the mineralization to the flowsheet that is similar to the one used in the LCT 2 test.

The East mineralization contains much lower silver and lead head grades, but with a substantially higher zinc head, in comparison with the Master composite. The test results indicated that the mineralization also responded well to the test procedure. Nearly 90% of the lead was concentrated into a 53% Pb concentrate from a 1.9% Pb feed. The zinc circuit recovered over 97% of the zinc into a 59% Zn concentrate.

Table 3-10 Locked Cycle Test Results – 2008/2009 PRA Test Work

Product	Weight (%)	Assay			Distribution		
		Ag (g/t)	Pb (%)	Zn (%)	Ag (%)	Pb (%)	Zn (%)
LCT1 (Cycles 4-6) – Master Composite							
2nd Pb Cleaner Conc.	18.0	4,871.4	72.0	2.2	94.0	98.8	3.6
2nd Zn Cleaner Conc.	17.1	200.7	0.4	61.5	3.7	0.5	94.4

ALEXCO KENO HILL MINING CORP. BELLEKENO PROJECT
QUARTZ MINING LICENCE MILL DEVELOPMENT AND OPERATIONS PLAN

1st Zn Cl. Scav. Tails	8.1	80.8	0.3	0.8	0.7	0.2	0.6
Bulk Flotation Tails	56.8	27.4	0.1	0.3	1.7	0.5	1.5
Calculated Head	100	933.1	13.1	11.2	100	100	100
LCT2 (Cycles 4-6) – Master Composite							
2nd Pb Cleaner Conc.	18.8	4,877.7	72.0	3.1	95.2	98.2	5.6
2nd Zn Cleaner Conc.	18.2	157.9	0.3	53.1	3.0	0.4	92.2
1st Zn Cl. Scav. Tails	7.4	36.5	0.3	0.7	0.3	0.2	0.5
Bulk Flotation Tails	55.6	31.6	0.3	0.4	1.8	1.3	2.2
Calculated Head	100	963.5	13.8	10.5	100	100	100
LCT3 (Cycles 4-6) – East Composite							
2nd Pb Cleaner Conc.	3.2	5,705.5	53.1	5.0	68.3	89.6	1.0
2nd Zn Cleaner Conc.	28.1	254.8	0.5	59.1	26.5	7.0	97.6
1st Zn Cl. Scav. Tails	3.9	45.1	0.3	1.4	0.6	0.6	0.3
Bulk Flotation Tails	64.8	19.0	0.1	0.3	4.6	2.8	1.1
Calculated Head	100	270.2	1.9	17.0	100	100	100

Figure 3-7 Locked Cycle Test Flowsheet (LCT 1) – 2008/2009 Test Work

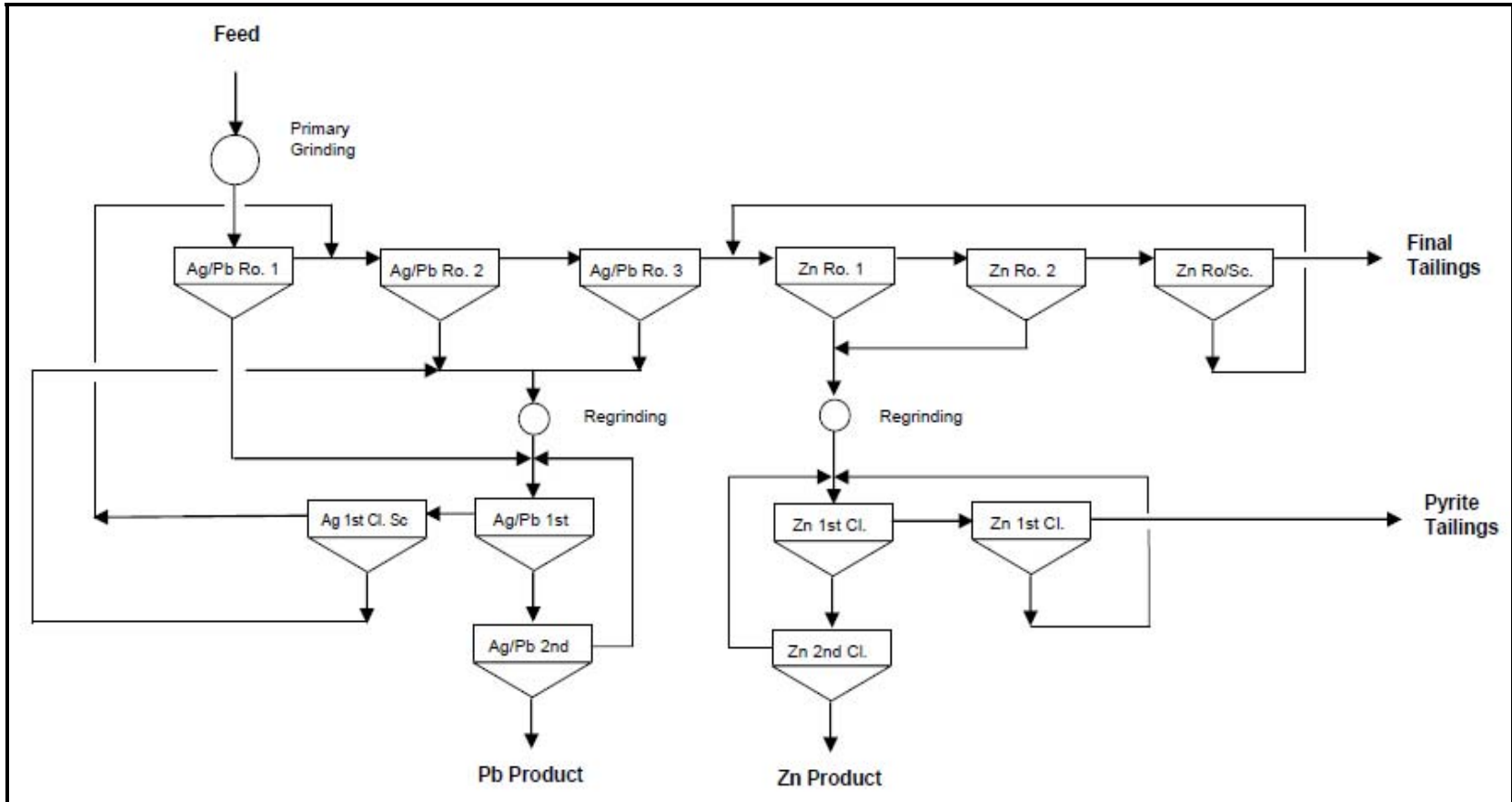
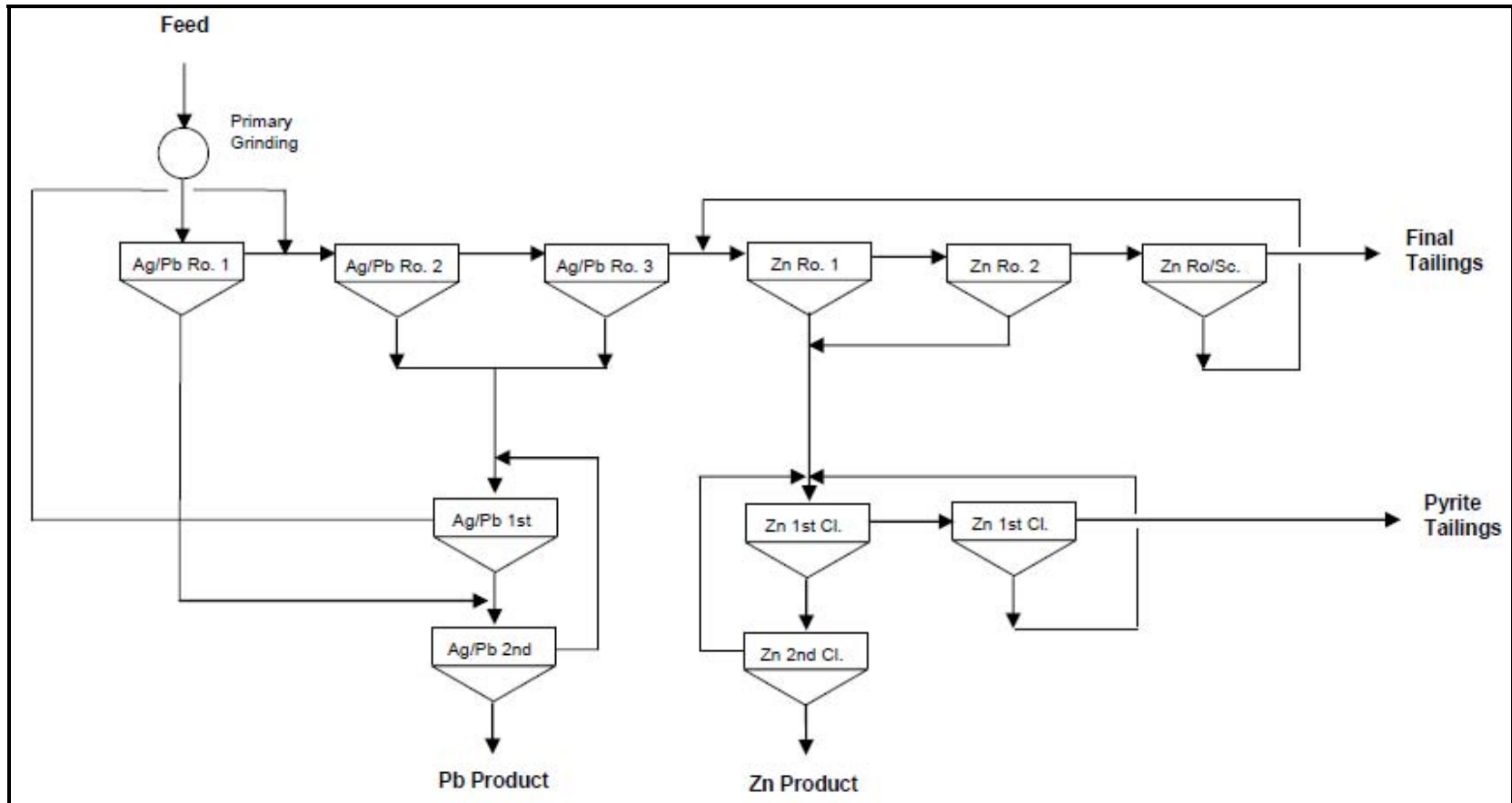


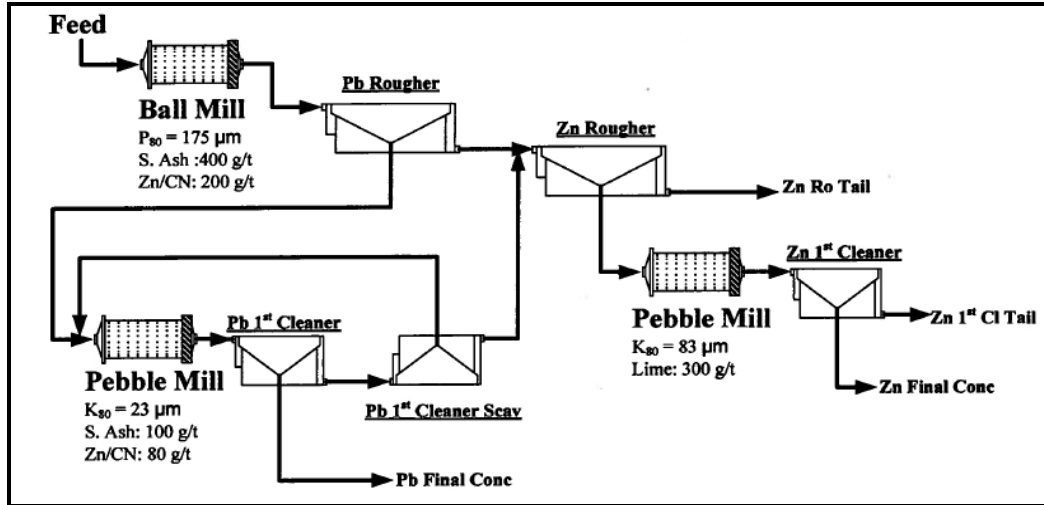
Figure 3-8 Locked Cycle Test Flowsheet (LCT 2) – 2008/2009 Test Work



2007 Test Work

The 2007 test program conducted a locked cycle test to explore the effect of the circulation of middlings on metal recovery and concentrate quality. The test used the process conditions developed during the open cycle testing. The flowsheet is shown in Figure 3-9.

Figure 3-9 Locked Cycle Test Flowsheet – SGS



The test results, as summarized in Table 3-11, indicate that 97.5% of the lead was concentrated into a lead-silver concentrate grading 72.5% with 78.4% of the silver and 49.1% of the gold also reporting to the lead-silver concentrate. Zinc recovery was 71.7% at a grade of 56.0%.

Table 3-11 Locked Cycle Test Results – 2007 SGS Test Work

Product	Weight (%)	Grade				Recovery (%)			
		Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Pb	Zn	Au	Ag
Lead-Silver Concentrate	16.4	72.5	5.37	3.0	5864	97.6	7.6	49.1	78.4
Zinc Concentrate	14.9	0.45	56.0	1.2	750	0.6	71.7	18.2	9.1
Zinc Cleaner Tailings	5.6	0.87	38.8	0.95	1111	0.4	18.4	5.3	5.0
Zinc Rougher Tailings	62.9	0.24	0.44	0.433	142	1.3	2.4	27.2	7.3

Head	100	12.2	11.6	1.0	1227	100	100	100	100
-------------	------------	-------------	-------------	------------	-------------	------------	------------	------------	------------

The zinc loss to the zinc cleaner tailings was 18.4%. Zinc grade in the tailings was high, assaying at 38.8% Zn. This indicates that zinc cleaner flotation required additional reagents and scavenger flotation to improve metal recovery.

The two additional open cycle tests after the locked cycle tests confirmed that with further process optimization, metallurgical performance would improve, in particular, the recovery of the zinc minerals.

1996 Test Work

In 1996, PRA performed a locked cycle test on the BK/SK composite to simulate potential metallurgical performance in industrial operation. The average results were obtained from the last three cycle tests and are presented in Table 3-12. Improved metallurgical performance was attained in the tests when compared to SGS's test results, in particular for silver and zinc. A total of 95.3% lead was recovered to the lead-silver concentrate along with 95.7% silver. Very little zinc reported to the lead-silver concentrate and 94.3% zinc was recovered in the zinc concentrate. Lead and zinc concentrate grades were high, reaching 77.6% Pb in the lead-silver concentrate and 52.1% zinc in the zinc concentrate.

Table 3-12 Locked Cycle Test Results – 1996 PRA Test Work

Product	Weight (%)	Grade			Recovery (%)		
		Pb (%)	Zn (%)	Ag (g/t)	Pb	Zn	Ag
Lead-Silver Concentrate	15.6	77.6	0.88	6253	95.3	3.1	95.7
Zinc Concentrate	8.2	2.56	52.1	233	1.6	94.3	1.9
Zinc Rougher/Scavenger Tailings	76.2	0.51	0.16	33.0	3.0	2.7	2.5
Head	100.0	12.73	4.51	1022	100.0	100.0	100.0

3.1.6.3 Characterization of Concentrates

In the 2008/2009 testing program, PRA analyzed the lead-silver and zinc concentrates generated from the LCT 1 tests. Table 3-13 lists some of the key assay data. Antimony concentration (0.43%) in the lead-silver concentrate and cadmium content (0.80%) in the zinc concentrate may be higher than the penalty limit by some of smelters. The zinc concentrate contains 371 ppm indium.

Table 3-13 Lead-Silver and Zinc Concentrate Assay – 2008/2009 Test Work

Element	Unit	Lead Concentrate	Zinc Concentrate
As	%	0.08	0.056
Sb	%	0.425	0.016
In	ppm	<5	371
Ga	ppm	<10	77
Ge	ppm	<10	<10
Se	%	<0.01	<0.01
Te	ppm	<5	30
Cd	ppm	276	7974
Al ₂ O ₃	%	0.16	0.07
BaO	%	<0.01	<0.01
CaO	%	0.24	0.15
Fe ₂ O ₃	%	2.7	9.49
K ₂ O	%	<0.01	<0.01
MgO	%	0.08	<0.01
MnO	%	0.39	0.18
Na ₂ O	%	0.03	0.04
P ₂ O ₅	%	<0.01	<0.01
SiO ₂	%	1.84	0.47
TiO ₂	%	0.03	0.03
LOI	%	8.16	13.13
Total	%	13.59	23.57

The 1996 and 2007 test work also assayed the final concentrates for multi-elements. The results are very similar to the data obtained from the 2008/2009 testing program. Antimony concentrations determined in the lead-silver concentrates are 0.58% and 0.59% respectively for the lead-silver concentrates produced from the 1996 testing program and the 2007 testing

program. SGS reported 0.66% Cd in the zinc concentrate, while PRA recorded a slightly higher cadmium level (0.75%) in the zinc concentrate.

No indium assay was conducted in the 1996 and 2007 testing program.

In 1996, PRA determined the specific gravities for the lead-silver and zinc concentrates. The specific gravity is 6.49 for the lead-silver concentrate and 3.95 for the zinc concentrate.

3.1.6.4 Variability Tests

In the 2008/2009 testing program, open-cycle variability tests were conducted on various zone and level composites from the Bellekeno deposit. Table 3-14 compared the metallurgical performances of two zone composites with the Master composite. The SW Composite showed a similar metallurgical performance as the Master composite.

Table 3-14 Summary of Variability Test – Zone Composites

Test ID	Composite ID	Grade (%)						Recovery (%)		
		Calc. Head			Pb Cl. Conc		Zn Cl. Conc	Pb Ro. Conc.		Zn Ro. Conc
		Ag	Pb	Zn	Pb	Zn		Ag	Pb	
F12	Master Comp	959.1	14.5	10.9	73.9	2.2	59.6	96.1	99.2	88.4
F14	East Comp	337.5	2.3	15.5	59.7	7.9	57.6	87.6	96.0	80.0
F15	SW Comp	1269.6	20.0	8.2	72.0	2.4	60.3	97.6	99.4	83.7

With lower silver and lead values than in the Master composite, the East zone composite yielded a lower grade lead-silver concentrate with lower metal recoveries correspondingly. The more zinc reported to the lead-silver concentrate for the East composite compared to the other two composites.

PRA also tested metallurgical performance of the level composites from the Bellekeno deposit using baseline conditions. Test results are presented in Table 3-15 for the SW zone samples and Table 3-16 for the East zone samples.

In general, these samples responded well to the test conditions and similarly to the Master composite, except for the ESW-1 sample. Approximately 21% of the zinc reported to the zinc flotation tailings (ESW-1, Test F21). PRA claimed that the poor result was due to collector starvation because of non-optimum flotation conditions for the much higher zinc head.

Table 3-15 Summary of Level Testing, SW Zone – 2008/2009 Test Work

Test ID	Composite ID	Grade (%)						Recovery (%)		
		Calc. Head			Pb Cl. Conc		Zn Cl. Conc	Pb Ro. Conc.		Zn Ro. Conc
		Ag	Pb	Zn	Pb	Zn		Ag	Pb	
F17*	SW-1	2,187.4	33.3	6.4	68.9	3.3	43.9	94.6	98.8	61.4
F18	SW-2	148.4	2.3	1.2	78.1	0.9	57.1	91.2	97.1	80.7
F19*	SW-3	1,528.1	27.8	7.0	73.9	2.2	54.3	96.7	99.2	80.1
F20*	SW-4	892.1	12.7	12.6	80.0	2.0	55.4	97.0	99.3	91.8

* no regrind on 1st lead-silver rougher flotation concentrate.

Table 3-16 Summary of Level Testing, East Zone – 2008/2009 Test Work

Test ID	Composite ID	Grade (%)						Recovery (%)		
		Calc. Head			Pb Cl. Conc		Zn Cl. Conc	Pb Ro. Conc.		Zn Ro. Conc
		Ag	Pb	Zn	Pb	Zn		Ag	Pb	
F21	ESW-1	133.1	1.08	32.5	78.8	2.5	60.9	67.8	94.5	75.4
F22	ESW-2	188.9	2.81	10.1	80.8	1.1	59.9	78.8	96.6	92.1
F23	ENE-1	130.5	0.20	9.85	13.4	1.5	63.1	71.4	88.3	93.6
F24*	ENE-2	568.7	3.77	9.34	63.6	7.6	60.0	88.3	94.8	83.2

* regrind on all the lead-silver rougher flotation concentrates.

3.1.6.5 Tailings Production Trial

A large scale open cycle flotation test (F16) was performed to produce tailings for backfill testing. A 50 kg mixture of core samples and assay rejects were used for the tailings generation. To better simulate the tailings produced from the locked cycle tests, the lead-silver rougher concentrate was subjected to one stage of cleaner flotation and the resulting cleaner tailings was forwarded to the zinc cleaner flotation. Although the final rougher flotation tailings grade was similar those obtained from bench testing, the zinc cleaner tailings contained much higher lead and zinc contents due to insufficient flotation time and starvation of reagents in the large scale testing. The zinc cleaner tailings had to be further floated in three stages of scavenger flotation. The summary results are summarized in Table 3-17.

Table 3-17 Tailings Production Test Results – 2008/2009 Test Work

Product	Weight (%)	Assay			Distribution		
		Ag (g/t)	Pb (%)	Zn (%)	Ag (%)	Pb (%)	Zn (%)
1st Silver-Lead Cl. Conc.	11.7	4,644	67.7	3.40	54.2	52.1	3.9
1st Zinc Cl. Conc.	7.9	445	3.5	40.4	3.5	1.8	31.4
Zinc Cl. Scav. Conc	20.0	1,842	32.6	31.4	36.7	42.8	61.9
3rd Zinc Cl. Scav. Tailings	5.1	560	7.2	3.7	2.9	2.4	1.9

Total Ro. Flotation Conc.	44.7	2,183	33.8	22.5	97.3	99.1	99.1
Final Bulk Tailings	55.3	48.9	0.25	0.16	2.7	0.9	0.9
Calculated Head	100.0	1,003	15.2	10.2	100.0	100.0	100.0

3.1.7 Thickening Test

In 1996, PRA conducted settling tests on the BK/SK flotation feed, silver-lead concentrate, and zinc concentrate; Percol 156 was used as flocculant. The test results are given in Table 3-18.

Table 3-18 Settling Test Results – 1996 Test Work

Sample	Percol 156 (g/t)	Unit Thickener Area (m ² /t/d)
BK/SK Comp (Fl. Feed)	0	0.09
	10	0.03
Lead-Silver Concentrate	0	0.09
	10	0.01
Zinc Concentrate	0	0.07
	10	0.01

The 2008/2009 testing program also determined settling rates with addition of flocculant Percol 351. Test results are tabulated in Table 3-19.

Table 3-19 Settling Test Results – 2008/2009 Test Work

Sample	Percol 351 (g/t)	Unit Thickener Area (m ² /t/d)
Lead-Silver Concentrate - LCT1	20	0.01
Zinc Concentrate - LCT1	20	0.02

Zinc Ro/Scav. Tailings - LCT1	20	0.03
--------------------------------------	-----------	-------------

3.1.8 Filtration Test

The 2008/2009 testing conducted two vacuum filtration tests on the settled lead-silver and zinc concentrates generated from the LCT 1 test. The obtained filtration rates were 192.8 kg/m²/h for the lead-silver concentrate and 274.0 kg/m²/h the zinc concentrate respectively.

Larox Inc. conducted pressure filtration tests in 1996 on lead-silver and zinc concentrates; however, no report is available for review.

3.1.9 Characterization of Flotation Tailings

3.1.9.1 Tailings and Tailings Water Assay

In 2008, PRA used whole rock assay and inductively-coupled plasma (ICP) analysis (with aqua regia digestion) to determine the chemical characters of the bulk tailings. As in Table 3-20, the main components in the tailings are silicone and iron.

Table 3-20 LCT1 Bulk Tailings Assay – 2008/2009 Test Work

Elements	Units	LCT1 Bulk Tails
TIC*	%	0.55
Al₂O₃	%	1.72
CaO	%	2.28
Fe₂O₃	%	22.3
MgO	%	0.88
SiO₂	%	51.2
LOI[#]	%	15.1
As	ppm	409
Sb	ppm	19
Cu	ppm	338
Pb	ppm	1,171
Zn	ppm	2,594
Fe	ppm	162,448
Mg	ppm	5,587

* TIC = total inorganic carbon.

LOI = loss on ignition.

As shown in Table 3-21, the tailings water assay by ICP scan revealed that zinc concentration is high. However, the water will be used as process make-up water.

Table 3-21 Tailings Water Assay

Elements	LCT1 Bulk Tailings (mg/L)
Sb	<0.1
As	<0.2
Bi	<0.1
Cd	0.12
Ca	145
Cr	<0.01
Cu	0.64
Fe	4.77
Pb	0.45
Ag	<0.02
Zn	20.31

3.1.9.2 Acid-Base Accounting Test

The 2008/2009 program conducted Acid-Base Accounting (ABA) tests on the bulk tailings (low sulphides) and the zinc cleaner scavenger tailings (high sulphides) generated from the LCT 1 test. Table 3-22 shows the results. It appears that the bulk tailings is not likely acid-generating, however, the zinc cleaner scavenger tailings may pose some acid generation potential, and therefore will be transported back underground for backfill. PRA recommended further environmental tests to characterize the kinetics of the acid generation.

Table 3-22 ABA Tests on LCT1 Tailings – 2008/2009 Test Work

Sample ID	Acid Potential	Neutralization Potential (NP)		
		Actual	Ratio	Net
Bulk Tailings - LCT1 Cyc 5	22.2	43.3	2.0	21.1
Zn Cl. Sc. Tailings - LCT1 Cyc 5	146.9	65.9	0.4	-81.0

By using the Morin and Hutt procedure, in 2007 SGS determined the acid generation potential on the final rougher tailings sample produced from the locked cycle test LCT1. As shown in Table 3-23, the results of the acid-base accounting tests suggest that acid generating from the sample is likely.

Table 3-23 ABA Tests on LCT1 Tailings – 2007 Test Work

Parameter	Units	Zn Ro. Tails
Paste pH		8.62
NP ¹	t CaCO ₃ /1,000 t	113
AP	t CaCO ₃ /1,000 t	114
Net NP	t CaCO ₃ /1,000 t	-1.3
NP/AP	ratio	0.99
S	%	3.67
Sulphide	%	3.65
SO ₄	%	<0.4
C	%	4.60
Carbonate	%	0.662
CO ₃ NP ²	t CaCO ₃ /1,000 t	
CO ₃ Net NP	t CaCO ₃ /1,000 t	
CO ₃ NP/AP	ratio	
Classification	based on ABA NP ¹	PAN*
Classification	based on CO ₃ NP ²	

¹ measured in ABA test

² theoretical based on CO₃ content alone

* PAN = potentially acid neutralizing based on ABA test data alone

Green = net NP values less than 20 t CaCO₃/1,000 t

Orange = NP/AP ratios less than 3.

However, as shown in Table 3-24, the SGS report also indicated a nearly neutral Net Acid Generation (NAG) pH (~8).

Table 3-24 NAG Test – 2007 Test Work

Parameter	Unit	LCT1 Zn Ro. Tail.
Sample Weight	g	2.47
Vol. H2O2	mL	250
Final pH		7.97
NaOH	normality	0.1
Vol NaOH to pH 4.5	mL	0
Vol NaOH to pH 7.0	mL	0
NAG at pH4.5	kg H₂SO₄/t	0
NAG at pH 7.0	kg H₂SO₄/t	0

3.1.9.3 Toxicity Characteristic Leaching Procedure Test

In the 2008/2009 test work, PRA conducted 2 toxicity characteristic leaching procedure (TCLP) tests on the combined bulk tailings produced from the Cycles 5 and 6 of the LCT1 test. One test was on filtered wet tailings and the other on 50°C-dried tailings. The leachates were assayed for dissolved metals by inductively-coupled plasma mass spectroscopy (ICP-MS). The results are summarized in Table 3-25. It appears that all the metal concentrations are less than TCLP limits.

Table 3-25 TCLP Leachates Assay – 2008/2009 Test Work

Elements	Units	Sample ID	
		Leachate (Dry Sample)	Leachate (Wet Sample)
SO ₄	mg/L	19.1	16.4
Sb	µg/L	5.2	4.3
As	µg/L	6.0	4.0
Cd	µg/L	150.2	144.8
Cr	µg/L	<0.5	<0.5
Pb	µg/L	10,004.7	10,554.7
Hg	µg/L	<0.1	<0.1
Se	µg/L	<0.5	<0.5
Ag	µg/L	<0.05	<0.05

3.2 Flowsheet Development

The process flowsheet design is based on the preliminary test work results of Process Research Associates Ltd. (PRA) and SGS-Lakefield (SGS) as well as information collected from a site visit that Wardrop conducted in March 2008. The proposed process will employ conventional crushing, grinding, flotation, and dewatering processes.

Main valuable sulphides in the ore will be recovered by conventional differential flotation with a cyanide-free zinc suppressing regime. The flotation process will eliminate the potential environmental concerns of using cyanide in the process flowsheet. Silver and lead minerals will be recovered together into a lead concentrate and zinc minerals will be recovered into a separate zinc concentrate.

The flotation process will produce two tailings; zinc rougher scavenger flotation tailings and first zinc cleaner scavenger flotation tailings. The first zinc cleaner scavenger tailings with a higher pyrite content will be completely backfilled in the underground mine together with a portion of the zinc rougher scavenger flotation tailings while the balance of the zinc rougher scavenger tailings with low pyrite content will be dry-stack stored on the surface.

The process flowsheet will include the following main process components:

- a mobile crushing plant consisting of a jaw crusher, cone crusher, and vibrating screen
- primary grinding circuit
- lead flotation circuit and concentrate regrinding circuit (future option)
- zinc flotation circuit
- concentrates dewatering circuits
- low and high pyrite tailings dewatering and storage including paste backfill and dry stacking facilities.

3.2.1 Design Criteria

The process plant is designed to treat a nominal process rate of 149,000 t/a of silver, lead, and zinc ore, or 408 t/d at an overall plant availability of 92% (80% for the crushing circuit). The nominal process plant rate with the current mine plan is 90,000 t/a or 250 t/d of treated ore. The grinding circuit will produce an 80% passing 174 μm flotation feed. A high frequency screen will be used in a closed circuit with a ball mill. The key design criteria are shown in Table 3-26.

Table 3-26 Process Design Criteria

Description	Unit	Value	Source
Type Of Deposit			
Silver/Lead/Zinc sulphide mineralization			
<i>Ore Characteristics</i>			
Specific Gravity	g/cm ³	3.46	Test Reports
Bulk Density	t/m ³	2.1	Industry
Moisture Content	%	5.0	Client
Abrasion Index (Average)	g	0.438	Test Reports
Operating Schedule			
<i>Crusher Plant</i>			
Shift/Day		1	Client
Hours/Shift	h	8	Client
Hours/Day	h	8	Client
<i>Grinding and Flotation Plant</i>			
Shift/Day		2	Client
Hours/Shift	h	12	Client
Hours/Day	h	24	Client
Days/Year	day	365	Client
Plant Availability/Utilization			
Overall Plant Feed	mt/a	149,000	Calculation
Overall Plant Feed	mt/d	408	Client
Crusher Plant Availability	%	80.0	Client
Grinding and Flotation Plant Availability	%	92.0	Client
Crushing Process Rate	mt/h	63.8	Calculation
Grinding/Flotation Process Rate	mt/h	18.5	Calculation
Head Grades (LOM)	% Pb	9.47	Client
	% Zn	5.60	Client
	g/t Au	0.42	Client
	g/t Ag	871	Client
Recovery (LOM)	Pb %	96.9	Test Reports
	Zn %	88.4	Test Reports
Recovery (LOM) including in Pb & Zn concentrates	Au %	71.6	Test Reports
Recovery (LOM) including in Pb & Zn concentrates	Ag %	93.8	Test Reports
Silver-Lead Concentrate Grade (LOM)	% Pb	70.3	Test Reports
	% Zn	2.3	Test Reports
	g/t Au	1.5	Test Reports
	g/t Ag	6,185	Test Reports
Zinc Concentrate Grade (LOM)	% Pb	0.5	Test Reports
	% Zn	54.4	Test Reports
	g/t Au	1.1	Test Reports
	g/t Ag	300	Test Reports
Silver-Lead Concentrate Mass Recovery (LOM)	%	13.1	Test Reports
Silver-Lead Concentrate Production (LOM)	t/a	19,454	Calculation
Zinc Concentrate Mass Recovery (LOM)	%	9.1	Test Reports
Zinc Concentrate Production (LOM)	t/a	13,569	Calculation

3.3 Process Description

The Bellekeno plant will consist of the following process circuits, installed as a modular design, where applicable:

- primary and secondary crushing circuits with a belt conveyor to transport the crushed ore to the covered fine ore stockpile
- draw down pockets reclaiming the crushed ore from the covered fine ore stockpile
- primary ball milling in a closed circuit with a high frequency screen to produce a grinding product of 80% passing 174 μm
- the ground high frequency screen underflow feeding to lead rougher scavenger flotation circuit to recover lead and silver minerals; the process generating a higher grade lead rougher flotation concentrate and a lower grade lead rougher flotation concentrate
- the lower grade lead rougher flotation concentrate together with the second cleaner flotation tailings being reground in a ball mill to a final product of 80% passing 45 μm (potential future addition to the process)
- the ground lower grade lead rougher flotation concentrate and the higher grade lead rougher flotation concentrate being upgraded in three stages of cleaner flotation
- zinc rougher scavenger flotation on the lead rougher scavenger flotation tailings to recover zinc minerals; the circuit producing the final low pyrite flotation tailings
- the zinc rougher flotation concentrate being upgraded in three stages of cleaner flotation; the cleaner circuit generating a high pyrite tailings
- thickening and pressure filtration of the lead and zinc concentrates
- thickening and pressure filtration of the high and low pyrite tailings, disposed either at underground paste backfill or at surface dry stack facility.

3.3.1 ROM Ore Crushing, Ore Storage, and Reclaim

3.3.1.1 Crushing and Screening

ROM ore crushing will be undertaken using a mobile crushing plant. ROM ore will be dumped by 30-t haulage trucks into the jaw crusher feed hopper with a 47-t capacity. The hopper will be equipped with 450 mm openings stationary grizzly to prevent oversize ore entering the downstream jaw crusher.

The feed to the jaw crusher will be controlled using a vibrating grizzly feeder. The 508 mm by 914 mm jaw crusher with 75 kW motor will crush the ROM ore at a nominal rate of 63.8 t per operating hour. The jaw crusher will reduce the ore size from minus 450 mm to a size passing 80% 50 mm with the crusher closed side setting (CSS) of 70 mm. The crushed ore will discharge onto the crusher discharge conveyor belt. The ore will then be transferred onto another conveyor belt, the sizing screen feed conveyor. This conveyor will feed the vibrating sizing screen, with the jaw and cone crusher products and produce the final crushed product of passing 80% of -12 mm. The oversize product from the sizing screen will feed the secondary cone crusher with rate of approximately 54 t per operating hour. The crushing system will operate in close circuit. The crushed material (P80 of -12 mm) will be conveyed to a fine ore stockpile with 550 t live capacity. The crushing system will be operated 8 h/d at a process rate of 63.8 t/h.

Crushed ore reclaim will be achieved via two draw down pockets located beneath the fine ore stockpile. Ore will be reclaimed onto the ball mill feed conveyor belt at a nominal rate of 18.5 t per operating hour.

The crushing plant is based on the assumption of 8 h operation time, and capital and operating cost restrictions.

3.3.2 Primary Grinding Circuit

Ore from the ball mill feed conveyor will discharge into the feed chute of the ball grinding mill which will be a heavy duty tyre driven type grinding mill 1,800 mm in diameter and 3,600 mm long, with an installed power of 180 kW designed to provide effective impact breakage of the ore. Mill slurry will discharge through the slots in the discharge trommel.

The ball mill discharge trommel will be sprayed with process water and it will direct any oversize material into an oversize collection bin for periodic disposal. The trommel undersize material will be discharged into a pump box and feed to a high frequency screen. The coarse fraction from the high frequency screen will return to the ball mill. The finer product with size of 80% passing 174 μm , will gravity flow to flotation circuit.

Grinding media as steel balls will be added as required via the ball mill feed conveyor. This will discharge the grinding media into the ball mill feed hopper.

Spillage sump and pump will be located near the discharge pump box for the ball mill. Spillage will be returned to the ball mill feed hopper.

The ball mill feed conveyor belt will be sampled every shift to provide a head assay of the feed to the plant.

Sodium sulphite and zinc sulphite will be added to the ball mill feed to suppress zinc minerals during lead mineral flotation.

3.3.3 Classification

The ball mill trommel undersize will flow into pump box, which will feed a high frequency screen. The screen will have 3 screen frames with 210 µm separation panels. The screen underflow material, at a nominal particle size of 80% passing 174 µm, will flow by gravity to a lead conditioning tank. The particle size indicator (PSI) will control the grinding size of the undersize material. The high frequency screen coarse fraction will be discharged into the grinding ball mill feed hopper.

3.3.4 Silver-Lead Flotation

3.3.4.1 Lead Rougher and Scavenger Flotation

The high frequency screen underflow fraction from the primary grinding circuit will be further conditioned in agitated tanks with zinc sulphate, sodium sulphite, and lead collectors (namely 3418A and SIPX) at a pulp density of 32.0% solids.

The conditioning tanks will have a residence time of total 5 minutes at the design volumetric flow rate.

The conditioned slurry will then flow into the feed box of the first of five 8-m³ lead flotation tank cells with a total maximum residence time of 25 minutes. Test work has indicated that a maximum residence time of 10 minutes will be adequate for the flotation of the silver and lead sulphide minerals. However, should a shorter residence time be required, some of the cells

can be taken off-line. Low pressure blower air will be injected into each cell mechanism to generate the froth for the flotation of lead and silver sulphide minerals.

Lead rougher concentrate from the first two cells will flow by gravity to the first cleaner concentrate standpipe, while the concentrate from the last three rougher flotation cells will report also by gravity to the second cleaner flotation tailings standpipe.

The scavenger flotation train will consist of two 8 m³ tank cells with a total maximum residence time of 10 minutes and will be configured in such a way that concentrate will be pumped directly to the lead conditioning tank. The scavenger flotation tailings will flow into a standpipe and will be pumped to the zinc flotation circuit.

The size of flotation cells in lead rougher and rougher scavenger flotation circuits are based to match the existing 8 m³ OK-type flotation cells available at the existing Keno mine site.

3.3.4.2 Lead First Cleaner Flotation

The first cleaner flotation circuit is sized to handle all of the future regrind second cleaner flotation tailings and part of the rougher flotation concentrate that will be generated.

The regrind second cleaner flotation tailings and part of the rougher concentrate will be upgraded in the first cleaner flotation. The first cleaner tailings will return to the lead rougher flotation conditioning tanks, while the concentrate together with part of the rougher flotation concentrate will feed the second cleaner flotation stage.

The major equipment used in the first lead cleaner flotation circuit will include the following:

- three 3 m³ conventional flotation cells
- one 1,400 mm diameter and 2,300 mm long tyre-driven regrind ball mill with 45 kW installed power.

The reagents sodium iso-butyl xanthate (SIBX), 3418A, and MIBC will be added to the first cleaner flotation cells, as required. The cleaner flotation feed will gravitate from the lead regrind cyclone overflow into the feed box of the first of three 3 m³ first cleaner flotation cells. Blower air will be injected into each cell mechanism. The first cleaner flotation train has a total maximum residence time of 18 minutes. This residence time has been deemed adequate but can be reduced, if required, by taking flotation cells off-line. The first cleaner flotation tailings will be recycled to the lead conditioning tanks while the concentrate will flow into a standpipe

that, together with part of the rougher flotation concentrate, will be transferred to the second cleaner flotation circuit.

3.3.4.3 Lead Rougher Concentrate and Second Cleaner Tailings Regrind

Lead bulk rougher concentrate from the last three cells and second cleaner flotation tailings will be reground in the regrind ball mill operating in a closed circuit with two 100 mm cyclones. Cyclone overflow will flow by gravity to the first lead cleaner flotation cells. The regrinding prior to first cleaner flotation will further liberate silver and lead minerals from gangues and other sulphide minerals to improve product quality and metal recovery. The target regrind particle size will be 80% passing 45 µm.

Zinc sulphate and sodium sulphite will be added to the circuit to improve the rejection of zinc minerals in subsequent upgrading processes.

The regrind mill circuit will be installed in the process after additional set of test work confirming the benefits of further lead and silver liberation of the rougher concentrate and second cleaner tailings.

3.3.4.4 Lead Second Cleaner Flotation

The second cleaner flotation circuit is sized to handle all of the first cleaner flotation concentrate, part of the rougher flotation concentrate and third cleaner flotation tailings that will be generated.

The first cleaner concentrates, part of the rougher flotation concentrate and third cleaner flotation tailings will be upgraded in the second cleaner flotation. The second cleaner tailings will recycle back to the regrind mill and then the first cleaner flotation, while the second cleaner flotation concentrate will feed the third cleaner stage.

The major equipment used in the second lead cleaner flotation circuit will include two 3 m³ conventional flotation cells.

The reagents SIBX, 3418A, sodium sulphite, zinc sulphate, and MIBC will be added to the second cleaner flotation cells, as required. The second cleaner flotation feed will gravitate

from the third cleaner flotation cell and the first cleaner and rougher concentrates will be pumped into the feed box of the first of two 3 m³ second cleaner flotation cells. Blower air will be injected into each cell mechanism. The cleaner flotation train has a total maximum residence time of 12.5 minutes. This residence time has been deemed adequate, but can be reduced, if required, by taking flotation cell off-line. Second cleaner flotation concentrate will flow into a standpipe, which will transfer the slurry to the third cleaner flotation circuit.

3.3.4.5 Lead Third Cleaner Flotation

The third cleaner flotation circuit is sized to handle all of the second cleaner flotation concentrate that will be generated.

The second cleaner concentrate will be upgraded in the third cleaner flotation. The third cleaner tailings will return by gravity to the second lead cleaner flotation, while the concentrate will be pumped to the lead concentrate thickener for dewatering.

The major equipment used in the third lead cleaner flotation circuit will include one 3 m³ conventional flotation cell.

The reagent MIBC will be added to the third cleaner flotation circuit, as required. The third cleaner flotation feed will be pumped from the second cleaner circuit into the feed box of the 3 m³ cleaner flotation cell. Blower air will be injected into the cell mechanism. The third cleaner flotation cell has a residence time of 10 minutes. The third cleaner flotation concentrate will flow into a standpipe, which will transfer the slurry to the lead concentrate dewatering circuit. The third cleaner flotation tailings will be recycled by gravity to the second cleaner flotation circuit.

The lead flotation area will be equipped with dedicated spillage sump and pump for clean-up purposes.

3.3.5 Zinc Flotation

3.3.5.1 Zinc Rougher Flotation

Prior to zinc flotation, lead flotation tailings will be conditioned with copper sulphate to activate depressed zinc minerals, and lime to suppress pyrite. The flotation will generate a zinc

rougher concentrate in four 8 m³ flotation cells and subsequently rougher scavengers concentrate in one same size cell. SIPX will be used as zinc mineral collector.

The scavenger concentrate will return to the zinc rougher circuit head conditioning tank while the rougher scavenger flotation tailings will feed to the low pyrite tailings dewatering circuit.

Lead flotation tailings slurry will flow into the first of two zinc flotation conditioning tanks at a pulp density of 29.5% solids. The conditioning tanks will have a residence time of 3.5 minutes at the design volumetric flow rate. The reagents (SIBX, lime, and copper sulphate) will be added to the conditioning tanks prior to flotation as required.

The conditioned slurry will then flow into the feed box of the first of four 8 m³ rougher flotation tank cells with a total maximum residence time of 22.5 minutes. Test work has indicated that a maximum residence time of 30 minutes will be adequate for the flotation of the gold and sulphide minerals. However, should a shorter residence time be required, some of the cells can be taken off-line. Low pressure blower air will be injected into each cell mechanism to generate the froth for the flotation of zinc minerals.

The zinc rougher flotation train will be configured in such a way that concentrate will be pumped directly to the first zinc cleaner flotation circuit. The zinc rougher flotation tailings will flow by gravity into the rougher scavenger flotation cell.

The size of flotation cells in zinc rougher and rougher scavenger flotation circuits are based to match the existing 8 m³ OK flotation cells available at the existing Keno mine site.

3.3.5.2 First Zinc Cleaner Flotation and First Zinc Cleaner Scavenger Flotation

The rougher flotation concentrate will be further upgraded by three stages of cleaner flotation in six 3 m³ conventional flotation cells. The first cleaner flotation tailings will be pumped back to the zinc circuit head conditioning tank. The second and third cleaner tailings will be recycled to the preceding cleaning stages. The third cleaner concentrate will be the final zinc concentrate, which will be dewatered prior to shipping.

The first zinc cleaner flotation circuit is sized to handle all of the rougher flotation concentrate, as well as the first cleaner scavenger flotation concentrate and second cleaner flotation tailings that will be generated.

The first zinc cleaner flotation feed will be pumped from the zinc rougher concentrate standpipe, first zinc cleaner scavenger flotation standpipe and by gravity from the zinc second cleaner flotation cell into the feed box of the first of three 3 m³ cleaner flotation cells. Blower air will be injected into each cell mechanism. The first cleaner flotation train has a total maximum residence time of 12.5 minutes. This residence time has been deemed adequate, but can be reduced, if required, by taking flotation cells off-line. The first cleaner flotation concentrate will flow into a standpipe, which will transfer the slurry to the second zinc cleaner flotation circuit.

The first cleaner scavenger flotation tailings will be the high pyrite tailings, which will be dewatered prior to disposing them underground as paste backfill.

3.3.5.3 Second Zinc Cleaner Flotation

The first zinc cleaner flotation concentrate will be further upgraded by second cleaner flotation in two 3 m³ conventional flotation cells. The second zinc cleaner flotation circuit is sized to handle all of the first zinc cleaner flotation concentrate that will be generated.

The second cleaner flotation feed will be pumped from the first zinc cleaner flotation standpipe into the feed box of the first of two 3 m³ cleaner flotation cells. Blower air will be injected into each cell mechanism. The second zinc cleaner flotation train has a total maximum residence time of 12.5 minutes. This residence time has been deemed adequate but can be reduced, if required, by taking a flotation cell off-line. Cleaner flotation concentrate will flow into a standpipe, which will transfer the slurry to the third cleaner flotation circuit.

3.3.5.4 Third Zinc Cleaner Flotation

The third cleaner flotation circuit is sized to handle all of the second zinc cleaner flotation concentrate that will be generated.

The third cleaner flotation feed will be pumped from the second zinc cleaner flotation standpipe into the feed box of the 3 m³ third cleaner flotation cell. Blower air will be injected into the cell mechanism. The third cleaner flotation cell has a residence time of 10 minutes. The third cleaner concentrate will be the final zinc concentrate, which will be dewatered prior to shipping.

The zinc flotation area will be equipped with dedicated spillage sump and pump for clean-up purposes.

3.3.6 Lead and Zinc Concentrates Dewatering And Loadout

3.3.6.1 Lead Concentrate

The final lead flotation concentrate will be discharged to the third lead cleaner concentrate standpipe and will then be pumped to the lead concentrate thickener. Flocculent will be added at strength of 0.3% concentration as an aid in settling the solids. The thickener will be a 3.05 m diameter high rate unit fitted with an automated rake lifting mechanism and an auto-dilution system. It will produce a thickener underflow density of 60% solids, which will be pumped to the lead concentrate, filter feed stock tank. Thickener overflow solution will flow into a collection process water tank and will be pumped to the lead flotation circuit for re-use.

A 25 m³ holding tank will hold the thickener underflow concentrate prior to dewatering by a pressure filter. The concentrate filter feed tank has a residence time of 10 hours in order to provide sufficient time for regular maintenance on the concentrate filter. The filter will be an 800 mm by 800 mm pressure filter unit with 22 plates and a 45 m² filtration area. Slurry will be pumped into the filter chambers on a batch basis, and solution will be squeezed out by pressure. Then air will be blown through to dry the cake to attain the required moisture level of 8%. Filter cake will be discharged periodically onto a stockpile. A manually-taken sample will control the moisture content of the filter cake and will be used for metallurgical mass balance purposes. Filtrate from the filter will be returned to the concentrate thickener.

The dewatered lead concentrate will be discharged to the lead concentrate stockpile, which will have a storage capacity for 7 days of lead concentrate production.

Filtrate from the pressure filter will be pumped back to thickener feed well as dilution water. The concentrate thickener overflow will be distributed to the lead flotation circuit as process water.

The lead concentrate dewatering and load-out area will be equipped with dedicated spillage sump and pump for clean-up purposes. Spillage will be returned to the lead concentrate thickener.

3.3.6.2 Zinc Concentrate

The final zinc flotation concentrate will be discharged to the third zinc cleaner concentrate standpipe and will then be pumped to the zinc concentrate thickener. Flocculent will be added at strength of 0.3% concentration as an aid in settling the solids. The thickener will be a 3.05 m diameter high rate unit fitted with an automated rake lifting mechanism and an auto-dilution system. It will produce a thickener underflow density of 60% solids, which will be pumped to the zinc concentrate, filter feed stock tank. Thickener overflow solution will flow into a collection process water tank and will be pumped to the zinc flotation circuit for re-use.

A 25 m³ holding tank will hold the thickener underflow concentrate prior to dewatering by a pressure filter. The concentrate filter feed tank has a residence time of 10 hours in order to provide sufficient time for regular maintenance on the concentrate filter. The filter will be an 800 mm by 800 mm pressure filter unit with 22 plates and a 45 m² filtration area. Slurry will be pumped into the filter chambers on a batch basis, and solution will be squeezed out by pressure. Then air will be blown through to dry the cake to attain the required moisture level of 8%. Filter cake will be discharged periodically onto a stockpile. A manually taken sample will control the moisture content of the filter cake and will be used for metallurgical mass balance purposes. Filtrate from the filter will be returned to the concentrate thickener.

The dewatered zinc concentrate will discharge to the zinc concentrate stockpile, which will have a storage capacity for seven days of zinc concentrate production.

Filtrate from the pressure filter will be pumped back to thickener feed well as dilution water. The concentrate thickener overflow will be distributed to the zinc flotation circuit as process water.

The zinc concentrate dewatering and load-out area will be equipped with dedicated spillage sump and pump for clean-up purposes. Spillage will be returned to the zinc concentrate thickener.

Both lead and zinc pressure filters are sized to be able to handle the total amount of concentrates produced and filtered in a batch system in case one of the filters is down for maintenance.

3.3.7 High Pyrite and Low Pyrite Tailings Dewatering and Handling

3.3.7.1 High Pyrite Tailings

The high pyrite flotation tailings will be pumped from the zinc first cleaner scavenger tailings standpipe to the high pyrite tailings thickener where it will be combined with dilute flocculent solution at a concentration of 0.3% strength in order to aid the settling process. The thickener will be a 3.05 m diameter high rate type to enable a high underflow density of 58% solids to be produced ahead of tailings filtration. Thickener overflow solution will gravitate into the water polishing/settling pond. Underflow slurry will be pumped to the tailings storage tank and will then be pumped to the tailings filter presses for dewatering. The dewatered high pyrite tailings will be discharged onto the filtered tailings belt conveyor. The tailings will be dewatered to an 85% solids content product, which will be suitable for disposal by truck from the stockpile to the underground back fill facility. Filtrates from the filter will be collected into filtrate standpipe and will be return to the high pyrite thickener as dilution water.

The high and low pyrite tailings thickening area will be equipped with one dedicated spillage sump and pump for clean-up purposes. The spillage will be returned to the high pyrite tailings thickener.

The major equipment for high pyrite tailings management includes:

- 3.05 m diameter tailings thickener
- 800 mm by 800 mm pressure filter with 30 plates and a 60 m² filtration area.

3.3.7.2 Low Pyrite Tailings

The low pyrite flotation tailings will be pumped from the zinc rougher scavenger tailings standpipe to the low pyrite tailings thickener where it will be combined with dilute flocculent solution at a concentration of 0.3% strength in order to aid the settling process. The thickener will be a 6.1 m diameter high rate type to enable a high underflow density of 58% solids to be produced ahead of low pyrite tailings filtration. Thickener overflow solution will gravitate into the water polishing/settling pond. Underflow slurry will be pumped to the tailings storage tank and will then be pumped to the tailings filter presses for dewatering. The dewatered low pyrite tailings will be discharged onto the filtered tailings belt conveyor. The tailings will be dewatered to an 85% solids content product, which will be suitable for disposal, by truck from the stockpile to either the underground paste fill or dray stacking facilities. Filtrates from the filter will be collected into filtrate standpipe and will be return to the low pyrite thickener as dilution water.

The low and high pyrite tailings thickening area will be equipped with one dedicated spillage sump and pump for clean-up purposes. The spillage will be returned to the high pyrite tailings thickener.

Part of the dewatered low pyrite flotation tailings will be trucked to the underground mine site and placed in the underground stopes as back fill.

The rest of the dewatered low pyrite tailings, with 10 to 15% moisture, will be transported by trucks to the dry stack tailings storage facility. The major equipment for low pyrite tailings management includes:

- 6.1 m diameter tailings thickener
- 800 mm by 800 mm pressure filter with 30 plates and a 60 m² filtration area.

Both low and high pyrite tailings pressure filters are sized to be able to handle the total amount of tailings produced and filtered in a batch system in case one of the filters is down for maintenance.

3.4 Plant Services

3.4.1 Water Supply

The water reticulation system for the process plant consists of the following unit operations:

- fresh water supply
- process water supply
- non-potable water supply
- gland service water supply.

3.4.1.1 Fresh Water Supply System

Fresh water will be supplied to a 4 m diameter by 4 m high storage tank from Galekeno 900.

Fresh water will be used primarily for the following:

- reagent preparation
- gland seal water
- general mill water supply.

By design, the fresh water tank will be full at all times. The gland seal water from the fresh water source will be stored in a 2 m diameter by 2 m high tank prior to delivery to various service points.

Fresh water will be delivered from Galekeno 900. It will be delivered to the fresh water tank on demand. This water will be used for gland seal and reagents make-up. Daily fresh water consumption has been estimated to be about 1.38 m³/h on an average basis, assuming that all the process water generated in the plant can be recycled for reuse with no deleterious operational effects.

The tank will be located at an elevation of 40 m above the plant. Due to the insufficient hydraulic head available to supply the necessary line pressure two pumps, one operating and one standby will be required.

Gland service water will be drawn from a dedicated tank, which will be fed by the fresh water tank. It will be used to supply gland service water for all centrifugal water and slurry pumps in the plant.

3.4.1.2 Process Water Supply System

Process water will be supplied to the plant via centrifugal pumps, one operating and one stand-by unit. This water supply will be used for process stream dilution as well as by the plant clean-up hosing stations.

Process water will consist primarily of reclaim water from the water polishing pond, as well as treated sewage water, unused concentrates, and tailings thickeners overflow. The reclaimed water will be directed to a 7 m diameter by 7 m high process water storage tank, from where the water will be dispersed to the distribution lines in the process plant. Approximately 51.5 m³/h of water will be necessary for the process operation including water from thickeners overflow.

3.4.2 Air Supply

3.4.2.1 Air Supply and Distribution

Two 365 cfm compressors, each with 75 kW motors, will supply plant and instrument air to the process plant. The air discharging from the compressors will pass through a 730 cfm filter to remove remnant grease or oil and will be fed to 4 air receivers.

A low pressure centrifugal blower will be provided to supply dedicated low pressure air to the various flotation circuits.

The air service systems will supply air to the following areas:

- flotation: low pressure air for flotation cells will be provided by air blower
- filtering: high pressure air for filter pressing and drying of concentrates, provided by a dedicated air compressor
- crushing: high pressure air will be provided for required services in the crushing facility
- instrumentation: instrument air will come from the plant air compressors and stored in a dedicated air receiver.

3.4.3 Instrumentation and Process Control

The instrument index was developed during the process of taking the Process Flow Diagrams (PFDs) and developing them into Process and Instrumentation Diagrams (P&IDs). The instruments were specified and recorded to provide an instrument index that contains all of the instrumentation to develop this process.

The plant control system will consist of individual locally mounted control panels, located near the main equipment. There will be no Distributed Control System (DCS) or PC-based Operator Interface Stations (OIS). Alarm annunciation will be local to the major equipment or located on the local control panel. The local control panels will act as a marshalling point for monitoring and control of nearby equipment and instrumentation. It will also act as a distribution point of power for instrumentation. There will be no communication between the local control stations.

3.4.4 Quality Control

A metallurgical and assay laboratory will conduct daily quality control and optimize process performance.

The assay laboratory will be equipped with necessary analytical instruments to provide all routine assays for the mine, the plant, and environmental monitoring. The instruments of most importance are:

- an atomic absorption spectrophotometer (AAS)
- an ICP mass spectrometer.

The metallurgical laboratory will undertake all basic test work to monitor metallurgical performance and to improve process flowsheet and efficiency. The laboratory will be equipped with a laboratory crusher, a ball mill, particle size analysis devices, flotation cells, filtering devices, balances, and pH meters.

3.5 Metal Production Projection

-

Table 3-27 summarizes projected metal production. The projection is based on metallurgical test results and the updated mining schedule. It appears that the mill feed grades projected by

the updated mining schedule is different from the samples used in the testing programs. Further confirmation testing should be performed.

On average, the LOM average annual concentrate production is estimated to be approximately:

- lead-silver concentrate: 11,750 t; containing 70.3% Pb, 6,185 g/t Ag, 1.5 g/t Au
- zinc concentrate: 8,190 t; containing 54.4% Zn, 300 g/t Ag, 1.1 g/t Au.

Table 3-27 Metal Production Projection

Year	Product	Mass (%)	Grade				Recovery			
			Au (g/t)	Ag (g/t)	Pb (%)	Zn (%)	Au (%)	Ag (%)	Pb (%)	Zn (%)
2010	Head	100.0	0.44	1,010	11.73	5.26	100.0	100.0	100.0	100.0
	Pb-Ag Conc	16.1	1.3	5,924	71.0	2.2	47.8	94.6	97.6	6.7
	Zn Conc	8.5	1.1	305	0.64	54.3	21.2	2.6	0.5	87.4
2011	Head	100.0	0.45	994	11.54	5.43	100.0	100.0	100.0	100.0
	Pb-Ag Conc	15.9	1.3	5,921	71.0	2.2	47.8	94.5	97.5	6.4
	Zn Conc	8.8	1.1	302	0.63	54.4	21.6	2.7	0.5	87.7
2012	Head	100.0	0.43	820	8.50	5.49	100.0	100.0	100.0	100.0
	Pb-Ag Conc	11.8	1.72	6,392	70.1	2.3	47.7	91.7	97.1	4.9
	Zn Conc	8.9	1.10	298	0.47	54.4	23.1	3.2	0.5	88.5
2013	Head	100.0	0.37	717	7.04	6.09	100.0	100.0	100.0	100.0
	Pb-Ag Conc	9.7	1.8	6,616	68.6	2.8	47.4	90.0	95.0	4.5
	Zn Conc	10.0	1.1	297	0.40	54.6	29.5	4.1	0.6	89.4
Average	Head	100.0	0.42	871	9.47	5.6	100.0	100.0	100.0	100.0
	Pb-Ag Conc	13.1	1.5	6,185	70.3	2.3	47.7	92.7	96.9	5.4
	Zn Conc	9.1	1.1	300	0.52	54.4	23.9	3.1	0.5	88.4

3.5.1 Concentrate Dewatering

The silver-lead concentrate will be pumped to a 3 m diameter high rate thickener. The underflow of the thickener will have a solid density of approximately 60%. A 23 m³ holding tank will hold the thickener underflow concentrate prior to dewatering to approximately 8% moisture by a pressure filter. The dewatered concentrate will discharge to the lead concentrate stockpile, which will have a storage capacity for 7 days of lead concentrate production.

Filtrate from the pressure filter will be pumped back to thickener feed as well as dilution water. The concentrate thickener overflow will be distributed to the lead flotation circuit as process water.

The zinc concentrate will be pumped to a 3 m diameter separate high rate thickener. The underflow of the thickener, with a solid density of 60%, will be further dewatered to approximately 8% moisture by a pressure filter. Prior to the filtration, a 23 m³ holding tank will retain the thickened concentrate in order to reduce potential interruption of filtration operation. The dewatered concentrate will be discharged onto the zinc concentrate stockpile, which will have a 7-day storage capacity.

3.5.2 Tailings and Pyrite Concentrate Dewatering and Handling

Final tailings will be thickened in a 5 m diameter high-rate thickener. Thickener underflow will be further dewatered by a pressure filter; filtrate will return to the tailings thickener feed well. Thickener overflow will be recycled as mill make-up water together with surface run-off water, mine water, and overflows from the two concentrate thickeners. The water in the polishing pond will be recycled back to the mill as makeup water.

Pyrite concentrate will be dewatered by a 1 m thickener and stored in a holding tank prior to further dewatering by a pressure filter, which will be used for final tailings filtration.

The dewatered pyrite flotation concentrate and a portion of the dewatered tailings will be trucked to the Bellekeno mine site and mixed with binder (cement) and water to generate

backfill paste with approximately 77% solids. The paste backfill will be delivered to an underground pumping and distribution system for backfill of mined out stopes.

The rest of the dewatered tailings, with ~15% moisture, will be transported by trucks to the dry stack tailings storage facility located adjacent to the mill site.

The major equipment for tailings management includes:

- 5.0 m diameter tailings thickener;
- 1 m diameter pyrite concentrate thickener;
- Pressure filter;
- Cement silo with dust collector;
- Twin screw paste mixer; and
- Variable speed positive displacement paste pumps.

4.0 REAGENT HANDLING AND STORAGE

Most reagents will be received in bulk as in palletized bags, chemtainers, drums, or bulk bags.

The covered and curbed reagent storage and preparation area will be located adjacent to the flotation area. A forklift with a drum handler attachment will be used for reagent handling, while the electric hoist servicing the concentrate load-out and reagent areas will lift the reagents to the respective reagent mixing area located above the mixed reagent storage area. The reagent system will include unloading and storage facilities, mixing tanks, transfer pumps, and feeding equipment. Table 4-1 shows the reagents currently being specified for use in the process plant.

All the reagents will be prepared in a separate reagent preparation and storage facility in a containment area inside the mill building. The reagent storage tanks will be equipped with level indicators and instrumentation to ensure that spills do not occur during normal operation. Appropriate ventilation and fire and safety protection will be provided at the facility.

All solid reagents such as copper sulphate, zinc sulphate, sodium sulphite, and SIPX will be dissolved, mixed, and diluted prior to being transferred into separate holding tanks from where the reagents will be distributed to various addition points.

Lime will be stored in a dedicated silo. It will be retrieved from the silo by a screw conveyor and mixed with water to produce a lime slurry. The slurry will be stored in a 3 m diameter by 3.5 m high agitated tank and distributed to addition points via a pressurized lime loop. Alternatively, lime solution may be transported from the Elsa mixing facility and delivered into the lime solution storage tank.

Liquid collectors and frother will be stored in separate holding tanks prior to being pumped in undiluted form to various addition points. Anti-scale chemicals may be required to minimize scale build-up in the reclaim or recycle water lines. This reagent will be delivered in liquid form and metered directly into the reclaim water tank.

Please see Material Safety Data Sheets (MSDS), presented as part of the Hazardous Materials Management Plan, for detailed toxicological as well as human health and safety considerations for all proposed mill reagents. Emergency response planning and medical considerations are presented in the Emergency Response Plan.

Table 4-1 Summary of Reagents – Bellekeno Plant

Reagent	Preparation Method	Use
Flocculant	Received as powder in 25 kg bags; mixed to 0.3% storing strength; transferred to a storage tank and dosed directly to thickeners following further dilution to 0.3% dosing strength.	Flocculation of flotation high and low pyrite tailings and flotation lead and zinc concentrates in thickeners.
Copper Sulphate-Regulator	Received as powder in 25 kg bags; mixed to 10% strength; transferred to a storage tank. Dosed to the zinc flotation circuit.	Regulator for zinc sulphide minerals in flotation process.
MIBC-frother	Received as liquid in 200 L drums; dosed undiluted to lead and zinc flotation circuits.	Promotion and stabilization of froth bubbles in flotation cells.
SIBX-collector	Received as powder in 25 kg bags; mixed to 10% strength; transferred to a storage tank. Dosed to both lead and zinc flotation circuits.	Collector reagent for sulphide minerals into the froth phase of the flotation cells.
3418A-collector	Received as liquid in 200 L drums; dosed undiluted to lead flotation circuit.	Collector reagent for lead and silver sulphide minerals into the froth phase of the flotation cells.
Zinc Sulphate Regulator	Received as powder in 25 kg bags; mixed to 10% solution strength; transferred to a storage tank. Dosed to the primary grinding and lead flotation circuit, if required.	Regulator of lead sulphide minerals in flotation process.
Sodium Sulphite Regulator	Received as powder in 25 kg bags; mixed to 10% solution strength; transferred to a storage tank. Added to the primary grinding and lead flotation circuit if required.	Regulator of lead sulphide minerals in flotation process.
Lime Regulator	Received as powder in 1 ton bags, mixed to 20% storing strength; transferred to a storage tank and dosed directly to lead regrind and zinc flotation circuits.	

Anti-scale chemicals may be required to minimize scale build-up in the reclaim or recycle water lines. This reagent will be delivered in liquid form and metered directly into the reclaim water tank.

5.0 TAILINGS PROCESS OPERATIONS

One stream of low-pyrite and one stream of high-pyrite tailings will be produced at the mill. The low-pyrite and high-pyrite tailings will be pumped into the designated thickeners for dewatering to 58% solids. Both thickened tailings streams will then be pumped into stock tanks before being fed into the filter.

A disc or pressure filter will dewater both low-pyrite and high-pyrite tailings to approximately 85% solids on a batch basis, producing material for conventional dry stack tailings (low-pyrite tailings) and backfill material (low-pyrite and high-pyrite tailings) for underground disposal. The amount of low-pyrite tailings is estimated to be 6.6 t/h at 85% solids, and the amount high-pyrite tailings is estimated to be 1.2 t/h at 85% solids.

The dewatered tailings will be discharged onto a conveyor belt, and into two separate stockpiles before being loaded onto a truck for surface deposition as dry stack or to the underground mine for use in backfill operations. Only low-pyrite tailings (approximately 50% of the total tailings amount) will be deposited as dry stack. These tailings will be placed and compacted according to the surface deposition engineering specifications and the Tailings Management Plan. All the high-pyrite tailings together with the remaining low-pyrite tailings will be deposited underground for use in backfill.

Backfill will consist of cemented rock fill which includes a combination of underground waste rock, tailings, cement (or binder) and water at the prescribed dosing rate determined by the desired final fill strength.

6.0 DRY STACK TAILINGS FACILITY OPERATIONS

Approximately 50% - 60% of the low-pyrite tailings will be stored in an engineered dry stack tailings facility (DSTF) north of the mill building. In accordance with paragraph 5.1(b) of QML-0009, a detailed Dry Stack Tailings Facility Construction and Operation Plan will be submitted for approval that will contain all details related to construction, operation, maintenance, environmental mitigation and monitoring for this facility.

7.0 ANCILLARY FACILITIES

7.1 Water Supply and Distribution

7.1.1 Mill Fresh Water Supply System

The mill will require approximately 33.75 m³/day of freshwater makeup. In order to supply this water, treated water from the Galkeno 900 adit will be piped to the mill site. In addition, water will be drawn from the mill site runoff collection/treatment pond, with backup surface locations on Christal Lake and Christal Creek surface water if necessary. Fresh water makeup for the mill will be supplied to a 10 m diameter by 10 m high storage tank. Fresh water will be available primarily for firewater for emergency use, gland water for mill pumps and lubrication system, and for general mill water supply. The fresh water tank will be designed to also provide sufficient firewater for emergency situations. Potable water for mill employees will be delivered to the mill from the camp.

7.1.2 Note regarding potential Groundwater sources

In accordance with submissions received during the YESAA assessment of the Bellekeno Mine, and incorporated into the Decision Document, Alexco will conduct a thorough independent groundwater hydrogeological assessment consisting of the installation of monitoring wells prior to operation of the mill or any tailings deposition. The groundwater assessment program will be designed to collect data about groundwater levels, flow rates, flow direction, chemistry, recharge rates, etc., in order to provide reassurances to stakeholders that our mill operation will not negatively impact local water wells, or Lightning Creek. We propose to undertake the field work for this program prior to mill construction commencing in January 2010.

Alexco will submit the report of the independent hydrogeologist to the Water Board for review. Providing that the results of the groundwater assessment program do indeed confirm our current assessment, then we could request permission to develop groundwater well(s) for use in the mill, as a backup source to be used in case our primary sources, Galkeno 900 adit, Christal Lake or Christal Creek surface water become unusable for some reason.

7.1.3 Process Water Supply System

Mill process water will consist primarily of reclaim water from the water polishing pond, fresh water makeup, and thickener overflow. The reclaimed water will be directed to a 7 m diameter by 7 m high process water storage tank, from where the water will be dispersed to the distribution lines in the process plant. Approximately 66.82 m³/h of water will be necessary for the process operation including water from thickener overflow. The majority of this water is internal recycled water or has been brought in the ore. See Section 6.1 on Water Management for mill water balance table and schematic (Table 6-5 and Figure 6-3, respectively).

7.2 Assay Laboratory

A metallurgical and assay laboratory will conduct daily mine, mill and environmental quality control and optimize process performance. The assay laboratory will be equipped with necessary analytical instruments to provide all routine assays for the mine, the plant, and onsite environmental monitoring for treatment plant process control. The main analytical tool will be an atomic absorption spectrophotometer (AAS). The metallurgical laboratory will undertake all basic test work to monitor metallurgical performance and to improve process flow sheet and efficiency. The laboratory will be equipped with laboratory crushers, ball mills, particle size analysis devices, flotation cells, filtering devices, balances, and pH metres, and other equipment as necessary.

7.3 Electrical Substation and Stand-by Generators

Permanent power for the operation will be provided from the Yukon Energy grid by means of a power tap at the main 69 kV Line between Elsa and Keno City. Alexco will construct a new overhead power line from the main 69 kV power line to the mill site location. A new substation will be constructed between the 69 kV line and the mill site to drop the voltage down to 4160V. The Substation will be nominally 3MVA capacity and will transform the incoming 69 kV power to 4160V for site distribution. Construction and backup power will be supplied by a 500 kw diesel generator unit located onsite. Figure A00-18-002 in Appendix A shows the arrangement for power line and distribution to the mill site.

7.4 Fuel Storage and Handling

Fuel tanks for storage of diesel fuel for equipment and haul trucks will be required at the mill site. In addition, a propane tank will store fuel for heating. Locations for these facilities are shown on Figure 2-1. A Storage Tank System Permit will be secured from YG Environment in accordance with the Environment Act *Storage Tank Regulations* for installation and operation of fuel storage tanks.

7.5 Temporary Construction Facilities

A construction office complex supplied with temporary power, water supply, and sewage disposal will be used at the plant site to support construction for the project.

A construction lay down area, a contract aggregate screening plant, and a batch plant will be required. A suitable amount of aggregate material to supply construction is available from nearby sources; in particular, the Bardusan Placer Mine on Lightning Creek is a ready source of aggregates of various particle sizes.

8.0 KENO CITY SOCIOECONOMIC CONSIDERATIONS

Keno City has a small but steady tourism economy based on recreational use of the area and the historic mining heritage. Alexco realizes the importance of Keno City as an old mining town as well as how paramount the quality of life is to its residents. Alexco has met with the Keno City community to present the project and understand potential issues. In recognition of this, significant efforts have been made to incorporate design elements and mitigative strategies that will minimize the impacts on Keno City residents and their quality of life, and to ensure public health and safety.

8.1 Potential Effects

- Increased Traffic, Traffic Safety and Effects to Roads;
- Noise pollution;
- Dust;
- Visual;
- Environmental;
- Public Safety;

- Tourism Industry;
- Cumulative Effects of Other Development Activities; and
- Diminishment of the current quality of life.

8.2 Consultation and Mitigation

Based on discussions with the Keno City community, a Keno City Socio-Economic Mitigation Plan has been developed to address local residents' concerns with the mine development proposal and effects to local socio-economic and environmental conditions. Alexco recognizes that the community supports mining activities and the fact that local residents' existing presence in the area have sustained area infrastructure and thus made it easier for Alexco to continue its operations. Keno City has made considerable efforts towards developing a viable tourism industry that revolves around the historic mining heritage in the area. Alexco believes that this is an important initiative that the community has undertaken and a real opportunity exists for the company and the community to enhance and optimize the mining/tourism/heritage aspects of the area. Alexco will continue to work with the community to ensure that adequate communication protocols are in place regarding its development activities, and to continue discussions with the community to look at opportunities to enhance the project and support mining heritage opportunities so that the company is viewed as a good corporate citizen and neighbor.

8.3 Keno City Socio-Economic Mitigation Plan

This mitigation plan has been specifically developed to address the community concerns that have been brought forward by the Keno City local residents. Considering that the Bellekeno mine and mill will have direct influence to residents of Keno City, some time has been devoted to understanding and addressing their concerns. The plan is intended to address and mitigate potential effects as identified by the community and to maintain the quality of life presently experienced by the community. Following are some key element of this Plan:

8.3.1 Communication Protocol

- Effective and open communication between the mine and local residents is a critical issue to get right, therefore the development and implementation of a communication protocol has been given a high priority. Over this past summer, several meetings have been held, using the services of a third party professional facilitator who was suggested by the community and paid for by Alexco. This protocol will ensure that

direct communications with the local community continues and provides a mechanism where the community can be apprised of company activities and present issues for identification and resolution. Senior company management will meet with the local residents as required and provide activity updates and information sharing as determined by the protocol.

8.3.2 Access Management and Traffic

- Mine traffic will be redirected around Keno City to ensure that direct ore haulage traffic is routed around the community and interference with the local community is minimized. **Error! Reference source not found.** shows the proposed routing of traffic around the community. There will be light vehicle and equipment (graders, etc) traffic within Keno City but all ore haul traffic will be redirected at the commencement of production;
- 40 km/hr speed limit within or near the town;
- No use of engine retarder brakes in town limits;
- Review of highway access, signage and sign placement with YG Highways;

Alexco has committed to upgrading the north end of the Christal Lake road, to its junction with the Silver Trail Highway, as soon as possible and prior to commencement of production. Some construction activity and traffic will use the public road through Keno City until the Christal Lake road upgrade has been completed.



Legend

- - - - - Keno City Bypass North
- - - - - Keno City Bypass South
- Silver Trail Highway
- = = = = = Haul Road



0 250 500 Meters



ALEXCO KENO HILL MINING CORP.

**BELLEKENO PROJECT
TRAFFIC MANAGEMENT PLAN**

DATE: 12/7/2009	FIGURE 1	
DRAWN BY:EA	CHECKED BY:RLM	SCALE: 1:7,500
FILE: \\dawson\d\project\allprojects\alex-05-01\bellekeno\gis\mxd\construction_site_plan\fig4_2 borrow areas.mxd		

Table 8-1 and Table 8-2 summarize the estimated volume of traffic in the Keno City area for both the construction and operations phases. Additional

Site access and traffic management will be dealt within a comprehensive Traffic Management Plan, to be submitted for approval as per paragraph 5.1(b) of QML-0009.

Table 8-1 Estimated Daily Traffic Count – Construction Phase

Traffic Type	Load Category	Month							
		1	2	3	4	5	6	7	8
Mobilize mining equipment	H	1	1						
Construction camp installation	H	1	1						
Mobilize earthworks equipment	H	1							
Major earthworks (roads, diversion, etc)	H	15	15	15					
De-mobilize earthworks equipment	H			1					
Mobilize construction support equipment	H	1	1	1	1	1	1	1	1
De-mobilize construction equipment	H							1	1
Import structural steel, plate work, rebar	H		1	1					
Major mechanical & Electrical Equipment	H		1	1	1				
Bulk materials	H		1	1	1	1	1	1	1
Sub-total - Heavy > 10 tons		19	21	20	3	2	2	3	3
Personnel transport (pickups, autos)	L	10	10	10	10	10	10	10	10
Buses	L	2	2	2	2	2	2	2	2
Light Service Trucks (< 10 t)	L	2	2	2	2	2	2	2	2
Sub-total - Light < 10 tons		14	14	14	14	14	14	14	14
Grand Total		33	35	34	17	16	16	17	17

Table 8-2 Estimated Daily Traffic Count – Operations Phase

Vehicle Type - One way traffic count	Travel Direction	Shift Change	Day Shift	Shift Change	Night Shift
		6:00 AM	7:00 AM	4:00 PM	7:00 PM
		8:00 AM	7:00 PM	6:00 PM	7:00 PM
Light Trucks (< 1 ton) and Autos	Elsa to mine/mill	4	8	4	6
Buses	Elsa to mine/mill	2		2	
Heavy Trucks (> 5 tonne), bulk materials	Elsa to mine/mill		8		
Ore Trucks (>20 tonne) hauling ore	mine to mill		14		
Ore Trucks (>20 tonne) hauling tailings or empty	mill to mine		14		
Total round trips per day		6	44	6	6

Notes:

- 1) Warehouse receiving and shipping normally confined to hours between 8:00 AM and 4:00 PM. This will minimize heavy truck traffic during shift changes. Normally no heavy truck deliveries on night shift.
- 2) Bulk materials includes fuel, reagents, materials and supplies and concentrate haulage.
- 3) Above values are considered typical of daily traffic anticipated during operations. Variations up to 50 % are possible on any given day.
- 4) Based on 408 t/d production rate which results in highest ore haulage traffic count

8.3.3 Predicted Noise Impact and Mitigations

Increased noise from the Flame and Moth mill site has been expressed as a concern for Keno City residents and has been reflected in the YESAA Decision Document.

Noise is measured in terms of decibels. On the **decibel scale**, the smallest audible sound (near total silence) is 0 dB. A sound 10 times more powerful is 10 dB. A sound 100 times more powerful than near total silence is 20 dB. A sound 1,000 times more powerful than near total silence is 30 dB. Here are some common sounds and their decibel ratings:

Near total silence - 0 dB

A whisper - 15 dB

Normal conversation - 60 dB

A lawnmower - 90 dB

A car horn - 110 dB

A rock concert or a jet engine - 120 dB

A gunshot or firecracker - 140 dB

All of these decibel examples are from the position of standing next to the source of the noise. The level of the noise coming from the crushing plant at the Flame and Moth site is estimated to be approximately 90 dB (noise level standing next to the crushing plant ~3 m). With the construction of noise sound barrier walls or panels around the crushing facility, the noise directly on the outside of the noise sound barrier (~3 m) is estimated to be reduced by approximately 10 times or 10 dB. The intensity of sound diminishes greatly the further a person is from the source of the noise. Sound intensity reduces inversely to the distance away from the source.

If the distance from the source of the noise is doubled (i.e. from 3 m to 6 m) the intensity of the noise is reduced by 4 times. If the distance from the noise goes from 3 m to 30 m, the intensity of the noise is reduced by 100 times. The distance from Keno City to the Flame and Moth mill location is approximately 1.5 km. The decrease in noise level from a distance of 10

meters from the crushing plant to Keno City is calculated as approximately -44 dB. This results in an estimated noise level in Keno City from the crushing facility of ~36 dB.

The crushing facility has a throughput capacity of 65 tonnes/hr. Although the crusher is oversized compared to the daily ore tonnes, this is the smallest type of crushing plant available. Since the crushing facility can process significantly more ore tonnes than will be mined it will not operate continuously, even during the day shift hours. At the higher mining rate of 400 t/d, the crushing plant will need to process ore for approximately 6 hours per day on day shift only. This results in a periodic crushing operation and will not create a continuous 24/7 additional background noise condition.

Mitigation measures to reduce noise will include:

- Seek variance from Yukon Workers Compensation Health and Safety Board to modify equipment backup indicators with strobe light for night time operation;
- Ore haulage to/from Bellekeno and the Flame and Moth Mill will be conducted on day shift only (7 am – 7 pm);
- Sound abatement panels or walls constructed around the crushing facility to reduce noise.
- The crushing facility will only be operated during the day shift (7 am – 7 pm);
- Insulate the mill building for noise reduction; and
- Orientation of the mill doors away from the community and sound baffling.

During the YESAA assessment, the issue of noise was highlighted by assessors and reflected in the YG Decision Document issued July 10, 2009. The Decision Document calls for a Noise Impact Study (NIS) to be conducted prior to mining.

Alexco commits to undertaking a Noise Impact Study, as per the requirements set out in the Decision Document. Specifically, the NIS will:

- Analyze baseline conditions during conditions of low ambient noise.
- Calculate the potential noise emissions from all activities that generate significant noise.

- Calculate the noise emission level that the closest receiver may experience due to those activities. Consideration must be given to local environmental conditions (e.g. terrain, temperature inversions, and downwind conditions relative to sensitive receivers) and proposed mitigations.
- Calculate the cumulative noise emission of this project in combination with existing and proposed activities (e.g. care and maintenance, Keno City).

A noise abatement and management plan will be developed based on the results of the noise impact study. The plan will aim to achieve the following:

- Identify appropriate measures to reduce noise emissions.
- Incorporate these measures into project design and implementation.

Upon commencement of each block of operations (e.g. crusher; bypass construction; ore traffic), a verification study will be conducted. This will consist of continuous monitoring over a two week period. Monitoring will aim to capture the ambient noise levels at sensitive receivers, inclusive of what the project is contributing. If unacceptable noise levels are identified further measures to reduce the noise levels are required.

Additional details on noise abatement measures and sound monitoring are contained within the Noise Abatement Plan.

8.3.4 Dust abatement

Alexco commits to incorporate industry best management practices to minimize dust releases from its operations. The majority of public concerns expressed on this subject during YESAA assessment related to the potential for fugitive dust from the milling operation.

The single largest potential source of dust from a mining operation is the potential for windblown dust from tailings facilities. This has been a feature of slurry tailings deposits in past mining operations, where desiccated 'beaches' of tailings form above water line in large, valley fill tailings impoundments. The system proposed for the Bellekeno mill, however, is completely different from valley-fill slurry tailings deposits of the past. The Dry Stack technology results in a filtered, moist tailings deposit that is placed and compacted in lifts to achieve certain design compaction levels. Also, with the added feature of progressive

construct & progressive reclaim, only one year (approximately one hectare in surface area) will be exposed at any one time. Each year's dry stack after construction is covered with an evapotranspirative cover and revegetated.

Therefore, not only is the footprint minimized, but damp and compacted tails will not be subject to wind erosion. Should desiccation be observed to be occurring in summer months, the Operation, Maintenance and Surveillance Manual for the Day Stack Tailings Facility will dictate procedures to be undertaken for rewetting with spray bars or trucked water to maintain moist conditions prior to covering.

In addition to these mitigative dust control measures pertaining to the DSTF, Alexco will also follow a number of industry best management preventative practices for dust control for all aspects of the mine and mill operation including:

- If excess dust is produced by the crusher, dust screens will be installed around the crushing facility;
- Use of dust suppression techniques, such as the application of water as necessary, to the Dry Stack Tailing Facility, non-AML rock storage and the haul roads and mill site area, if and when dusting conditions occur;
- Under no circumstances will waste oil or other hydrocarbon product be used for dust suppression;
- Operational areas will be designed to minimize pollution from dust, taking account of prevailing wind conditions, and using enclosures for loadout areas, buildings as screens, etc.

During the YESAA assessment, the issue of dust was highlighted by assessors and reflected in the YG Decision Document issued July 10, 2009. The Decision Document calls for dust (TSP) monitoring to be conducted during operations.

Alexco commits to undertaking TSP monitoring, as per the requirements set out in the Decision Document. The TSP monitoring program will be comprised of two phases. First, upon commencement of operations, a simple TSP air samplers will be installed at the edge of the mill site in between the mill and Keno City. If warranted by initial dustfall measurements

indicating TSP concentrations in excess of 150 micrograms per cubic meter, a more extensive monitoring system will be put in place, and additional dust suppression measures will be undertaken in order to achieve the TSP objective of less than 150 micrograms per cubic meter.

8.3.5 Light Pollution and Visual Impact

Mitigation measures which limit visual impact include:

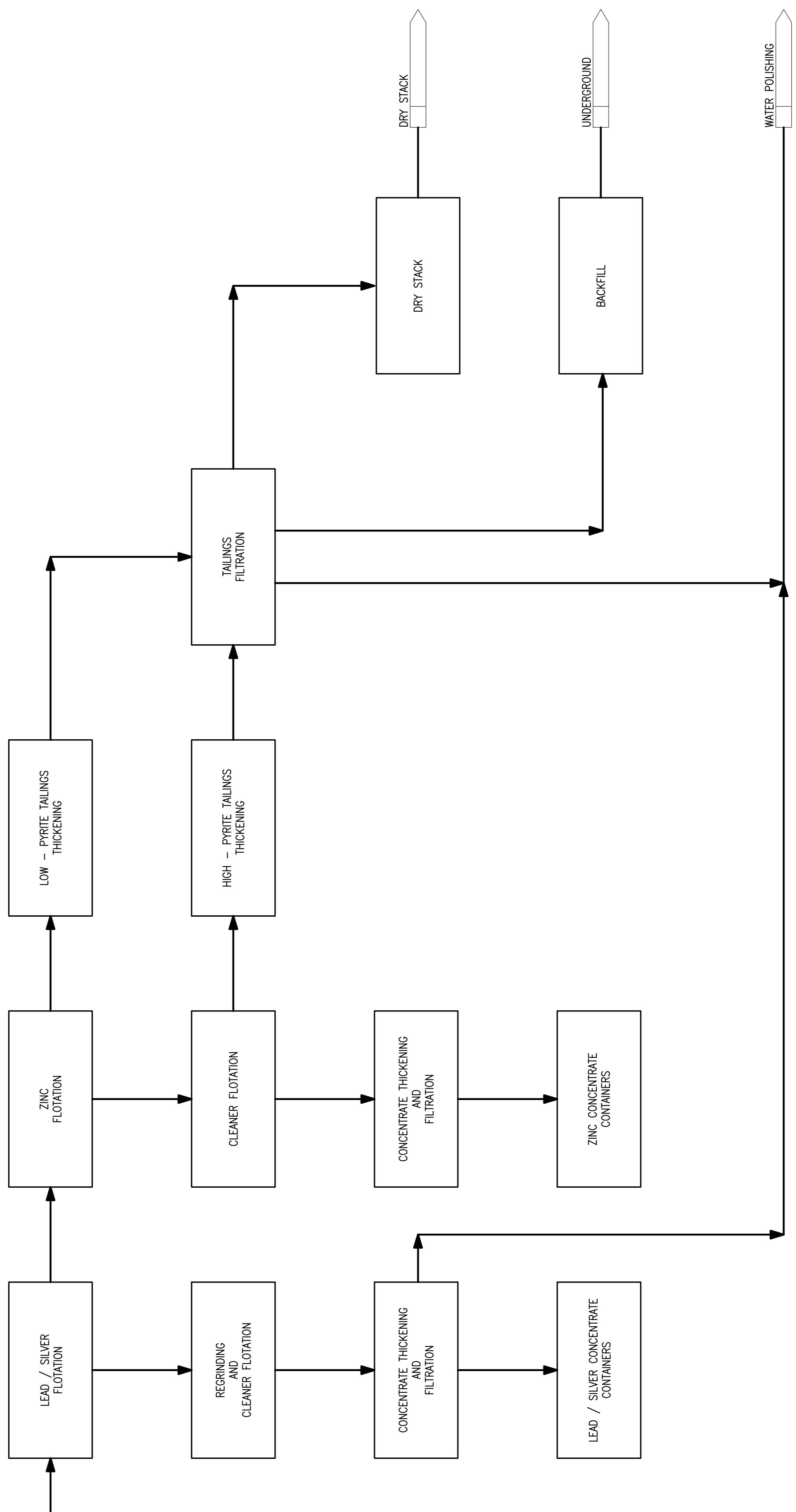
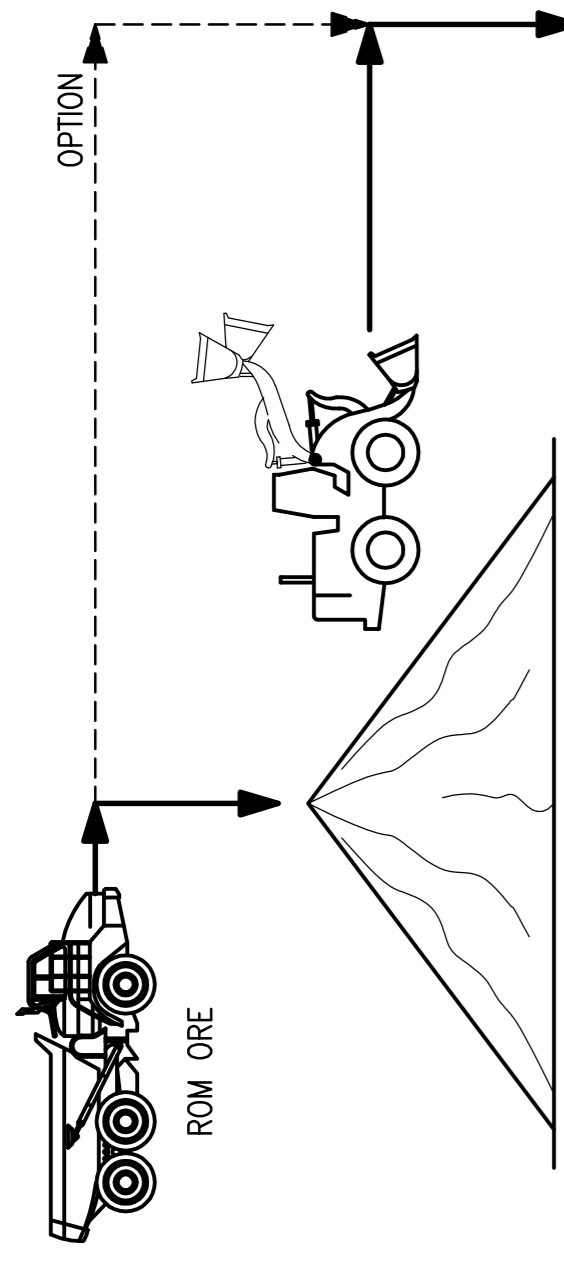
- Minimize clearing of trees and brush around mill site to limit mill view;
- Utilize annual progressive construction and reclamation of the DSTF;
- Mill buildings and ancillary facilities will be constructed in natural earth tones in order to help them blend with surrounding area.

Mitigation measures to reduce light pollution include:

- Yard lights will have overhead covers in order to prevent atmospheric light pollution and skyglow;
- Directional lighting will be used and will be pointed away from Keno City as much as possible;
- Natural topography will prevent light from the mill site to reach Keno City directly.

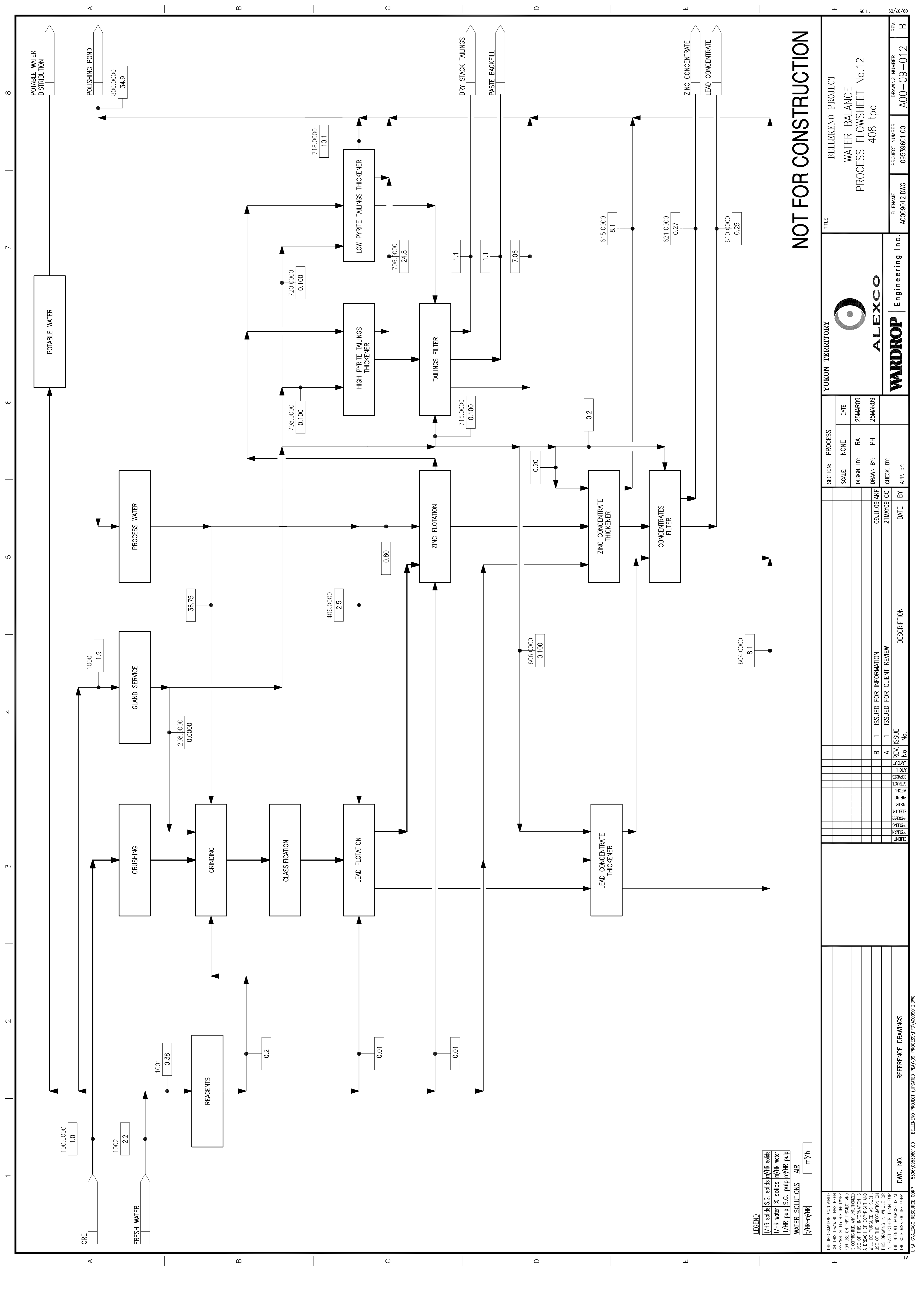
APPENDIX A

PROJECT DRAWINGS



NOT FOR CONSTRUCTION

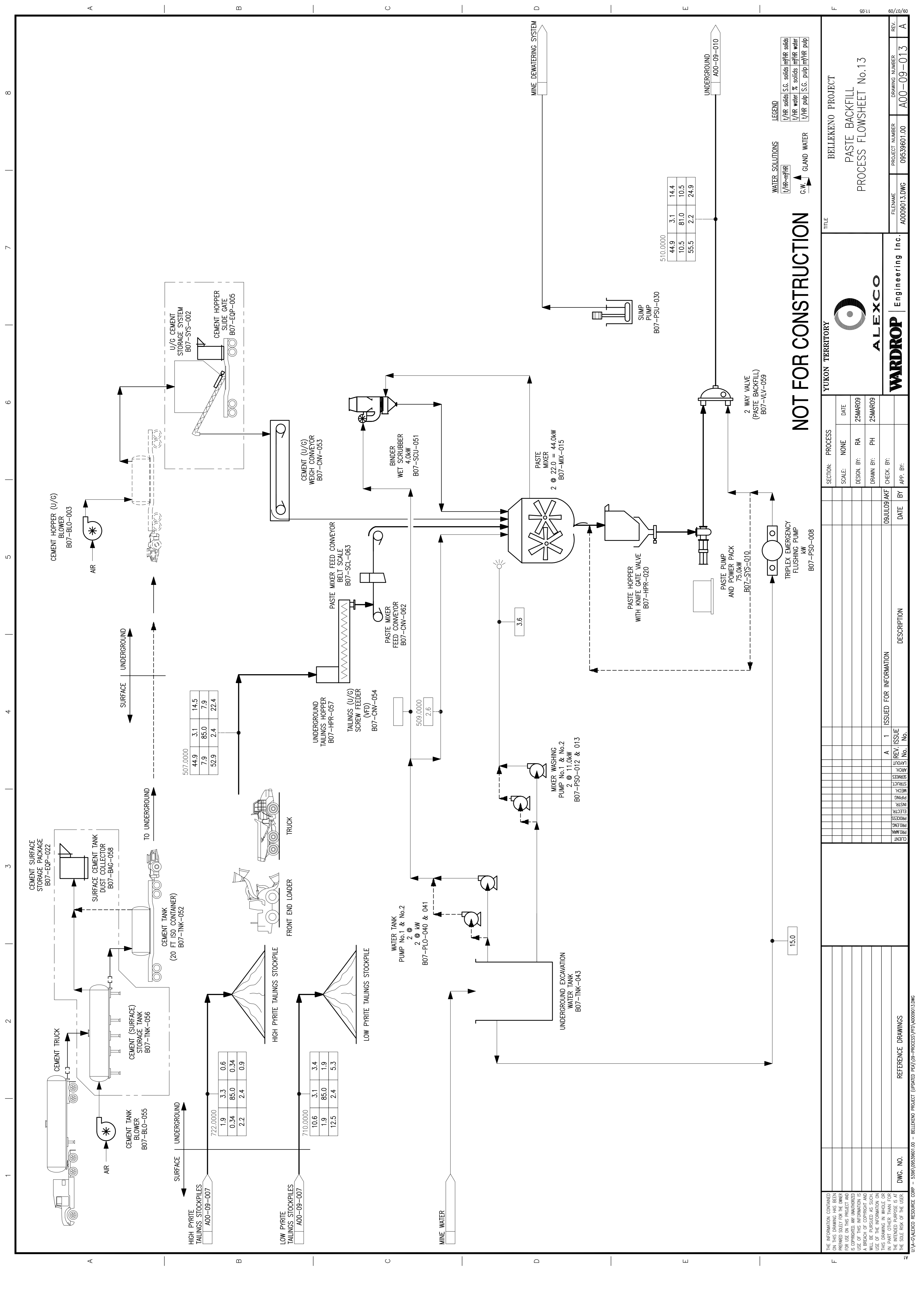
THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEERING DEPARTMENT OF VALECO RESOURCE CORP. FOR THE BELLEKENO PROJECT. ANY UNAUTHORIZED USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PURSUED AS SUCH. THIS DRAWING IN WHOLE OR IN PART IS THE PROPERTY OF VALECO RESOURCE CORP. AND IS TO BE USED FOR THE INTENDED PURPOSE AS AT THE SOLE RISK OF THE USER.		DWG. NO. REFERENCE DRAWINGS	
CLIENT: PRODMAN PROJECT: PROCESS INSTR: ELECTR MECH: PIPING STRUCT: STRUCT SEMCON: SEMCON ARCH: ARCH CIVIL: CIVIL MISC: MISC			
REV. NO.	DESCRIPTION	DATE	BY
B 1	ISSUED FOR INFORMATION	09JUL09 AKF	
A 1	ISSUED FOR CLIENT REVIEW	21MAY09 CC	
SECTION: PROCESS		SCALE: NONE	DATE: 25MAR09
DESIGN BY: RA		DRAWN BY: PH	CHECK BY:
PROJECT NUMBER: 09539601.00		PROJECT NUMBER: 09539601.00	DRAWING NUMBER: A00-09-001
FILENAME: A0009001.DWG		REV. B	
TITLE: BELLEKENO PROJECT SIMPLIFIED FLOWSHEET PROCESS FLOWSHEET No.1		DRAWING NUMBER: A00-09-001	
YUKON TERRITORY		ALEXCO	
WARDROP Engineering Inc.		60/LO/60	



LEGEND
 t/HR solids S.C. solids m³/HR solids
 t/HR water % solids m³/HR water
 t/HR pulp S.G. pulp m³/HR pulp
 WATER SOLUTIONS AIR
 t/HR-m³/h

NOT FOR CONSTRUCTION

THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEER AND IS NOT TO BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN CONSENT OF THE ENGINEER. USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PURSUED AS SUCH. USE OF THE INFORMATION ON THIS DRAWING IN WHOLE OR IN PART FOR ANY OTHER PROJECT IS AT THE SOLE RISK OF THE USER.		CLIENT PROGRAM PROCESS ENGINEER ARCHITECT STRUCTURAL MECHANICAL PIPING INSTRUMENTATION ELECTRICAL	
REV. NO.	DESCRIPTION	DATE	BY
B 1	ISSUED FOR INFORMATION	09/JUL/09 AKF	
A 1	ISSUED FOR CLIENT REVIEW	21/MAY/09 CC	
SECTION: PROCESS		SCALE: NONE	DATE: 25/MAR/09
DESIGN BY: RA		DESIGN BY: PH	25/MAR/09
DRAWN BY: CC		CHECK BY:	
APP. BY:			
PROJECT NUMBER: 095339601.00		PROJECT NUMBER: 095339601.00	DRAWING NUMBER: A00-09-012
FILENAME: A0009012.DWG		REV. B	
TITLE: BELLEKENO PROJECT WATER BALANCE PROCESS FLOWSHEET No.12 408 tpd		YUKON TERRITORY	
ALEXCO		WARDROP Engineering Inc.	



507.0000

44.9	3.1	14.5
7.9	85.0	7.9
52.9	2.4	22.4

722.0000

1.9	3.3	0.6
0.34	85.0	0.34
2.2	2.4	0.9

710.0000

10.6	3.1	3.4
1.9	85.0	1.9
12.5	2.4	5.3

510.0000

44.9	3.1	14.4
10.5	81.0	10.5
55.5	2.2	24.9

LEGEND

1/HR solids S.G. solids m³/HR solids

1/HR water % solids m³/HR water

1/HR pulp S.G. pulp m³/HR pulp

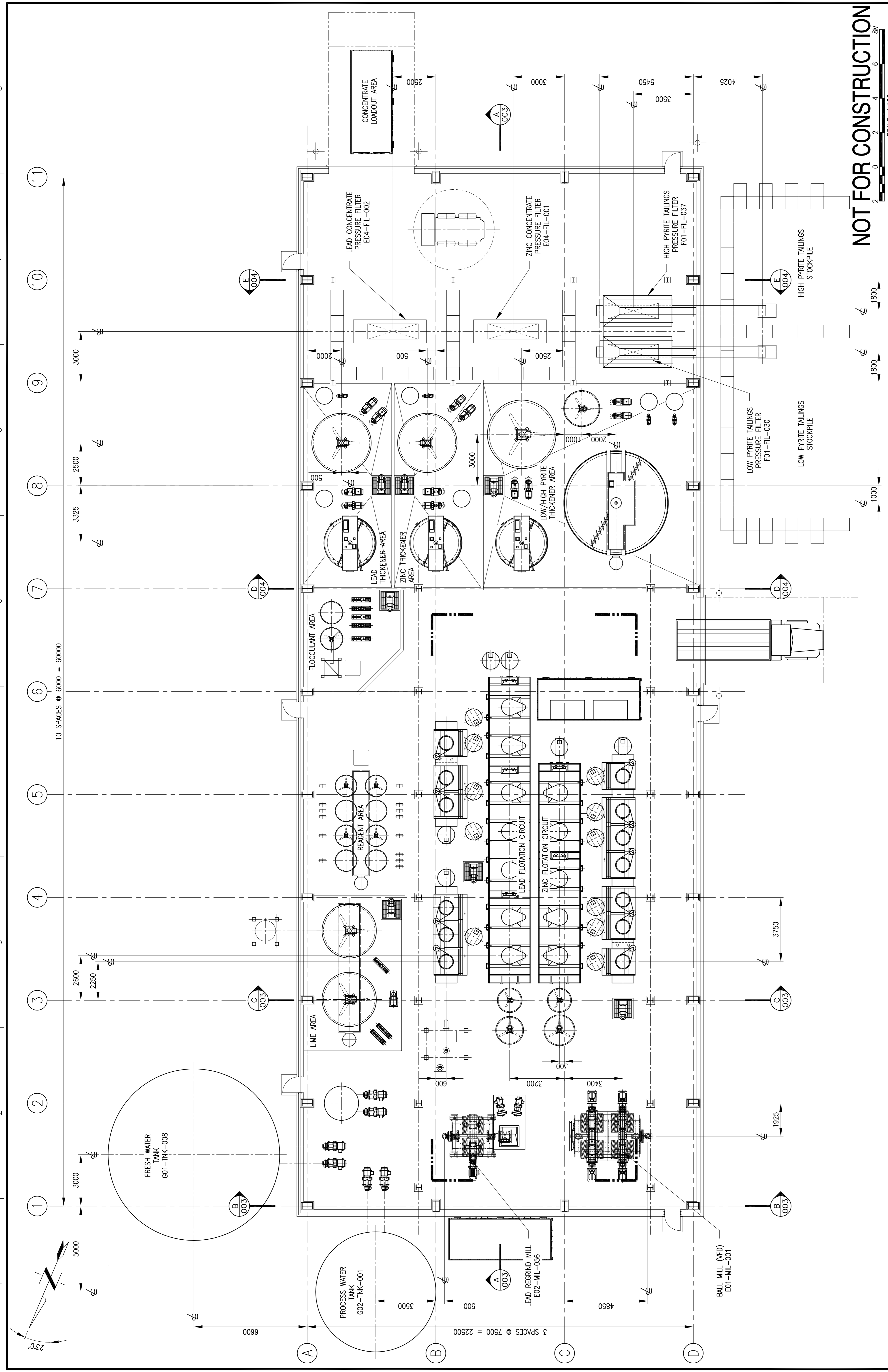
WATER SOLUTIONS

1/HR-m³/HR

G.W. GLAND WATER

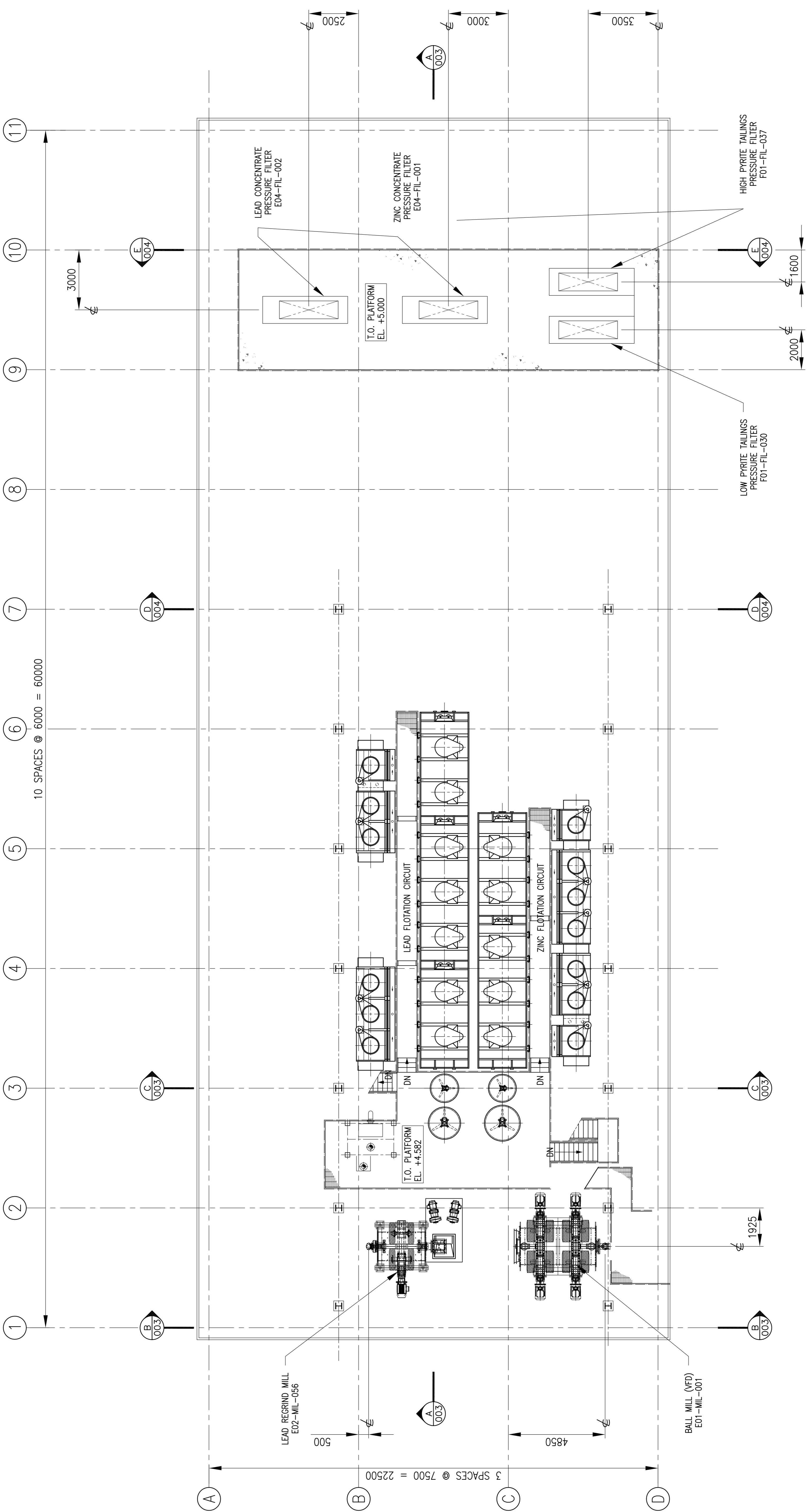
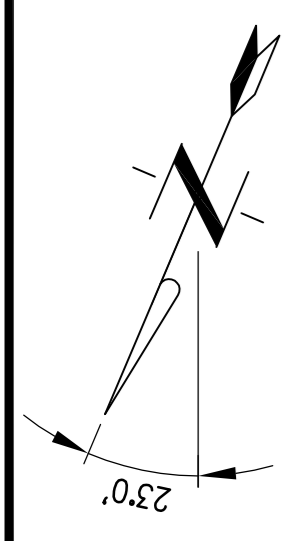
NOT FOR CONSTRUCTION

CLIENT: BELLEKENO PROJECT PROJECT: PASTE BACKFILL DRAWING: PROCESS FLOWSHEET No.13		YUKON TERRITORY ALEXCO Engineering Inc.
SECTION:	PROCESS	FILENAME: A0009013.DWG
SCALE:	NONE	PROJECT NUMBER: 09539601.00
DESIGN BY:	RA	DRAWING NUMBER: A00-09-013
DRAWN BY:	PH	REV. NUMBER: A
CHECK BY:		
APP. BY:		
DATE:	09JUL09 AKF	
ISSUED FOR INFORMATION	1	
REV. / ISSUE No.		
ARCH		
STRUCT		
MECH		
PLUMB		
ELECTR		
PROG		
CLIENT		
DWG. NO.	REFERENCE DRAWINGS	

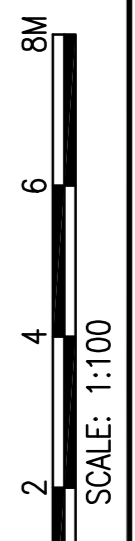


NOT FOR CONSTRUCTION
SCALE: 1:100

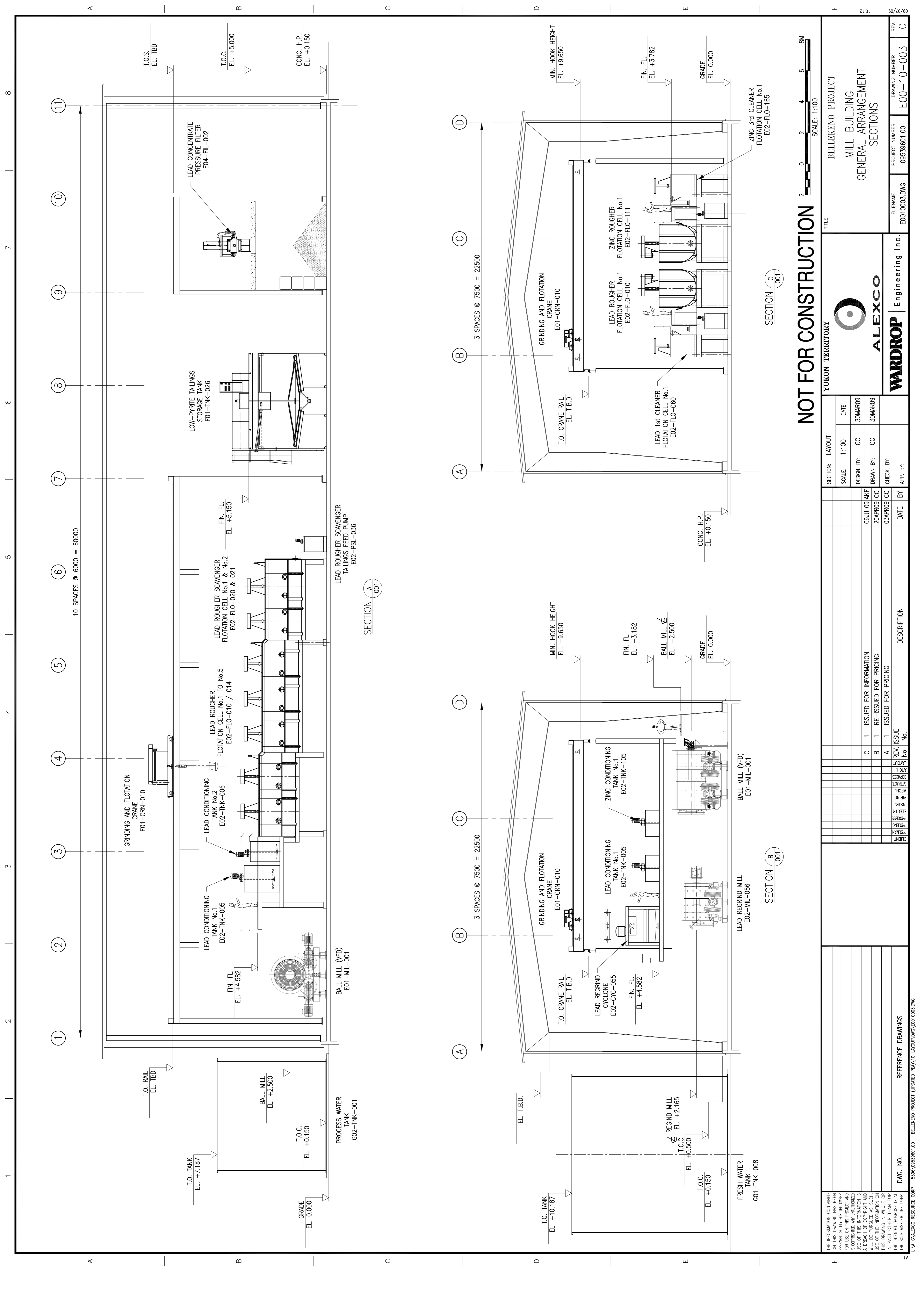
THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEER AND THE ENGINEER'S FIRM FOR THE PROJECT AND IS NOT TO BE USED FOR ANY OTHER PROJECT. USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PURSUED AS SUCH. USE OF THE INFORMATION ON THIS DRAWING IN WHOLE OR IN PART FOR ANY OTHER PROJECT IS AT THE SOLE RISK OF THE USER.		DWG. NO. REFERENCE DRAWINGS	
CLIENT: BELLEKENO PROJECT (UPDATED PEY)\0-LAYOUT\DWG\E0010001.DWG		PROJECT NUMBER: 09539601.00	
PROJECT NAME: E0010001.DWG		DRAWING NUMBER: E00-10-001	
FILENAME: E0010001.DWG		REV. NO. C	
TITLE: BELLEKENO PROJECT MILL BUILDING GENERAL ARRANGEMENT OPERATING FLOOR PLAN		YUKON TERRITORY	
SECTION: LAYOUT		DATE: 30MAR09	
SCALE: 1:100		DESIGN BY: CC	
DESIGN BY: CC		DRAWN BY: CC	
DRAWN BY: CC		CHECK BY:	
CHECK BY:		APP. BY:	
APP. BY:		DATE:	
DATE:		DESCRIPTION:	
REV. NO. 1		DESCRIPTION: ISSUED FOR INFORMATION	
REV. NO. 2		DESCRIPTION: RE-ISSUED FOR PRICING	
REV. NO. 3		DESCRIPTION: ISSUED FOR PRICING	
REV. NO. 4		DESCRIPTION:	
REV. NO. 5		DESCRIPTION:	
REV. NO. 6		DESCRIPTION:	
REV. NO. 7		DESCRIPTION:	
REV. NO. 8		DESCRIPTION:	
REV. NO. 9		DESCRIPTION:	
REV. NO. 10		DESCRIPTION:	
REV. NO. 11		DESCRIPTION:	



NOT FOR CONSTRUCTION



THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEER FOR THE PROJECT AND IS NOT TO BE USED FOR ANY OTHER PROJECT. USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PURSUED AS SUCH. USE OF THIS INFORMATION ON THIS DRAWING IN WHOLE OR IN PART IS AT THE SOLE RISK OF THE USER.		DWG. NO. REFERENCE DRAWINGS	
CLIENT PROGRAM ENGINEERING PROCESS INSTRUMENTATION MECHANICAL STRUCTURAL SERVICES ARCHITECTURAL LAYOUT			
A 1 ISSUED FOR INFORMATION		DATE BY	
09/JUL/09 AKF		09/JUL/09 AKF	
SECTION: LAYOUT		SCALE: 1:100	
DATE: 30/MAR/09		DESIGN BY: CC	
DRAWN BY: CC		CHECK BY:	
FILENAME: E0010002.DWG		PROJECT NUMBER: 09539601.00	
DRAWING NUMBER: E00-10-002		DRAWING NUMBER: A	
TITLE: BELLEKENO PROJECT MILL BUILDING GENERAL ARRANGEMENT UPPER FLOOR PLAN		YUKON TERRITORY	
ALEXCO		WARDROP Engineering Inc.	



NOT FOR CONSTRUCTION

SECTION:	LAYOUT
SCALE:	1:100
DESIGN BY:	CC
DATE:	30MAR09
DRAWN BY:	CC
CHECK BY:	CC
APP. BY:	

YUKON TERRITORY

ALEXCO Engineering Inc.

BELLEFENO PROJECT
MILL BUILDING
GENERAL ARRANGEMENT
SECTIONS

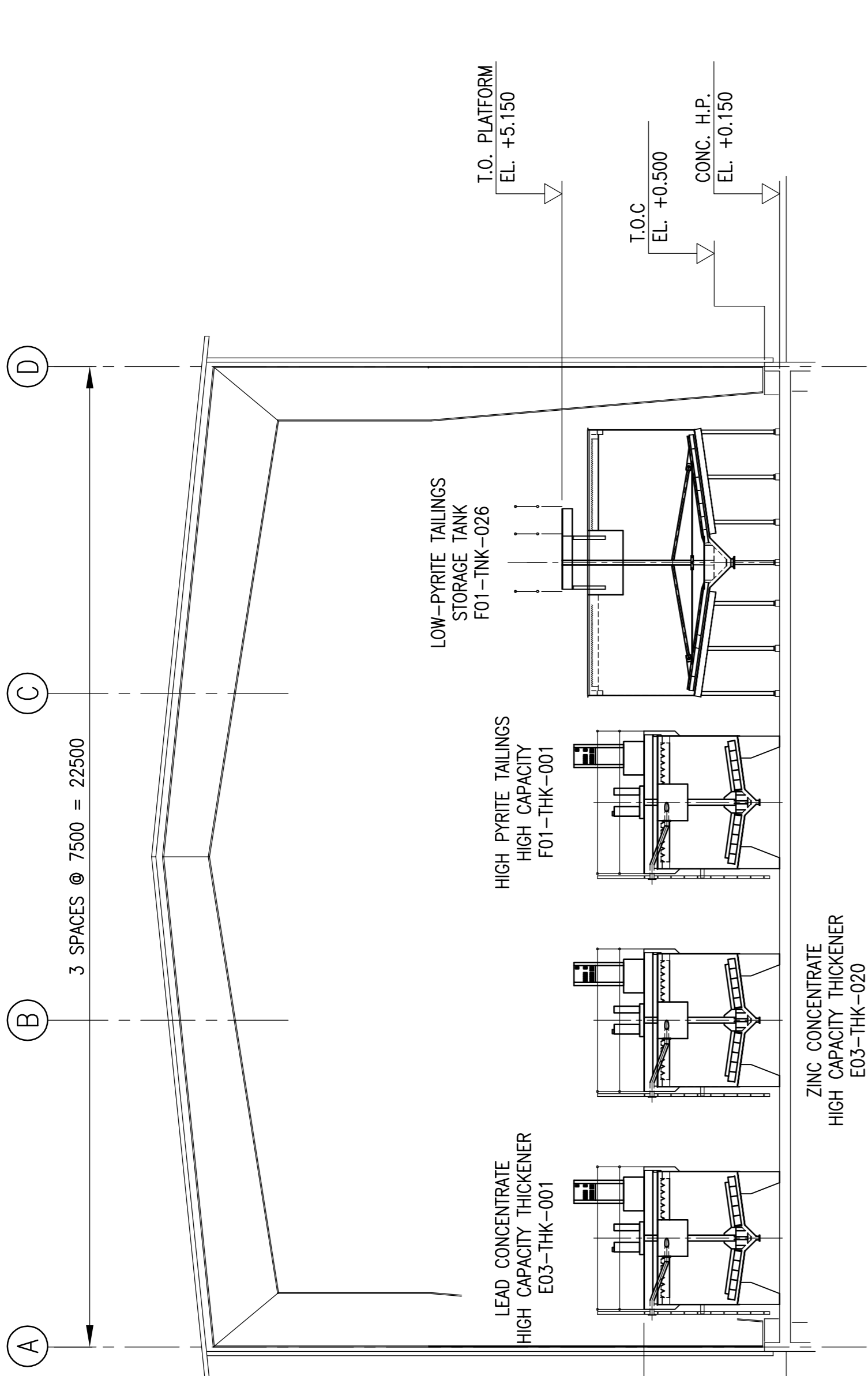
FILENAME	E0010003.DWG	PROJECT NUMBER	09539601.00	DRAWING NUMBER	E00-10-003
REV.	C				

SECTION	SCALE	DATE	DESIGN BY	DRAWN BY	CHECK BY	APP. BY	DATE	DESCRIPTION
C	1	30MAR09	CC	CC	CC			ISSUED FOR INFORMATION
B	1	30MAR09	CC	CC	CC			RE-ISSUED FOR PRICING
A	1	30MAR09	CC	CC	CC			ISSUED FOR PRICING

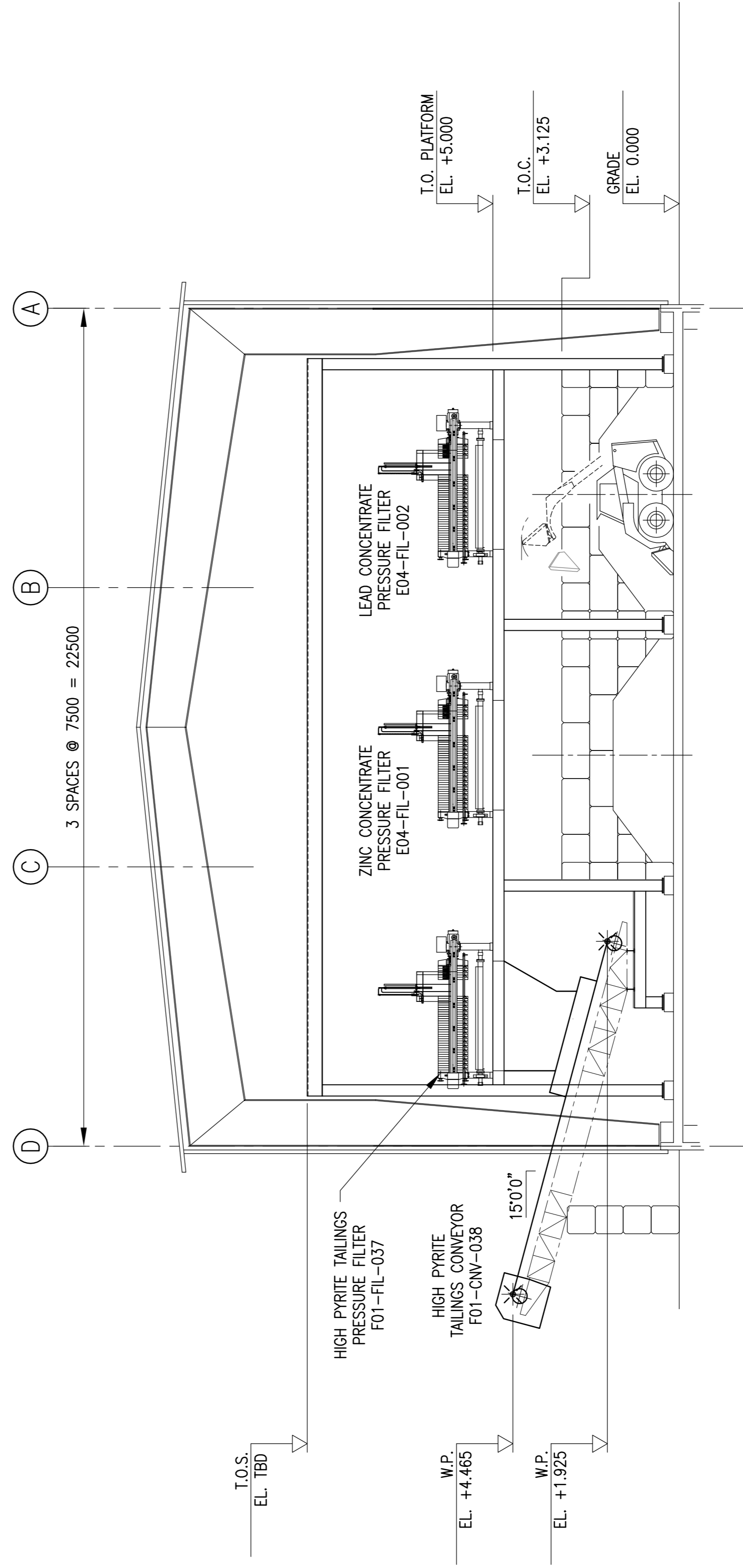
DWG. NO.	REFERENCE DRAWINGS

THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEER AND IS NOT TO BE USED FOR ANY OTHER PURPOSE WITHOUT THE WRITTEN CONSENT OF THE ENGINEER. THE ENGINEER ASSUMES NO LIABILITY FOR ANY DAMAGE OR INJURY TO PERSONS OR PROPERTY ARISING FROM THE USE OF THIS DRAWING IN WHOLE OR IN PART. THE USER OF THIS DRAWING SHALL BE RESPONSIBLE FOR THE SOLE RISK OF THE USER.

UVA-SVALESCO RESOURCE CORP - 5396/09539601.00 - BELLEFENO PROJECT (UPDATED PE)\10-LAYOUT\DWG\E0010003.DWG

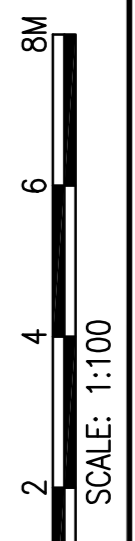


SECTION D-001

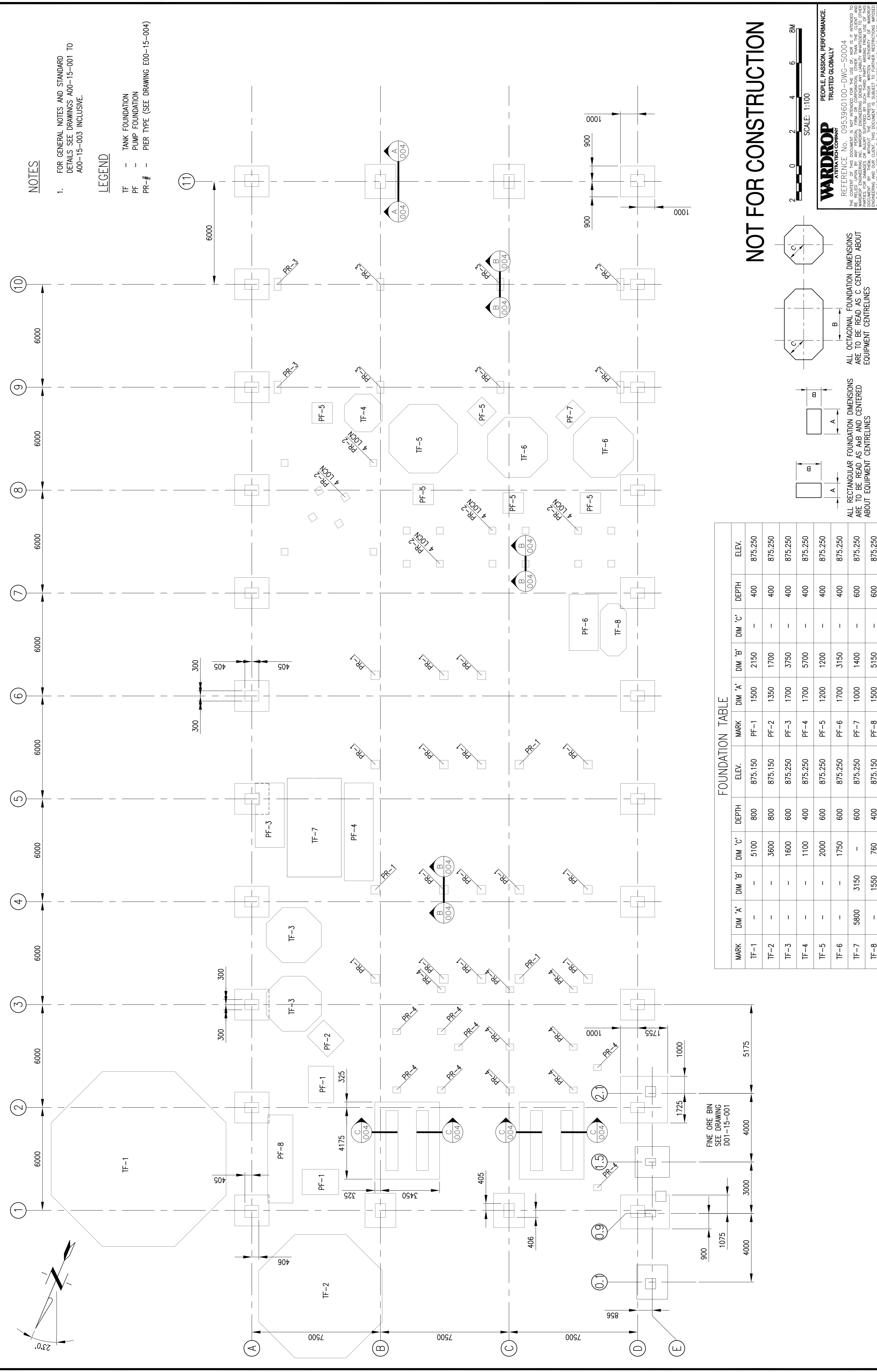
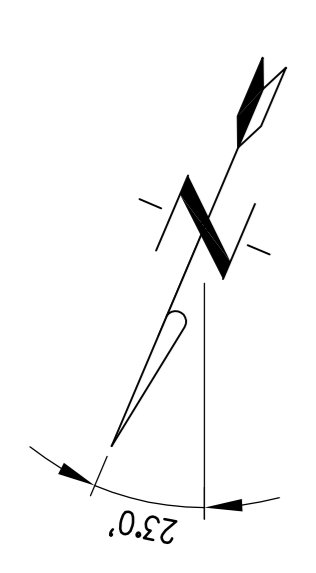


SECTION E-001

NOT FOR CONSTRUCTION



THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEER OR ARCHITECT FOR THE PROJECT AND IS NOT TO BE USED FOR ANY OTHER PROJECT. USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PURSUED AS SUCH. USE OF THE INFORMATION ON THIS DRAWING IN WHOLE OR IN PART FOR ANY OTHER PROJECT IS AT THE SOLE RISK OF THE USER.	DWG. NO. REFERENCE DRAWINGS	CLIENT PROJECT NO. 09JUL09AKF ARCH. LAYOUT ARCH. NO. 1 STRUCT. SERVICES ARCH. NO. 1 MECH. SERVICES ARCH. NO. 1 PIPING ARCH. NO. 1 INSTR. ARCH. NO. 1 ELECTR. ARCH. NO. 1 PROCESS ARCH. NO. 1 PROGM. ARCH. NO. 1	ISSUED FOR INFORMATION	DATE 09JUL09AKF	BY
			REV. ISSUE NO. 1	DATE	BY
SECTION: LAYOUT			SCALE: 1:100	DESIGN. BY: CC	DATE 30MAR09
FILENAME: E0010004.DWG			PROJECT NUMBER: 09539601.00	DRAWN BY: CC	CHECK. BY:
TITLE: BELLEFENO PROJECT MILL BUILDING GENERAL ARRANGEMENT SECTIONS			DRAWING NUMBER: E00-10-004	PROJECT NUMBER: 09539601.00	REV. A
YUKON TERRITORY					
WARDROP Engineering Inc.					



NOTES

1. FOR GENERAL NOTES AND STANDARD DETAILS SEE DRAWINGS A00-15-001 TO A00-15-003 INCLUSIVE.

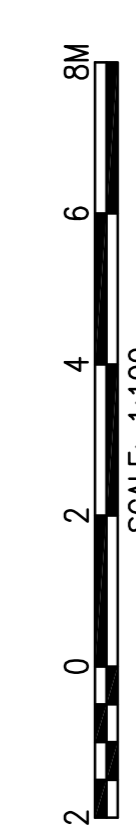
LEGEND

TF = TANK FOUNDATION
 PF = PUMP FOUNDATION
 PR-# = PIER TYPE (SEE DRAWING E00-15-004)

FOUNDATION TABLE

MARK	DIM 'A'	DIM 'B'	DIM 'C'	DEPTH	ELEV.	MARK	DIM 'A'	DIM 'B'	DIM 'C'	DEPTH	ELEV.
TF-1	-	-	5100	800	875.150	PF-1	1500	2150	-	400	875.250
TF-2	-	-	3600	800	875.150	PF-2	1350	1700	-	400	875.250
TF-3	-	-	1600	600	875.250	PF-3	1700	3750	-	400	875.250
TF-4	-	-	1100	400	875.250	PF-4	1700	5700	-	400	875.250
TF-5	-	-	2000	600	875.250	PF-5	1200	1200	-	400	875.250
TF-6	-	-	1750	600	875.250	PF-6	1700	3150	-	400	875.250
TF-7	5800	3150	-	600	875.250	PF-7	1000	1400	-	600	875.250
TF-8	-	1550	760	400	875.150	PF-8	1500	5150	-	600	875.250

NOT FOR CONSTRUCTION



WARDROP
 PEOPLE. PASSION. PERFORMANCE.
 TRUSTED GLOBALLY

REFERENCE No. 0953960100-DWG-S0004

THE CONTENT OF THIS DOCUMENT IS NOT INTENDED FOR THE USE OF, NOR IS IT INTENDED TO BE BELIEVED BY ANY PERSON, FROM OR CORPORATION, OTHER THAN THE CLIENT AND PARTIES TO THIS CONTRACT. THE CLIENT AND PARTIES TO THIS CONTRACT SHALL BE RESPONSIBLE FOR DAMAGES OR INJURY SUFFERED BY SUCH THIRD PARTY ARISING FROM USE OF THIS DOCUMENT. THE CLIENT AND PARTIES TO THIS CONTRACT SHALL BE RESPONSIBLE FOR DAMAGES OR INJURY SUFFERED BY SUCH THIRD PARTY ARISING FROM USE OF THIS DOCUMENT. THE CLIENT AND PARTIES TO THIS CONTRACT SHALL BE RESPONSIBLE FOR DAMAGES OR INJURY SUFFERED BY SUCH THIRD PARTY ARISING FROM USE OF THIS DOCUMENT.

YUKON TERRITORY

ALEXCO Engineering Inc.

BELLEKENO PROJECT
 MILL BUILDING
 CONCRETE
 FOUNDATION PLAN

SECTION: CONCRETE
 SCALE: 1:100
 DATE: 08APR09
 DESIGN BY: ATM
 DRAWN BY: MRK
 CHECK BY:
 APP. BY:

REVISIONS:

NO.	REV.	ISSUE	DATE	BY
C	1	ISSUED FOR INFORMATION	09JUL09AKF	
B	1	ISSUED FOR INFORMATION ONLY	24JUN09MRK	
A	1	ISSUED FOR SQUAD REVIEW	05JUN09MRK	

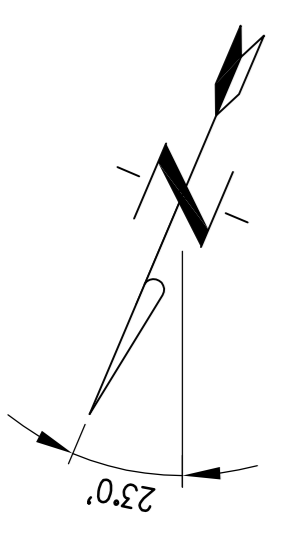
PRELIMINARY DRAWING
 NOT TO BE USED FOR CONSTRUCTION

OVERALL GENERAL NOTES - CONCRETE SHEET 3
 OVERALL GENERAL NOTES - CONCRETE SHEET 2
 OVERALL GENERAL NOTES - CONCRETE SHEET 1

REFERENCE DRAWINGS

DWG. NO.

PROJECT NUMBER: 09539601.00
 DRAWING NUMBER: E00-15-001
 FILENAME: E0015001.DWG

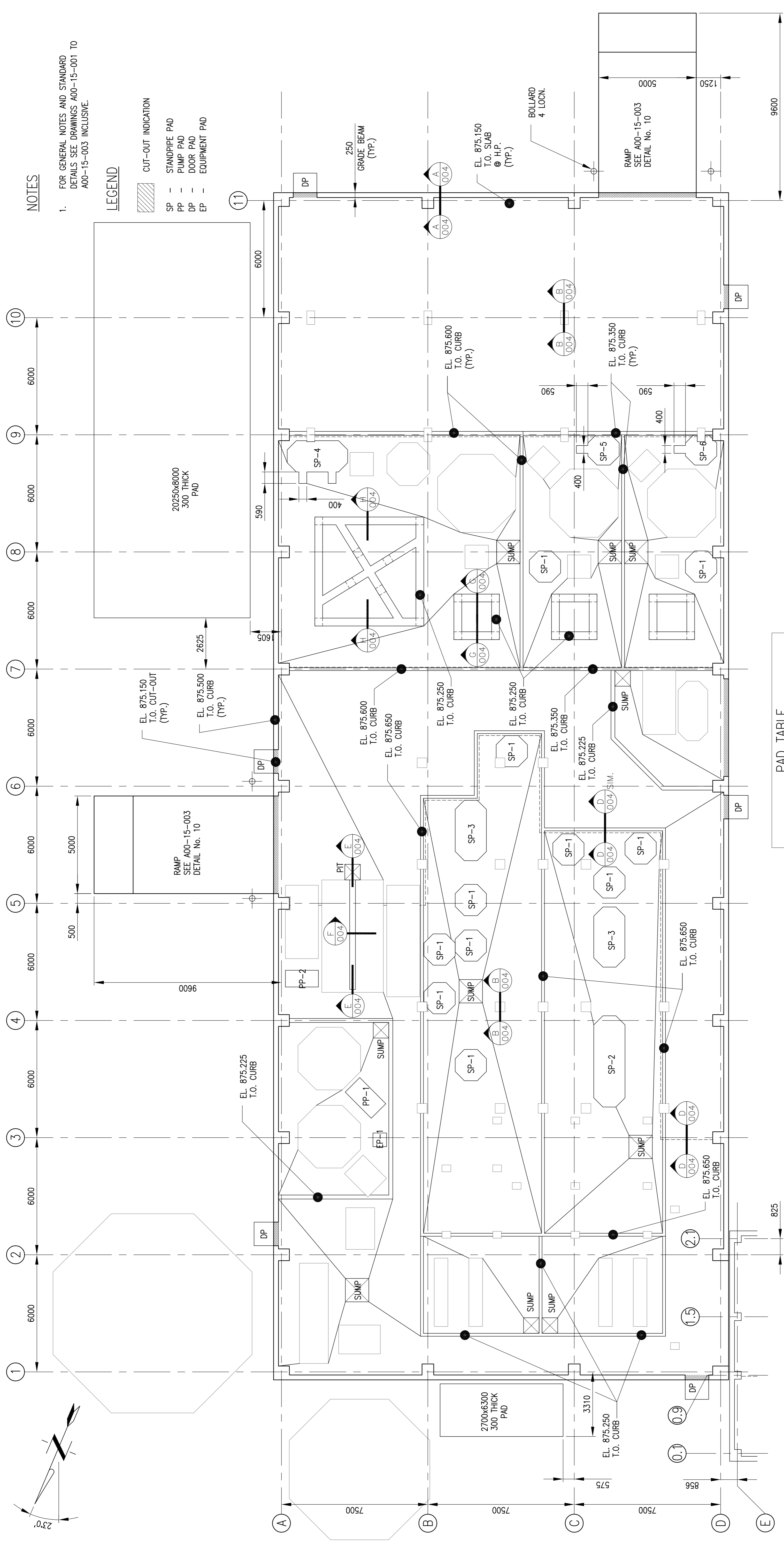


NOTES

1. FOR GENERAL NOTES AND STANDARD DETAILS SEE DRAWINGS A00-15-001 TO A00-15-003 INCLUSIVE.

LEGEND

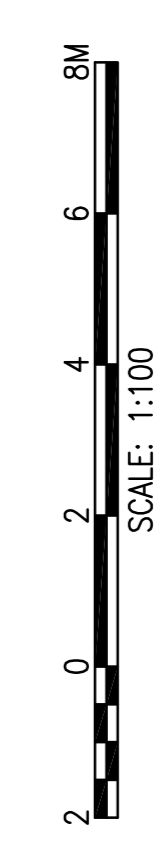
- CUT-OUT INDICATION
- SP - STANDPIPE PAD
- PP - PUMP PAD
- DP - DOOR PAD
- EP - EQUIPMENT PAD



PAD TABLE

MARK	DIM 'A'	DIM 'B'	DIM 'C'	ELEV.
SP-1	-	-	800	875.250
SP-2	-	3100	800	875.250
SP-3	-	1500	800	875.250
SP-4	-	1500	800	875.250
SP-5	-	-	800	875.250
SP-6	-	-	800	875.250
EP-1	700	700	-	875.250
PP-1	750	1900	-	875.250
PP-2	850	1700	-	875.250

NOT FOR CONSTRUCTION

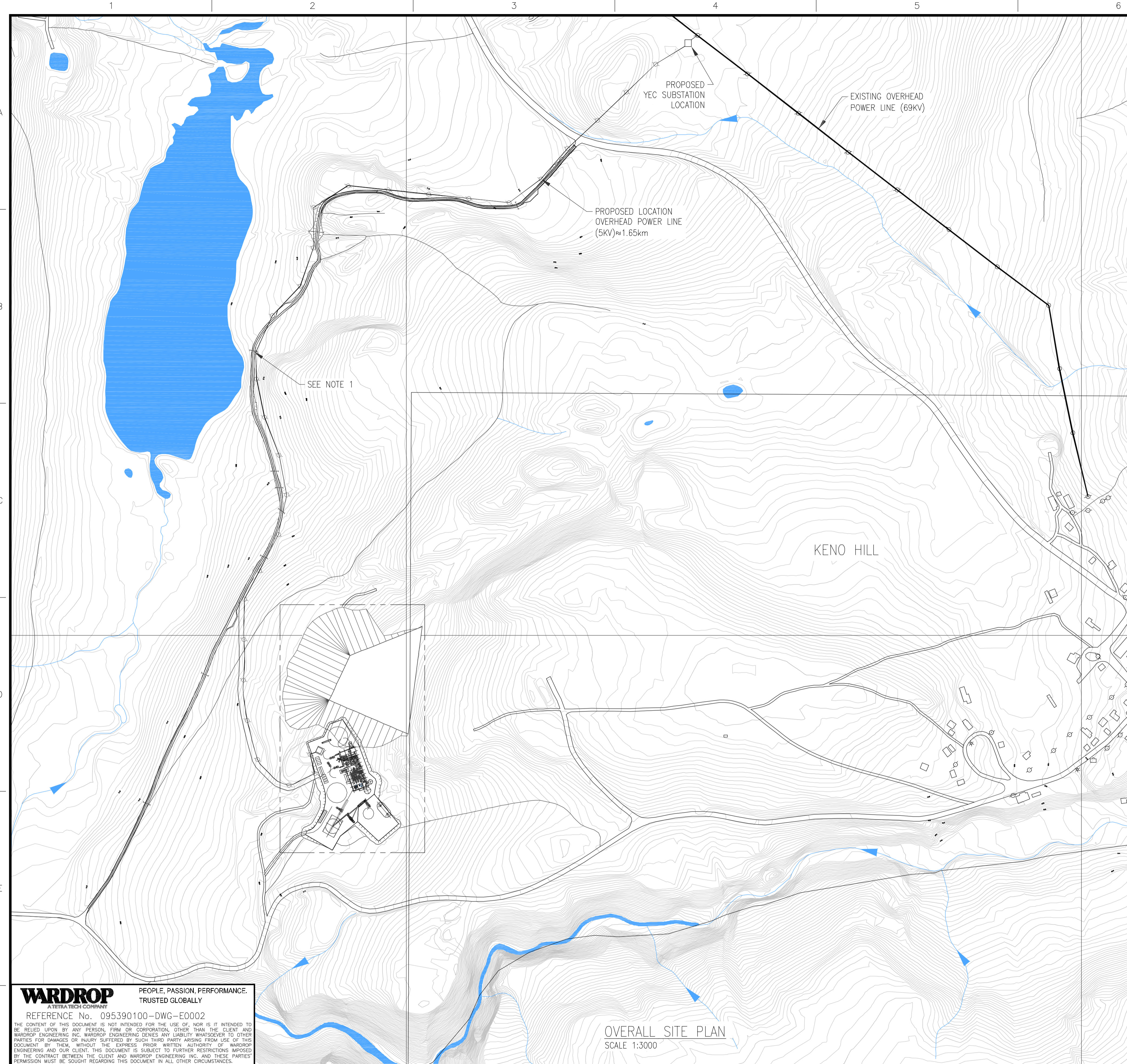


WARDROP
PEOPLE. PASSION. PERFORMANCE.
TRUSTED GLOBALLY

REFERENCE No. 0953960100-DWG-S0005
THE CONTENT OF THIS DOCUMENT IS NOT INTENDED FOR THE USE OF, NOR IS IT INTENDED TO BE BELIEVED BY ANY PERSON, FROM OR CORPORATION, OTHER THAN THE CLIENT AND PARTIES TO THE CONTRACT. THE CLIENT AND PARTIES TO THE CONTRACT SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AUTHORITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPROPRIATE AUTHORITIES.

ALL RECTANGULAR FOUNDATION DIMENSIONS ARE TO BE READ AS A AND CENTERED ABOUT EQUIPMENT CENTRELINES
ALL OCTAGONAL FOUNDATION DIMENSIONS ARE TO BE READ AS C CENTERED ABOUT EQUIPMENT CENTRELINES

<p>THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED BY THE ENGINEER AND THE ENGINEER'S FIRM FOR THE PROJECT DESCRIBED HEREIN. IT IS NOT TO BE USED FOR ANY OTHER PROJECT OR PURPOSE WITHOUT THE WRITTEN CONSENT OF THE ENGINEER AND THE ENGINEER'S FIRM.</p>		<p>CLIENT: ALEXCO TERRITORY</p>
<p>PRELIMINARY DRAWING NOT TO BE USED FOR CONSTRUCTION</p>		<p>SECTION: CONCRETE</p>
<p>E00-15-004 MILL BUILDING - CONCRETE - MISC. SECTIONS AND DETAILS E00-15-003 MILL BUILDING - CONCRETE - ELEVATIONS E00-15-001 MILL BUILDING - CONCRETE - FOUNDATION PLAN</p>		<p>SCALE: 1:100</p>
<p>REFERENCE DRAWINGS</p>		<p>DATE: 08APR09</p>
<p>DWG. NO.</p>		<p>DESIGN BY: ATM</p>
<p>PROJECT NUMBER: 09539601.00</p>		<p>DRAWN BY: MRK</p>
<p>FILENAME: E0015002.DWG</p>		<p>CHECK BY:</p>
<p>DRAWING NUMBER: E00-15-002</p>		<p>APP. BY:</p>
<p>PROJECT NUMBER: 09539601.00</p>		<p>DATE: 09JUL09AKF</p>
<p>DWG. NO. E00-15-002</p>		<p>DATE: 24JUN09MRK</p>
<p>PROJECT NUMBER: 09539601.00</p>		<p>DATE: 05JUN09MRK</p>
<p>DWG. NO. E00-15-002</p>		<p>DATE:</p>

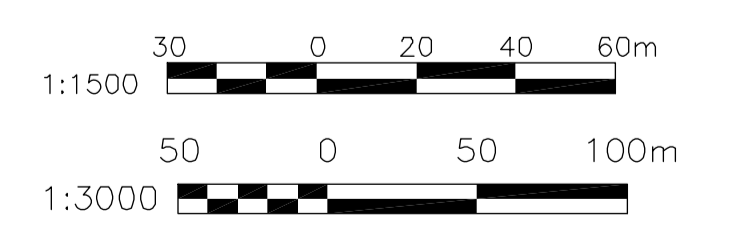


NOTES:
 1. POWERLINE AND POWER POLE NOT TO SCALE.

LEGEND:
 —○— PROPOSED POWER LINE

FLAME AND MOTH SITE PLAN
 SCALE 1:1500

OVERALL SITE PLAN
 SCALE 1:3000



WARDROP PEOPLE, PASSION, PERFORMANCE. TRUSTED GLOBALLY
 A TERRATECH COMPANY
 REFERENCE No. 095390100-DWG-E0002
 THE CONTENT OF THIS DOCUMENT IS NOT INTENDED FOR THE USE OF, NOR IS IT INTENDED TO BE RELIED UPON BY ANY PERSON, FIRM OR CORPORATION, OTHER THAN THE CLIENT AND WARDROP ENGINEERING INC. WARDROP ENGINEERING DENIES ANY LIABILITY WHATSOEVER TO OTHER PARTIES FOR DAMAGES OR INJURY SUFFERED BY SUCH THIRD PARTY ARISING FROM USE OF THIS DOCUMENT BY THEM, WITHOUT THE EXPRESS PRIOR WRITTEN AUTHORITY OF WARDROP ENGINEERING AND OUR CLIENT. THIS DOCUMENT IS SUBJECT TO FURTHER RESTRICTIONS IMPOSED BY THE CONTRACT BETWEEN THE CLIENT AND WARDROP ENGINEERING INC. AND THESE PARTIES' PERMISSION MUST BE SOUGHT REGARDING THIS DOCUMENT IN ALL OTHER CIRCUMSTANCES.

THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED SOLELY FOR THE OWNER FOR USE ON THIS PROJECT AND IS COPYRIGHTED. ANY UNAUTHORIZED USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PURSUED AS SUCH. USE OF THE INFORMATION ON THIS DRAWING IN WHOLE OR IN PART OTHER THAN FOR THE INTENDED PURPOSE IS AT THE SOLE RISK OF THE USER.	DWG. NO.	REFERENCE DRAWINGS
	A00-18-001	OVERALL SITE SINGLE LINE DIAGRAM
	A00-10-002	OVERALL SITE GENERAL ARRANGEMENT

PRELIMINARY DRAWING		NOT TO BE USED FOR CONSTRUCTION	
DATE	BY	DESCRIPTION	REV. ISSUE
25MAY09	JSM	ISSUED FOR INFORMATION	B 1
22MAY09	JSM	ISSUED FOR INFORMATION	A 1

SECTION: ELECTRICAL
 SCALE: AS NOTED DATE
 DESIGN BY: SA 04MAY09
 DRAWN BY: JSM 04MAY09
 CHECK BY: SS 25MAY09
 APP. BY: SPN 25MAY09

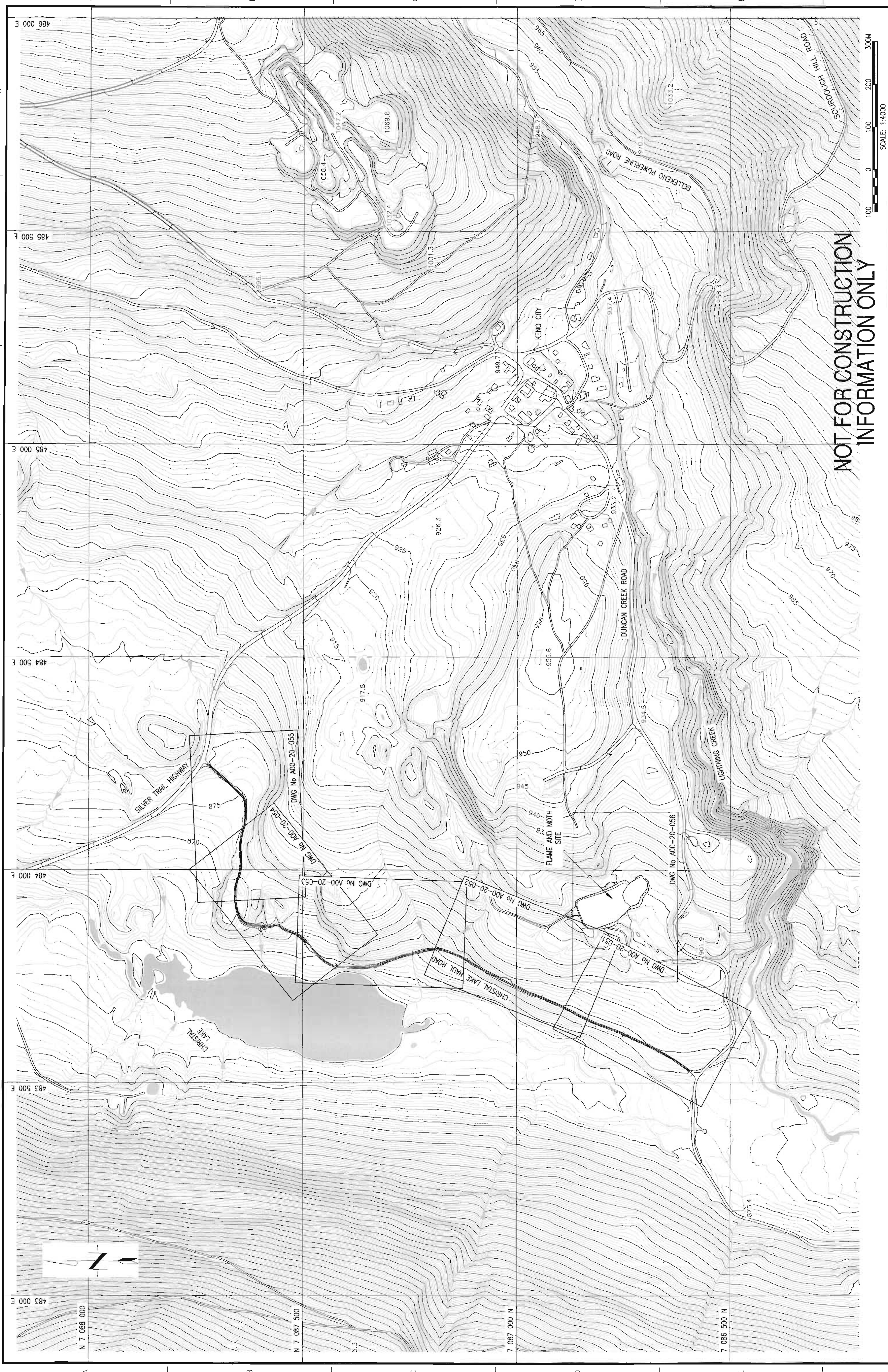
ALEXCO

WARDROP Engineering Inc.

YUKON TERRITORY

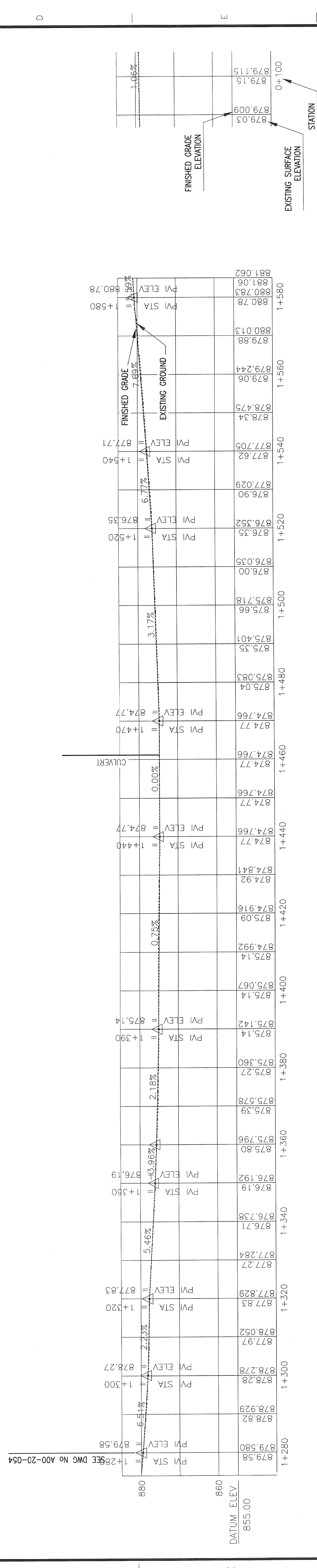
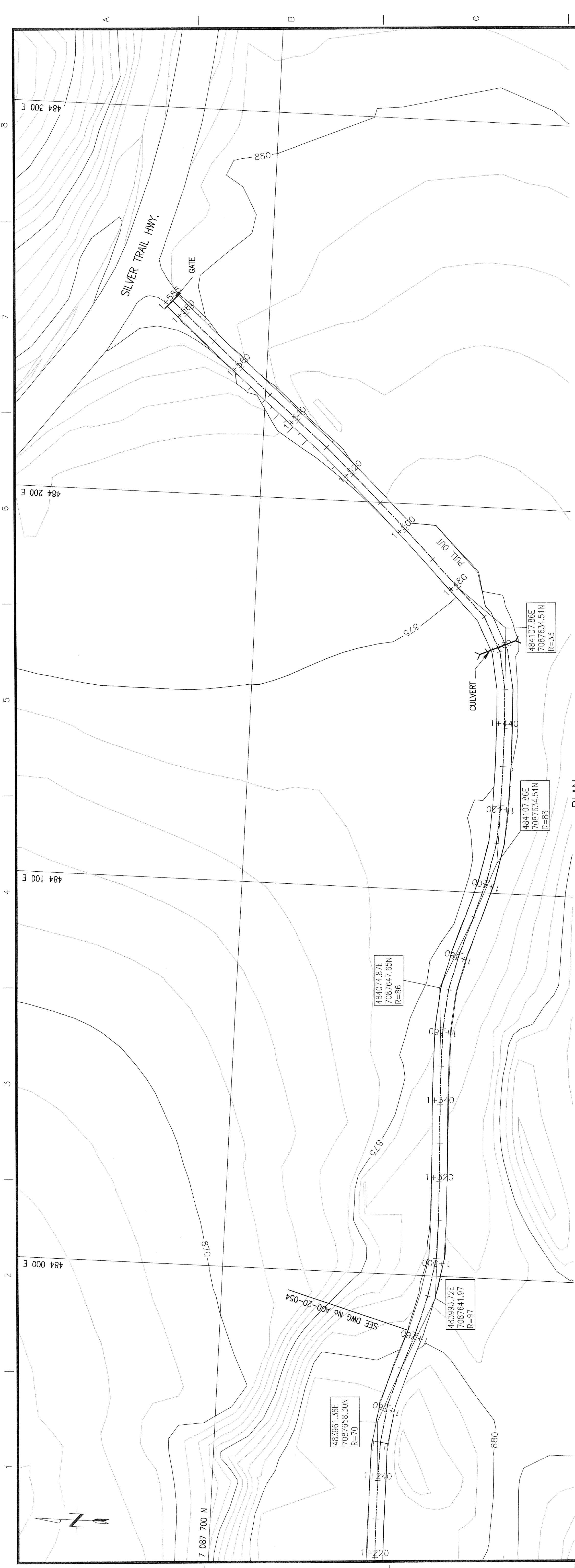
TITLE: **BELLEKENO PROJECT**
 OVERALL SITE
 FLAME AND MOTH
 ELECTRICAL GENERAL ARRANGEMENT

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0018002.DWG	09539601.00	A00-18-002	B

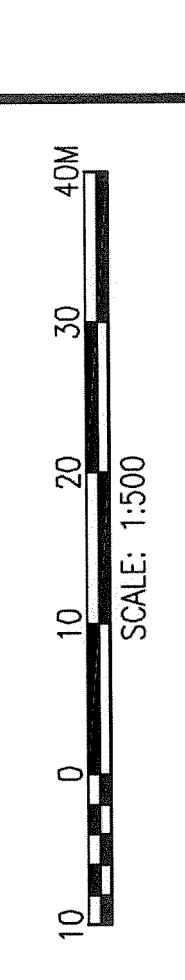


NOT FOR CONSTRUCTION INFORMATION ONLY

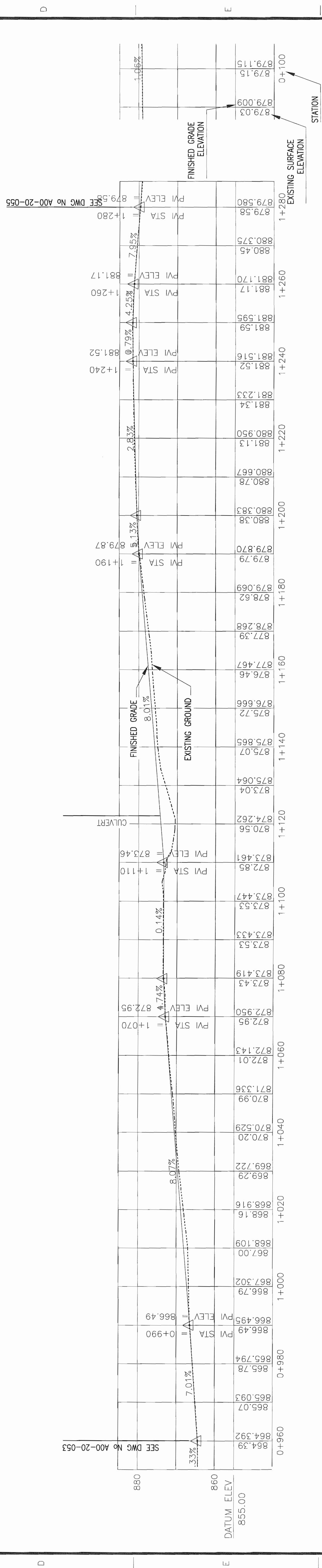
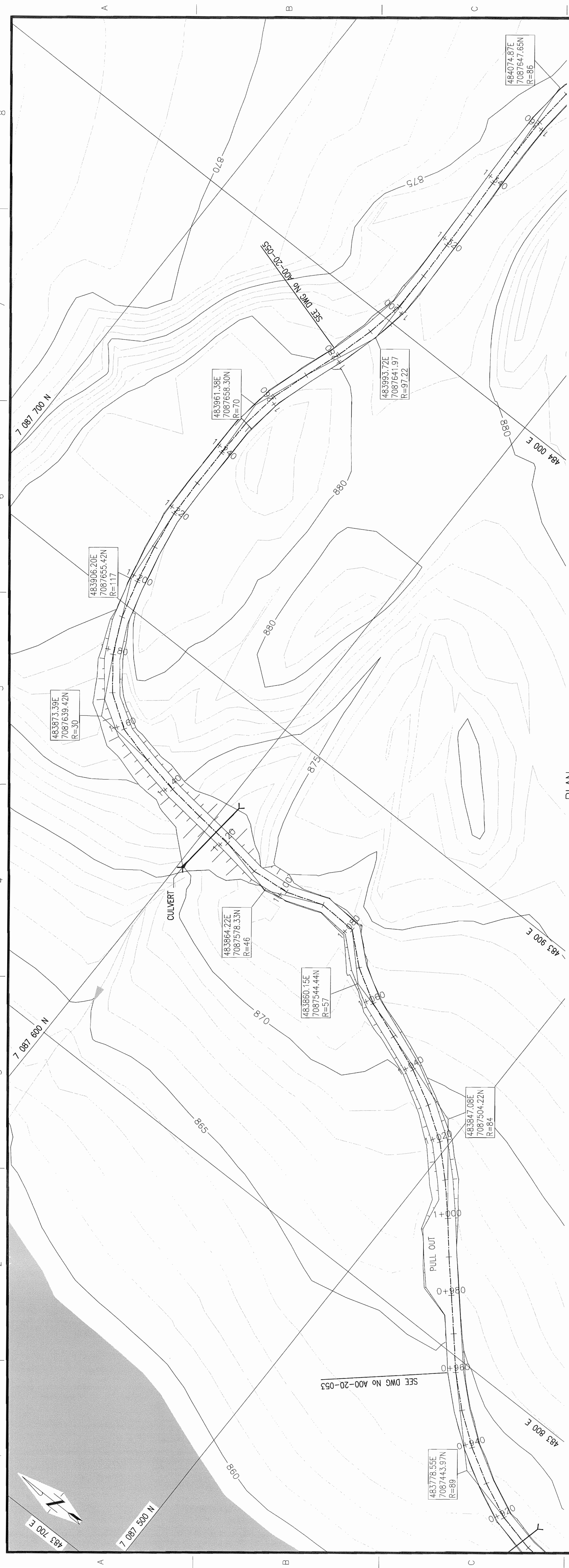
<p>THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED SOLELY FOR THE OWNER FOR USE ON THE PROJECT AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. WITHOUT THE WRITTEN PERMISSION OF THE ENGINEER, NO PART OF THIS DRAWING OR THE INFORMATION ON IT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. WITHOUT THE WRITTEN PERMISSION OF THE ENGINEER, NO PART OF THIS DRAWING OR THE INFORMATION ON IT MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.</p>	<p>REFERENCE DRAWINGS</p>	<p>PROFESSIONAL ENGINEER YUKON TERRITORY DWAYNE HARVEY 2007-2012</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>CLIENT</th> <th>PROGRAM</th> <th>PROCESS</th> <th>ELI TR</th> <th>INSTR</th> <th>PRINC</th> <th>MECH</th> <th>STRUCT</th> <th>SEVICES</th> <th>ARCH</th> <th>LAND</th> <th>REV. ISSUE</th> <th>No.</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>A</td> <td>1</td> </tr> </table>	CLIENT	PROGRAM	PROCESS	ELI TR	INSTR	PRINC	MECH	STRUCT	SEVICES	ARCH	LAND	REV. ISSUE	No.												A	1	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>SECTION:</th> <th>CIVIL-EARTH</th> </tr> <tr> <th>SCALE:</th> <td>1:4000</td> </tr> <tr> <th>DESIGN BY:</th> <td>MW</td> </tr> <tr> <th>DATE:</th> <td>MAY09</td> </tr> <tr> <th>DRAWN BY:</th> <td>AO</td> </tr> <tr> <th>CHECK BY:</th> <td>JM</td> </tr> <tr> <th>DATE:</th> <td>23JUN09</td> </tr> <tr> <th>APP. BY:</th> <td></td> </tr> </table>	SECTION:	CIVIL-EARTH	SCALE:	1:4000	DESIGN BY:	MW	DATE:	MAY09	DRAWN BY:	AO	CHECK BY:	JM	DATE:	23JUN09	APP. BY:		<p>ISSUED FOR PRELIMINARY DESIGN PURPOSES</p>	<p>DESCRIPTION</p>
CLIENT	PROGRAM	PROCESS	ELI TR	INSTR	PRINC	MECH	STRUCT	SEVICES	ARCH	LAND	REV. ISSUE	No.																																				
											A	1																																				
SECTION:	CIVIL-EARTH																																															
SCALE:	1:4000																																															
DESIGN BY:	MW																																															
DATE:	MAY09																																															
DRAWN BY:	AO																																															
CHECK BY:	JM																																															
DATE:	23JUN09																																															
APP. BY:																																																
<p>YUKON TERRITORY</p> <p>ALEXCO Engineering Inc</p>		<p>BELLEKENO PROJECT</p> <p>PLANT SITE FOOTPRINT AND CHRISTAL LAKE HAUL ROAD SHEET INDEX</p>		<p>FILENAME: A0020057.DWG PROJECT NUMBER: 09559601.00 DRAWING NUMBER: A00-20-057</p>																																												



NOT FOR CONSTRUCTION INFORMATION ONLY



THE INFORMATION CONTAINED HEREIN IS FOR USE ON THE PROJECT AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. WITHOUT THE WRITTEN PERMISSION OF THE ENGINEER, NO PART OF THIS DRAWING IN WHOLE OR IN PART OTHER THAN FOR THE INTENDED PURPOSE IS TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. THE USER ASSUMES ALL LIABILITY FOR THE SOLE RISK OF THE USER.		DWG. NO. A00-20-057 PLANT SITE FOOTPRINT AND CHRISTAL LAKE HAUL ROAD SHEET INDEX REFERENCE DRAWINGS	
		CLIENT: ALEXCO PROJECT: BELLEKENO PROJECT (UPDATED) PE(A) 20-054-CIVIL-EARTH(DWG) A0020055.DWG DATE: 23 JUN 09 BY: JIM CHECK: JIM DRAWN BY: AO DESIGN BY: MW AS NOTED SCALE: AS NOTED SECTION: CIVIL-EARTH	
YUKON TERRITORY ALEXCO WARDROP Engineering Inc.		TITLE: BELLEKENO PROJECT PLANT SITE PREPARATION AND SITE ROADS CHRISTAL LAKE HAUL ROAD PLAN AND PROFILE STA 1+280 TO 1+610	
FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0020055.DWG	09539601.00	A00-20-055	B

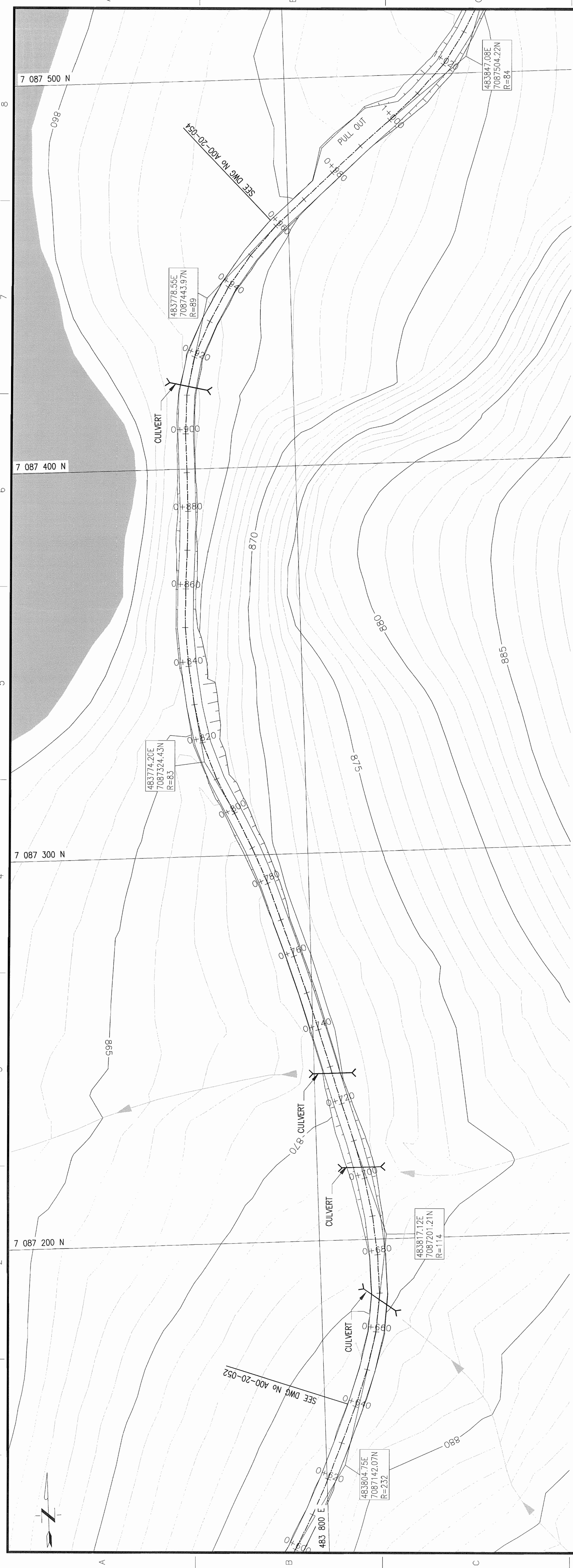


**NOT FOR CONSTRUCTION
INFORMATION ONLY**

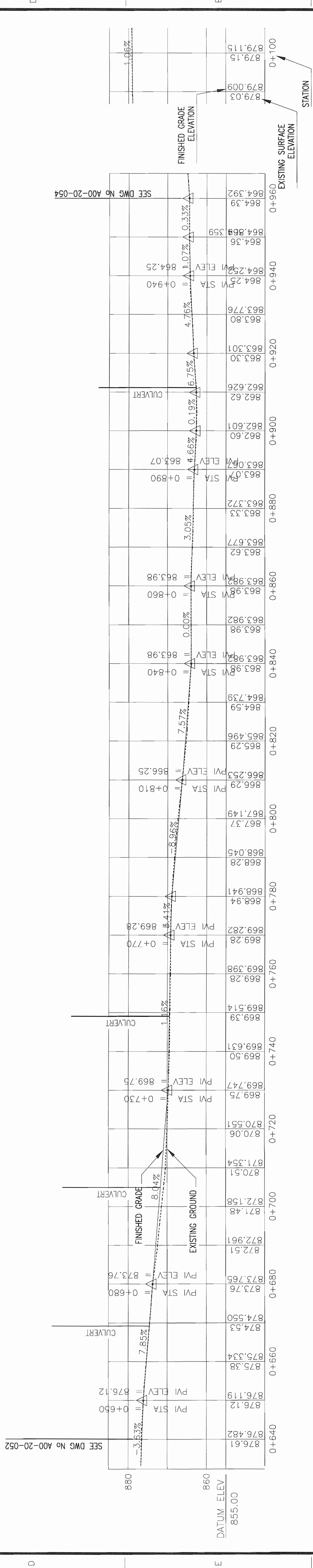
PROFILE
SCALE 1:500 V
1:500 H

SCALE: 1:500

<p>THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED SOLELY FOR THE OWNER'S USE AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, WITHOUT THE WRITTEN PERMISSION OF ALEXCO. ANY UNAUTHORIZED REPRODUCTION OR TRANSMISSION OF THIS DRAWING IN WHOLE OR IN PART OTHER THAN FOR THE INTENDED PURPOSE IS AT THE SOLE RISK OF THE USER.</p>	<p>REFERENCE DRAWINGS</p>	<p>PROFESSIONAL ENGINEER DWAYNE HARVE TERRITORY 2027-6-35</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>CLIENT</th> <th>PROGRAM</th> <th>PROCESS</th> <th>ELECTR.</th> <th>MECHAN.</th> <th>STRUCT.</th> <th>HAZ. STUD.</th> <th>SYMBOLS</th> <th>NOTES</th> <th>REV. ISSUE</th> <th>DATE</th> <th>BY</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>B 1</td> <td>ISSUED FOR PRELIMINARY DESIGN PURPOSES</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>A 1</td> <td>ISSUED FOR PEA UPDATE</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>23JUN09 MW</td> <td>JM</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>05JUN09 MW</td> <td>JM</td> </tr> </table>	CLIENT	PROGRAM	PROCESS	ELECTR.	MECHAN.	STRUCT.	HAZ. STUD.	SYMBOLS	NOTES	REV. ISSUE	DATE	BY										B 1	ISSUED FOR PRELIMINARY DESIGN PURPOSES											A 1	ISSUED FOR PEA UPDATE												23JUN09 MW	JM											05JUN09 MW	JM	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>SECTION:</th> <th>CIVIL-EARTH</th> </tr> <tr> <th>SCALE:</th> <td>AS NOTED</td> </tr> <tr> <th>DESIGN BY:</th> <td>MW</td> </tr> <tr> <th>DRAWN BY:</th> <td>AO</td> </tr> <tr> <th>CHECK BY:</th> <td>JM</td> </tr> <tr> <th>APP. BY:</th> <td></td> </tr> </table>	SECTION:	CIVIL-EARTH	SCALE:	AS NOTED	DESIGN BY:	MW	DRAWN BY:	AO	CHECK BY:	JM	APP. BY:		<p>YUKON TERRITORY</p> <p style="text-align: center;">ALEXCO</p> <p style="text-align: center;">WARDROP Engineering Inc.</p>	<p>TITLE</p> <p>BELLEKENO PROJECT PLANTSITE PREPARATION AND SITE ROADS CHRISTAL LAKE HAUL ROAD PLAN AND PROFILE STA 0+960 TO 1+280</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>FILENAME</th> <th>PROJECT NUMBER</th> <th>DRAWING NUMBER</th> <th>REV.</th> </tr> <tr> <td>A0020054.DWG</td> <td>09539601.00</td> <td>A00-20-054</td> <td>B</td> </tr> </table>	FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.	A0020054.DWG	09539601.00	A00-20-054	B
CLIENT	PROGRAM	PROCESS	ELECTR.	MECHAN.	STRUCT.	HAZ. STUD.	SYMBOLS	NOTES	REV. ISSUE	DATE	BY																																																																												
									B 1	ISSUED FOR PRELIMINARY DESIGN PURPOSES																																																																													
									A 1	ISSUED FOR PEA UPDATE																																																																													
										23JUN09 MW	JM																																																																												
										05JUN09 MW	JM																																																																												
SECTION:	CIVIL-EARTH																																																																																						
SCALE:	AS NOTED																																																																																						
DESIGN BY:	MW																																																																																						
DRAWN BY:	AO																																																																																						
CHECK BY:	JM																																																																																						
APP. BY:																																																																																							
FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.																																																																																				
A0020054.DWG	09539601.00	A00-20-054	B																																																																																				



PLAN
SCALE 1:500



PROFILE
SCALE 1:500 V
1:500 H

NOT FOR CONSTRUCTION
INFORMATION ONLY

THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED SOLELY FOR THE OWNER'S USE AND IS NOT TO BE USED FOR ANY OTHER PURPOSE. ANY UNAUTHORIZED USE OF THIS INFORMATION IS PROHIBITED. THE USER ASSUMES ALL LIABILITY FOR THE USE OF THIS INFORMATION IN WHOLE OR IN PART OTHER THAN THAT FOR THE INTENDED PURPOSE. IT IS THE SOLE RISK OF THE USER.

DATE: 05/06/03
PROJECT NUMBER: 09539601.00
DRAWING NUMBER: A00-20-053
REV: B

FILENAME: A0020053.DWG

SECTION: CIVIL-EARTH
SCALE: AS NOTED
DATE: MAY09
DESIGN BY: MW
DRAWN BY: AO
CHECK BY: JM
APP. BY:

DATE: 23JUN09 MW
DATE: 05JUN09 MW

DESCRIPTION: B 1 ISSUED FOR PRELIMINARY DESIGN PURPOSES
A 1 ISSUED FOR PEA UPDATE

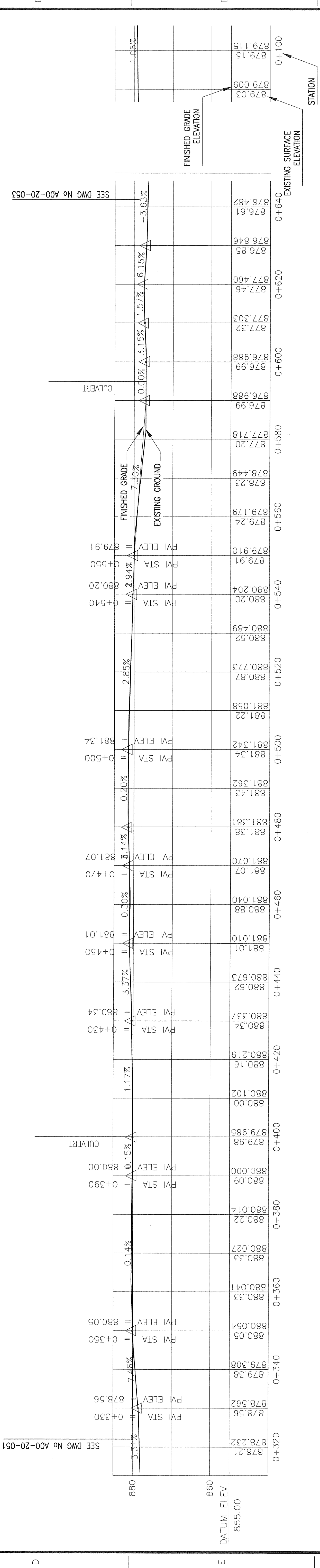
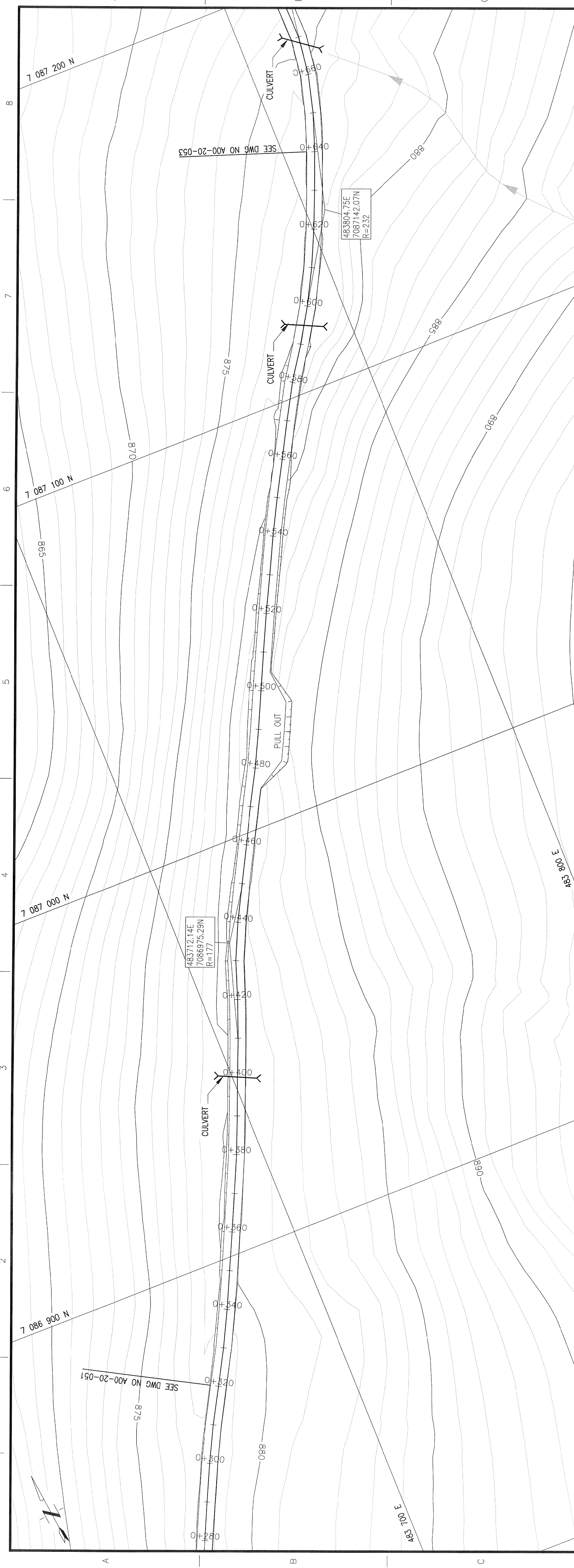
REV. ISSUE No. No.

PROG. PROGRAM
ELECTR. ELECTR.
INSTR. INSTR.
PRING. PRING.
MECH. MECH.
STRUCT. STRUCT.
BRIDGE BRIDGE
SCHEM. SCHEM.

PROFESSIONAL ENGINEER
DWAYNE HARVE
TERRITORY
2009-6-23

YUKON TERRITORY
ALEXCO
WARDROP Engineering Inc.

TITLE: BELLEKENO PROJECT
PLANTSITE PREPARATION AND SITE ROADS
CHRISTAL LAKE HAUL ROAD
PLAN AND PROFILE
STA 0+640 TO 0+960



**NOT FOR CONSTRUCTION
INFORMATION ONLY**

THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF ALEXCO TERRITORY ENGINEERING INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF ALEXCO TERRITORY ENGINEERING INC.

FOR USE ON THIS PROJECT AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF ALEXCO TERRITORY ENGINEERING INC.

USE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PUNISHED AS SUCH. THIS DRAWING IS WHOLE OR IN PART OTHER THAN FOR THE INTENDED PURPOSE IS AT THE SOLE RISK OF THE USER.

U:\A-C\ALEXCO RESOURCE CORP - 5388\09539601.00 - BELLEKENO PROJECT (UPDATED PEA)\00-CIVIL-EARTH\DWG\A0020052.DWG

SECTION: CIVIL-EARTH
SCALE: AS NOTED
DESIGN BY: MW
DRAWN BY: AO
CHECK BY: JM
DATE: 23JUN09 MW
05JUN09 JM

DESCRIPTION: ISSUED FOR PRELIMINARY DESIGN PURPOSES
ISSUED FOR PEA UPDATE

REV. No. DESCRIPTION

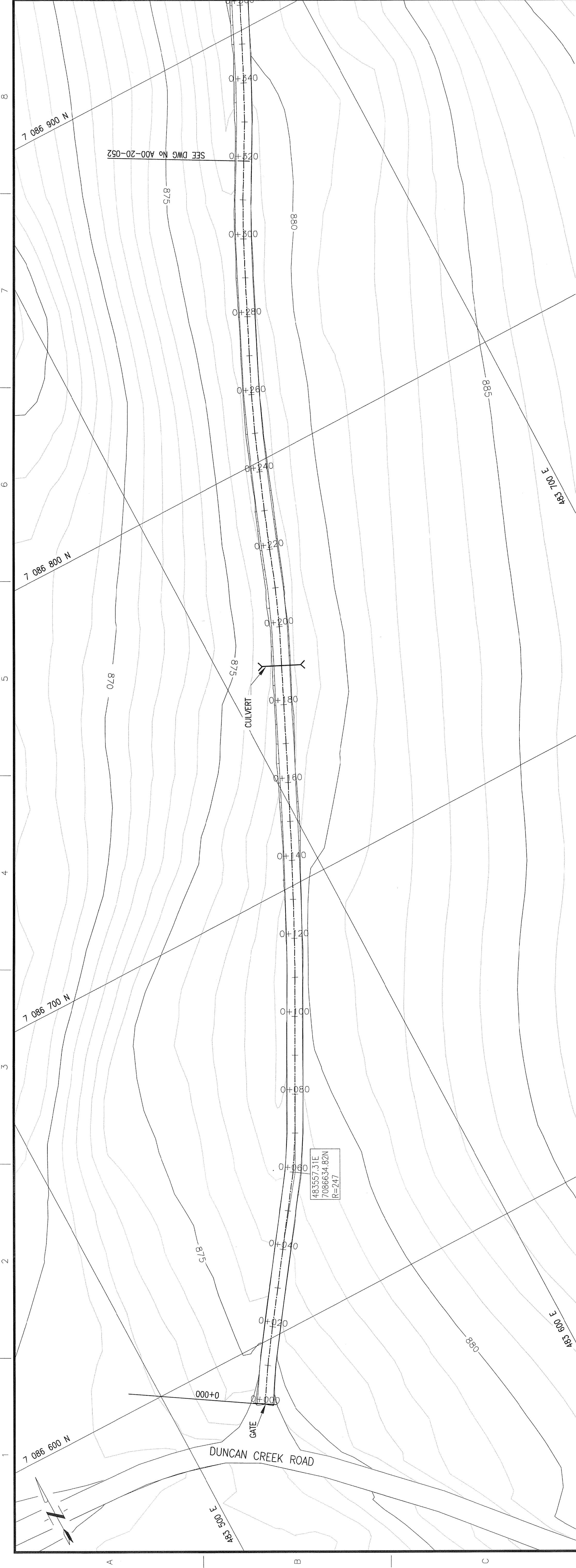
B	1	ISSUED FOR PRELIMINARY DESIGN PURPOSES
A	1	ISSUED FOR PEA UPDATE

PROJECT NUMBER: 09539601.00
DRAWING NUMBER: A00-20-052

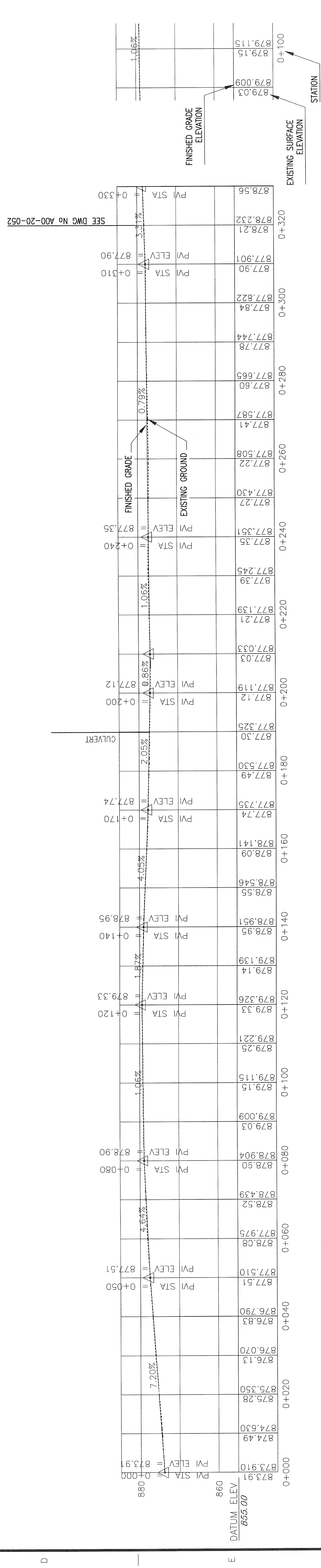
BELLEKENO PROJECT
PLANT SITE PREPARATION AND SITE ROADS
CHRISTAL LAKE HAUL ROAD
PLAN AND PROFILE
STA 0+320 TO 0+640

YUKON TERRITORY
ALEXCO
WARDROP Engineering Inc.

FILENAME: A0020052.DWG
PROJECT NUMBER: 09539601.00
DRAWING NUMBER: A00-20-052



PLAN
SCALE: 1:500



PROFILE
SCALE: 1:500 V
1:500 H

**NOT FOR CONSTRUCTION
INFORMATION ONLY**

THE INFORMATION CONTAINED ON THIS DRAWING HAS BEEN PREPARED SOLELY FOR THE OWNER FOR USE ON THIS PROJECT AND NO OTHER USE IS INTENDED. ANY REUSE OR MISUSE OF THIS INFORMATION IS A BREACH OF COPYRIGHT AND WILL BE PUNISHED AS SUCH. USE OF THE INFORMATION ON THIS DRAWING IN WHOLE OR IN PART FOR ANY OTHER PROJECT OR PURPOSE IS AT THE SOLE RISK OF THE USER.	REFERENCE DRAWINGS A00-20-057 PLANT SITE FOOTPRINT AND CHRISTAL LAKE HAUL ROAD SHEET INDEX		SECTION: CIVIL-EARTH SCALE: AS NOTED DESIGN BY: MW DRAWN BY: AO CHECK BY: JM DATE: 23JUN09 MW 05JUN09 MW	DATE: 05JUN09 MW BY: JM	DESCRIPTION: B 1 ISSUED FOR PRELIMINARY DESIGN PURPOSES A 1 ISSUED FOR PEA UPDATE	REV. ISSUE No. 1 No.
			SECTION: CIVIL-EARTH SCALE: AS NOTED DESIGN BY: MW DRAWN BY: AO CHECK BY: JM DATE: 23JUN09 MW 05JUN09 MW	DATE: 05JUN09 MW BY: JM	DESCRIPTION: B 1 ISSUED FOR PRELIMINARY DESIGN PURPOSES A 1 ISSUED FOR PEA UPDATE	REV. ISSUE No. 1 No.
YUKON TERRITORY ALEXCO WARDROP Engineering Inc.		BELLEKENO PROJECT PLANT SITE PREPARATION AND SITE ROADS CHRISTAL LAKE HAUL ROAD PLAN AND PROFILE STA 0+000 TO 0+320		FILENAME: A0020051.DWG PROJECT NUMBER: 09539601.00 DRAWING NUMBER: A00-20-051	PROJECT NUMBER: 09539601.00 DRAWING NUMBER: A00-20-051	REV: B

GENERAL NOTES:

CONCRETE

- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH WARDROP'S SPECIFICATION NUMBER 03-30-00 CAST-IN-PLACE CONCRETE IN CASE OF CONFLICT REFER TO THE GENERAL CONTRACT CONDITION.
- THESE STANDARD NOTES SHALL BE USED UNLESS OTHERWISE NOTED ON THE PROJECT DRAWINGS.
- CONCRETE DESIGN, SUPPLY AND CONSTRUCTION MUST COMPLY WITH THE LATEST EDITION OF GOVERNING CODES, SPECIFICATIONS AND STANDARDS INCLUDING:
-NATIONAL BUILDING CODE OF CANADA (NBC)
-CAN/CSA-A23.1 CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION
-CAN/CSA-A23.2 METHODS OF TEST FOR CONCRETE
-CAN/CSA-A23.3 DESIGN OF CONCRETE STRUCTURES
- MINIMUM CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS MUST BE AS FOLLOWS:
-ALL STRUCTURAL CONCRETE UNO. 30 MPa
-LEAN OR BLINDING CONCRETE 15 MPa
- USE CAN/CSA-A3001 PORTLAND CEMENT TYPE GU UNO.
- NOMINAL MAXIMUM AGGREGATE SIZE 20mm UNO., IN ACCORDANCE WITH CAN/CSA-A23.1
- ALL REINFORCEMENT TO BE IN ACCORDANCE WITH CAN/CSA-630.18 GRADE 400 MPa DEFORMED STEEL BARS.
- USE CAN/CSA-630.5 WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT.
- REINFORCING STEEL SHALL BE DETAILED, SHOP FABRICATED AND PLACED IN ACCORDANCE WITH:
-CAN/CSA-A23.1 AND CAN/CSA-A23.2
-RSC - REINFORCING STEEL INSTITUTE OF CANADA
-MANUAL OF STANDARD PRACTICE
-CONCRETE REINFORCING STEEL INSTITUTE
-MANUAL OF STANDARD PRACTICE
CONSTRUCTION CONTRACTOR IS RESPONSIBLE FOR SHOP DRAWING REVIEW.
- UNLESS NOTED OTHERWISE ON DRAWINGS ALL SPLICES SHALL BE IN ACCORDANCE WITH CAN/CSA-A23.3 GRADE 400 MPa. SPLICES TO BE STAGGERED AND MUST HAVE A MINIMUM CLASS "B" SPLICE LENGTH AS LISTED BELOW:
TOP BARS SHALL BE SPLICED USING 1.3 TIMES THE FIGURES BELOW:

lc	BAR SIZE	10M	15M	20M	25M	30M	35M
30 MPa		400	600	800	1100	1300	1500

- ALL REINFORCEMENT HOOKS AND BENDS MUST BE STANDARD UNO.
- REINFORCEMENT SPACING SHOWN ON DRAWINGS IN ALL CASES IS CENTER TO CENTER OF BAR.
- ALL REINFORCEMENT BARS NOT SPECIFICALLY LOCATED ON THE DRAWING MUST BE PLACED SYMMETRICALLY WITH RESPECT TO SUPPORTS.
- DOWEL WALLS TO FOOTINGS WITH SAME BAR SIZE AND SPACING AS WALL REINFORCEMENT UNO.
- CLEAR CONCRETE COVER TO REINFORCEMENT, UNO.
-CONCRETE POURED ON GROUND: 75mm
-CONCRETE EXPOSED TO GROUND 40mm FOR 15M BARS OR SMALLER OR EXPOSED TO WEATHER: 50mm FOR 20M BARS OR LARGER
-INTERIOR FACES OF SLABS AND WALLS: MIN. 20mm OR BAR DIA.
-INTERIOR FACES OF COLUMNS AND BEAMS: 40mm
- BAR NOTATION GIVES THE FOLLOWING INFORMATION IN THIS ORDER:
NUMBER OF BARS (IF QUOTED) - BAR SIZE
BAR SPACING AND PLACING INFORMATION (IF QUOTED)
FOR EXAMPLE - 15M @ 150 TP
- SECURE CROSSING BARS AT INTERSECTIONS BY USING TIE-WIRE OF NOT LESS THAN 1.6mm THICK. REINFORCING STEEL SHALL HAVE ADEQUATE SUPPORTS SPACED NOT MORE THAN 1200mm APART IN ANY DIRECTION AND SHALL BE FIRMLY ANCHORED BEFORE CONCRETE IS POURED. PLASTIC CHAIR SUPPORTS SHALL BE USED IN CORROSIVE ATMOSPHERE.
- FOR OPENINGS OR INSERTS LESS THAN 450mm THE REINFORCING STEEL SHALL BE DEFLECTED, NOT CUT.
- WELDING OF REINFORCEMENT OR THE USE OF POSITIVE MECHANICAL SPLICING IN PLACE OF LAP SPLICES IS PERMITTED ONLY WITH THE WRITTEN APPROVAL OF THE ENGINEER.
- TOLERANCES FOR PLACING REINFORCEMENT:
FOR CLEAR CONCRETE PROTECTION OF REINFORCEMENT WHERE DEPTH OF A FLEXURAL MEMBER THICKNESS OF A WALL OR SMALLEST DIMENSION OF A COLUMN IS:
200mm OR LESS - +/- 8mm
200mm TO 600mm - +/- 12mm
600mm OR LARGER - +/- 20mm
LATERAL SPACING OF BARS SHALL BE WITHIN +/-30mm OF THE SPECIFIED SPACING.
LONGITUDINAL LOCATION OF BENDS AND ENDS OF BARS +/-50mm.
AT DISCONTINUOUS ENDS OF MEMBERS +/-20mm.

REGARDLESS OF ANY TOLERANCE REQUIREMENTS FOR PLACING THE CONCRETE COVER SHALL IN NO CASE BE REDUCED BY MORE THAN ONE THIRD OF THE SPECIFIED COVER.

DWG. NO.	REFERENCE DRAWINGS



- FLOOR SLAB ON GRADE TO BE POURED IN CHECKER BOARD PATTERN WITH CONSTRUCTION JOINTS AND CONTROL JOINTS AT 6000 C/C IN EACH DIRECTION. EXACT LOCATION MAY BE VARIED TO SUIT BUILDING FOUNDATIONS AND EQUIPMENT PADS. EXPANSION JOINTS IN FLOOR ARE TO BE PROVIDED WHERE SHOWN ON THE DRAWINGS.
- TO CONTROL SHRINKAGE CRACKING OF CONCRETE, CURE AND PROTECT FRESHLY DEPOSITED CONCRETE IN ACCORDANCE WITH CAN/CSA-A23.1.
- POURING OF CONCRETE BELOW 5 DEGREES C. SHALL CONFORM TO THE COLD WEATHER CONCRETING REQUIREMENTS OF CSA STANDARD CAN. 3 - A23.1.
- BEFORE CONCRETE IS POURED ALL OPENINGS, ANCHOR BOLTS, INSERTS ETC. INCLUDING EMBEDDED ITEMS FOR THE MECHANICAL, ELECTRICAL, OR ANY OTHER TRADES SHALL BE CHECKED AGAINST THE DRAWINGS.
- ALL ANCHOR BOLTS SHALL CONFORM TO CAN/CSA-640.21 GRADE 300M (300MPa).
- ALL ANCHOR BOLTS SHALL BE SET USING A TEMPLATE FIXED TO THE FORMWORK TO ENSURE THAT PLACEMENT TOLERANCES ARE MAINTAINED.
- ANCHOR BOLTS AND EMBEDDED MATERIAL SHALL BE PLACED ACCORDING TO DIMENSIONS AS SHOWN ON THE DRAWINGS AND WITH TOLERANCES AS FOLLOWS:
SINGLE BOLTS & EMBEDDED MATERIAL: +/-3mm IN LOCATION & ELEVATION
BOLT GROUPS: +/-3mm IN LOCATION & ELEVATION
MAXIMUM DIFFERENCE WITHIN GROUPS: +/-3mm
ROCK BOLTS: +/-3mm
- GROUTING UNDER MACHINE BASES SHALL BE 'SIKA GROUT 212 HP' AND UNDER STRUCTURAL COLUMNS SHALL BE 'MASTEFLOW 928' OR APPROVED EQUIVALENT.
- FOR WATERPROOFING THE CONCRETE STRUCTURES, WHERE INDICATED, APPLY ONE COAT OF XYPEX CONCENTRATE AT 0.8kg/m² PLUS ONE COAT OF XYPEX MODIFIED AT 0.8kg/m². BY XYPEX CORPORATION LTD. OR APPROVED EQUAL ON THE CONCRETE SURFACES AS NOTED ON THE DRAWINGS. APPLY AS PER MANUFACTURER'S SPECIFICATIONS.
- CHAMFER EXPOSED CORNERS OF COLUMNS AND BEAMS 20mm UNO.
- CLEAN SURFACES OF ALL CONSTRUCTION JOINTS THOROUGHLY AND REMOVE LATANCE. IN ADDITION, WET THE SET CONCRETE SURFACE AT CONSTRUCTION JOINTS THOROUGHLY AND COAT WITH NEAT CEMENT GROUT PRIOR TO POURING NEW CONCRETE.
- APPLY SEALANT TO ALL JOINTS USING SIKAFLEX-ICSL SEALANT OR APPROVED EQUAL. APPLY AS PER MANUFACTURER'S INSTRUCTIONS.
- CONCRETE FLOORS AND GROUND SLABS SHALL HAVE TROWELLED FINISHES UNLESS OTHERWISE NOTED ON THE DRAWINGS.
- FOR FLOOR SLAB SEALER/HARDENERS SEE DRAWINGS.
- MISCELLANEOUS STEEL TO COMPLY WITH CAN/CSA-640.21 GRADE 300W UNO., ALL PIPE MATERIALS SHALL CONFORM TO ASTM A53 TYPE S GRADE B (Fy = 240MPa MIN.).
- SLEEVES, PIPES, OR HOLES MUST BE PLACED THROUGH CONCRETE ONLY WHERE SHOWN ON DRAWINGS OR APPROVED BY THE ENGINEER.
- FOR THE AREAS WHERE STYROFOAM INSULATION IS NOT USED UNDER SLAB ON GRADE, USE 0.25mm (10 MILS) THICK POLYETHYLENE SHEET UNDER ALL SLABS POURED ON GRADE, UNO.
- THE FINAL 0.15m BELOW THE SLAB-ON-GRADE SHALL BE CONSTRUCTED WITH CRUSHED BASE COURSE GRAVEL THAT CONFORMS TO THE SPECIFICATIONS DETAILED IN TABLE 1 OF THE TECHNICAL MEMO FROM EBA DATED 23 JULY 2009 (FILE: W14101178.002)

FOUNDATIONS, EXCAVATION, AND BACKFILL

- ALL CIVIL WORK TO BE CARRIED OUT IN ACCORDANCE WITH SPECIFICATION NUMBER 31 -23-01 AND TECHNICAL MEMO FROM EBA (FILE: W14101178.002) DATED 23 JULY 2009 AND SUBSEQUENT CORRESPONDENCES.
- ALL STRUCTURES AND TANKS ARE DESIGNED TO BE FOUNDED AT THE ELEVATIONS AND LOCATIONS SHOWN ON THE DRAWINGS AND MUST BE ON SOLID UNDISTURBED NATIVE GROUND, COMPACTED STRUCTURAL FILL, ROCK OR LEAN CONCRETE.
- EXCAVATE TO THE BASE OF FOOTING ELEVATION. REMOVE AND WASTE ANY REMAINING TOPSOIL, ORGANIC CLAY AND OTHER DELETERIOUS MATERIALS WITHIN THE PROPOSED RAFT FOOTING AREA. CONDUCT FINAL CLEAN-UP OF FOOTING BASE WITH HAND TOOLS. REMOVE ANY FROZEN SOIL.
- AFTER PREPARATION, PROTECT FOOTING BASES FROM WETTING, DRYING AND FREEZING. REMOVE ALL AFFECTED SOIL AS REQUIRED.
- DO NOT CONSTRUCT FOOTINGS ON FROZEN SOIL MATERIAL AND DO NOT PERMIT THE SOILS BELOW THE FOOTING TO FREEZE AFTER CONSTRUCTION OF FOOTINGS.
- ON COMPLETION OF THE EXCAVATION, THE GEOTECHNICAL ENGINEER MUST CONFIRM IN THE FIELD THE BEARING CAPACITY AND TYPE OF NATIVE MATERIAL AT THE FOUNDING ELEVATION BEFORE PLACING FORMS, REINFORCEMENT OR CONCRETE. THIS CONFIRMATION MUST BE IN WRITING. ANY NECESSARY REMEDIAL WORK SHALL BE COMPLETED AS DIRECTED BY THE GEOTECHNICAL ENGINEER. SHOULD NATIVE MATERIAL BE CONFIRMED TO BE FROST SUSCEPTIBLE, THE EXCAVATION FOR LOCAL FOOTINGS SHOULD CARRY DOWN TO BELOW FROST LEVEL AND BACKFILL WITH COMPACTED NON FROST SUSCEPTIBLE (NES) MATERIAL IN ACCORDANCE TO THE RECOMMENDATION OF THE GEOTECHNICAL ENGINEER.

- REMOVE UNSUITABLE MATERIAL AND REPLACE WITH COMPACTED STRUCTURAL FILL OR LEAN CONCRETE AS DIRECTED BY THE GEOTECHNICAL ENGINEER.
- DO NOT INCREASE THE HEIGHT OF COLUMNS, PIERS, OR WALLS WITHOUT WRITTEN APPROVAL FROM THE ENGINEER.
- PLACE BACKFILL SIMULTANEOUSLY ON BOTH SIDES OF WALLS, GRADE BEAMS, AND BURIED STRUCTURES TO AVOID UNBALANCED LOADING.
- BACKFILL BOTH SIDES OF GRADE BEAMS (FOUNDATION WALL) WITHIN 600mm FROM SIDE TO SIDE. COMPACT BACKFILL TO A MINIMUM OF 98% OF STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM D-698) AT OR NEAR OPTIMUM MOISTURE CONTENT.
- ANY OVER EXCAVATION OF FOUNDATION GRADES MUST BE MADE GOOD WITH BLINDING CONCRETE FOR FOOTINGS ON ROCK OR WITH COMPACTED STRUCTURAL FILL TO ACHIEVE THE BEARING CAPACITY.
- EXCAVATE TO THE SUBGRADE ELEVATION OF FLOOR SLAB. REMOVE AND WASTE ANY REMAINING TOPSOIL, ORGANIC CLAY AND OTHER DELETERIOUS MATERIALS WITHIN THE PROPOSED RAFT FOUNDATION AREA.
- THE SURFACE SHOULD BE PROOF ROLLED TO DETECT WET AND/OR SOFT SOILS. SUBGRADE AREAS WHICH EXHIBIT UNACCEPTABLE DEFLECTION DURING PROOF ROLLING SHOULD BE EXCAVATED AND REPLACED WITH COMPACTED PIT RUN GRANULAR FILL.
- GRANULAR SOILS BELOW FLOOR SLAB SHOULD BE PLACED AND UNIFORMLY COMPACTED IN THIN LIFTS 300mm MAXIMUM TO A MINIMUM OF 100 PERCENT OF STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM D-690) AT OR NEAR OPTIMUM MOISTURE CONTENT.

SECTION:	CONCRETE
SCALE:	NONE
DESIGN BY:	ATM
DRAWN BY:	MRK
CHECK BY:	SEP
APP. BY:	<i>[Signature]</i>
DATE:	12 Aug 09

YUKON TERRITORY

WARDROP Engineering Inc.

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0015001.DWG	09539601.00	A00-15-001	0

TITLE

BELLEKENO PROJECT

OVERALL GENERAL NOTES

CONCRETE - SHEET 1

WARDROP
A TRITAC COMPANY

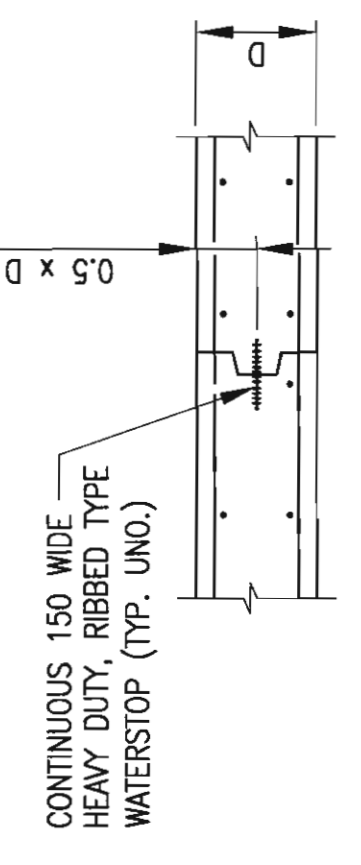
PEOPLE. PASSION. PERFORMANCE.
TRUSTED GLOBALLY

REFERENCE No. 095360100-DWG-S0001

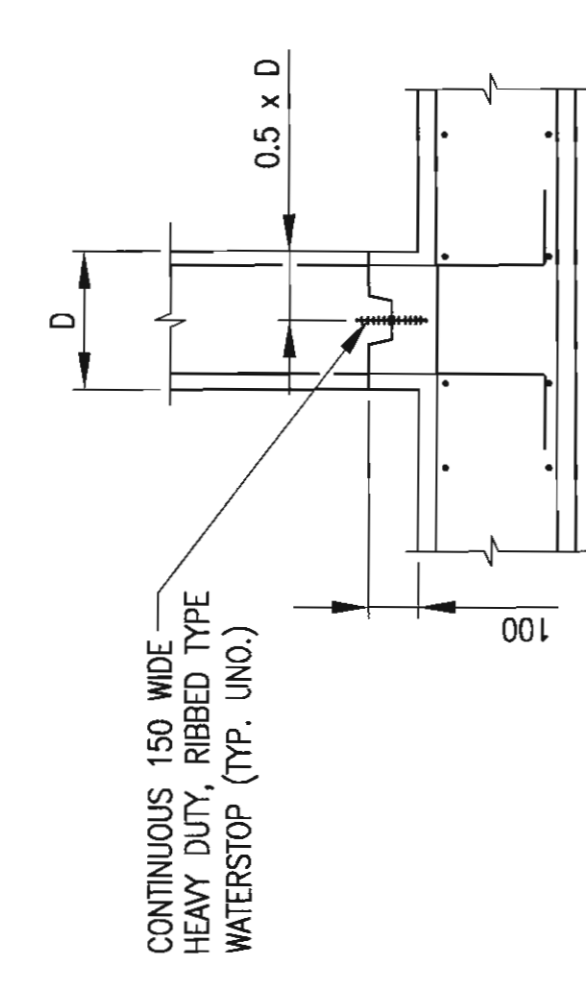
THIS DRAWING IS THE PROPERTY OF WARDROP ENGINEERING INC. AND IS TO BE USED ONLY BY ANY PERSON FROM THE COMPANY FOR THE PROJECT AND FOR THE PURPOSES OF THE PROJECT. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN AUTHORITY OF WARDROP ENGINEERING INC. ANY UNAUTHORIZED USE OF THIS DRAWING OR DOCUMENT IS PROHIBITED. THE ADDRESS FROM WHICH THIS DRAWING OR DOCUMENT IS ISSUED IS THE ADDRESS OF WARDROP ENGINEERING INC. AND THESE PARTIES BY THE CONTRACT BETWEEN THE CLIENT AND WARDROP ENGINEERING INC. AND THESE PARTIES PERMISSION MUST BE SOUGHT REGARDING THIS DOCUMENT IN ALL OTHER CIRCUMSTANCES.

NOTATION AND ABBREVIATIONS

ADD'L	ADDITIONAL	kPa	KILOPASCALS (kN/m ²)
ALT.	ALTERNATE	LG	LONG
ABR.	ALTERNATE BAR REVERSED	LLH	LONG LEG HORIZONTAL
⊙	AT	LLV	LONG LEG VERTICAL
B/B	BACK TO BACK	L.P.	LOW POINT
⊕ OR BL	BARLINE	MAX.	MAXIMUM
BOT.	BOTTOM	MPa	MEGAPASCALS (N/mm ²)
B1	LOWEST OF BOTTOM LAYERS	MIN.	MINIMUM
B2	SECOND LOWEST OF BOTTOM LAYERS	M.C.	MOMENT CONNECTION
⊕	CENTERLINE	N.F.	NEAR FACE
C/C	CENTER TO CENTER	NOM.	NOMINAL
CHPL	CHECKER PLATE	N/S	NEAR SIDE
CL	CLEAR DIMENSION	O.D.	OUTSIDE DIAMETER
C/W	COMPLETE WITH	OPG.	OPENING
CONC.	CONCRETE	PED.	PEDESTAL
DIAG.	DIAGONAL	PL	PLATE
∅	DIAMETER	RAD.	RADIUS
DWG.	DRAWING	REF.	REFERENCE
E.F.	EACH FACE	REIN.	REINFORCING
E.W.	EACH WAY	STD.	STANDARD
EL.	ELEVATION	STIFF.	STIFFENER
F/S	FAR SIDE	T	TOP
FB	FLAT BAR	t	TONNE (1000 kg)
F.F.	FAR FACE	T1	HIGHEST OF TOP LAYERS
FL	FLOOR	T2	SECOND HIGHEST OF TOP LAYERS
F.D.	FLOOR DRAIN	T.O.C.	TOP OF CONCRETE
FTG.	FOOTING	T.O.S.	TOP OF STEEL
FND.	FOUNDATION	TYP.	TYPICAL
GRTG	GRATING	U.N.O.	UNLESS NOTED OTHERWISE
HORIZ.	HORIZONTAL	U/S	UNDER SIDE
H.P.	HIGH POINT	VERT.	VERTICAL
I.D.	INSIDE DIAMETER	W.P.	WORK POINT



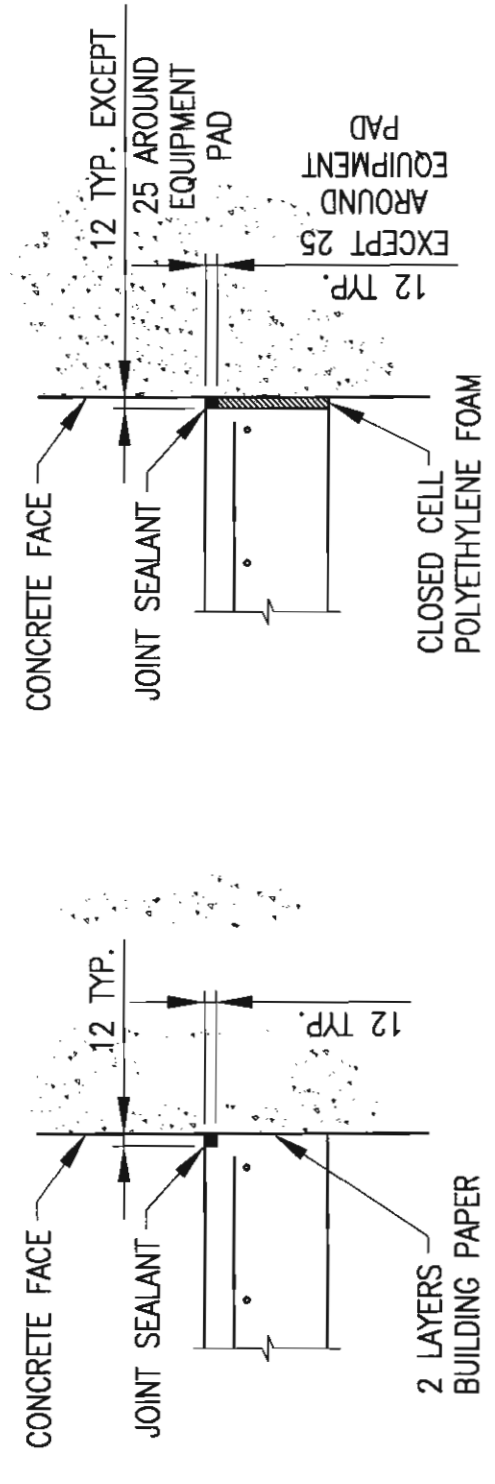
JOINT IN SLAB



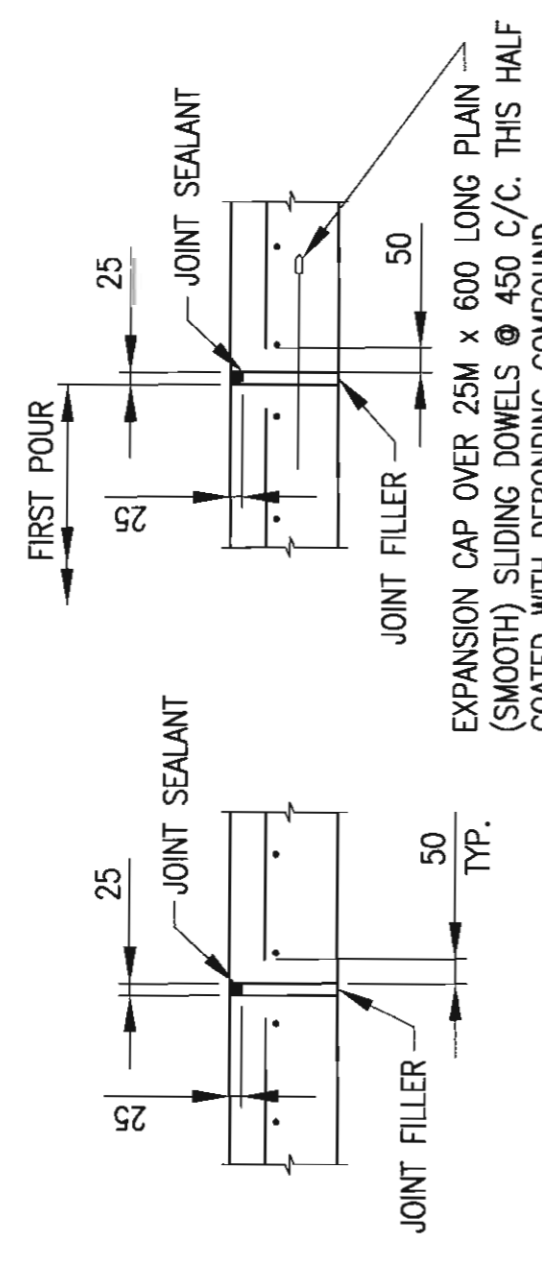
JOINT AT SLAB

WATERTIGHT JOINT

3



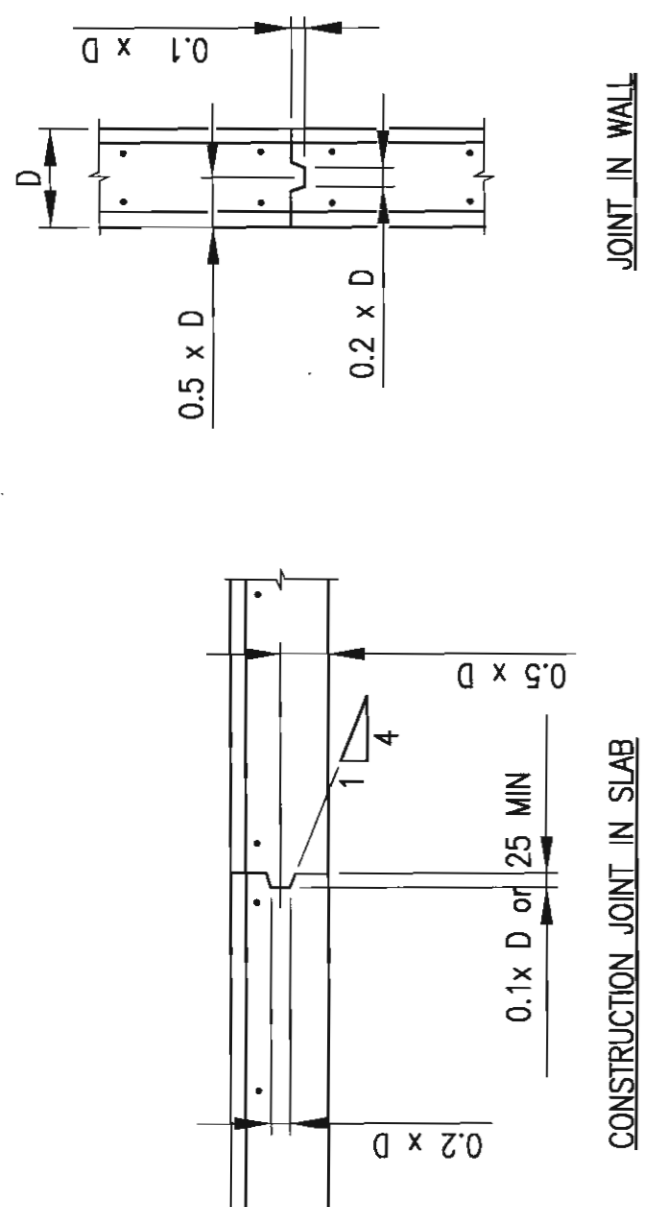
EXPANSION JOINTS



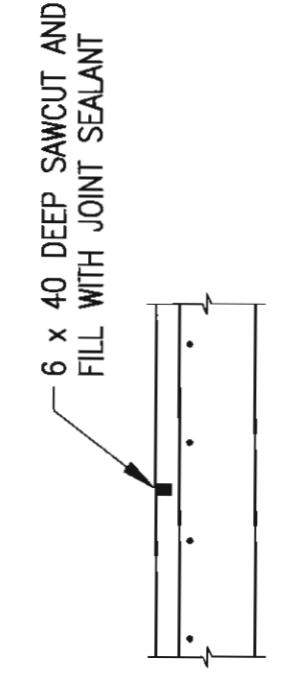
ISOLATION JOINTS (FOR HEAVY TRAFFIC AREAS)

EXPANSION JOINT / ISOLATION JOINT

2



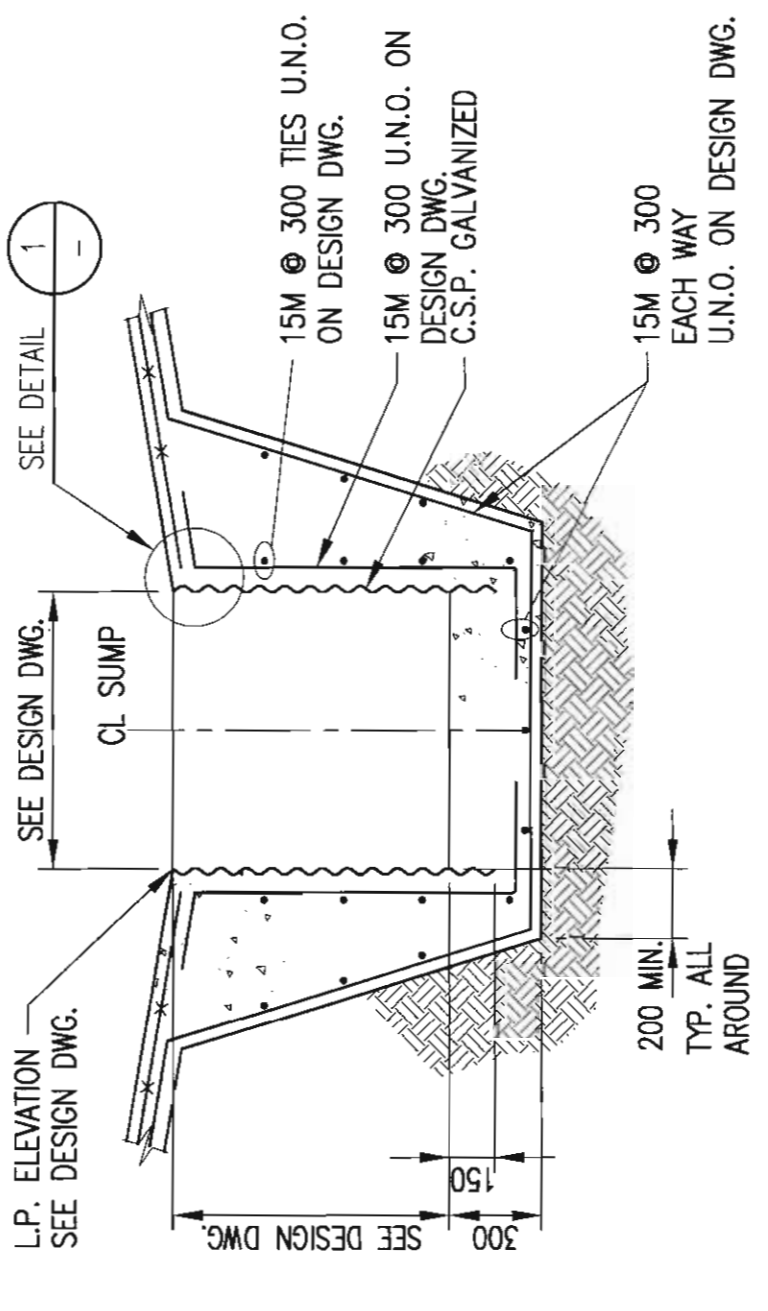
CONSTRUCTION JOINTS (UNLESS SHOWN OTHERWISE ON DESIGN DRAWING)



CONTROL JOINTS

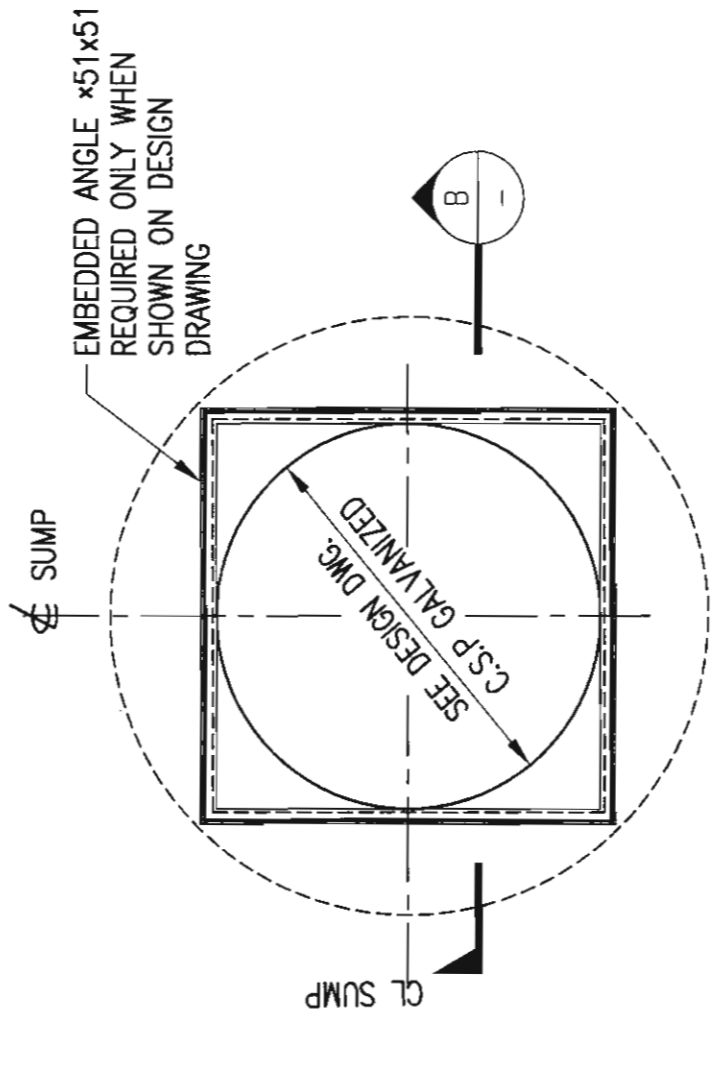
CONSTRUCTION JOINT / CONTROL JOINT

1



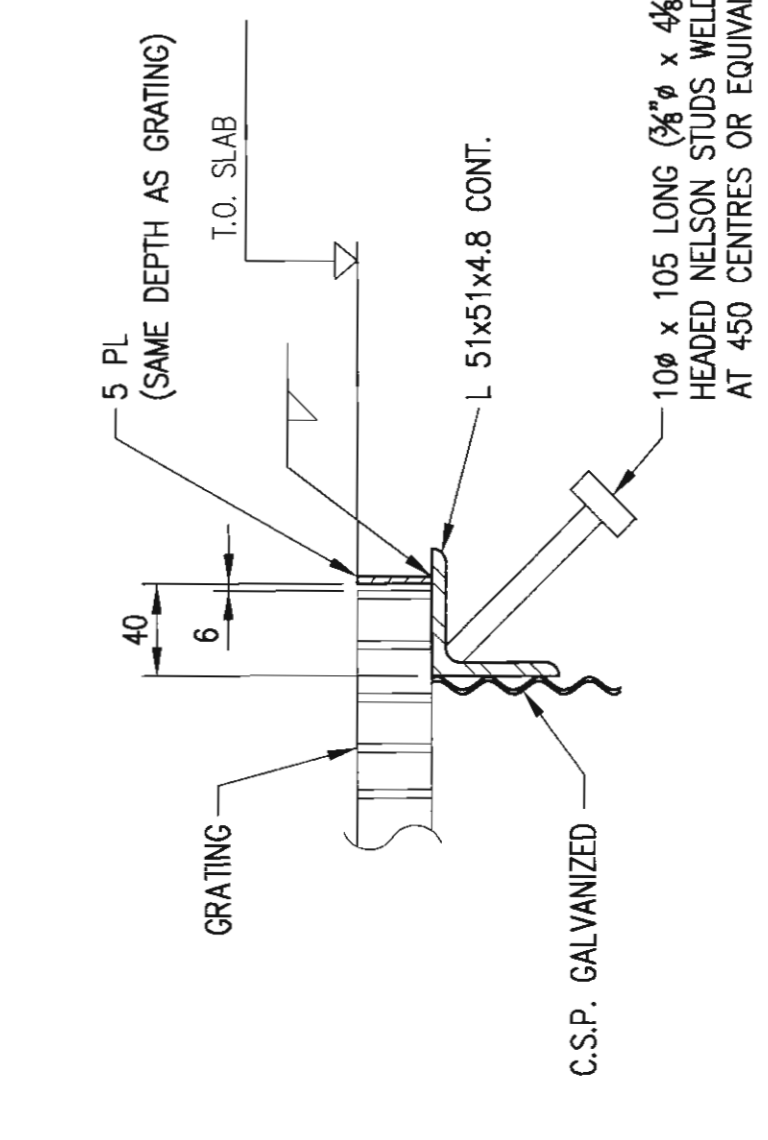
SECTION B-B

SUMP IN SLAB ON GRADE



PLAN

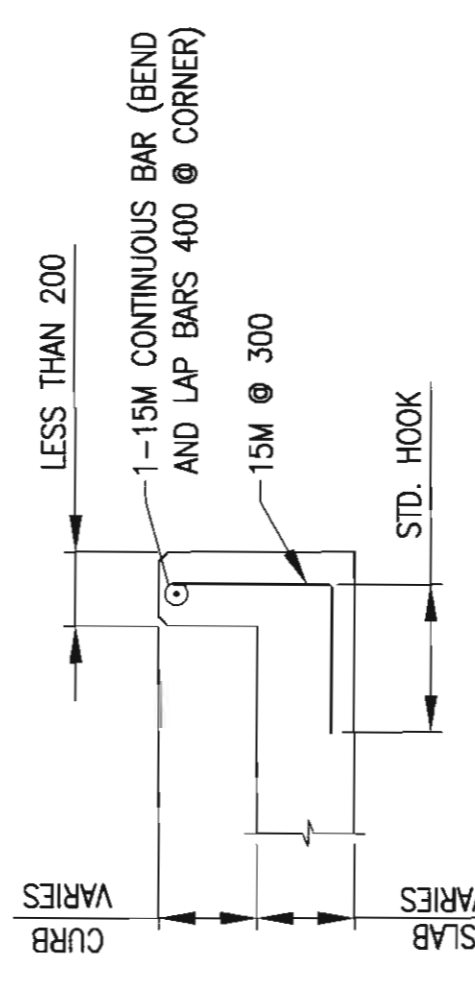
SUMP IN SLAB ON GRADE



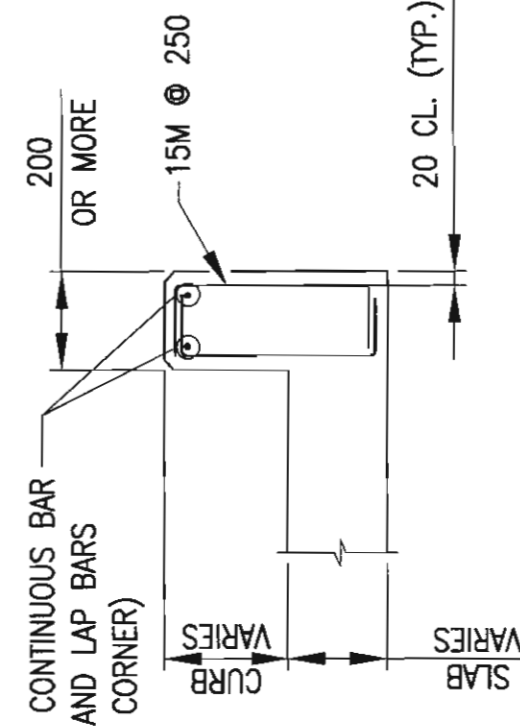
DETAIL 1-1

CURB THICKNESS 200 OR MORE TYP. CURB REINFORCEMENT

5



CURB THICKNESS LESS THAN 200



THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF ALEXCO ENGINEERING INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREIN. ANY REUSE OR MODIFICATION OF THIS INFORMATION WITHOUT THE WRITTEN PERMISSION OF ALEXCO ENGINEERING INC. IS STRICTLY PROHIBITED. ALEXCO ENGINEERING INC. IS NOT RESPONSIBLE FOR ANY ERRORS OR OMISSIONS IN THIS DRAWING. THE USER OF THIS DRAWING SHALL BE RESPONSIBLE FOR VERIFYING ALL DIMENSIONS AND CONDITIONS BEFORE CONSTRUCTION.

YUKON TERRITORY

ALEXCO ENGINEERING INC.

WARDROP Engineering Inc.

PEOPLE. PASSION. PERFORMANCE. TRUSTED GLOBALLY.

REFERENCE NO. 095360100-DWG-S0002
THIS DRAWING IS THE PROPERTY OF WARDROP ENGINEERING INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREIN. ANY REUSE OR MODIFICATION OF THIS INFORMATION WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. IS STRICTLY PROHIBITED. WARDROP ENGINEERING INC. IS NOT RESPONSIBLE FOR ANY ERRORS OR OMISSIONS IN THIS DRAWING. THE USER OF THIS DRAWING SHALL BE RESPONSIBLE FOR VERIFYING ALL DIMENSIONS AND CONDITIONS BEFORE CONSTRUCTION.

BELLEKENO PROJECT

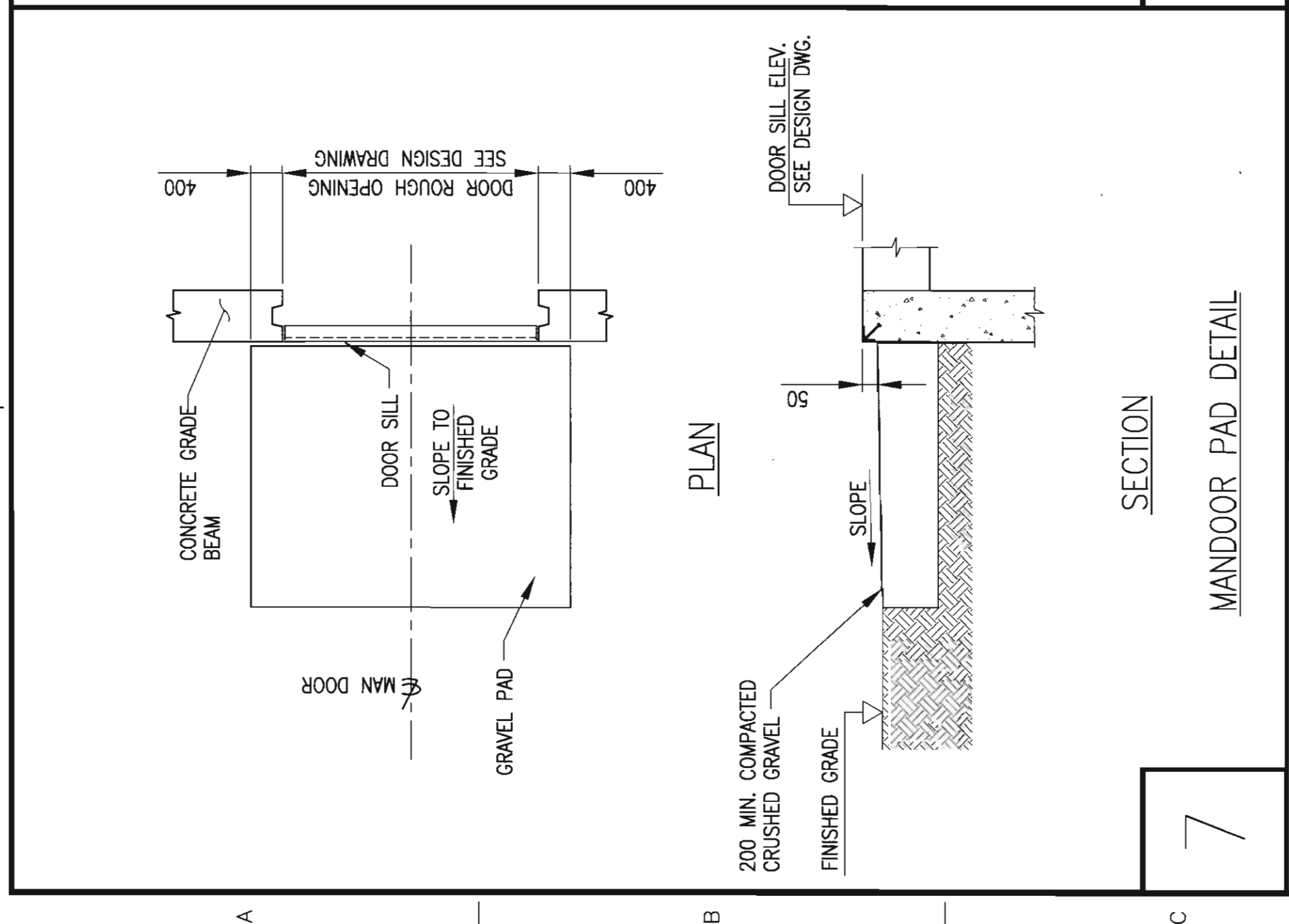
OVERALL GENERAL NOTES
CONCRETE - SHEET 2

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0015002.DWG	09539601.00	A00-15-002	0

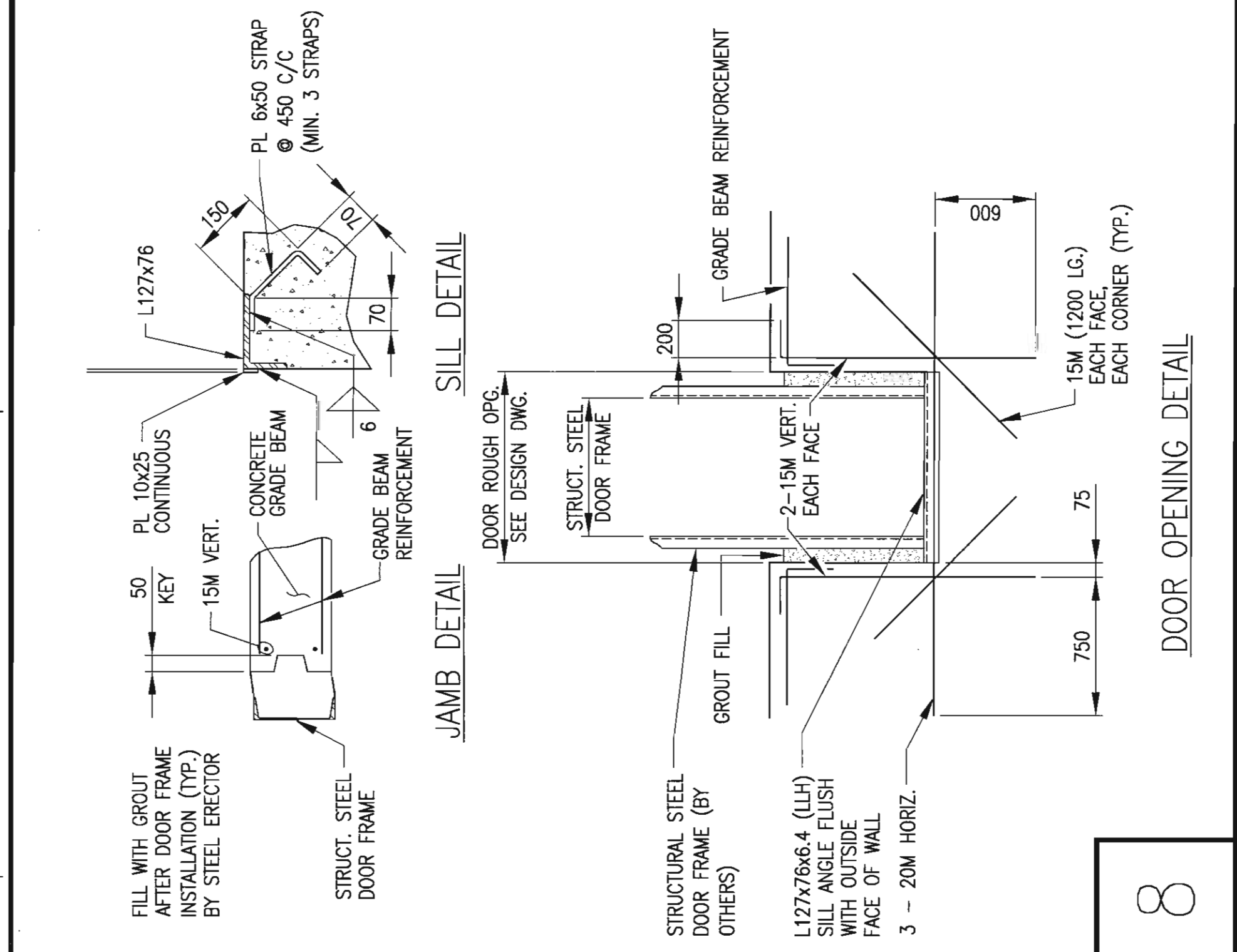
SECTION: CONCRETE
SCALE: NONE
DESIGN BY: ATM 08APR09
DRAWN BY: MRK 14APR09
CHECK BY: SEP 12AUG09
DATE BY: *[Signature]* 17.AUG.09

NO.	DATE	DESCRIPTION
0	1	ISSUED FOR CONSTRUCTION

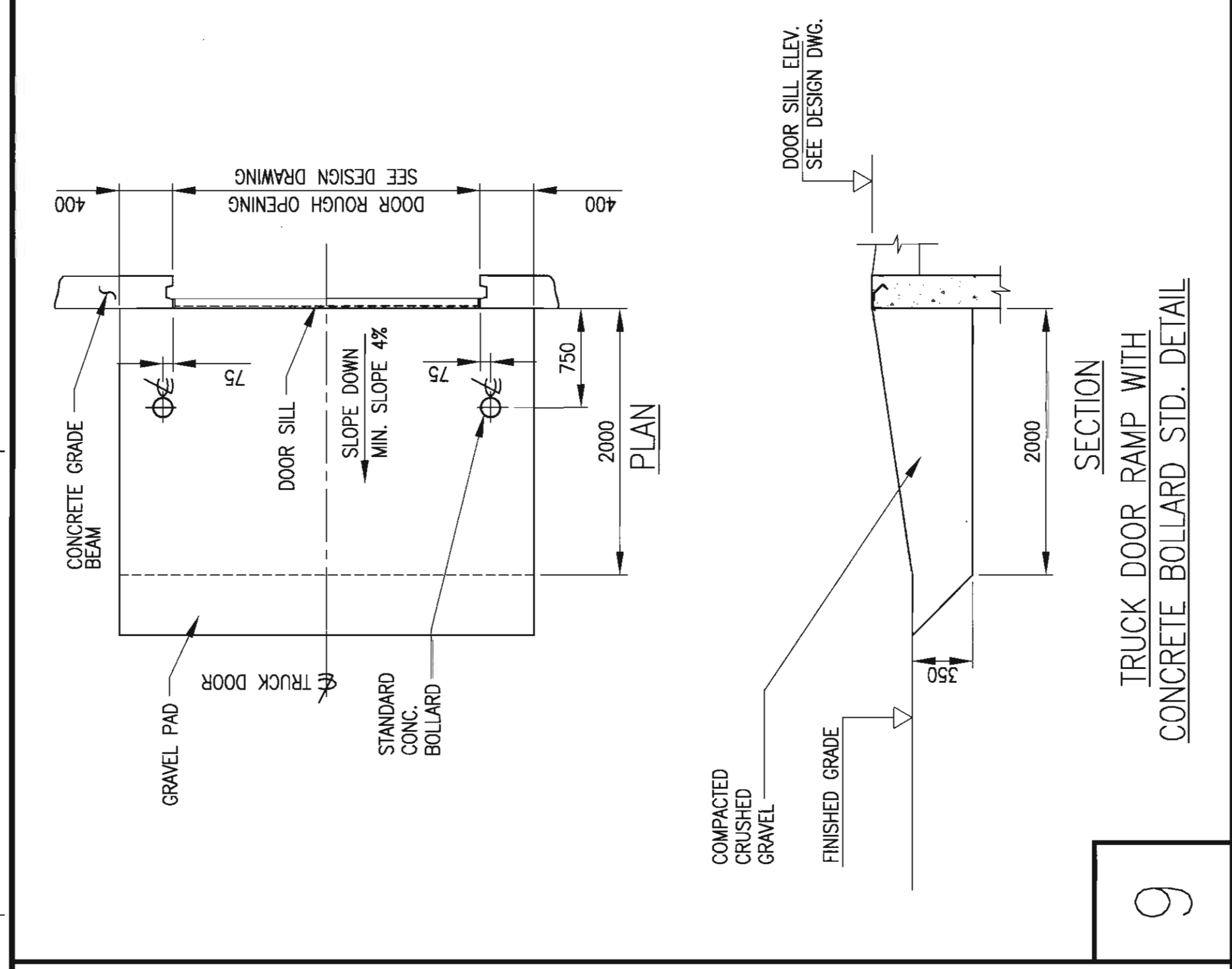
DWG. NO. REFERENCE DRAWINGS



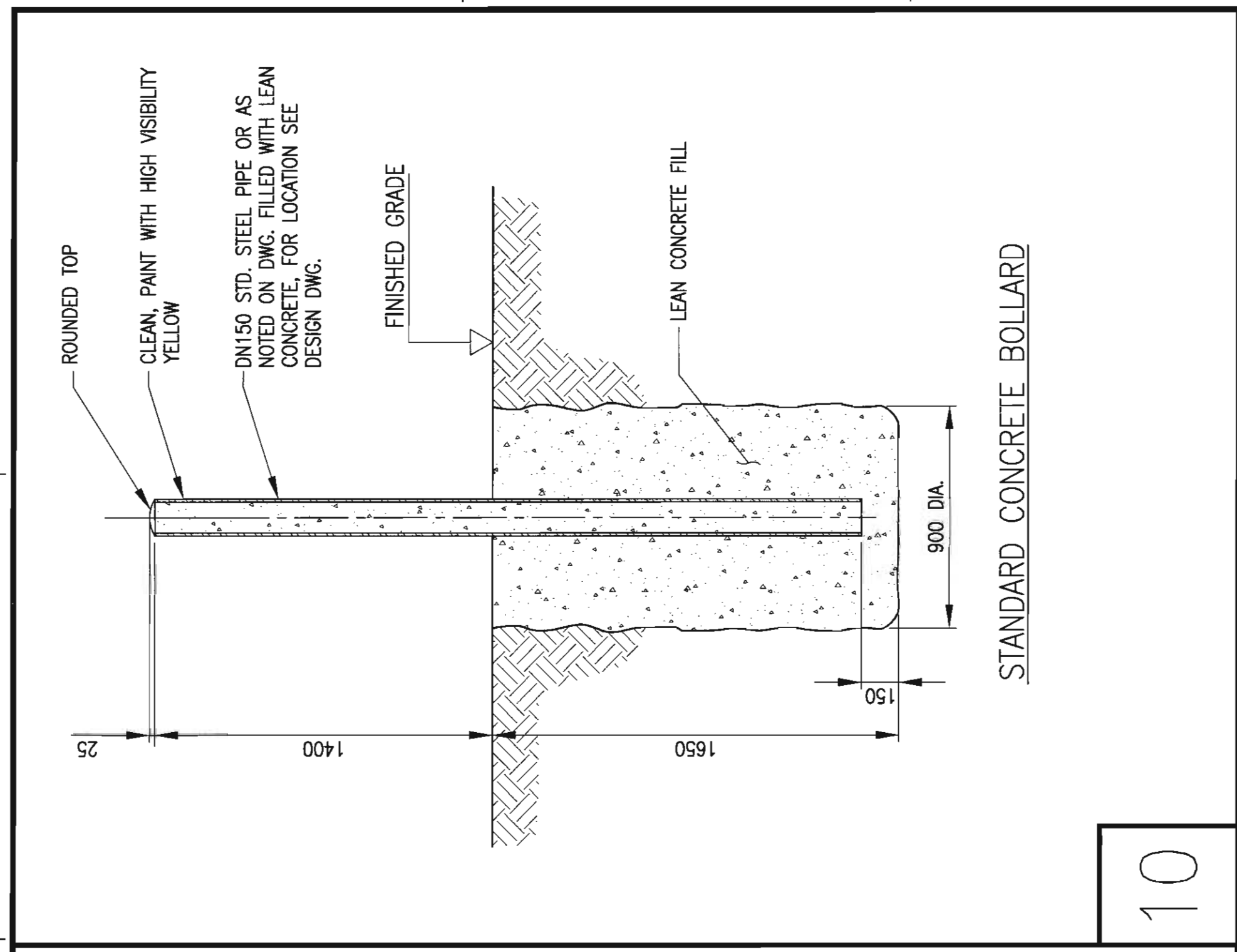
7



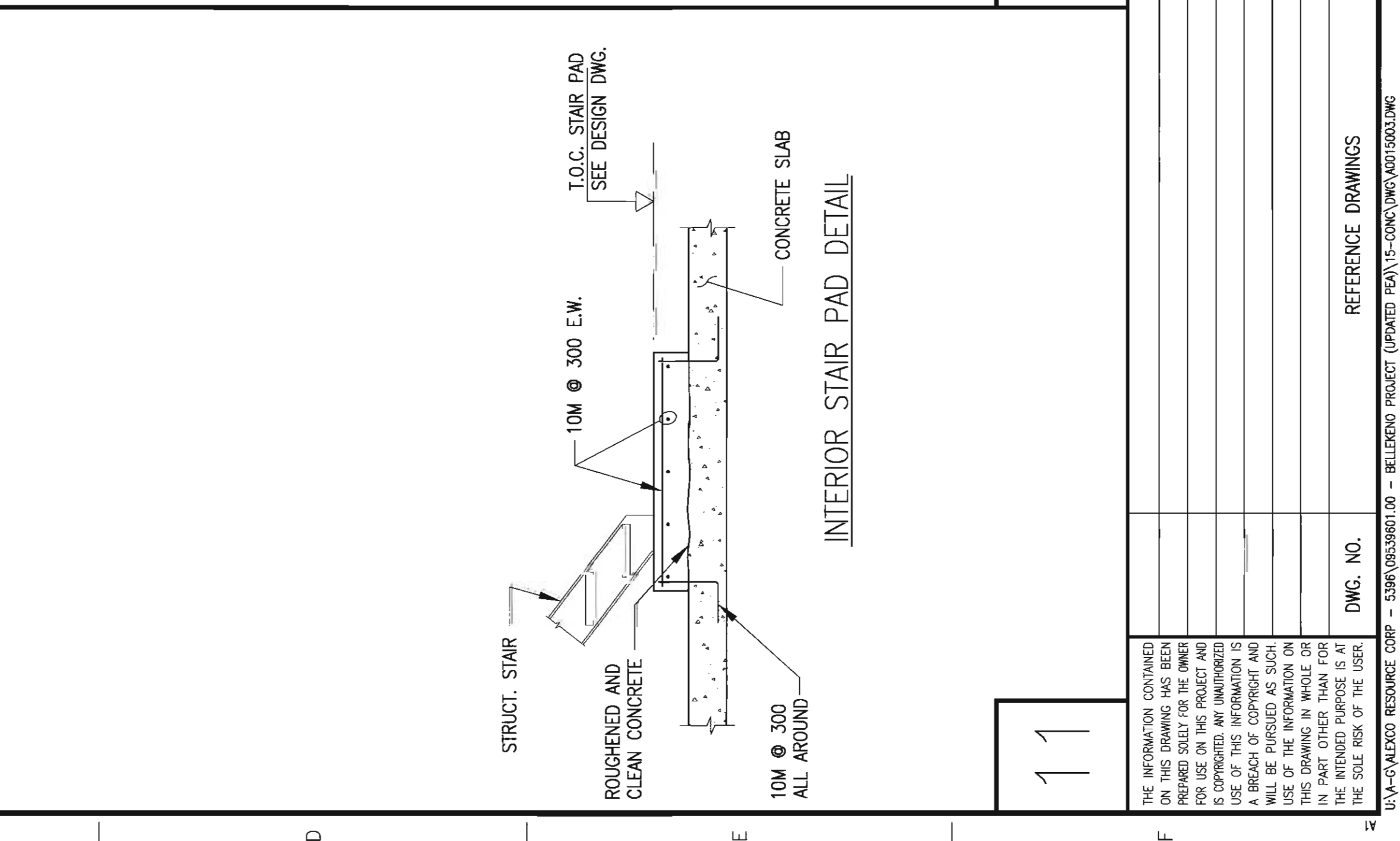
8



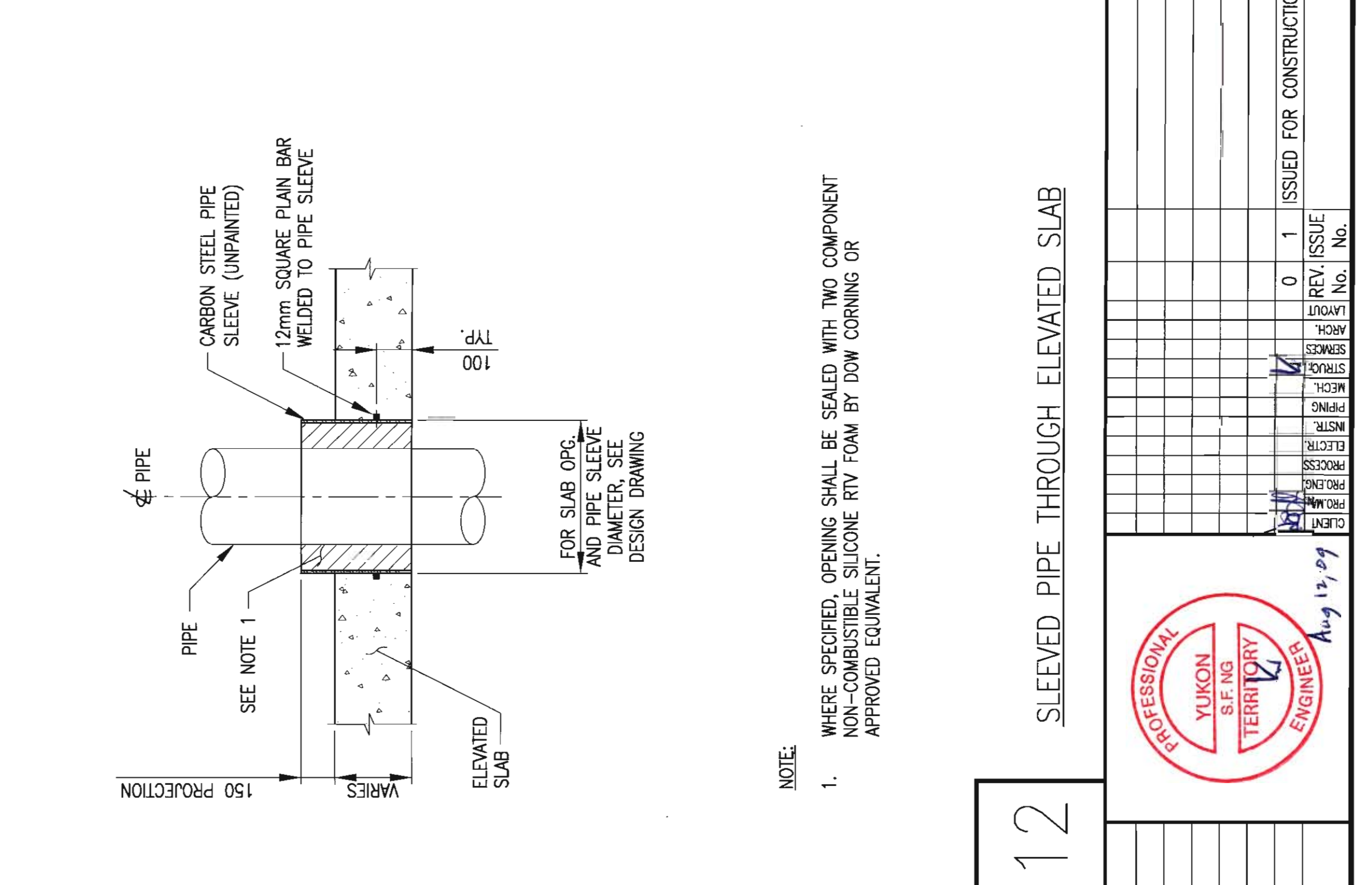
9



10



11



12

SECTION: CONCRETE		SCALE: NONE	DATE: 08APR09
DESIGN BY: ATM		DRAWN BY: MRK	CHECK BY: SEP
APP. BY: <i>[Signature]</i>		DATE: 12 AUG 09	DATE: 17 AUG 09
<p>ISSUED FOR CONSTRUCTION</p> <p>REV. NO. 0</p> <p>REV. DATE</p> <p>REV. BY</p> <p>REV. NO.</p>			
DESCRIPTION		DATE	
YUKON TERRITORY		DATE	

YUKON TERRITORY

ALEXCO

WARDROP Engineering Inc.

WARDROP
A TERRITORY COMPANY
PEOPLE. PASSION. PERFORMANCE.
TRUSTED GLOBALLY.

REFERENCE NO. 095360100-DWG-S0003

THIS DRAWING IS THE PROPERTY OF WARDROP ENGINEERING INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED IN THIS DRAWING. IT IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. ANY UNAUTHORIZED USE OF THIS DRAWING IS PROHIBITED AND WILL BE PROSECUTED TO THE FULL EXTENT OF THE LAW. WARDROP ENGINEERING INC. ACCEPTS NO LIABILITY FOR ANY DAMAGE OR LOSS OF PROFITS OR BUSINESS, INCLUDING REASONABLE ATTORNEY'S FEES, ARISING FROM THE USE OF THIS DRAWING. THE CLIENT AND WARDROP ENGINEERING INC. AGREE THAT THE CLIENT'S USE OF THIS DRAWING IS LIMITED TO THE PROJECT AND SITE SPECIFICALLY IDENTIFIED IN THIS DRAWING. THE CLIENT'S USE OF THIS DRAWING FOR ANY OTHER PROJECT OR SITE IS PROHIBITED. THE CLIENT'S USE OF THIS DRAWING FOR ANY OTHER PROJECT OR SITE IS AT THE SOLE RISK OF THE USER.

BELLEKENO PROJECT

OVERALL GENERAL NOTES

CONCRETE - SHEET 3

FILENAME: A0015003.DWG
PROJECT NUMBER: 0953601.00
DRAWING NUMBER: A00-15-003
REV. 0

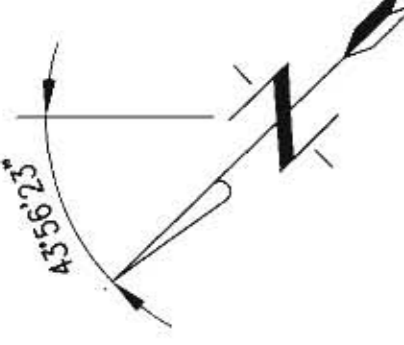
11

12

DESCRIPTION

YUKON TERRITORY

WARDROP
A TERRITORY COMPANY
PEOPLE. PASSION. PERFORMANCE.
TRUSTED GLOBALLY.

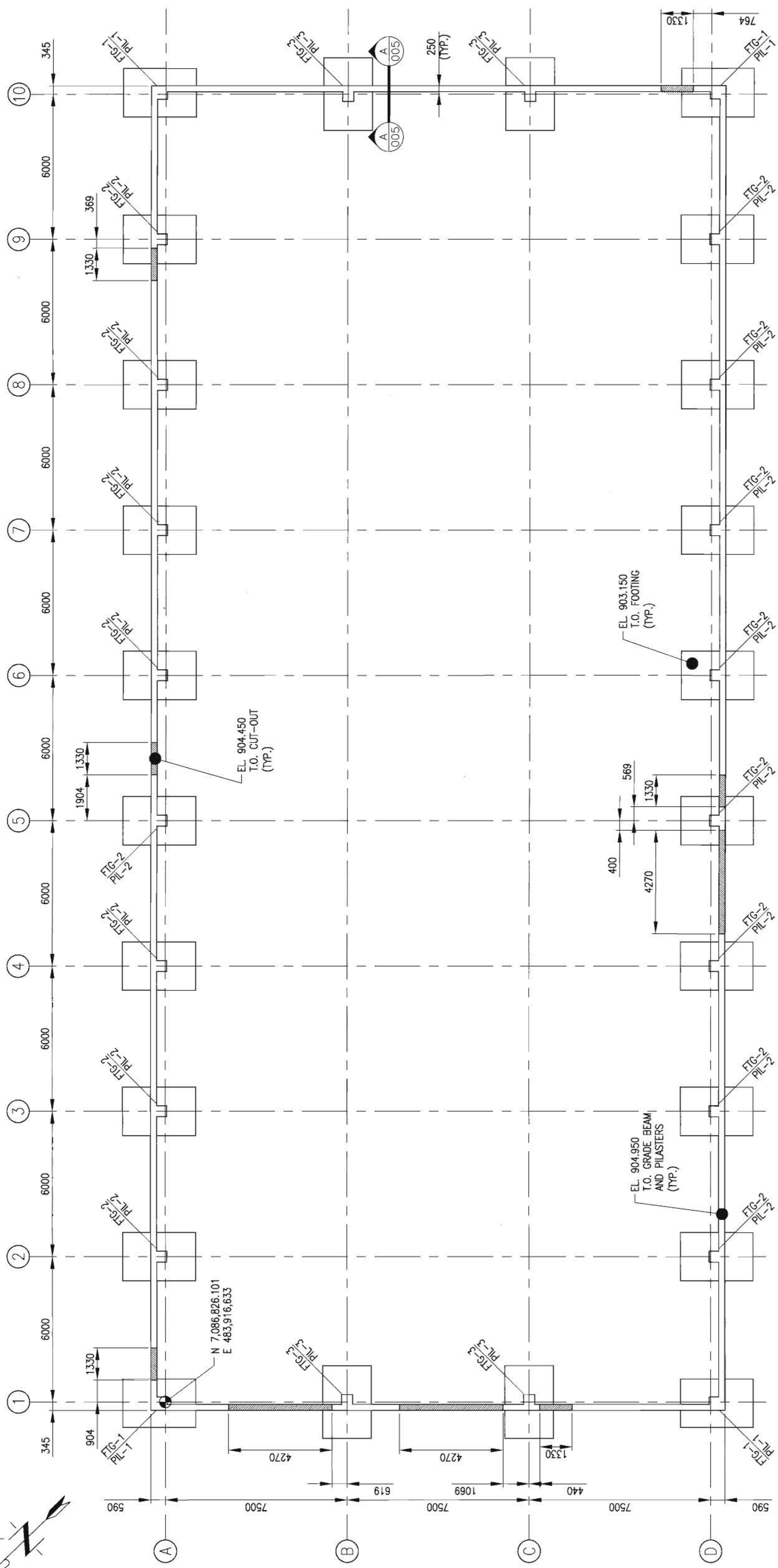


NOTES

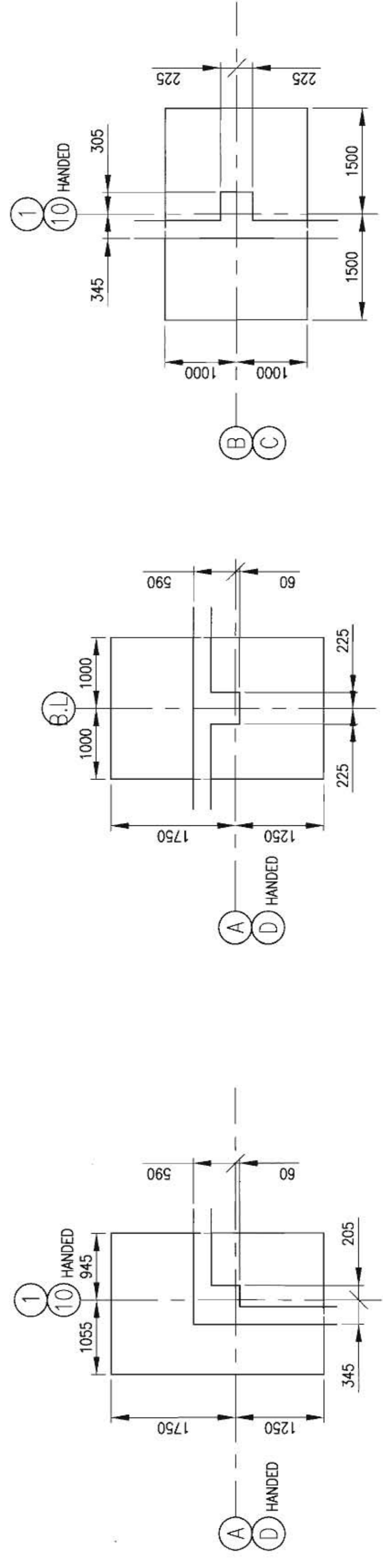
- FOR GENERAL NOTES AND STANDARD DETAILS SEE DRAWINGS A00-15-001 TO A00-15-003 INCLUSIVE.
- MINIMUM ALLOWABLE SOIL BEARING PRESSURE 250 kPa.
- ALL BEARING SURFACES FOR FOUNDATION SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH EBA'S TECHNICAL MEMO REF. FILE : W1410178.002, DATED 23 JULY 2009.

LEGEND

- FTG-# -- FOOTING TYPE
 PIL-# -- PILASTER TYPE
 (SEE DRAWING E00-15-005)
 [Hatched Box] -- CUT-OUT INDICATION



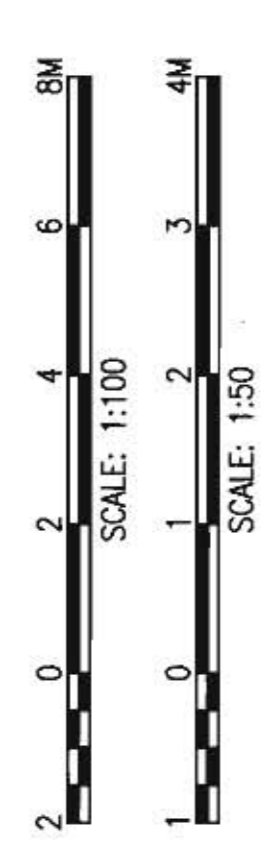
FOUNDATION PLAN
SCALE 1:100



FOOTING TYPE FTG-1
SCALE 1:50
4 LOCATIONS

FOOTING TYPE FTG-2
SCALE 1:50
16 LOCATIONS

FOOTING TYPE FTG-3
SCALE 1:50
4 LOCATIONS



WARDROP
 A TRUSTED COMPANY
 PEOPLE. PASSION. PERFORMANCE.
 TRUSTED GLOBALLY

REFERENCE No. : 095360100-DWG-S0004
 THIS DRAWING IS THE PROPERTY OF WARDROP ENGINEERING INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED IN THE TITLE. ANY REUSE, REPRODUCTION, OR DISTRIBUTION OF THIS DRAWING FOR ANY OTHER PROJECT OR SITE WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. IS STRICTLY PROHIBITED. WARDROP ENGINEERING INC. ACCEPTS NO LIABILITY FOR ANY DAMAGES OR INJURIES SUFFERED BY ANY PARTY ARISING FROM USE OF THIS DRAWING. THE CLIENT'S RESPONSIBILITY IS TO OBTAIN NECESSARY PERMITS AND APPROVALS FROM THE LOCAL AUTHORITIES. THE CLIENT'S RESPONSIBILITY IS TO OBTAIN NECESSARY PERMITS AND APPROVALS FROM THE LOCAL AUTHORITIES. THE CLIENT'S RESPONSIBILITY IS TO OBTAIN NECESSARY PERMITS AND APPROVALS FROM THE LOCAL AUTHORITIES.

FILENAME	E0015001.DWG	PROJECT NUMBER	095360100	DRAWING NUMBER	E00-15-001	REV.	0
----------	--------------	----------------	-----------	----------------	------------	------	---

YUKON TERRITORY

ALEXCO
 Engineering Inc.

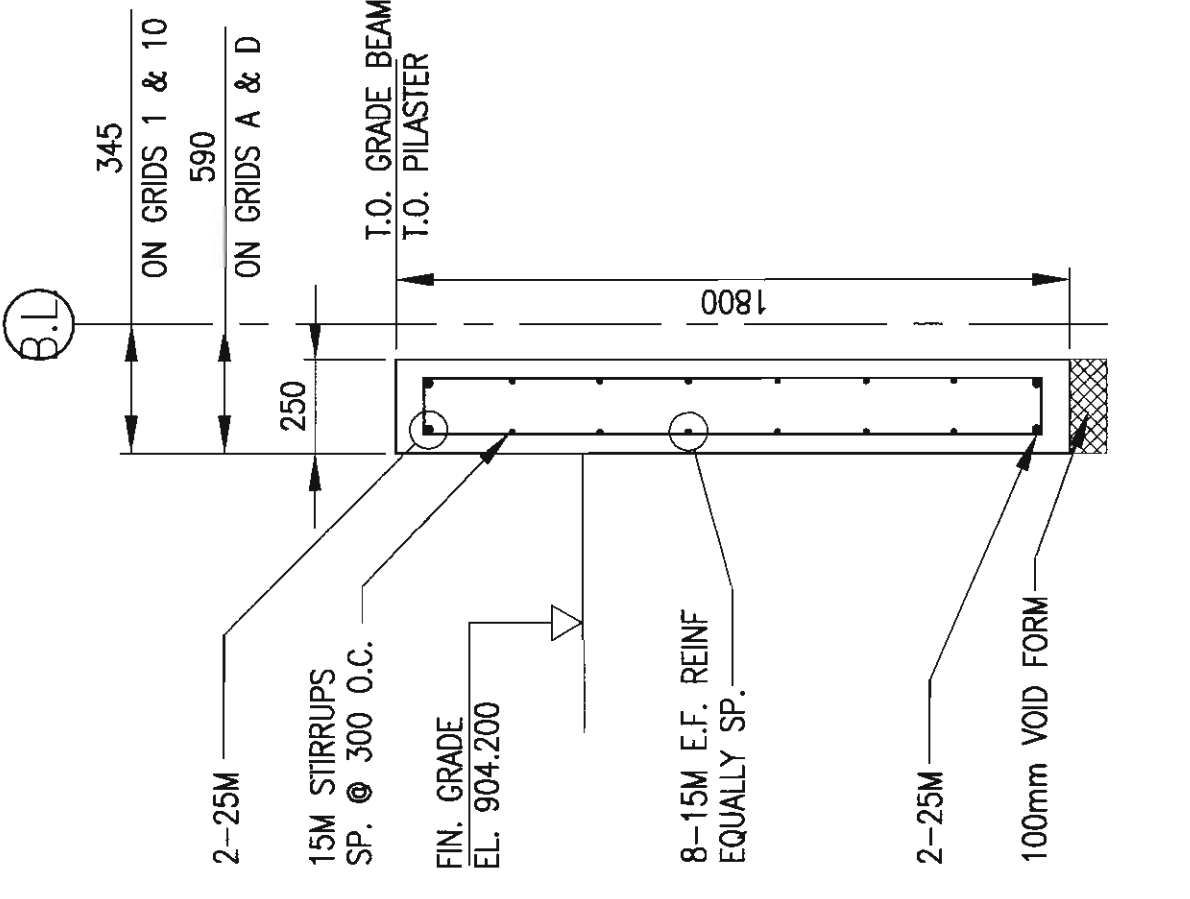
SECTION:	CONCRETE
SCALE:	1:100 UNO.
DATE:	12 AUG 09
DESIGN BY:	ATM
MARK:	13 APR 09
DRAWN BY:	MRK
CHECK BY:	SEP
APP. BY:	[Signature]

NO.	REV.	ISSUE	DESCRIPTION
0	1	ISSUED FOR CONSTRUCTION	

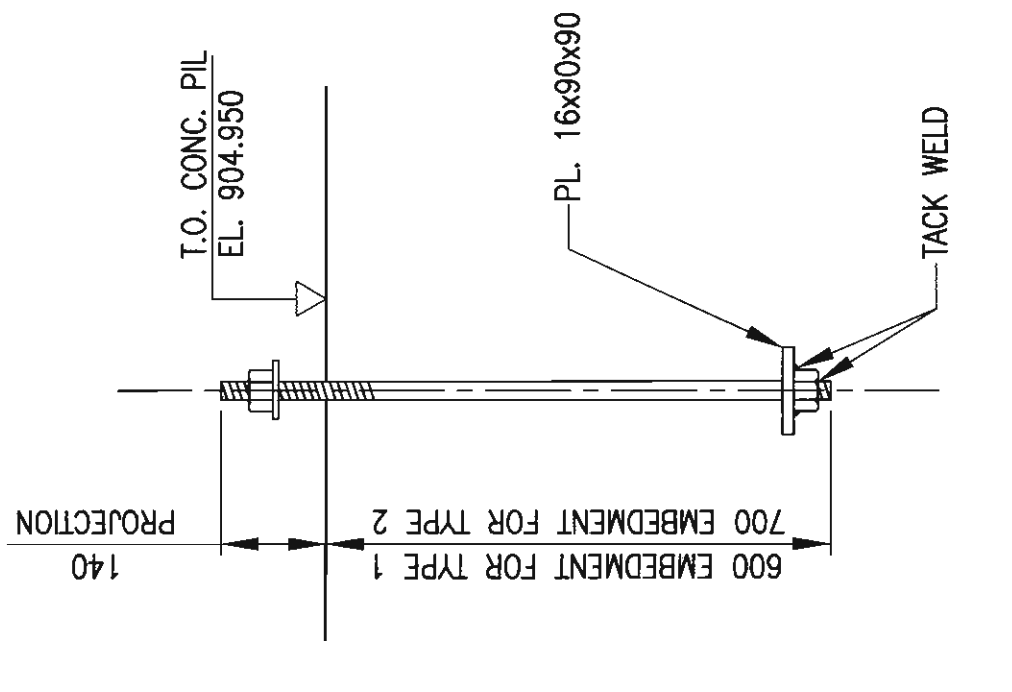
THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF WARDROP ENGINEERING INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED IN THE TITLE. ANY REUSE, REPRODUCTION, OR DISTRIBUTION OF THIS DRAWING FOR ANY OTHER PROJECT OR SITE WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. IS STRICTLY PROHIBITED. WARDROP ENGINEERING INC. ACCEPTS NO LIABILITY FOR ANY DAMAGES OR INJURIES SUFFERED BY ANY PARTY ARISING FROM USE OF THIS DRAWING.
E00-15-005 MILL BUILDING - CONC. - PILASTER PLANS, SECTIONS AND DETAILS
A00-15-003 OVERALL GENERAL NOTES - CONCRETE SHEET 3
A00-15-002 OVERALL GENERAL NOTES - CONCRETE SHEET 2
A00-15-001 OVERALL GENERAL NOTES - CONCRETE SHEET 1
REFERENCE DRAWINGS
DWG. NO.
USA-042000 RESOURCE CORP. - 5386 (052360100 - BELLEKENO PROJECT) (UPDATED FEAT) 15-CONC.DWG (E0015001.DWG)

NOTES

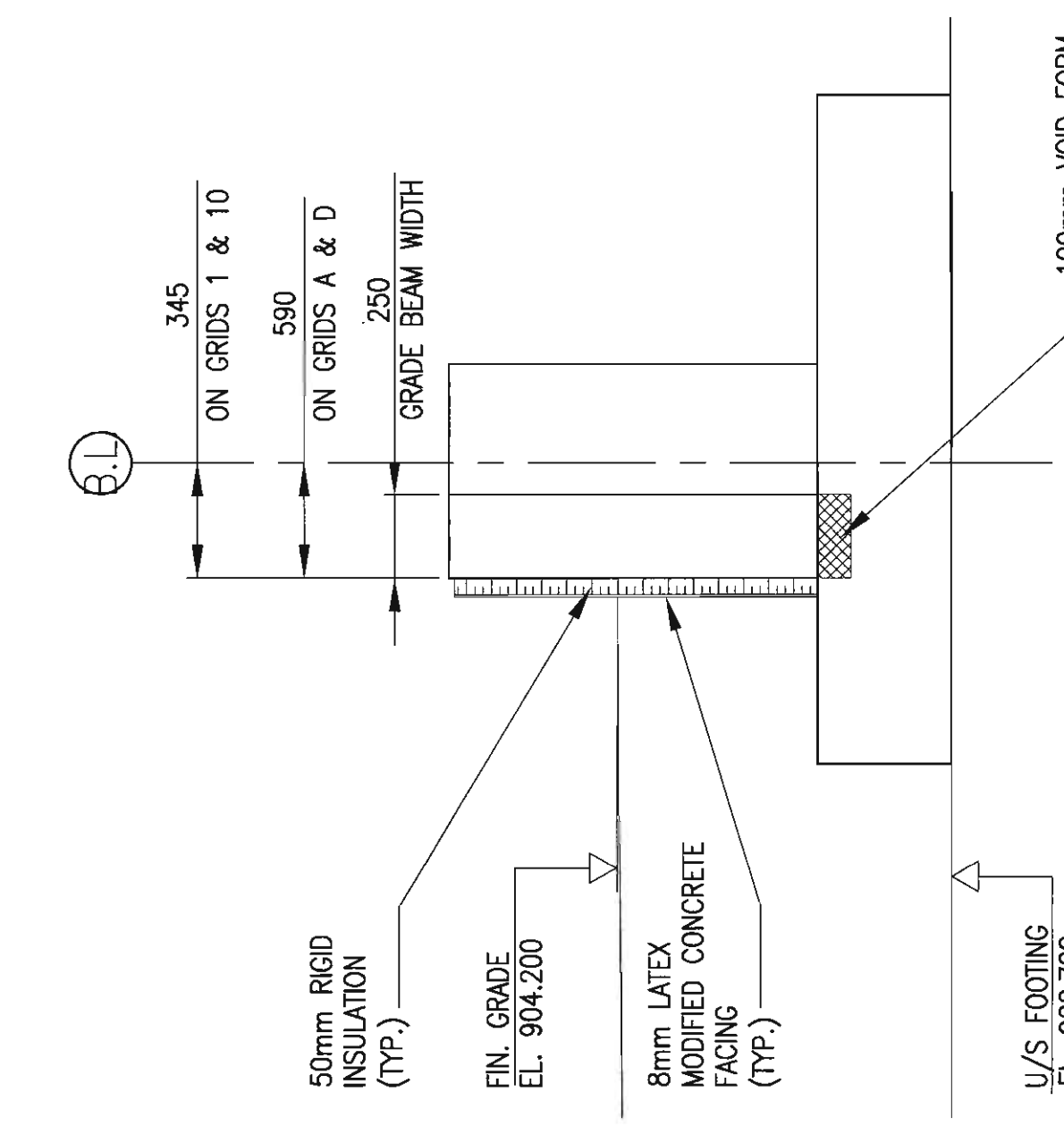
1. FOR GENERAL NOTES AND STANDARD DETAILS SEE DRAWINGS A00-15-001 TO A00-15-003 INCLUSIVE.



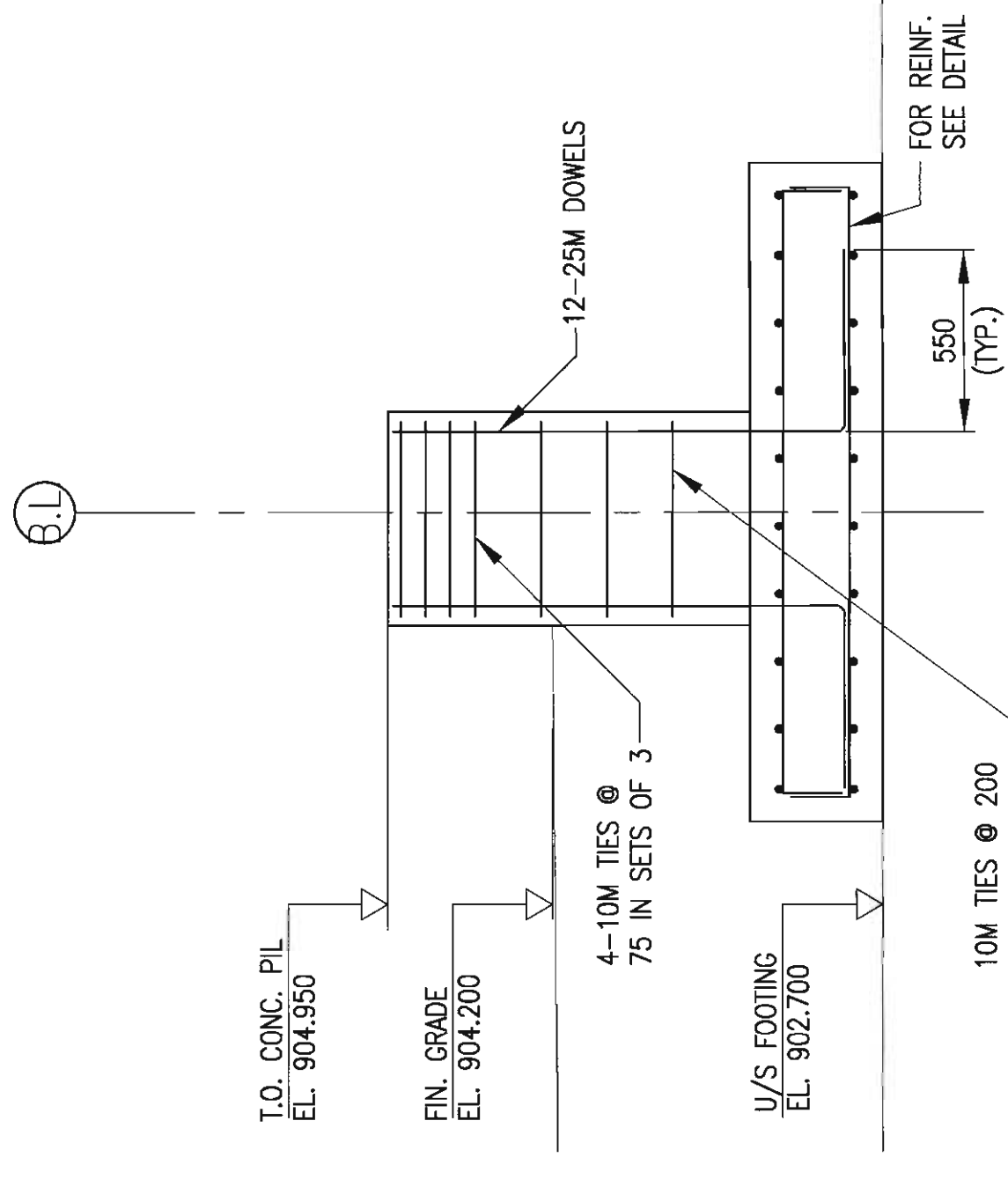
TYPICAL GRADE BEAM SECTION
SCALE 1:20
INSULATION NOT SHOWN FOR CLARITY



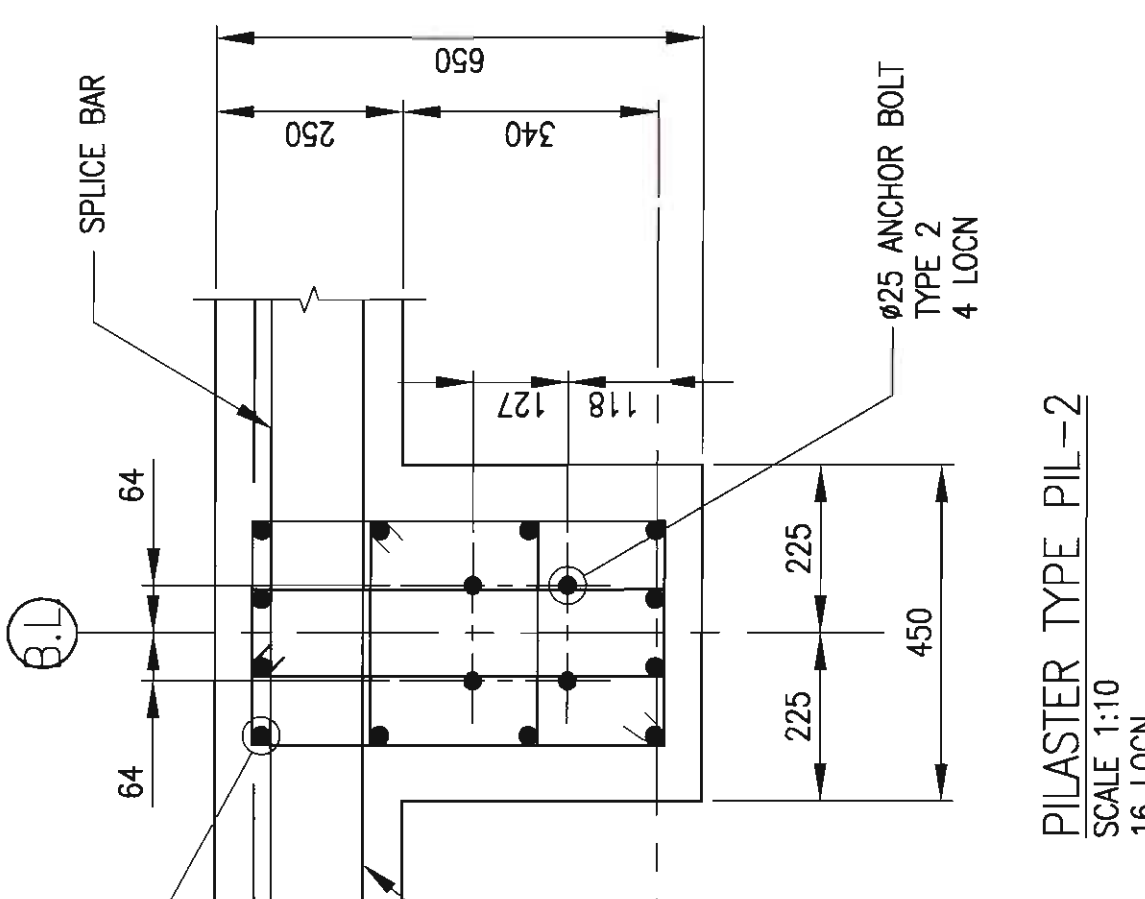
ANCHOR BOLT TYPES
SCALE N.T.S.
TYPE 1 - Ø19 ANCHOR BOLT
TYPE 2 - Ø25 ANCHOR BOLT



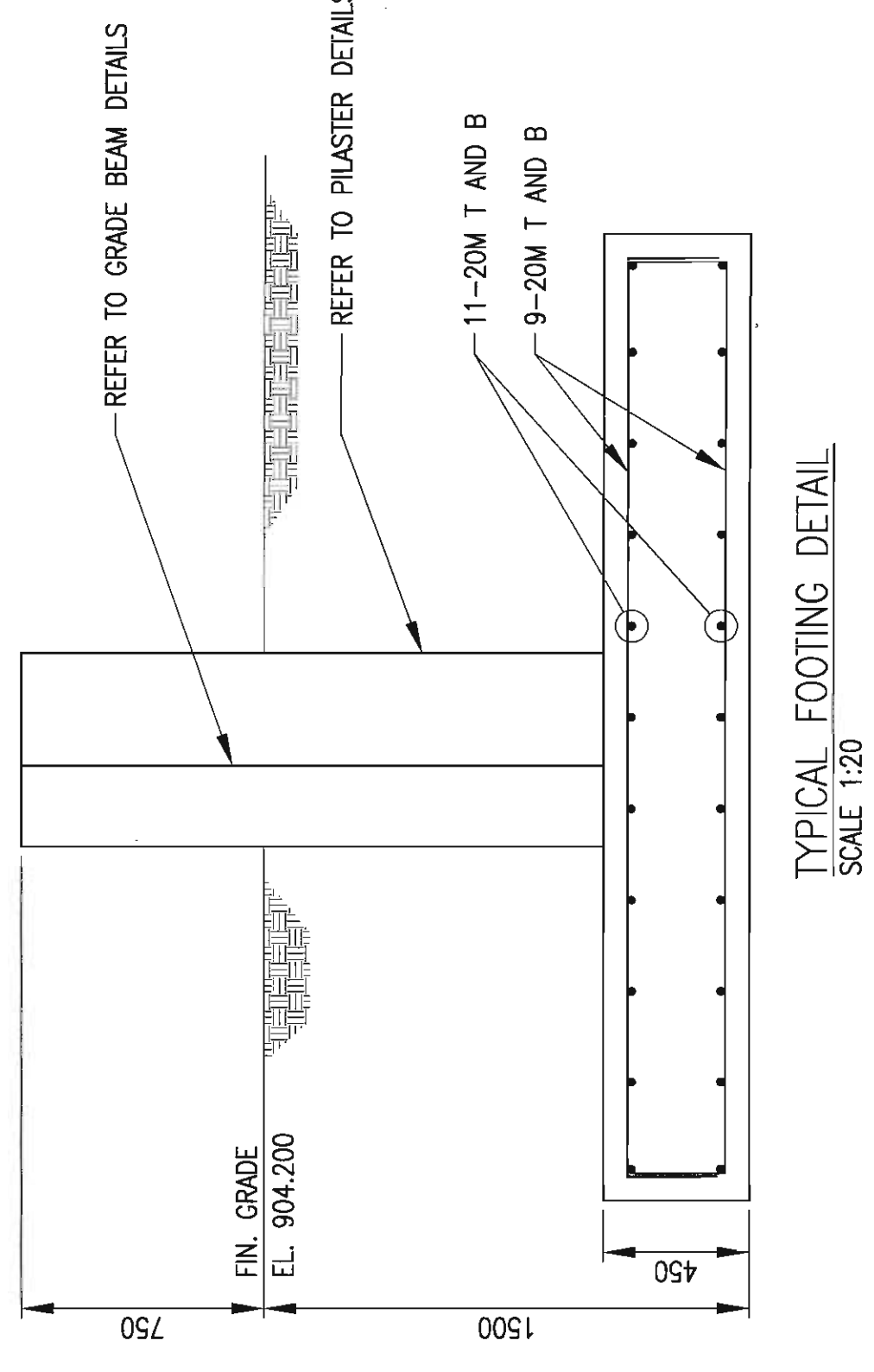
TYPICAL INSULATION SECTION
SCALE N.T.S.
REINFORCEMENT NOT SHOWN FOR CLARITY



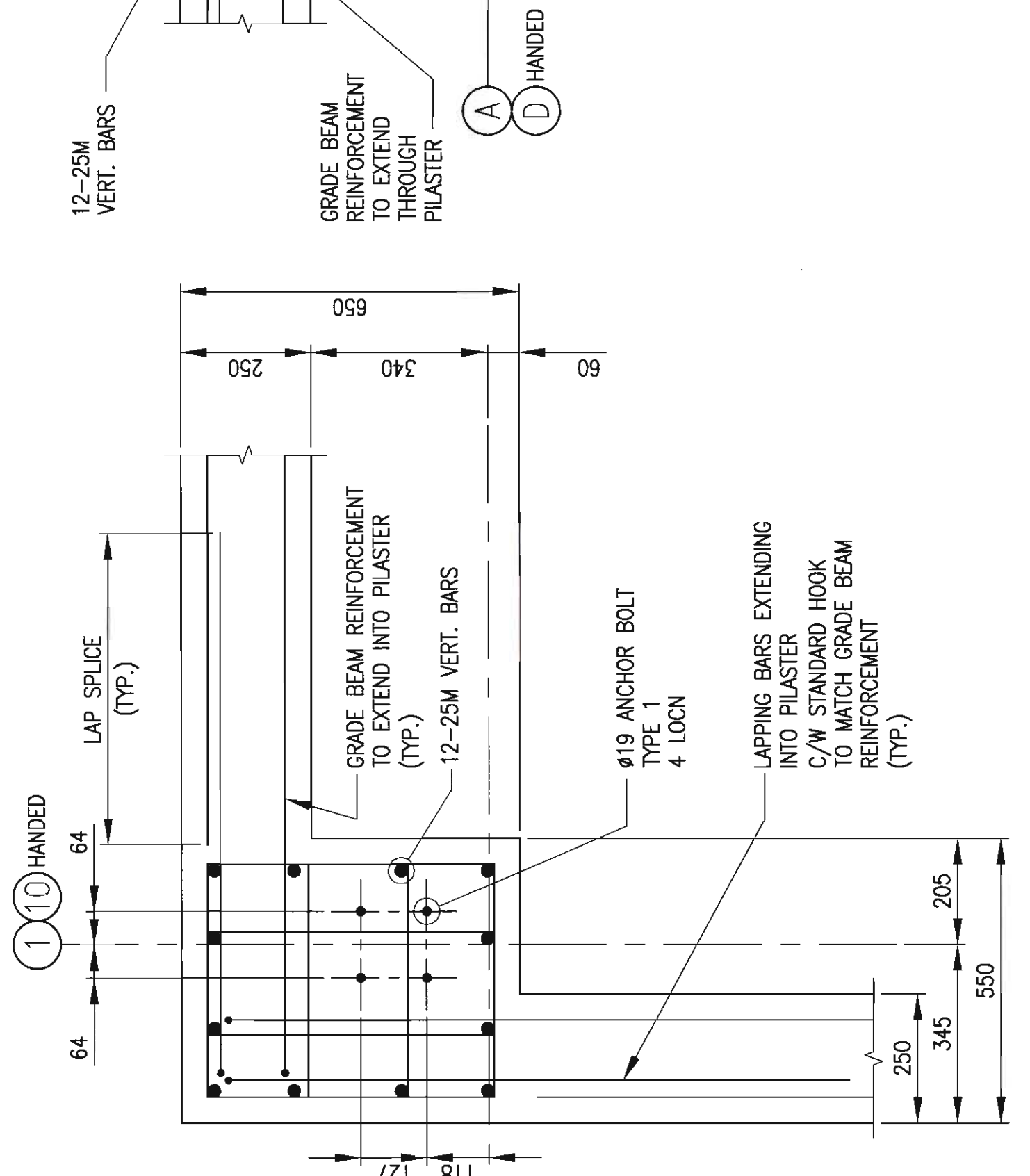
TYPICAL PILASTER & FOOTING SECTION
SCALE 1:20
GRADE BEAM REINFORCEMENT NOT SHOWN FOR CLARITY



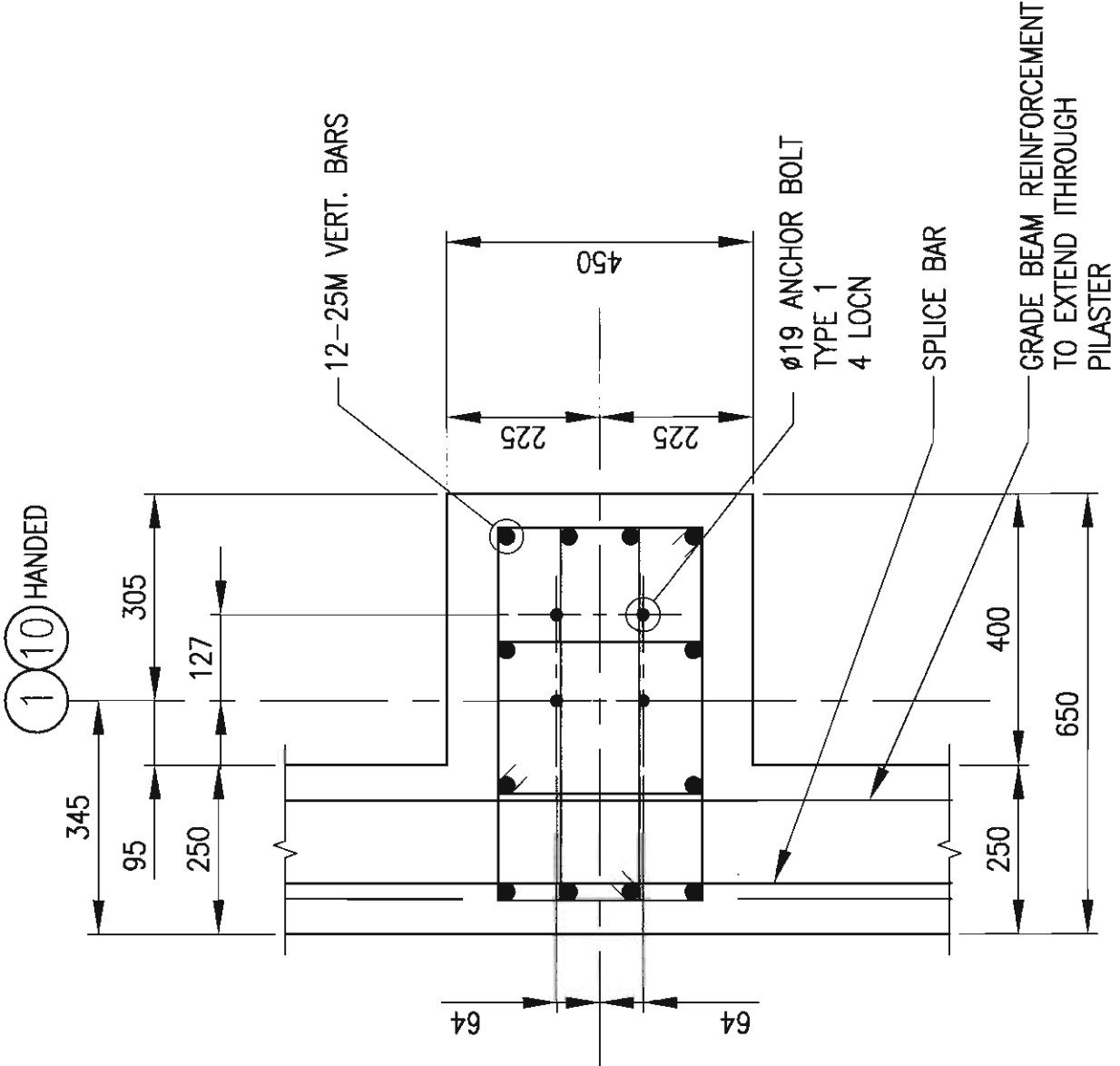
PILASTER TYPE PIL-2
SCALE 1:10
16 LOCN



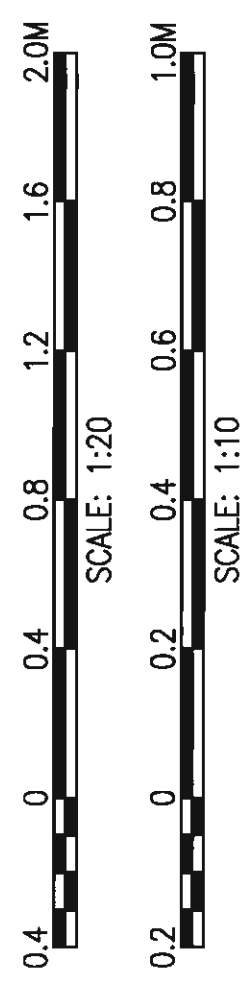
TYPICAL FOOTING DETAIL
SCALE 1:20



PILASTER TYPE PIL-1
SCALE 1:10
4 LOCN



PILASTER TYPE PIL-3
SCALE 1:10
4 LOCN



WARDROP
A TRUTHFUL COMPANY
PEOPLE. PASSION. PERFORMANCE.
TRUSTED GLOBALLY
REFERENCE NO.: 0953960100-DWG-S0018
THIS DRAWING IS THE PROPERTY OF WARDROP ENGINEERING INC. AND THESE PARTS ARE TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED. ANY REUSE, REPRODUCTION, OR OTHER USE OF THIS DRAWING WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. IS PROHIBITED. WARDROP ENGINEERING INC. AND THESE PARTS ARE TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED.

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
E0015005.DWG	09539601.00	E00-15-005	0

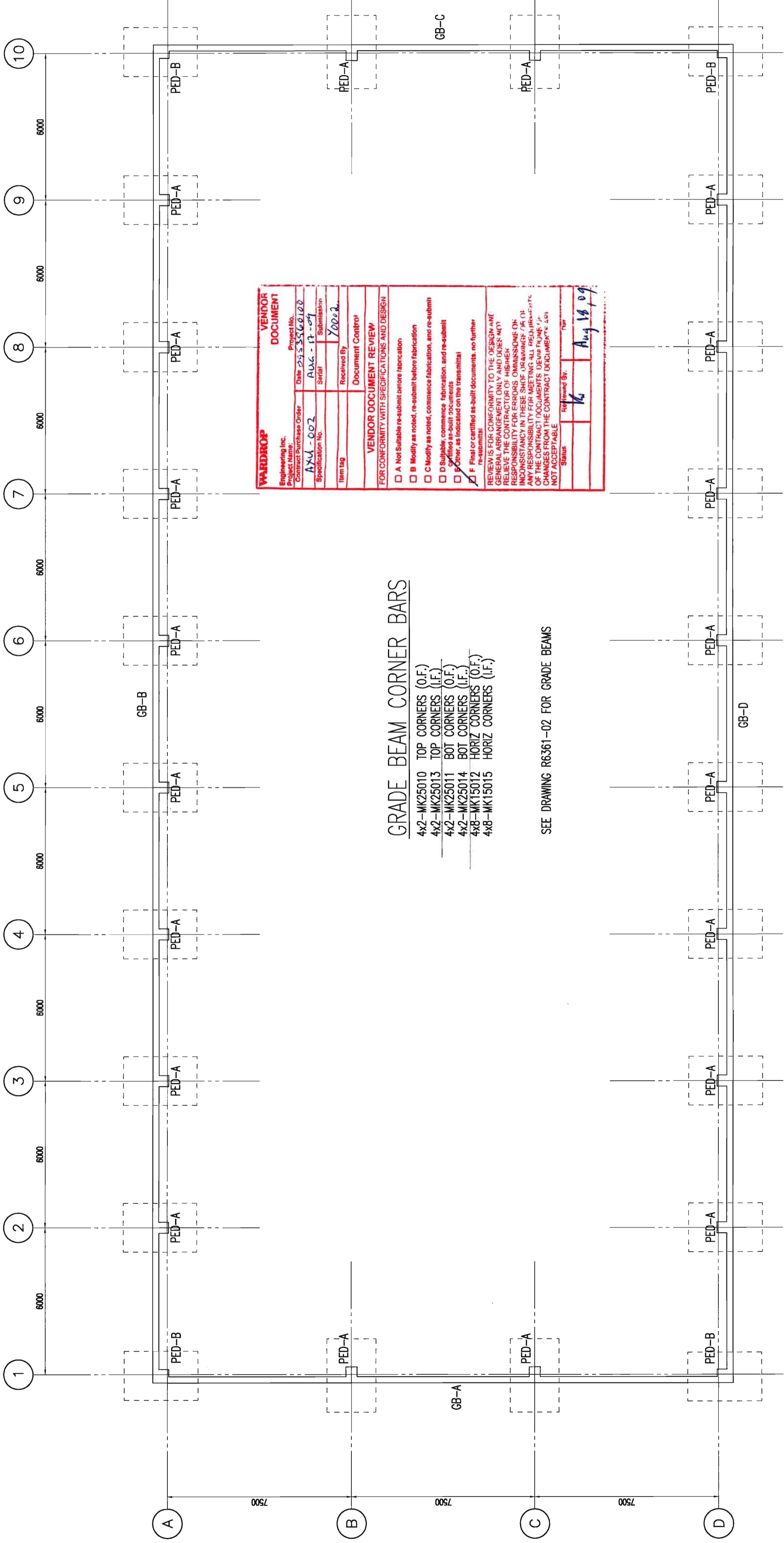
YUKON TERRITORY
ALEXCO
WARDROP Engineering Inc.

SECTION:	CONCRETE
SCALE:	1:20 U.N.C.
DESIGN BY:	CMK 29JUL09
DRAWN BY:	MRK 30JUL09
CHECK BY:	SEP 12AUG09
APP. BY:	<i>[Signature]</i> 12 AUG 09

NO.	DATE	DESCRIPTION
0	12 AUG 09	ISSUED FOR CONSTRUCTION
1	12 AUG 09	ISSUE

PROFESSIONAL
YUKON TERRITORY
ENGINEER
Aug 12, 09

THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF WARDROP ENGINEERING INC. AND IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED. ANY REUSE, REPRODUCTION, OR OTHER USE OF THIS DRAWING WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. IS PROHIBITED. WARDROP ENGINEERING INC. AND THESE PARTS ARE TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED.
E00-15-001 MILL BUILDING - CONCRETE - FOUNDATION PLAN
REFERENCE DRAWINGS
DWG. NO.

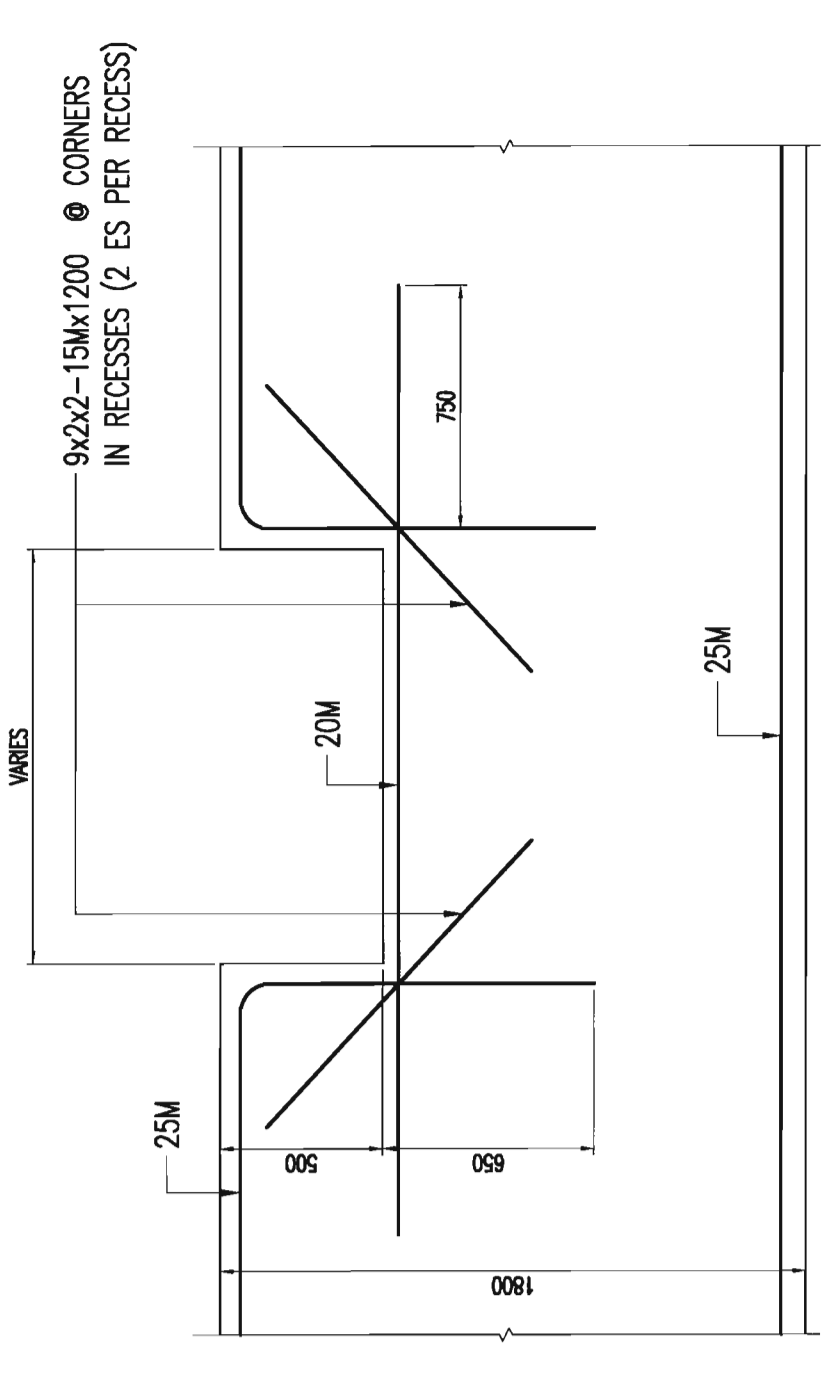


GRADE BEAM CORNER BARS

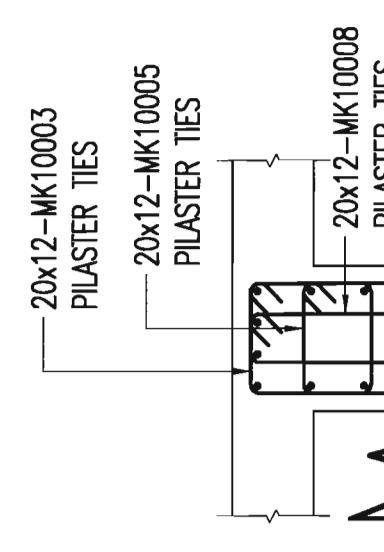
- 4x2-MK25010 TOP CORNERS (OF)
- 4x2-MK25013 TOP CORNERS (UF)
- 4x2-MK25011 BOT CORNERS (OF)
- 4x2-MK25014 BOT CORNERS (UF)
- 4x8-MK15012 HORIZ CORNERS (OF)
- 4x8-MK15015 HORIZ CORNERS (UF)

SEE DRAWING RC361-02 FOR GRADE BEAMS

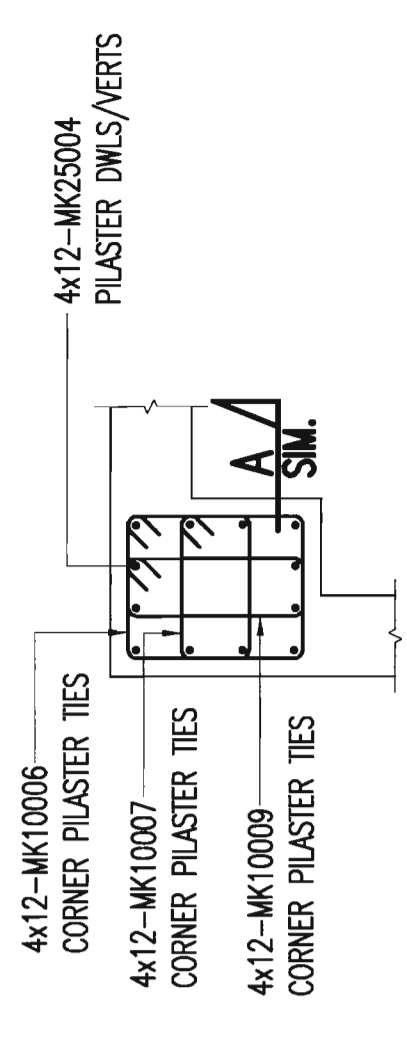
FOUNDATION PLAN



DOOR RECESS
(9 REQUIRED)



PED-A
PLASTER DIMS/VERTS
(20 REQUIRED)



PED-B
PLASTER DIMS/VERTS
(4 REQUIRED)

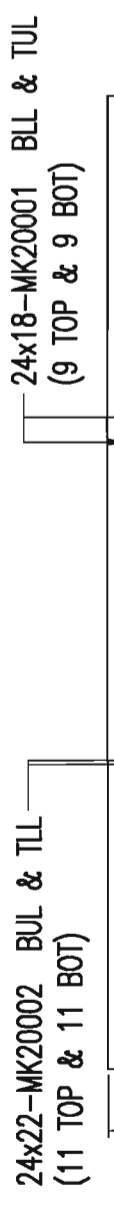
WARDROP
Engineering Inc.
10000 16th Avenue S.E.
Edmonton, Alberta T7C 1G2
Order: 293-2550/012
Date: 04-11-09
Spec: 11-09-09
Sheet: 11-09-09
Specification No: 11-09-09
Title: 11-09-09

VENDOR DOCUMENT REVIEW
Document Control
Reviewed By: [Signature]
Date: Aug 18 09

TERMS OF CONTRACT WITH SPECIFICATIONS AND DESIGN

- A. Not suitable as-is, re-evaluate before fabrication.
- B. Modify as noted, re-evaluate before fabrication.
- C. Modify as noted, commence fabrication, start re-evaluate.
- D. Supply, commence fabrication, and re-evaluate.
- E. Other, as instructed on the transmittal.
- F. Free or certified as-built documents, no further re-evaluation.

THIS DOCUMENT IS THE PROPERTY OF WARDROP ENGINEERING INC. IT IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED IN THESE SHEET HEADINGS. IT IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, WITHOUT THE WRITTEN PERMISSION OF WARDROP ENGINEERING INC. THE CONTRACT DOCUMENTS GOVERN THIS PROJECT. ANY DISCREPANCY IN THESE SHEET HEADINGS OR IN THIS DOCUMENT SHALL BE REFERRED TO THE CONTRACT DOCUMENTS. WARDROP ENGINEERING INC. IS NOT RESPONSIBLE FOR THE DESIGN OF THE CONTRACT DOCUMENTS. WARDROP ENGINEERING INC. IS NOT RESPONSIBLE FOR THE DESIGN OF THE CONTRACT DOCUMENTS. WARDROP ENGINEERING INC. IS NOT RESPONSIBLE FOR THE DESIGN OF THE CONTRACT DOCUMENTS.



PAD FOOTING SECTION
(24 REQUIRED)

TOP SPLICES	BOTTOM SPLICES
10M = 520	10M = 400
15M = 780	15M = 600
20M = 1040	20M = 800
25M = 1430	25M = 1100

CONCRETE COVER

CONC. CAST AGAINST & EXPOSED TO EARTH:	75mm
CONC. EXPOSED TO GROUND OR WEATHER:	40mm for 15m or smaller 50mm for 20m or larger

BENDING DETAILS FOR RUN: - 6361-001

Bar Mark	Qty	Size (dial length)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1003	24	10M	2000	11	100	350	550	750	950	1150	1350	1550	1750	1950	2150	2350	2550	2750	2950	3150	3350	3550	3750	3950	4150	4350	4550	4750	4950	5150	5350	5550	5750	5950	6150	6350	6550	6750	6950	7150	7350	7550	7750	7950	8150	8350	8550	8750	8950	9150	9350	9550	9750	9950	10150	10350	10550	10750	10950	11150	11350	11550	11750	11950	12150	12350	12550	12750	12950	13150	13350	13550	13750	13950	14150	14350	14550	14750	14950	15150	15350	15550	15750	15950	16150	16350	16550	16750	16950	17150	17350	17550	17750	17950	18150	18350	18550	18750	18950	19150	19350	19550	19750	19950	20150	20350	20550	20750	20950	21150	21350	21550	21750	21950	22150	22350	22550	22750	22950	23150	23350	23550	23750	23950	24150	24350	24550	24750	24950	25150	25350	25550	25750	25950	26150	26350	26550	26750	26950	27150	27350	27550	27750	27950	28150	28350	28550	28750	28950	29150	29350	29550	29750	29950	30150	30350	30550	30750	30950	31150	31350	31550	31750	31950	32150	32350	32550	32750	32950	33150	33350	33550	33750	33950	34150	34350	34550	34750	34950	35150	35350	35550	35750	35950	36150	36350	36550	36750	36950	37150	37350	37550	37750	37950	38150	38350	38550	38750	38950	39150	39350	39550	39750	39950	40150	40350	40550	40750	40950	41150	41350	41550	41750	41950	42150	42350	42550	42750	42950	43150	43350	43550	43750	43950	44150	44350	44550	44750	44950	45150	45350	45550	45750	45950	46150	46350	46550	46750	46950	47150	47350	47550	47750	47950	48150	48350	48550	48750	48950	49150	49350	49550	49750	49950	50150	50350	50550	50750	50950	51150	51350	51550	51750	51950	52150	52350	52550	52750	52950	53150	53350	53550	53750	53950	54150	54350	54550	54750	54950	55150	55350	55550	55750	55950	56150	56350	56550	56750	56950	57150	57350	57550	57750	57950	58150	58350	58550	58750	58950	59150	59350	59550	59750	59950	60150	60350	60550	60750	60950	61150	61350	61550	61750	61950	62150	62350	62550	62750	62950	63150	63350	63550	63750	63950	64150	64350	64550	64750	64950	65150	65350	65550	65750	65950	66150	66350	66550	66750	66950	67150	67350	67550	67750	67950	68150	68350	68550	68750	68950	69150	69350	69550	69750	69950	70150	70350	70550	70750	70950	71150	71350	71550	71750	71950	72150	72350	72550	72750	72950	73150	73350	73550	73750	73950	74150	74350	74550	74750	74950	75150	75350	75550	75750	75950	76150	76350	76550	76750	76950	77150	77350	77550	77750	77950	78150	78350	78550	78750	78950	79150	79350	79550	79750	79950	80150	80350	80550	80750	80950	81150	81350	81550	81750	81950	82150	82350	82550	82750	82950	83150	83350	83550	83750	83950	84150	84350	84550	84750	84950	85150	85350	85550	85750	85950	86150	86350	86550	86750	86950	87150	87350	87550	87750	87950	88150	88350	88550	88750	88950	89150	89350	89550	89750	89950	90150	90350	90550	90750	90950	91150	91350	91550	91750	91950	92150	92350	92550	92750	92950	93150	93350	93550	93750	93950	94150	94350	94550	94750	94950	95150	95350	95550	95750	95950	96150	96350	96550	96750	96950	97150	97350	97550	97750	97950	98150	98350	98550	98750	98950	99150	99350	99550	99750	99950	100150	100350	100550	100750	100950	101150	101350	101550	101750	101950	102150	102350	102550	102750	102950	103150	103350	103550	103750	103950	104150	104350	104550	104750	104950	105150	105350	105550	105750	105950	106150	106350	106550	106750	106950	107150	107350	107550	107750	107950	108150	108350	108550	108750	108950	109150	109350	109550	109750	109950	110150	110350	110550	110750	110950	111150	111350	111550	111750	111950	112150	112350	112550	112750	112950	113150	113350	113550	113750	113950	114150	114350	114550	114750	114950	115150	115350	115550	115750	115950	116150	116350	116550	116750	116950	117150	117350	117550	117750	117950	118150	118350	118550	118750	118950	119150	119350	119550	119750	119950	120150	120350	120550	120750	120950	121150	121350	121550	121750	121950	122150	122350	122550	122750	122950	123150	123350	123550	123750	123950	124150	124350	124550	124750	124950	125150	125350	125550	125750	125950	126150	126350	126550	126750	126950	127150	127350	127550	127750	127950	128150	128350	128550	128750	128950	129150	129350	129550	129750	129950	130150	130350	130550	130750	130950	131150	131350	131550	131750	131950	132150	132350	132550	132750	132950	133150	133350	133550	133750	133950	134150	134350	134550	134750	134950	135150	135350	135550	135750	135950	136150	136350	136550	136750	136950	137150	137350	137550	137750	137950	138150	138350	138550	138750	138950	139150	139350	139550	139750	139950	140150	140350	140550	140750	140950	141150	141350	141550	141750	141950	142150	142350	142550	142750	142950	143150	143350	143550	143750	143950	144150	144350	144550	144750	144950	145150	145350	145550	145750	145950	146150	146350	146550	146750	146950	147150	147350	147550	147750	147950	148150	148350	148550	148750	148950	149150	149350	149550	149750	149950	150150	150350	150550	150750	150950	151150	151350	151550	151750	151950	152150	152350	152550	152750	152950	153150	153350	153550	153750	153950	154150	154350	154550	154750	154950	155150	155350	155550	155750	155950	156150	156350	156550	156750	156950	157150	157350	157550	157750	157950	158150	158350	158550	158750	158950	159150	159350	159550	159750	159950	160150	160350	160550	160750	160950	161150	161350	161550	161750	161950	162150	162350	162550	162750	162950	163150	163350	163550	163750	163950	164150	164350	164550	164750	164950	165150	165350	165550	165750	165950	166150	166350	166550	166750	166950	167150	167350	167550	167750	167950	168150	168350	168550	168750	168950	169150	169350	169550	169750	169950	170150	170350	170550	170750	170950	171150	171350	171550	171750	171950	172150	172350	172550	172750	172950	173150	173350	173550	173750	173950	174150	174350	174550	174750	174950	175150	175350	175550	175750	175950	176150	176350	176550	176750	176950	177150	177350	177550	177750	177950	178150	178350	178550	178750	178950	179150	179350	179550	179750	179950	180150	180350	180550	180750	180950	181150	181350	181550	181750	181950	182150	182350	182550	182750	182950	183150	183350	183550	183750	183950	184150	184350	184550	184750	184950	185150	185350	185550	185750	185950	186150	186350	186550	186750	186950	187150	187350	187550	187750	187950	188150	188350	188550	188750	188950	189150	189350	189550	189750	189950	190150	190350	190550	190750	190950	191150	191350	191550	191750	191950	192150	192350	192550	192750	192950	193150	193350	193550	193750	193950	194150	194350	1

VECTREX
Engineering Inc.
2555 Highway 100
St. John's, NL A1B 2X9
Tel: (709) 753-6600
Fax: (709) 753-6601
www.vectrex.com

REVISIONS

No.	Description	Date
1	As Issued	11/25/09
2	Revised	11/25/09

VECTREX PROJECT INFORMATION

Project Name: BELLEKENO PROJECT
Project Location: MILL BUILDING
Drawing Title: GRADE BEAMS
Drawing No: RB501-02
Date: 11/25/09
Scale: As Shown

VECTREX DESIGN INFORMATION

Design Code: CANADIAN CODES
Design Standard: CANADIAN CODES
Design Basis: CANADIAN CODES
Design Assumptions: CANADIAN CODES
Design Notes: CANADIAN CODES

VECTREX DOCUMENT CONTROL

Document No: RB501-02
Revision No: 02
Revision Date: 11/25/09

VECTREX PROJECT TEAM

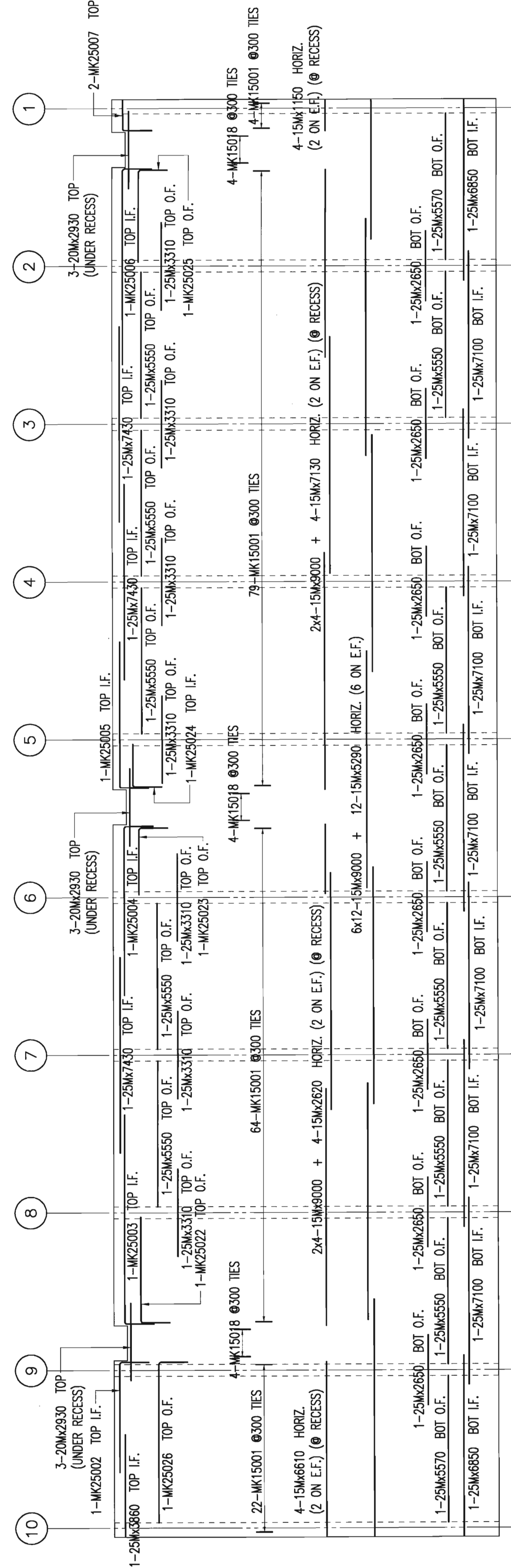
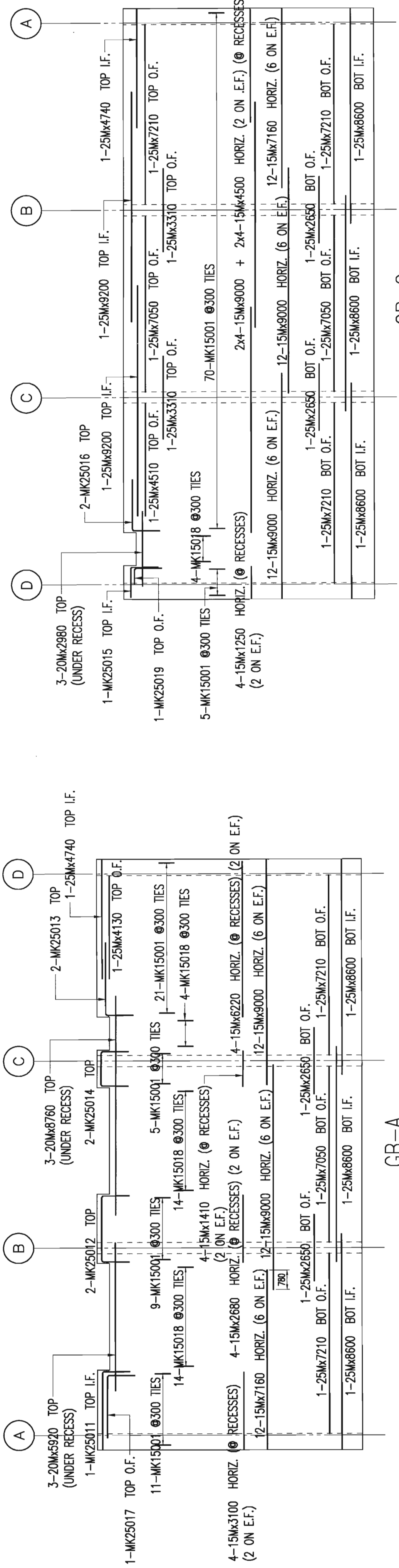
Project Manager: [Name]
Designer: [Name]
Checker: [Name]
Approver: [Name]

TYPICAL LAP SPLICES

TOP SPLICES	BOTTOM SPLICES
10M = 520	10M = 400
15M = 780	15M = 600
20M = 1040	20M = 800
25M = 1430	25M = 1100

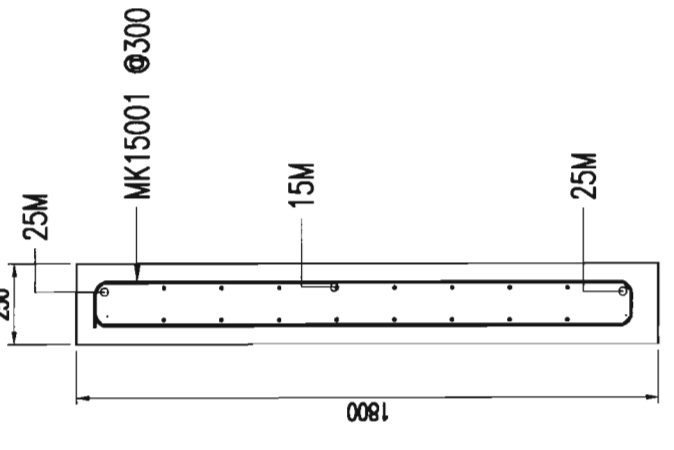
CONCRETE COVER

CONC. CAST AGAINST & EXPOSED TO EARTH: 75mm
CONC. EXPOSED TO GROUND OR WEATHER: 40mm for 15m or smaller, 50mm for 20m or larger



BENDING DETAILS FOR RUN: 6361-002

Bar Mark	Qty	Section	Length	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
6361	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6362	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6363	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6364	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6365	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6366	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6367	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6368	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6369	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6370	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6371	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6372	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6373	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6374	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6375	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6376	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6377	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6378	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6379	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6380	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6381	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6382	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6383	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6384	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6385	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6386	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6387	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6388	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6389	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6390	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6391	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6392	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6393	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6394	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6395	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6396	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6397	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6398	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6399	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6400	1	25Mx3100	3000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100



TYPICAL GB SECTION

Revisions and Issue Record

No.	Description	Date	By
1	Revised	11/25/09	NH

The full intent and purpose of this drawing is the placing of reinforcing steel bars ONLY. It is NOT to be used as a construction document for the Contractor or other Sub-Contractors. The Contractor or other Sub-Contractors shall be responsible for the interpretation of the drawing and for the construction of the project. THIS DRAWING IS NOT TO BE SCALED.

Harris Steel
6813 - LECUC STREET
ALBERTA
HARRIS STEEL SERVICES LIMITED FAX: (780) 986-2059
TEL: (780) 986-2059


Project: BELLEKENO PROJECT
MILL BUILDING
Drawing: GRADE BEAMS

Contractor: ALEXCO RESOURCE CORP.
Customer: ALEXCO RESOURCE CORP.
Refer to: Rev. No. 6361-002
Date Drawn: 11/25/09
Checked: [Name]
Dwg. No.: RB501-02
3/4/09/2004 OA | NH | 81386561

APPENDIX B

DESIGN CRITERIA

- i) CIVIL DESIGN CRITERIA
- ii) MECHANICAL DESIGN CRITERIA
- iii) PIPING DESIGN CRITERIA
- iv) BUILDING SERVICES DESIGN CRITERIA
- v) STRUCTURAL DESIGN CRITERIA
- vi) INSTRUMENTATION DESIGN CRITERIA
- vii) ELECTRICAL DESIGN CRITERIA

 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Checked By	Approved By	Project Manager	Client
A	21 Apr 2009	Issued for Internal Review	CW	MB		JA	
B	09 July 2009	Issued for Information	CW	MB		JA	



 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0	CODES AND SPECIFICATIONS	3
1.1	Federal Government of Canada.....	3
1.2	Roads and Transportation Association of Canada (RTAC)	3
1.3	Yukon Territorial Government.....	3
2.0	SITE INFORMATION.....	4
3.0	CIVIL SITE WORK CRITERIA	4
3.2	Aggregate Supply	4
3.3	Earth And Rock Work	5
4.0	ROAD DESIGN CRITERIA.....	5
5.0	DESIGN LOADS.....	6
5.1	Site Grading.....	6
5.2	Run-off Control	6

 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

1.0 CODES AND SPECIFICATIONS

Unless stated otherwise, the design of all structures and facilities will be based on, but not be limited to, applicable portions of the most current edition of the following codes, specifications, industry standards, regulations and other reference documents.

1.1 FEDERAL GOVERNMENT OF CANADA


- National Building Code of Canada
- Supplement No. 1 – Climatic Information for Building Design in Canada
- Northern Inland Waters Act and Regulations
- Fisheries Act and Regulations
- Territorial Lands Act and Regulations
- Yukon Territories Water Act and Regulations
- Explosives Act
- Guidelines for Canadian Drinking Water Quality, latest edition.
- Health and Safety Act
- Water License.

1.2 ROADS AND TRANSPORTATION ASSOCIATION OF CANADA (RTAC)

- Design of Surface Mine Haulage Roads-Bureau of Mines Information Circular 8758
- Geometric Design Standards for Canadian Roads and Streets
- Drainage Manual.

1.3 YUKON TERRITORIAL GOVERNMENT

- Mining Safety Act and Regulations
- Environmental Protection Act and Regulations
- Commissioner's Land Act and Regulations
- Explosive Use Act
- Fire Prevention Act
- Yukon Department of Transportation.

 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

2.0 SITE INFORMATION

.1 Survey Datum

The topographic mapping, horizontal and vertical control (metric elevations) for the project have been provided by the Owner. The project site horizontal co-ordinate and grid system is based on UTM Nad 83.

.2 Road Information

- Christal Lake Haul Road – (upgrade to existing road) ~ 1580 m long, running northeast from Duncan Creek Rd (existing Yukon Highways Road) to Silver Trail Highway.
- Flame and Moth Road – (new road) ~ 250 m long, running north from Duncan Creek Rd (existing Yukon terr. Rd) to the Flame and Moth Site.
- By-Pass Road – (new road) ~ running east from Duncan Creek Rd (existing Yukon Highways Road) to the Lightning Creek Bridge – Option 1 is 270 m and Option 2 is 150 m long.
- Twin Road – (new road) ~ 400 m long running southeast above the existing public road to the Bellekeno Power Line Road and Sourdough Hill Road junction.

3.0 CIVIL SITE WORK CRITERIA

.1 Cut-and-fill quantities shall be minimized by excavating a single level area for all buildings.

.2 Different levels of pads will be used as necessary to improve operating characteristics.


.3 Building outline to make best use of ground contours and geotechnical conditions.

.4 Ground survey shall confirm site elevations.

.5 Erosion control shall conform to the drainage/water management plan developed by the Geotechnical Engineer.

3.2 AGGREGATE SUPPLY

.1 Sub-base, maximum particle size 75 mm, to be used for road base material.

 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .2 Base, crushed material, maximum particle size 50 mm, to be used for road base material.
- .3 Surfacing, crushed material, maximum particle size 25 mm, to be used for road and plant site surfaces.

3.3 EARTH AND ROCK WORK

- .1 Recommendations on cuts, fills, compaction, material gradations, and temporary and permanent slopes to be confirmed by the Geotechnical Engineer.

4.0 ROAD DESIGN CRITERIA

- .1 The road design criteria of the road type is shown in Table 1. The design vehicle used as the basis of design criteria is shown in Table 2.
 - Roads shall be all-weather construction
 - Off-site drainage shall be diverted around the site (by others)
 - Alternating vehicular pull-outs every 500 m
 - All roads are one way radio controlled
 - Pull outs length equals 1.5 times the vehicle length
 - Pull outs width equals 1.5 times the operating width.

Table 1 Road Design Criteria

	Haul Road
Operating Width	4 m *
Design Speed	50 km/hr
Cross fall	2%
Maximum Grade	8%
Surface	200 mm
Base	300 mm
Sub-base	500mm
Cut Side Slope	1.5 : 1
Fill Side Slope	2 : 1
Subgrade Compaction	95%
Granular Compaction	100%

* Excludes berms and ditches on both side of haul roads.


 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

Table 2 Design Vehicle

Road Type	Haul
Design Vehicle	Volvo A30E
Width	2.94 m
Length	10.3 m
Height	3.3 m
Weight	51 060 kg

5.0 DESIGN LOADS

Volvo A30E 28 t capacity:


	<u>Loaded</u>	<u>Empty</u>
	51 060 kg	28 000 kg
Front Axle	14 990 kg	12 500 kg
Drive Axle	36 070 kg	15 560 kg
Wheel Base	2.216 m	
Tire Pressure	267 kPa	

5.1 SITE GRADING

- .1 Plant site final grading will be a minimum of 150 mm below adjacent floor slabs.
- .2 Plant site final grading will generally have a minimum finish grade slope of 2% away from structures towards storm drainage facilities.
- .3 The plant site area will generally be covered by 300 mm of Base material overlain with 200 mm of Surfacing material – subject to geotechnical conditions.

5.2 RUN-OFF CONTROL

- .1 Drainage outside the plant site or road will be the responsibility of others.
- .2 Within the plant site and building run off, resulting from rainfall, will be conveyed to drainage ditches by sloping the plant site surface.
- .3 Storm run-off quantities for small areas in the plantsite shall be determined by the Rational Method using a minimum time of concentration of 15 minutes.
- .4 Interception ditches will, where possible, divert non-contact runoff from areas uphill of the disturbed areas (this work by others).

 ALEXCO	CIVIL 31 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .5 Precipitation and freshet design data for run-off control/drainage facilities will be determined in consultation with the Owner and EBA.

- .6 Ditches shall be trapezoidal design with a 300 mm minimal bottom width. Ditch bottom will be 500mm below the road sub-grade. Side slopes shall not be steeper than 1 vertical, 1.5 horizontal. Longitudinal slopes shall ensure passage of run-off; where velocity exceeds 1.0 meters per second, ditch linings and energy dissipating structures will be provided. Ditching will be avoided in ice rich till areas.

- .7 Open channel flow calculations shall be made according to the Manning Formula.

- .8 Culverts will be galvanized corrugated steel pipe, with a 600 mm minimum diameter.

- .9 Culverts shall have a minimum backfill cover of 450mm or the diameter divided by 2, whichever is greater.

END OF SECTION

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

SPECIFICATION REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Checked By	Approved By	Project Manager	Client
A	01 May 2009	Issued for Internal Review	MM	AF		JA	BT
B	09 July 2009	Issued for Information	MM	AF		JA	BT

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0	GENERAL	3
1.1	Scope	3
1.2	Codes and Standards	3
1.3	Reference Specifications	4
1.4	Layout	5
1.5	Equipment Selection Criteria	5
1.6	Painting and Protective Coatings	7
1.7	Insulation	7
2.0	DESIGN CONSIDERATION	8
2.1	Process Equipment	8
2.2	Lifting devices	8
2.3	Steel Tanks	9
2.4	Fibre Reinforced Plastic (FRP) Vessels and Tanks	9
3.0	PROCESS DISTRIBUTION SYSTEMS	10
3.1	Compressed Air System	10
3.2	Reagent Systems	11
3.3	Lime slaking System	12
3.4	Flocculant System	13
3.5	Cement System	13
3.6	Fuel System	13
4.0	WATER AND SOLUTION PUMP SYSTEM	14
4.1	Water and Solution Pump	14
4.2	Potable Water System (by Others)	15
4.3	Reclaim Water System	15
4.4	Fresh Water System	15
4.5	Gland Water System	16
4.6	Mine Water System	16
4.7	Fire Water System	16
5.0	WATER AND SLURRY PUMP SYSTEM	17
5.1	Slurry Pumps	17
6.0	MATERIAL HANDLING	18
6.1	Conveyors	18
6.2	Belting	19
6.3	Chutes and Platework	19

 ALEXCO <hr/> WARDROP Engineering Inc.	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
---	--	--

1.0 GENERAL


1.1 SCOPE

- .1 This design criterion outlines the basis for the overall design parameters and criteria to be adopted in the selection of mechanical equipment and systems used for the project.
- .2 The Bellekeno Project consists of an underground zinc and lead mine. The run-of-mine-feed will be designed to crushed and feed at nominal 408 tonnes per day of ore feed to the grinding and flotation circuits. The process facilities will consist of a primary and secondary crushing facility followed by the grinding and flotation processes.

1.2 CODES AND STANDARDS

- .1 All design material, equipment manufacturing, fabrication, testing, installation and construction shall be in accordance with the latest edition of the applicable codes and standards of the following organizations. The organizations include, but are not limited to, the following:

ABMA	American Bearing Manufacturers' Association
ACI	American Concrete Institute
AGMA	American Gear Manufacturers' Association
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CEC	Canadian Electrical Code
CEMA	Conveyor Equipment Manufacturers' Association
CISC	Canadian Institute of Steel Construction
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
EEMAC	Electrical Equipment Manufacturers Association
FM	Factory Mutual
HI	Hydraulic Institute
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers


 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

IESNA	Illuminating Engineering Society of North America
IFE	Industrial Fasteners Institute
ISA	Instrument Society of America
ISMA	Industrial Silencer Manufacturers' Association
ISO	International Organization for Standardization
JIC	Joint Industrial Council
MHIA	Material Handling Industry of America
MHEA	Material Handling Engineers Association
MPTA	Mechanical Power Transmission Association
MSHA	Mine Safety and Health Administration
MSS	Manufacturers' Standardization Society
NACE	National Association of Corrosion Engineers
NBC	National Building Code of Canada
NEC	National Electrical Code (US)
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFC	National Fire Code
NFPA	National Fire Protection Association
NFPI	National Fluid Power Institute
OSHA	Occupational Safety and Health Act
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
RMA	Rubber Manufacturers' Association
SNT	Society of Non-Destructive Testing
SAE	Society of Automotive Engineers
SSPC	Steel Structure Painting Council
TEMA	Tubular Exchanger Manufacturers' Association
UL	Underwriters Laboratories
CUL	Underwriters Laboratories of Canada
WHMIS	Workplace Hazardous Materials Information System
YWCHSB	Yukon Workers' Compensation Health and Safety Board

- .2 The codes and laws of the Yukon Territory, municipality or jurisdiction may take precedence over the aforementioned codes.

1.3 REFERENCE SPECIFICATIONS

- .1 For equipment general specification, weather and all site data refer "02 10 00 – Site Conditions and Equipment Standards" unless otherwise noted in the equipment Criteria.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

- .2 For all piping data and information (pipe velocity, pipe material, buried pipe) see “40 00 00 Piping Design Criteria”.
- .3 For all structural data and information see “05 00 00 Structural Design Criteria”.
- .4 For all electrical data and information see “26 00 00 Electrical Design Criteria”.
- .5 For all instrumentation data and control information see “40 90 00 Instrumentation Design Criteria”.
- .6 For all building services datas, fire fighting systems and dust control systems information see “23 00 00 Building Services Design Criteria”.

1.4 LAYOUT

- .1 Equipment shall be arranged in accordance with the current and approved process flowsheets.
- .2 The design criteria for equipment layout are as follows:
 - Gravity and natural properties of material flow shall be utilized to the maximum extent possible, to reduce energy inputs.
 - Arrangements shall provide a smooth process flow, and allow for merging with other process flow streams.
 - All material transfer points shall be designed to minimize spillage.
 - Adequate accessibility and clearance around equipment shall be provided for operation and maintenance.
 - Suitable Safe Working Load (SWL) rated cranes, monorails and hoists shall be provided for operation and maintenance purposes and at all equipment that may require replacement.
 - Wherever possible, ladders and catladders shall be avoided, and only after discussion with the Owner and/or the Owner’s Representative shall they be used in a design.
 - Optimal use of the structures and available space within the structures shall be implemented.
 - Floors shall be suitably sloped and drains/sumps shall be provided and positioned at the lowest point to collect spillage and wash-down water. Each area’s slope will be determined based on possible spills particle size and will be shown on the layout drawings. The slope range will be between 2% to 10%.

1.5 EQUIPMENT SELECTION CRITERIA

- .1 Manufacturers and fabricators shall be given the latitude to use their experience to employ the best design, installation practice and/or procedure, except where the latter would

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

contravene Standard Operating Procedures (SOP) or other standards of the mine or this criteria.

- .2 The equipment shall be robust and fit for heavy-duty applications found in a mining environment.
- .3 All equipment shall be conservatively rated and sized to withstand capacity changes due to process upsets and variations.
- .4 All equipment shall be designed to meet site conditions, such as altitude, ambient temperatures, seismic, wind, rain, humidity and any corrosive surrounding atmosphere.
- .5 The equipment shall meet or exceed the project specified production requirements for the 10 years expected plant life.
- .6 Wherever possible, standard “off the shelf” equipment and components shall be used.
- .7 All materials used in the construction or assembly of equipment shall be new and free of any defects. Material Test Certificate (MTC) and (NDT) shall be requested where applicable.
- .8 The equipment shall meet or exceed the current environmental standards of the jurisdiction in which it is installed, as well as any environmental restriction(s) that could or should be anticipated.
- .9 Where required for operation, maintenance or cleaning, equipment shall be provided with appropriate access. This access may include stairs and/or ladders, walkways and platforms complete with handrails, kneerails and kickboards that comply with the current applicable health and safety regulations.
- .10 All equipment shall be designed and/or selected in accordance with the process and site condition requirements. Other factors to be considered for equipment selection shall include the following:
 - Maximization of personnel health, safety and protection.
 - Ease of installation, operation, inspection, cleaning, maintenance, equipment removal and repairs.
 - Minimization of vibration and excessive noise.
 - Minimization of thermal expansion stresses.
 - Maximization of standardized components.
 - Availability of spare parts.
 - Demonstrate a successful operational history of comparable equipment and components in similar installations.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project


- .11 Noise levels shall be controlled and not exceed the most stringent of the values stated in MSHA regulations or “02 10 00 – Site Conditions and Equipment Standards”.
- .12 All equipment heavier than 34 kg shall be provided with lifting lugs or another convenient lifting arrangement.
- .13 Personnel health, safety and protection shall be prime factors in the mechanical design and layout of equipment. Equipment shall be in complete accordance with MSHA, NFC, OSHA and all other applicable codes and regulations.
- .14 All mechanical moving parts shall be guarded. The design of the guards shall allow their removal without having to remove other items of equipment.
- .15 All openings, sumps, vessels, bins, hoppers, elevated platforms or pits that constitute a hazard shall be adequately fenced or otherwise guarded.
- .16 Equipment shall be provided with appropriate access areas where required for operation, maintenance or cleaning.

1.6 PAINTING AND PROTECTIVE COATINGS

- .1 Manufacturer standard coating system shall be used for all supplied equipment. Suppliers shall provide their painting system for Owner and/or the Owner’s Representative review.
- .2 For all fabricated items such as tanks and steel works for mechanical equipment surface preparation, priming and finish coating shall comply with “02 10 00 Site Conditions and Equipment Standards”.
- .3 Under no circumstances shall machined parts be packaged for delivery without a suitable protective coating.

1.7 INSULATION

- .1 Wherever insulation is required, Supplier’s standard insulation shall be used only after Supplier’s proposed insulation system has been reviewed by the Owner and/or the Owner’s Representative.
- .2 Insulation thickness shall be calculated and insulation/cladding material shall be selected as per whether data outlined in “02 10 00 Site Conditions and Equipment Standards”.
- .3 All other insulation requirements shall conform to insulation specification and Health and Safety Regulations, provided by the Owner and/or the Owner’s Representative.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

2.0 DESIGN CONSIDERATION

2.1 PROCESS EQUIPMENT

- .1 Process equipment shall be specified in accordance with the process design criteria and flow sheets.
- .2 All process equipment design flows rates are based the plant design feed rate as stated in the Process Design Criteria and flow diagrams so no safety factor/margins shall be added to the equipment flow rates and throughputs specified in the Process Design Criteria or flow diagrams.


2.2 LIFTING DEVICES

CRANES & HOISTS

- .1 All cranes and hoists shall be designed, manufactured, tested and certified in accordance with the latest applicable editions of Crane Manufacturers Association of America (CMAA) Specifications #70 and #74 as well as the Hoist Manufacturers Institute (HMI) specification "100-74 – Standard Specification for Electric Wire Rope Hoists".
- .2 The Mill building will be equipped with two cranes on the same rail. The large crane (25 t) shall be used for erection and heavy maintenance purposes. A small crane (5 t) shall be used for light maintenance duties. The cranes have been selected based on the heaviest possible load during maintenance/erection period, as applicable.
- .3 The crushing area crane (5 t) shall be used for maintenance purposes only. The crane capacity may not cover the weight of the heaviest possible load during maintenance period in this area.

MONO RAILS

- .1 Monorail hoists shall be designed, manufactured, tested and certified in accordance with the latest applicable editions of Crane Manufacturers Association of America (CMAA) Specifications #70 and #74 as well as the Hoist Manufacturers Institute (HMI) specification "100-74 – Standard Specification for Electric Wire Rope Hoists".
- .2 A mono rail crane for the reagent area shall be provided. The hoist capacity shall be adequate for lifting and loading/unloading of the reagent bags and or drums.
- .3 A mono rail crane for the rod mill bin area shall be provided. The hoist capacity shall be adequate for maintenance of the bin vent system.
- .4 A mono rail crane for the crushing and screening conveyor tower shall be provided. The hoist capacity shall be adequate for maintenance of the bin vent system.

 ALEXCO WARDROP Engineering Inc.	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
---	--	--

2.3 STEEL TANKS

- .1 Tank sizing shall be as specified in the process design criteria and flow sheets.
- .2 Steel tanks can be bolted (only for field erected tanks) or welded construction.
- .3 Any tanks with the diameter less than 4200 mm shall be shop fabricated. All other larger diameter tanks shall come in maximum possible shippable sizes to reduce workmanship at site.
- .4 Tanks shall be designed with a minimum 300 mm freeboard for surges. Frothing allowance shall be determined on a case-by-case basis. Overflow will be designed for 150% of inflow capacity, and routed to the floor, which will be sloped to a sump or trench. Tank materials shall be suitable for the application and shall be evaluated on a case-by-case basis.
- .5 Outdoor tanks shall be heated and insulated as per process requirements for freeze protection. Heating will be electrical and if tanks require heat tracing, tank fabricator shall provide lugs or clips for tracing installation.

2.4 FIBRE REINFORCED PLASTIC (FRP) VESSELS AND TANKS

- .1 Process equipment shall be specified in accordance with the process design criteria and flow sheets.
- .2 FRP Vessels and Tanks shall be designed to the requirements of ASME RTP-1 "Reinforced Thermoset Plastic corrosion Resistant Equipment" latest edition or BS 4994 "Design and Construction of Vessels and Tanks in Reinforced Plastic".
- .3 Tanks shall be designed with a minimum 300 mm freeboard for surges. Frothing allowance shall be determined on a case-by-case basis. Overflow will be designed for 150% of inflow capacity, and routed to the floor, which will be sloped to a sump or trench.
- .4 The FRP tank agitators (if any) shall be preferably supported from separate steelwork above the tanks, thus limiting the static and dynamic loads on the tank walls.
- .5 Where applicable, tanks shall be fitted with lifting lugs at suitable positions to ensure a level lift. Each individual lug shall be designed to support the total tank weight and stiffeners shall be added to ensure that no deformation of the tank occurs during installation.

 ALEXCO WARDROP Engineering Inc.	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
---	--	--

3.0 PROCESS DISTRIBUTION SYSTEMS

3.1 COMPRESSED AIR SYSTEM

- .1 Compressed air system shall be designed considering maximum operational flexibility, good efficiency over a wide range of operating conditions, low maintenance and lifecycle cost with highest availability.
- .2 Three separate compressed air system shall be provided for:
 - Mill building compressed air system to provide both plant and instrument air; complete with air receivers and air dryer. This system will also provide compressed air for the underground mine operations.
 - Crusher building compressed air system for plant and instrument air c/w air receiver and air dryer. This shall provide compressed air for maintenance (tools) and instrumentation.
 - Boiler house compressed air system for plant air c/w air receiver. This system will provide compressed air for soot blowing at the boilers.
- .3 All compressor stations will be indoors.
- .4 The Mill building compressors will supply compressed air to the following areas/equipment:

Area/Equipment	Pressure (kPa)	Air Receiver	Note
Mine area	690	No	
Mills clutches	690	Yes	
Filter presses	690	Yes	Pressure to be confirmed
Mill building	690	Yes	General use
Disc Filter	690	Yes	
Column Cells	690	Yes	
Instrument air	690	Yes	Dry air (separate piping system)

- .5 The following air tools shall be used in the compressed air capacity calculation for the mill building compressed air system:

Tools	Quantity	Air Requirements (Nm ³ /min)	Service Factor	Note
Grinders	5	1.4	10%	
Drills	5	2.5	10%	
Wrenches	6	2.5	10%	
Chipping hammers	1	1	10%	
Paint spray	4	0.5	5%	

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .6 The crusher building compressor will supply compressed air to the following areas/equipment:

Area/Equipment	Pressure (kPa)	Air Receiver	Note
Instrument air	690	Yes	Dry air

- .7 The following air tools shall be used in the compressed air capacity calculation for the crusher building compressed air system:

Tools	Quantity	Air Requirements	Service Factor	Note
Grinders	5	1.4	10%	
Drills	5	2.5	10%	
Wrenches	6	2.5	10%	
Chipping hammers	1	1	10%	
Paint spray	4	0.5	5%	


- .8 The boiler house compressors will supply compressed air to the following areas/equipment:

Area/Equipment	Pressure (kPa)	Air Receiver	Note
Soot blowing	690	Yes	

- .9 Compressors shall be a packaged skid mounted type, electric motor driven, air cooled screw compressors that provide instrument air, plant air and mining air for the entire facility.
- .10 A safety factor of 30% will be applied to the final air requirements.
- .11 The mill building compressed air system will be designed for “n + 1” units where n is the number of units required to be running continuously to handle the projected continuous operating load.
- .12 No stand by units will be considered for the crusher building and the boiler house compressed air systems.
- .13 Compressors shall be rated considering site conditions and elevation as specified in “02 10 00 – Site Conditions and Equipment Standards”. Air compressors shall be derated for the site condition and elevation.
- .14 Instrument air systems for the mill building and crusher building shall have their own air filter, heatless desiccant type air dryer for instrument air supply and air receiver.

3.2 REAGENT SYSTEMS

- .1 Reagent system consists of the following units:

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

- SIPX system, in drums with 14 days of storage
- Copper sulphate system, in 1000 kg tote solid
- Sodium Sulphite System
- Zinc sulphate system, in 25 kg bags
- Bulk hydrated lime system (Quick Lime)
- Flocculant system (Magnafloc 10)
- Aeropline 3418A Collector system, in drums
- MIBC system, in drums

- .2 Reagent systems shall be sized and designed based on the Process Design Criteria and flow diagrams.
- .3 All reagent packages equipment will be specified individually and form part of different packages, such as tank package, mixer package and metering pump package.
- .4 Reagent systems with common non toxic and non hazardous properties will each have a separate containment area. Possible spills for such reagents will be collected in each sump individually.
- .5 Reagent systems with toxic or hazardous or specific properties will have dedicated containment areas. Possible spills for such reagents will be collected separately.
- .6 A minimum of two weeks of total reagent supply will be stored at site.
- .7 Reagent delivery and handling will be as per Process Design Criteria.

3.3 LIME SLAKING SYSTEM

- .1 Lime slaking system will be sized and designed based on the Process Design Criteria and flow diagrams.
- .2 Lime will be delivered in powder.
- .3 Lime slaking system exclusive of the holding tank and pump will be specified as a packaged unit.
- .4 Lime will be delivered by truck in bulk.
- .5 This package shall consist of a transfer system, a silo, a feeder, mixing tank, agitator and circulating pumps as per process flow diagrams.
- .6 Lime for slaking will be measured by timing control at the feeder.
- .7 Lime feed to the process will be by metering pumps.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

3.4 FLOCCULANT SYSTEM

- .1 Flocculant system will be sized and designed based on the Process Design Criteria and flow diagrams.
- .2 Flocculant will be delivered in 25kg bags.
- .3 Flocculant system will be purchased as a vendor package.
- .4 Flocculant will be delivered to site in bags.
- .5 This package shall consist of a bag breaking system, a hopper, a screw feeder, blower, mixing tank and mixer as per process flow diagrams.
- .6 Flocculant feed to the process will be by metering pumps.

3.5 CEMENT SYSTEM

- .1 Cement system will be sized and designed based on the Process Design Criteria and flow diagrams.
- .2 Cement system will be purchased as a package. Suitable for reclaiming cement, delivered to site by truck or 5 tonne jumbo bags.
- .3 This package shall incorporate an emptying system suitable for both truck and jumbo bag deliveries, a 500 tonnes silo, a screw feeder and transfer system. The area layout will further define possible additional requirements for jumbo bags handling and storage.

3.6 FUEL SYSTEM

- .1 Fuel system will be a design, supply and installation package. Supplier shall design supply all necessary equipment including fuel delivery system from the fuel tanker to the storage tanks including pumps (if necessary), dispensers, internal piping and instrumentation on the tank farm and transfer system. Inter connection piping shall be recommended but excluded.
- .2 Three types of fuel shall be used as follows:
 - Diesel fuel oil for diesel generator sets, boilers and surface vehicles
 - Diesel fuel for underground mine mobile fleet (low sulphur)
 - Gasoline for light vehicles
- .3 Diesel fuel oil shall be Arctic type suitable for the climatic conditions.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .4 Fuel delivery shall be by Fuel tanker. Fuel tanker size and fuel delivery frequency shall be as per supplier's recommendations.
- .5 Fuel tank(s) capacity shall be sized based on storage duration as specified below:


Consumer	Fuel type	Storage Required (days)	Total Storage (m³)
Diesel generators, surface fleet	Diesel fuel	14	840
Mine trucks	Diesel fuel (low sulphur)	14	200
Gasoline vehicles	Gasoline	14	2.5

- .6 Fuel tank(s) shall be aboveground, single wall, vertical or horizontal. Supplier to recommend tank type and size. All tanks will be located in a dike area to prevent any possible contamination (environmental permit requirements). Dike area's volume shall meet all necessary applicable codes requirements and at minimum shall be large enough to contain 110% of the largest tank volume.
- .7 Feed to the diesel generator sets will be via day tanks supplied by diesel generator units.
- .8 Fuel filling dispensing stations shall have spill containment pads.

4.0 WATER AND SOLUTION PUMP SYSTEM

4.1 WATER AND SOLUTION PUMP

- .1 Pump design flow rates will be operating flowrates as specified in the Process Flow Diagrams multiplied by a process variation factor of 1.2.
- .2 System friction head losses shall be calculated using the Darcy or Hazen and Williams formulae.
- .3 The rated impeller size shall not exceed 90% of the maximum impeller size and not less than 110% of the minimum impeller size.
- .4 Pump TDH will be calculated based on the design flow rates (excluding the froth factor). The design factor for TDH will be 20% on friction loss or 1.1X of TDH, which ever is greater.
- .5 Where possible the operating point on the head-capacity curve shall be close to, or just to the left of, the best efficiency point shown on the pump performance curve.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

- .6 Particular attention shall be paid to the NPSH requirement. Available NPSH shall exceed required NPSH by a minimum of 10% or 1 m, whichever is greater.
- .7 Open type impellers are preferred whenever entrained air is likely.
- .8 A 20% contingency will normally be added to calculated friction heads.

4.2 POTABLE WATER SYSTEM (BY OTHERS)

- .1 Potable water system will be design as per the Process Design Criteria and flow diagrams.
- .2 Well water will be pumped to potable water treatment package and treated water stored in a Potable water storage tank. Potable water is then distributed by potable water distribution pumps.
- .3 Pump flow will be as per process design criteria and pump head will be calculated based on the maximum pressure requirements at the farthest consumer.

4.3 RECLAIM WATER SYSTEM

- .1 Reclaim water system will be design as per the Process Design Criteria and flow diagrams.
- .2 Reclaim water from the Tailing Ponds and Underground Mine Water Settling pond will be collected in the Reclaim Water tank. Water will be distributed by Reclaim Water pumps.
- .3 The Reclaim Water Pumps flow will be as per process design criteria and pump head will be calculated based on the maximum pressure requirements by the farthest consumer.
- .4 The Reclaim water pumping system and related piping design shall consider the requirement for ensuring the system operating integrity for the climatic condition.

4.4 FRESH WATER SYSTEM

- .1 Fresh water system will be designed as per the Process Design Criteria and flow diagrams.
- .2 Fresh water from the mine dewatering lines will be collected in the Fresh Water Pond.
- .3 Collected water in the Fresh Water Pond will be transferred to the fresh water tank by Fresh water pond pumping system. Water from this tank will be distributed by the fresh water pump and distribution system.
- .4 Pump flow will be as per process design criteria and pump head will be calculated based on the maximum pressure requirements by the farthest consumer.

 ALEXCO <hr/> WARDROP Engineering Inc.	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
---	--	--

4.5 GLAND WATER SYSTEM

- .1 Gland water flow requirements will be as per the Process Design Criteria and flow diagrams.
- .2 Gland water pressure (P) for each pump will be calculated as follows:
 - $P = \text{Suction pressure} + 0.25 \times (\text{Discharge pressure} - \text{suction pressure}) + 100 \text{ kPa}$
- .3 Gland water will be distributed by the gland water pumps from the fresh water tank. For high pressure gland water requirements a separate high pressure pump will be provided.
- .4 Pump flow will be as per process design criteria and pump head will be calculated based on the maximum pressure requirements by the gland of the farthest pump.

4.6 MINE WATER SYSTEM

- .1 Mine water system will be as per the Process Design Criteria and flow diagrams.
- .2 Mine contact water will be collected in the underground mine water settling ponds No. 1 and 2. The collected water will be transferred to underground for mining purposes, to the reclaim water tank and also for distribution to hose stations in the mill building.
- .3 Pump flow will be as per Process Design Criteria and pump head will be calculated based on the maximum pressure requirements at the end point.

4.7 FIRE WATER SYSTEM

- .1 Fire water system will be as per The Fire Protection Design Criteria.
- .2 Fire water tank will be fed by the well water pumps. Fire water will be transferred into the distribution system by fire pumps. Pumps type and quantity will be as per Fire Protection Design Criteria.
- .3 A jockey pump will keep the fire water ring under pressure.
- .4 Pump flow will be as per Fire Protection Design Criteria and pump head will be calculated based on the maximum pressure requirements by the farthest hydrant/user.
- .5 Fire water tank and fire pumps for the camp will be by others. Tie in point on the tank will be provided to connect to the fire pumps for industrial area.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

5.0 WATER AND SLURRY PUMP SYSTEM

5.1 SLURRY PUMPS

- .1 Pump design flow rates will be operating flowrates as specified in the Process Flow Diagrams multiplied by a process variation factor of 1.1 and a mechanical flow factor to compensate impeller wear equal to 1.05 to 1.1.
- .2 The rated impeller size shall not exceed 90% of the maximum impeller size and not less than 110% of the minimum impeller size.
- .3 Pump TDH will be calculated based on the design flow rates (excluding the froth factor). The design factor for TDH will be 20% on friction loss or 1.1X of TDH, which ever is greater.
- .4 When pumping slurries, head losses and pump hydraulic efficiencies shall be adjusted where appropriate to reflect the "solids effect" of the slurry. The pump supplier shall confirm the head and efficiency de-rating factors used to calculate pump speed and brake power (kW).
- .5 When pumping abrasive slurries, impeller tip speeds shall preferably not exceed 19 m/s for rubber lined impellers and 25 m/s for hard metal impellers.
- .6 Where possible the operating point on the head-capacity curve shall be close to, or just to the left of, the best efficiency point shown on the pump performance curve.
- .7 Previous experience of pumping similar slurries shall be employed to specify the type of material to be used for the impellers and casings. Supplier recommendation shall also be requested.
- .8 Particular attention shall be paid to the NPSH requirement. Available NPSH shall exceed required NPSH by a minimum of 10% or 1 m, whichever is greater.
- .9 Open type impellers are preferred whenever entrained air is likely.
- .10 Froth factor will applied to pump flow rates as necessary.
- .11 The froth factor is a multiplier that increases the process design capacity to allow for the increased passing volume caused by the gas in the froth. The factored volume usually causes the pump to be at least one pipe size larger than would normally be selected. Depending on the manufacturer and the application, the factor applied will vary; typical values are 1.5 to 4. Froth factor for each pump will be applied as necessary. Froth factors value will be shown in pumps schedule as per process requirements.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

6.0 MATERIAL HANDLING

6.1 CONVEYORS

- .1 Design factor shall be 1.2.
- .2 The conveyors shall operate at fixed speed.
- .3 Maximum speed of conveyors shall not exceed 1.5 m/s.
- .4 Maximum angle of incline at all loading zones shall be limited to seven (7) degrees.
- .5 Maximum incline of rock and tailing conveyor shall not exceed fifteen (15) degrees.
- .6 Conveyors shall be selected for the design capacity tonnage as shown in Data Sheets.
- .7 Belt sag on carry side shall not exceed 2%.
- .8 Belt sag on the return side of the belt shall not exceed 3%.
- .9 All belt transition distances at the tail pulley loading zone shall be “full trough” design, and the length shall be according to CEMA’s latest edition for specific trough angle.
- .10 All belt transition distances at the discharge point shall be “half trough” design, and the length shall be according to CEMA’s latest edition for specific trough angle.
- .11 All conveyors shall be designed in accordance with the most current issue of the Conveyor Equipment Manufacturer’s Association (CEMA) manual.
- .12 Snub pulleys or other measures shall be utilized to ensure a positive traction of the driven pulley to ensure no belt slippage. Any modulus operandi with the exception of the snub pulley is subject to approval by the Owner's Representative.
- .13 Conveyor size optimization shall be given high priority.
- .14 Each conveyor shall have one primary and one secondary belt cleaner, and single mining duty V or Diagonal Plow.
- .15 Tracking of the belt shall be supported by Tru-Trainers, no substitution.
- .16 Impact absorbing media at any impact loading zone shall be impact cradles (beds).
- .17 Belt support at non-impact areas shall be provided by means of support cradles (beds).
- .18 Minimum maintenance clearances shall be as per “02 10 00 – Site Conditions and Equipment Standards”.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

- .19 All skirting shall be self adjusting/tensioning type that follows belt undulations, keep positive contact, and comes in contact with the belt at trough angle– 20 degrees. The rubber shall be wear resistant type.

6.2 BELTING

- .1 Crushing Conveyors and the Belt Feeders shall have RMA – 1 or better impact-rip-tear resistant grade of rubber covers.
- .2 Process conveyors shall have RMA – 2 grade of rubber covers.
- .3 Fabric for crushing conveyors shall have high impact-rip-tear resistance. Straight–warp such as in US-Flex type of belts is recommended.
- .4 Grade of rubber covers shall be selected in compliance with climatic conditions defined in “02 10 00 – Site Conditions and Equipment Standards”.


6.3 CHUTES AND PLATEWORK

- .1 Chute shall be designed according to “02 10 00 – Site Conditions and Equipment Standards”, and 05 00 00 – “Structural Design Criteria”.
- .2 All chutes and skirtboards shall be designed to withstand plugged conditions, impact and wear without deformation or failure of the walls and/or structural steel members or platework, and to loosen the bonding between wear liners and the plates.
- .3 Minimum cross sectional area of the chute shall be not less than four (4) times the cross sectional area of the load operating at full capacity.
- .4 Chutes shall be equipped with inspection doors placed on the “clean” side of the chute.
- .5 Chutes shall be designed so the trajectory shall strike material contained in the rock boxes or where unavoidable liner plates.
- .6 The minimum valley angle in chutes shall be 60 degrees from the horizontal where achievable.
- .7 Material free fall height shall be limited where practical by use of rock boxes or accelerating chutes where applicable.
- .8 Wherever possible, chute exits shall be designed to transfer the momentum of the material in the direction of flow of the downstream equipment.
- .9 Where required, multiple material diversions of flow paths (multiple rock boxes) shall be put into service.

 ALEXCO	MECHANICAL 41 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .10 “Accelerating” chute design shall be employed for chutes transferring material from slow moving belts, feeders onto much faster moving belt conveyors.
- .11 The Mass Flow chute design shall be implemented for bin discharge where possible, in order to improve material evacuation.
- .12 Chute design shall allow sufficient space for installation of a secondary cleaner within the chute where possible.
- .13 Chute back walls beyond the secondary cleaner shall have a minimum angle of 70 degrees.
- .14 Any non impact wall that shall have contact with removed carryback shall be lined with low friction material (UHMW) or similar liner.
- .15 Chute sections shall be flanged for field bolting and shall be made dust- tight by sealing the joints with rubber or felt gaskets. Flange connections shall be straight and welds shall be continuous.

END OF DESIGN CRITERIA

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Checked By	Approved By	Project Manager	Client
A	21 Apr 2009	Issued for Internal Review					
B	09 July 2009	Issued for Information					



 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0	SCOPE.....	3
2.0	CODES AND STANDARDS.....	3
2.1	Requirements	3
2.2	Other Requirements.....	3
3.0	GENERAL DESIGN DEFINITIONS.....	4
3.1	Design Pressure	4
3.2	Design Temperature	4
4.0	PIPING MATERIALS AND METHODS.....	4
4.1	General.....	4
5.0	PIPING DESIGN	5
5.1	Line Sizing Criteria.....	5
5.2	Line Sizing	5
5.3	Pipe slopes	6
5.4	Launders.....	6
5.5	Slurry Piping	7
5.6	Gravity Flow Pipelines	8
5.7	Solution Piping.....	9
5.8	Water Piping	9
5.9	Air Piping	10
5.10	Utility Piping.....	10
5.11	Personnel Protection.....	10
5.12	Insulation and Heat Tracing	11
6.0	GENERAL PIPING LAYOUT.....	12
6.1	Installation	12
6.2	Pipe Identification	14
7.0	STRESS ANALYSIS.....	15
8.0	VALVES.....	15

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

1.0 SCOPE

This Piping Design Criteria outlines the basis for the overall design of the piping systems, and the general requirements of the piping components and drawings.

All measurements (lengths, flows, pressures, temperatures) will be expressed in units of the metric system.

The base design codes shall be CSA Standard B51-2003.

2.0 CODES AND STANDARDS

2.1 REQUIREMENTS


The components of piping systems will comply, as a minimum and as appropriate, with the following standards. In the event of a conflict between codes and the technical specifications, the requirements of the more stringent shall govern:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASME B31.1	Code for pressure Piping "Power Piping"
ASTM B31.3	Code for "Chemical Plant and Petroleum Refinery Piping"
ASTM	American Society for Testing and Materials
AWWA	American Water Works Associations
AWS	American Welding Society
CSA	Canadian Standards Association
HIS	Hydraulic Institute Standards
NBC	National Building Code of Canada
NFC	National Fire Code
NFPA	National Fire Protection Association
PFI	Pipe Fabricators Institute
PPI	Plastic Pipe Institute
ULC/FM	Underwriters Laboratories Canada/Factory Mutual

2.2 OTHER REQUIREMENTS

Pressure piping systems such as steam, condensate, glycol, etc. are subject to design registration and shall be submitted for approval by the appropriate authorities.

All drawings associated with fire protection shall be submitted to the local Fire Marshal and to the insurance underwriter for approval (not required for the DFS).

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

3.0 GENERAL DESIGN DEFINITIONS

3.1 DESIGN PRESSURE

- .1 Design pressure shall be the most severe condition of internal or external pressure under normal operating conditions.
- .2 Normal operating condition is the most severe condition of pressure and temperature expected to exist when continuous operating conditions are in progress.
- .3 Normal operating conditions do not include pipe pressure testing and abnormal system operation.
- .4 Design pressure for unrelieved piping on pumped systems shall be the pump shut-off discharge pressure.
- .5 Design pressure for vacuum piping shall be full vacuum pressure.
- .6 Minimum design pressure shall be 1034 kPa.
- .7 Where two piping systems of different design pressures are connected, the piping system with the higher pressure will extend to the first block valve on the lower system.


3.2 DESIGN TEMPERATURE

- .1 Design temperature will be the maximum temperature under normal operating conditions as defined above.
- .2 Design temperature will be consistent throughout the complete system.

4.0 PIPING MATERIALS AND METHODS

4.1 GENERAL

- .1 Pipes, pipe components and valves will be classified primarily in accordance with material of pipe and components and each class group will be given a secondary classification based on service performed and/or pressure/temperature ratings. For reference see Piping Materials and Methods Specification 40 05 00.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

.2 The specification for the materials includes the following:

- Piping Specification General
- Piping Materials Class Index
- Pipe Support Specification Index
- Line List
- Valve List
- Tie-in list
- Pipe Materials Specifications
- Valve Specifications
- Rubber Lining
- Thermal Insulation
- Painting Labels & Colours
- Gasket Specification

5.0 PIPING DESIGN


5.1 LINE SIZING CRITERIA

Table 1.0 Line Sizes

Description		Velocity m/s
Slurries General	pump discharge	1.2 - 2.1
	gravity flow	0.5 - 1
Process Solutions Lines	pump discharge	2.0 - 2.5
	gravity flow	2.0 - 3.0
Air		15.0 - 30.0
Steam		30.0 - 45.0
Water	pump discharge	2.0 - 3.0
	gravity flow	2.0 - 3.0
Flocculant	pump discharge	0.25 - 0.5
Fuel Oil	pump discharge	1.0
Reagent	pump discharge	0.7

5.2 LINE SIZING

- .1 All piping sizes will be expressed in nominal pipe size using Metric Units.
- .2 Piping shall be sized for flowsheet design rated flow conditions. Provision for future increase in capacity shall be made only when specifically requested by client.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .3 Nominal Pipe size diameters 125mm, 175mm, 225mm, 325mm, 550mm, 800mm, shall not be used, except where required to connect to equipment. Conversion to standard piping shall be as near the equipment as possible.
- .4 Minimum pipe size run shall be 25mm except for connections to equipment, instrument services, lube oil piping and auxiliary services such as pump and x-ray tube cooling.
- .5 In pipe utilidors the minimum pipe size shall be 50mm
- .6 General pipe sizing will be based on:
 - Historic data for similar projects
 - Economics
 - Available pressure drop and power consumption
 - Velocity limitations
- .7 Pump suction lines will be at least one size larger than pump suction flange size.
- .8 Gravity piping shall be sized in general to provide maximum design flow at 50 – 60% full pipe.
- .9 Control valve bypasses on slurry piping shall be line size and on solution, air, and steam piping shall be control valve size.


5.3 PIPE SLOPES

Table 2.0 Pipe Slopes

Description	Nominal Size Fraction (mm)	Percent Solids (%)	Minimum Slope (angle)
Slurries	-	-	1 – 2
Solutions	-	-	0.5 – 1
Air and Vents	-	-	0.5 - 1
Steam and Condensate	-	-	0.5 – 1
Water	-	-	0.5 - 1

5.4 LAUNDERS

- .1 Launders are defined as an open channel for carrying suspended solids in water under gravity flow conditions. Although launder sizes are calculated, specified and


 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

verified by the Process and Mechanical Engineering groups, Launder design generally conform to the following guidelines:

- The quality that will flow in as open channel is dependent on several factors, which are the cross-sectional area of the flow stream, the slope of the launders, the roughness condition of the sides and bottom of the launder and the shape of the launder as well as the flow characteristics of the pulp itself. The preferred shape of the launder is the semi-circular bottom-type, where it is possible to use. This particular shape reduces the hydraulic radius, thus allowing for a lesser slope and still maintaining a required velocity. Flat bottom launders may be used where connections to distributors are rectangular in shape. Flat bottom launders may also be used where gravity flow pipelines are collected by a common launder.
- For each launder, minimum geometric parameters to ensure adequate flow, including slopes and sizes, shall be determined by appropriate calculation methods – the Colebrook White Formula, Manning formula or an approved equivalent.
- Slurry launders will have a minimum total depth of four times the flow depth.

5.5 SLURRY PIPING

- .1 All piping shall be routed as direct as possible to its destination minimizing the use of bends, and decreasing the chance of abrasion and plugging.
- .2 All piping shall be routed above ground whenever possible.
- .3 Erosive slurry service piping shall be rubber lined with natural rubber. Rubber lining thickness shall be minimum 6mm for pipes up to 200mm in diameter and 12mm for pipes larger than 200mm in diameter. For full details of rubber lining refer to Rubber Lining Specification 40 05 08.
- .4 Pipe bends shall have a minimum radius of three pipe diameters (3D) for pipe size 76mm and above. Five pipe diameters (5D) for pipe sizes 50mm and below unless layout constraints determine otherwise. Where necessary, material conducting hose will be used in place of bends.
- .5 Piping will be jointed to allow for rotating of spools. Rotating will extend the life of the pipe spools by allowing even distribution of wear due to abrasion.
- .6 Drain and flushing connections shall be provided on all pump suction and be of the quick disconnect type. For header sizes 100 mm and smaller ball type block valves shall be used for both drainage and flushing. For header sizes 200 mm and above Knifegate type valves shall be used for drainage and Butterfly valves shall be used


 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

for flushing. Flushing lines 50 mm and larger will be hard piped. All piping will be self draining with high point vents and low point drains located to facilitate maintenance and hydro testing.

- .7 Block valves shall be knifegate type fitted with replaceable natural gum rubber sleeves which allow full port flow and eliminate seat cavities preventing packing of the sleeve with solids. On smaller line sizes full port fully enclosed body style replaceable natural gum rubber sleeve pinch valves or diaphragm shall be provided.
- .8 Pump suction lines shall be minimum length and the use of bends or valves will be kept to a minimum. Suction piping shall be sloped down from the pumpbox to the pump suction inlet and have fabrication reducers with 10° included angle wherever possible.
- .9 High abrasion slurries shall be Carbon Steel extra heavy wall pipe butt welded and flanged, or Standard wall rubber lined pipe.
- .10 Low abrasion slurries shall be Standard wall pipe butt welded and flanged.
- .11 Slurry lines outside of buildings or heated areas shall be either Carbon Steel extra heavy wall pipe, Carbon Steel Standard wall rubber lined, Standard wall pipe, or HDPE flanged pipe and fittings. Wall thickness to suit pressure rating of system.
- .12 Piping at pumps shall be arranged to avoid interference with access to pumps, the surrounding maintenance areas, and pull spaces during maintenance. Removable spool pieces to be provided where required (e.g. pump suction and discharges) to permit maintenance with a minimum of piping disassembly.
- .13 Suitable supports and anchors shall be provided for piping at pumps such that excessive weight and stresses will not be transmitted to the pump casings. Temporary start-up strainers will be provided on non-slurry pump suctions.
- .14 The number and location of sampling connections shall be provided as per P&ID. All sampling points shall have an isolating or sampling valve.

5.6 GRAVITY FLOW PIPELINES

- .1 Although gravity flow pipeline sizes and velocities are calculated, specified and verified by the Process and Mechanical Engineering groups, gravity flow pipelines generally conform to the following guidelines:

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		


- .2 Pipelines carrying slurries will be designed to flow from 3% to 75% full, however they are generally sized 1/3 to 2/3 full.
- .3 Slopes shall be identified on P&ID's with the minimum slope.
- .4 Gravity flow pipeline slopes and sizes shall be determined by appropriate calculation methods – the Colebrook White Formula, Manning formula or an approved equivalent.

5.7 SOLUTION PIPING

- .1 Pressurized solution lines shall be sized as noted in Table 1.0. Exceptions shall be made for high viscosity fluids, low pressure drop requirements, and long lines where lower velocity would be used to optimize system and operating cost.
- .2 All piping will be self draining. Drain and vent connections shall be provided at high and low points of the piping system to facilitate maintenance and hydro testing.
- .3 Generally solution piping shall be Standard wall Carbon Steel pipe and butt welded or grooved fittings. Pipe fittings 50mm and below shall be 3000 # socket weld or threaded. If solution is corrosive, use Stainless Steel or Alloy specifications.
- .4 Pockets and dead ends shall be avoided.

5.8 WATER PIPING

- .1 Water system primary headers shall be “looped” so that all branch lines are fed from two directions.
- .2 Suitable allowance shall be made for future demands on the system by designing pipe racks to have a 10% additional capacity to accommodate future loads.
- .3 Generally water piping shall be Standard wall Carbon Steel pipe with butt weld or grooved fittings. Pipe fittings 50mm and below shall be 3000# threaded. If water is corrosive, use Stainless or Alloy Steel.
- .4 Block valves shall be butterfly type for 65mm and above and ball type for 50mm and below.
- .5 Combinations safety shower/eyewash stations are required adjacent to all locations where the release of harmful fluids, airborne dust, or non-toxic particles occurs.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

5.9 AIR PIPING


- .1 Compressed air piping shall be sized so that the pressure drop along the line shall not exceed 10% of the initial line pressure, with full capacity being delivered at the end of the line. Air piping shall be looped.
- .2 All take-offs shall be from the top of the header for horizontal piping.
- .3 All instrument air branch piping shall be run to within 6m of the instrument and terminated with a valve. Where clusters of instruments occur a single centrally located valved connection shall be provided.
- .4 All plant air piping shall be Standard wall Carbon Steel pipe with butt weld or grooved fittings. Pipe fittings 50mm and below shall be 3000# threaded.
- .5 All instrument air piping shall be Standard wall Carbon Steel Galvanised pipe with threaded or grooved fittings. Fittings 50mm and below shall be 150# Malleable iron threaded. Run out pipe and fittings from branch block valve shall be Stainless Steel tube and fittings.

5.10 UTILITY PIPING

- .1 Utility stations shall supply plant air and water at convenient locations on all floors such that all parts of the floor can be reached with a 15m flexible hose.
- .2 All air and utility stations shall be 25mm, equipped with 25mm ball valve and quick disconnect type hose connections.
- .3 Water utility station shall be 1 ½ mm diameter.
- .4 Utility headers shall be located on the top deck of pipeways whenever possible. The minimum size of process and utility headers on pipeways shall be 50mm.

5.11 PERSONNEL PROTECTION

- .1 Eye wash/emergency showers shall be provided in areas where operating personnel are subject to hazardous sprays or spills.
- .2 Pipes carrying hazardous chemicals shall have dual containment and safety shields at all flanged, mechanical joints and valves to protect personnel.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		


- .3 Acid, Lime, or other pipe lines carrying hazardous liquids shall be located close to grade level whenever possible. These lines shall be identified clearly with signs to avoid unnecessary risks.

5.12 INSULATION AND HEAT TRACING

- .1 Personnel protection shall be provided on uninsulated lines operating above 60°C where they constitute a hazard to the operating personnel during normal operating routine.
- .2 Piping subject to freezing weather shall have insulation and heat tracing, unless otherwise authorized by client, see Table 3.0.
- .3 Insulation shall be used on heated lines to minimize heat losses, see Table 3.0
- .4 Cold water lines in concealed spaces shall be insulated with anti-sweat type insulation.
- .5 For details on insulation see Piping Thermal Insulation Specification 40 05 09.

Table 3.0 Insulation & Heat Tracing Requirement

SERVICE	HEAT TRACING REQUIREMENTS	EMERGENCY HEAT TRACING REQUIREMENTS	INSULATION	ALTERNATIVE TO EMERGENCY HEAT TRACE
Reclaim Water	No	Yes, around pumps up to drain valve	Yes with heat tracing channel in case of retrofit	No
Fresh Water	No - buried	Yes, around pumps and any exposed pipe	Yes - exposed pipe	Slope line & provide emergency drain valves at low points of vertical lines
Potable Water	No - buried	Yes, around pumps and any exposed pipe	Yes - exposed pipe	Slope line & provide emergency drain valves at low points of vertical lines
Mine Contact Water	No - inside	No	Yes - exposed pipe	Slope line & provide emergency drain valves at low point of vertical lines
Well water (?)	No - buried	Yes - around pumps & fire water tank/WTP	Yes - exposed pipe	Slope line & provide emergency drain valves at low point of vertical


 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

				line
Fire Water – N/R	No - buried	Yes - around tank and pumps - supplied by vendor?	Yes - exposed pipe	No
Sewage (?)	No- buried	Yes, around pumps and any exposed pipe	Yes - exposed pipe	No
Glycol – N/R	No	No	Yes	N/A
Air to Mine	No	No	Yes	N/A
Tailings	No - self draining	No - but emergency power for flush connection in mill building	Yes	N/A
Fuel	Hold depending on fuel type	Hold depending on fuel type	Hold depending on fuel type	No
Propane	No	No	No	N/A
STP Collection Sump Pump to Settling Pond	No- buried	Yes, around pumps and any exposed pipe	Yes - exposed pipe	Slope line & provide emergency drain valves at low point of vertical line
Crushing Building Sump Pump to Settling Pond	No- buried	Yes, around pumps and any exposed pipe	Yes - exposed pipe	Slope line & provide emergency drain valves at low point of vertical line
Settling Pond to Contact Water Pond	No - self draining line	No	No	N/A
Tailings Seepage Pond to Tailings Pond	No - self draining line	No	No	N/A
STP Collection Sump Pump to Fresh Water Pond	No- buried	Yes, around pumps and any exposed pipe	Yes - exposed pipe	Slope line & provide emergency drain valves at low point of vertical line


6.0 GENERAL PIPING LAYOUT

6.1 INSTALLATION

- .1 Piping within buildings shall generally be installed in 6m (random) lengths, unless on a pipe rack or trestle where 12m lengths (double random, maximum) may be utilized. In highly congested areas or areas where maintaining piping will be difficult, 3m lengths may be used.
- .2 Flange bolt holes shall straddle centre lines unless otherwise indicated on the drawings.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .3 Headroom clearance for piping in the aisles is 5m. Clearance of 2.1m is provided over operating platforms. Minimum clearance of 5m for Pipe Rack to road is required.
- .4 All slurry and utility valves shall be accessible from floors and operating platforms. Spindle extensions and chain wheel operators are only to be installed where space constants limit normal access.
- .5 Piping shall be routed in piping corridors and grouped together. The arrangement of the piping should allow operations and maintenance to be carried out with minimum effort.
- .6 Piping systems shall be designed to allow for expansion and contraction. Expansion effects due to exposure to direct sunlight shall also be considered.
- .7 Piping shall be arranged to maximize inherent flexibility. Expansion joints shall only be used when it is absolutely necessary.
- .8 Piping shall not be routed through electrical rooms.
- .9 All walls and floor penetrations shall be sleeved.
- .10 All control valves shall have adequate clearance for disassembly without disturbing other equipment or piping.
- .11 Valves shall be oriented so that stems and hand wheels do not project into platform or passageway areas. However, valves should be situated so that they are readily accessible.
- .12 Vents and drain connections shall be provided at all high and low points on tanks. Drains shall never be less than 18mm in diameter. Vents consisting of plugged bosses shall be provided at the highpoints of all piping for hydrostatic testing. The plugs should be sealed after the hydrostatic test.
- .13 All pipe systems and equipment that require draining shall be provided with Valve connections.
- .14 After installation, all piping shall be cleaned by flushing with water until free of dirt, grit, welding slag, and foreign materials.
- .15 All services requiring metering will have minimum upstream and downstream clearances based on Instrumentation manufacturers recommendations.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .16 In safety and environmental critical applications where absolute and verifiable shut off is required the use of a double block and bleed shall be installed.

6.2 PIPE IDENTIFICATION

- .1 Pipes shall be marked by a system of identification set out in the following standards:
- ANSI Z53.1-1979, "Safety Colour Code for Marking Physical Hazards",
 - ANSI A13.1-1981 (R1985), Scheme for the Identification of Piping Systems.
- .2 Pipes shall be labelled as to contents and direction of flow as follows:
- Hazard shall be identified using the following colour codes:

Table 4.0 Classification of Hazards of Materials and Designation of colours


Classification	Background Colour	Colour of Letters for Legend
Materials of Inherently Hazardous		
Flammable or Explosive	Yellow	Black
Chemically Active or Toxic	Yellow	Black
Extreme Temperatures or Pressures	Yellow	Black
Radioactive	Yellow	Black
Materials of Inherently Low Hazardous		
Liquid or Liquid Mixture	Green	White
Gas or Gaseous Mixture	Blue	White
Fire Quenching Hazard		
Water, Foam, Carbon Dioxide, Halon etc.	Red	White

Table 5.0 Size of Legend Letters and Banding

Outside Diameter of Pipe or Covering	Length of Colour Background	Size of Letters	Width of Banding Tape
mm	mm	mm	mm
10 to 32	200	13	25
38 to 51	200	19	25
64 to 150	300	32	50
200 to 250	600	64	100
over 250	800	80	100

- .3 Labelling and Colour may be either:

Paint and stencil: Pipe is painted as per hazard colour code then text and flow direction arrows are stencilled in.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

Adhesive labels: Hazard colour Code adhesive label with flow direction arrows, banding tape applied either side of label.

.4 Location of text and arrows:

- maximum of 12 m centres on straight pipe;
- at all valves;
- at all changes in direction;
- at fittings for hose or other terminal connection;
- at 1.5 m above floor on vertical pipes;
- at 1.5 m from wall where pipe passes through the wall;
- at 1.5 m from equipment to which pipe is connected.;


When the contents of a container or pipe is a controlled product, there shall also be a WHMIS product identification label.

7.0 STRESS ANALYSIS

- .1 Piping stress analysis shall be performed on lines with thermal expansion or lines where weight or fluid dynamics may cause excessive stresses.
- .2 Piping stress analysis shall satisfy the requirements of applicable CSA and ANSI B31.1 codes.
- .3 Piping stress analysis shall be done using computer program, manual calculation or calculation tables from the "Piping Guide" published by Syentek Inc.
- .4 For pipe supporting guidelines, flexibility and pipe stress, refer to Piping Materials and Methods 40 05 02.
- .5 The stress analysis of lines shall be carried out using Caesar II.

8.0 VALVES

- .1 Piping will be responsible for all manual valves.
- .2 On/Off activated valves (XV's), control valves and PSV's.

 ALEXCO	PIPING 40 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- This package falls outside the piping scope. The Instrument and Process Engineering group shall be responsible for carrying out the control valve sizing. The Instrument Engineering group shall furnish piping with information required for piping hook-up.

- .3 Valves requiring attention, observation or adjustment during normal plant operation shall be located within reach from grade, platform or permanent ladder or stairway.

- .4 Operating valves shall be chain-operated when the bottom of handwheel is over 2m above the high point of grade or operating platform and is not accessible from permanent ladder or stairway.

- .5 The centreline of handwheel or handles on block valves used for shutdown only, located less than 4.5m above the high point of finish surface and those located in pipeways, may be accessible by portable ladder.

- .6 The centreline of handwheel or handles on block valves used for shutdown only, located over 4.5m above the high point of finish surface, except those located in pipeways, shall be operable from permanent ladder or platform.

- .7 Valve handwheels, handles and stems shall be kept out of operating aisles. Where this is not practical, the valve shall be elevated to 2m clear from the high point of operating surface to bottom of handwheel.

END OF SECTION

 ALEXCO	<p style="text-align: center;">BUILDING SERVICES 23 00 00 Design Criteria</p>	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

SPECIFICATION REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Checked By	Approved By	Project Manager	Client
A	09 Apr 2009	Issued for Internal Review	JMM	AF		JA	BT
B	09 July 2009	Issued for Information	JMM	AF		JA	BT

 ALEXCO	<p style="text-align: center;">BUILDING SERVICES 23 00 00 Design Criteria</p>	<p>Project Number: 09539601.00 Project Name: Bellekeno Project</p>
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0 INTRODUCTION3

2.0 SCOPE3

3.0 CODES, STANDARDS AND REGULATIONS.....3

4.0 DESIGN CRITERIA4

 4.1 Ambient Design Conditions4

 4.2 Internal Conditions.....4

5.0 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS.....4

6.0 FIRE PROTECTION SYSTEMS.....5

7.0 PLUMBING AND DRAINAGE7

 ALEXCO	BUILDING SERVICES 23 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

1.0 INTRODUCTION

- .1 The following outlines the scope of work; applicable codes, standards and regulations, HVAC design parameters; description of Heating Ventilation, Fire Protection and plumbing and sanitary drainage design parameters.

2.0 SCOPE

- .1 Building services shall be provided in the following areas:
 - Mill Building

3.0 CODES, STANDARDS AND REGULATIONS

- National Building Code of Canada (NBC)
- Canadian Plumbing Code (CPC)
- National Fire Code of Canada (NFC)
- American National Standards Institute (ANSI)
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- National Fire Protection Association (NFPA)
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- Associated Air Balance Council (AABC)
- National Environmental Balancing Bureau (NEBB)
- Underwriters Laboratories of Canada Standards (UL, ULC)
- Hydronics Institute (HI)
- Canadian Electrical Code (CEC)
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI)
- Canadian Standards Association (CSA)
- Occupational Safety and Health Act (OSHA)
- National Institute for Occupational Safety and Health (NIOSH)
- Instrument Society of America (ISA)
- American Conference of Governmental Industrial Hygienists (ACGIH)
- Air Movement and Control Association (AMCA)
- American Society for Testing and Materials (ASTM)
- Factory Mutual (FM)

 ALEXCO	BUILDING SERVICES 23 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .3 Mechanical ventilation shall be provided for the toilets, locker rooms, garbage rooms, battery rooms and any rooms that contain toxic or flammable materials. These rooms shall be vented directly to the outside and have a minimum of 10 l/s/m² (2 ft.³/min. per ft.²) exhaust, with make-up air coming from either heated primary air, or air transferred from adjacent areas. No contaminated air shall be recirculated. The point of discharge from all building exhausts shall be at least 1.5 m (5 ft.) from any openable window or door and 1 m (3 ft.) above and 3 m (10 ft.) away from any air intake.
- .4 Make-up air for the laboratory shall be handled through a packaged propane-fired make up air unit. ..
- .5 Free cooling will be utilized in all areas in lieu of air conditioning.
- .6 Propane fired radiant heaters controlled by remote thermostats shall be used to provide perimeter heating in the mill building.
- .7 An exhaust fan in the compressor room will operate on a reverse acting thermostat, to offset the heat gains in this room. The exhaust air will be delivered into the mill building and the make up air will enter the room from the mill building through wall louvres

6.0 FIRE PROTECTION SYSTEMS **(HOLD FOR CODE COMPLIANCE)**

- .1 The fire protection systems shall comply with the following requirements:
 - Operation of any fire protection device, including pressure switches, pull stations, smoke detectors, water flow switches and alarm valves shall be supervised and monitored by a central fire alarm panel, (CFP) which will be located in a room that is occupied 24 hours a day.
 - All detection devices shall be intelligent addressable.
 - Manual pull stations will be provided at exits of all buildings.
 - Detection systems, and manual pull stations shall initiate audible (horns), and visual (strobic), alarms at exits.
 - Each area shall be provided with its own stand alone fire alarm system, and all systems shall be networked to the central fire alarm panel.
 - All like equipment shall be of the same manufacturer.
 - Fire alarm panels shall incorporate batteries and battery charger for battery back up.
 - In addition to requirements of this design criteria, NFPA 13 shall be the design standard for all sprinkler systems. The most stringent requirements shall prevail.

 ALEXCO	BUILDING SERVICES 23 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- In addition to requirements of this design criteria, NPFA 14 shall be the design standard for all standpipe systems. The most stringent requirements shall prevail.
- All automatic sprinkler system control valves, standpipe water supply control valves, and fire water tank isolating valves shall be provided with chains and padlocks.
- All hydraulic equipment and lube oil systems with fluid reservoirs over 378 liters, or a combined total in excess of 378 liters within 6 metres, shall be protected with automatic sprinklers with 71 degrees Celsius heads. Sprinklers shall extend 3 meters beyond the hazard or to the closest solid wall, whichever is closest.
- Mechanical equipment, such as hydraulic units, lube units and conveyors, which are protected by sprinkler systems, shall be equipped with interlocks to automatically shut down the equipment in the event of sprinkler flow.
- UL/ULC approved fire stop systems, with UL/ULC listed and/or FM approved materials, and UL/ULC listed fire/smoke dampers shall be provided wherever fire rated walls or floors are penetrated by piping, cables and ductwork. Combustible insulation or sealants, such as polyurethane foam, will not be accepted.
- All construction material for electrical rooms, including insulation, shall be constructed of 100% non-combustible materials.
- Hand held all-purpose ABC fire extinguishers shall be provided in all buildings for local emergency fire fighting. Fire extinguishers shall be located at spacing as specified by NFPA 10, with additional units being located at each exit door from the area.
- Clean agent hand held fire extinguishers shall be provided in all electrical rooms and control rooms, with spacing in accordance with NFPA 10, plus additional units being located at each exit door from the area.
- Water velocities shall not exceed 6 metres per second in any section of above ground fire protection piping.
- The entire fire protection system shall be designed in accordance with the seismic requirements of NFPA 13 and FM data sheet FM-2-8.
- All fire protection equipment and materials shall be UL/ULC listed and / or FM approved for the intended purpose.
- All buildings and structures in excess of 14 meters in height, or having any dimension in excess of 30 metres, will be provided with wet class 2 standpipe systems with fixed hoses. Hoses shall be located such that all areas at all levels of the buildings, conveyor transfer towers and structures are within reach of a fire hose stream.
- The fire protection systems shall be designed and installed by professionals who are experienced in the proper design, installation and testing of fire protection and fire alarm systems.
- The sprinkler system piping will be hydraulically sized, designed, installed and tested by the "Fire Protection" contractor.
- Dry alarm valves will be located in heated spaces.
- Flow switches for individual, localized sprinkler systems shall include a shut off valve with a chain and a padlock.

 ALEXCO	BUILDING SERVICES 23 00 00 Design Criteria	Project Number: 09539601.00
WARDROP Engineering Inc.		Project Name: Bellekeno Project

- All sprinkler systems shall include an inspector's test connection, located at the most hydraulically remote part of the system.
- The time interval between activation of a dry sprinkler system and water reaching the most remote head shall not exceed 60 seconds.
- Piping for dry systems shall be constructed of galvanized steel.
- Auxiliary drain valves at all sprinkler system low points will be provided, to allow the complete system to be drained.
- Conveyors shall be provided with alignment switches to shut down the respective conveyor on misalignment.

7.0 PLUMBING AND DRAINAGE

- .1 The plumbing and drainage systems shall comply with the requirements of the National Plumbing Code.
- .2 Sewage from the Mill Building fixtures shall be directed to a holding tank for disposal by a mobile vacuum truck.
- .3 Hot and cold water piping shall be provided with individual shut off valves to all fixtures.
- .4 The minimum pipe size for under-slab piping shall be 75 mm.
- .5 Cleanouts shall be provided to all under-slab piping at 15 metre intervals and at each change of direction.
- .6 Plumbing piping through electrical rooms shall be avoided.
- .7 Stacks, drains and vents shall be sized in accordance with the National Plumbing Code.
- .8 Drains shall slope downward in the direction of flow, a minimum of 1:50 except as permitted in the National Plumbing Code.
- .9 Every plumbing fixture shall bear the CSA label.
- .10 Floor drains shall be deep seal type, with trap primers.
- .11 Water systems shall be protected against back-syphonage and back flow with back flow preventers.

 ALEXCO	BUILDING SERVICES 23 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .12 Laboratory wastes shall be neutralized in a collection tank, prior to being discharged into a separate drainage system from the sewer piping.

- .13 Cold water piping shall be insulated for condensation control.

END OF DESIGN CRITERIA



ALEXCO

WARDROP | Engineering Inc.

**STRUCTURAL
05 00 00
DESIGN CRITERIA**

Project Number:
09539601.00
Project Name:
Alexco Resource Corp.
Bellekeno Project

SPECIFICATION REVISION INDEX

Revision No.	Date Revised	Engineering Specification	Signatures					
			Prepared By	Checked By	Approved By	Engineering Manager	Project Manager	Client
A	25 May 09	Issued for Internal Review	AM	JA			JA	BT
B	09 July 09	Issued for Information	AM	JA			JA	BT

 ALEXCO	STRUCTURAL 05 00 00 DESIGN CRITERIA	Project Number: 09539601.00 Project Name: Alexco Resource Corp. Bellekeno Project
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0 GENERAL	3
1.1 Scope.....	3
1.2 References.....	3
1.3 Climatic Data.....	3
2.0 EXECUTION	4
2.1 Design Load Definitions.....	4
2.2 Design Load Factors	4
2.3 Design Loads	5
2.4 Deflection Limits (Under Live Service Load)	7
2.5 Material Properties	7

 ALEXCO WARDROP Engineering Inc.	STRUCTURAL 05 00 00 DESIGN CRITERIA	Project Number: 09539601.00 Project Name: Alexco Resource Corp. Bellekeno Project
---	--	---

1.0 GENERAL

1.1 SCOPE

- .1 This design document establishes the criteria for structural engineering design and construction of the Bellekeno Project Mill Plant. The specification defines applicable codes and standards, design loads, serviceability and materials of construction.

1.2 REFERENCES

- .1 Design and construction of the mine processing buildings will be in accordance with, but not limited to the following codes and standards. The publications listed below form part of this specification, and shall be used for the purposes listed. Other standards and recommended best practice will be used where applicable.

- Units of measure will be imperial.
- Client standard equipment numbering system to be used.
- Drawing numbers to be obtained from client.
- National Building Code of Canada 2005.
- Wardrop drafting standard to be used.
- Yukon Occupational Health and Safety Act.
- CAN/CSA S16.1 Limit States Design for Steel Structures.
- CAN/CSA A23.3-04, Design of Concrete Structures for Buildings.
- CAN/CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete Design of Concrete Structures for Buildings.
- Yukon Environment Act.
- Yukon Employment Standards Act.

1.3 CLIMATIC DATA

- .1 Based on Bellekeno Project Mill Plant Site, UTM Coordinates 7087630 N, 483918 E (Approximately 2 Km west of Keno City in Yukon):
- Snow Load, S_s (1/50) 2.50 kPa
 - Rain Load, S_r (1/50) 0.10 kPa
 - Hourly Wind Pressure, q (1/50) 0.35 kPa

 ALEXCO	STRUCTURAL 05 00 00 DESIGN CRITERIA	Project Number: 09539601.00 Project Name: Alexco Resource Corp. Bellekeno Project
WARDROP Engineering Inc.		

2.0 EXECUTION

2.1 DESIGN LOAD DEFINITIONS

.1 General: Loads and forces used for design shall be as defined in NBCC and as specified below:

- **Dead Loads (D):** Vertical loads due to the weight of permanent structural and non-structural components of a building or structure, including empty vessels, piping, ducting, electrical cables and trays and permanent fixtures.
- **Operating Loads (O):** Dead loads plus the weight of any liquids or solids present within the vessels, equipment, or piping during normal operation. This includes unusual conditions such as upset conditions when fluid levels could be higher than normal operating levels.
- **Live Loads (L):** The loads produced by use and occupancy of the structure. They include the weight of all movable loads, including personnel, tools, miscellaneous equipment, movable partitions, cranes, hoists, parts of dismantled equipment and stored material.
- **Snow Loads (S):** Snow loading on roofs or other exposed surfaces including the effects of snow drifts at offsets in roof elevations and obstructions.
- **Wind Loads (W):** Loading on the building cladding and roofing, overall structure and structural components caused by the wind.
- **Earthquake Loads (E):** Rare loads due to earthquake.
- **Impact Loads (I):** Live loads that induce impact on structures.
- **Dynamic Loads (N):** Forces that are caused by vibrating machinery such as screens, crushers, blowers, fans and compressors.
- **Lateral Pressure (H):** Forces caused by pressure of soil, granular materials or liquids contained in tanks or bins.

2.2 DESIGN LOAD FACTORS

- **Dead Loads (D)** 1.25
- **Operating Loads (O)** 1.25
- **Principal Live Loads (L)** 1.5
- **Companion Live Loads (L)** 0.5
- **Principal Snow Loads (S)** 1.5
- **Companion Snow Loads (S)** 0.5

 ALEXCO	STRUCTURAL 05 00 00 DESIGN CRITERIA	Project Number: 09539601.00 Project Name: Alexco Resource Corp. Bellekeno Project
WARDROP Engineering Inc.		

- Principal Wind Loads (W) 1.4
- Companion Wind Loads (W) 0.4
- Earthquake Loads (E) 1.0
- Impact Loads (I):

Description	Vertical
Monorails and trolley beams	1.25
Pendant or radio operated travelling crane girders	1.25
Supports for light machinery, shaft or motor-driven	1.2
Supports for reciprocating machinery	1.5
Supports for power-driven units	1.5

Note: Loads imposed on structural members subjected to impact forces will be multiplied by the live load factor in addition to being multiplied by the impact load factor.

- Lateral Pressure (H) 1.5

.1 Design of Cranes

- Vertical, transverse and longitudinal impact will not be considered to act concurrently.
- Bridge crane rails will be designed to resist a horizontal force applied perpendicular to the top of the rails equal to 20% of the sum of the capacity of the hoist and the weight of crane trolley. For bridge cranes this force can be equally distributed on each side.
- Bridge crane rails will be designed to resist a longitudinal force applied to the top of the rail equal to 10% of the maximum wheel loads of the crane and force from crane stops.
- Monorails will be designed to resist a horizontal force applied perpendicular to the top of the rails equal to 10% of the capacity of the hoist and the weight of the trolley.

2.3 DESIGN LOADS

- Roof Loads
 - w Dead Load (including steel) 1.3 kPa
 - w Weight of mechanical equipment: indicated on plans
 - w Superimposed dead load (weight of mechanical/electrical ductwork, piping, cable trays, etc.) typical 1.0 kPa
 - w Built-up Snow indicated on plans
 - w Wind Loads determined by building layout in accordance with NBCC
- Wind Loads: Cladding and Structural Components

 ALEXCO	STRUCTURAL 05 00 00 DESIGN CRITERIA	Project Number: 09539601.00 Project Name: Alexco Resource Corp. Bellekeno Project
WARDROP Engineering Inc.		

- w Reference the NBCC 2005 Structural Commentary I for loading.
- Earthquake Loads:
 - w Site Class D
 - w Seismic Importance Factor, I_E 1.0

The following seismic data has been interpolated using the 2005 National Building Code Seismic Hazard Calculation:

2% probability of exceedance in 50 years:

Sa(0.2)	=	0.440
Sa(0.5)	=	0.264
Sa(1.0)	=	0.130
Sa(2.0)	=	0.072
PGA	=	0.213
- Floor Loads
 - w Live Load
 - Heavy duty floor subject to vehicle traffic 7.2 kPa
 - Normal duty floor 4.8 kPa
 - w Monorails and Bridge Cranes indicated on plans
 - w Weight of Mechanical Equipment indicated on plans
 - w Superimposed dead load (weight of mechanical/electrical ductwork, piping, cable trays, etc.):
 - Typical 1.0 kPa
 - Electrical Room 0.5 kPa
 - Mechanical Room 0.5 kPa
 - w Structure Self Weight:
 - Steel grating on steel floor framing 1.5 kPa
 - 4" concrete slab on steel floor framing 2.9 kPa
 - 6" concrete slab on steel floor framing 4.1 kPa
 - w Lay down areas designed for 44.5 kN (10 kips) over any 4' x 8' (1.2 m x 2.4 m) area.
 - w All floor areas designed for 9 kN (2 kips) over any 2'-6" (0.76 m) square area.
 - w Fall Arrest Anchor Points designed for point load of 22 kN (5000 lbs) in any direction.
- Geotechnical:
 - w All designs are based on the Geotechnical Evaluation Report – Potential Mill Sites, Bellekeno Project Near Keno City, Yukon, by "EBA Engineering Consultants Ltd.", EBA File: W14101178, dated 08 December 2008 for Alexco Resources Canada Corp.

 ALEXCO	STRUCTURAL 05 00 00 DESIGN CRITERIA	Project Number: 09539601.00 Project Name: Alexco Resource Corp. Bellekeno Project
WARDROP Engineering Inc.		


2.4 DEFLECTION LIMITS (UNDER LIVE SERVICE LOAD)

- Roof framing L/240
- Wall cladding and girts L/180
- Floor framing L/360
- Crane runway beams:
 - w Vertical under full service no impact L/600 Vertical
 - w Lateral under full service no impact L/400 Lateral
- The total deflection of crane runway beams will not exceed 1" (25 mm)
- Wind sway of building columns:
 - w Buildings with Cranes L/400 and 1" (25 mm) max.
 - w Buildings without Cranes L/180 and 2" (50 mm) max.

2.5 MATERIAL PROPERTIES

- Concrete
 - w Unit weight of concrete 23.5 kN/m³ (150 pcf)
 - w Concrete strength at 28 days 30 MPa (4350 psi)
 - w Reinforcing steel: CSA G30.12, Grade 400, Ties and Stirrups Grade 300
 - w Class of Exposure (CSA A 23.1-04 Table 1):
 - (i) For interior floors: Class N
 - (ii) For piers, footings and grade beams: Class F2
- Masonry
 - w Unit weight of masonry concrete 20.5 kN/m³ (130 pcf)
 - w Masonry compressive strength at 28 15 MPa (2176 psi)
 - w 2-core light weight concrete block 8" x 8" x 16" (190 mm x 190 mm x 390 mm): CSA A 165-94.
- Structural Steel
 - w Channels, angles and plates: CSA G40.21, 300W.
 - w Wide Flange shapes: CSA G40.21, Grade 345W (Min.)
 - w Hollow Structural Sections: CSA G40.21, Grade 350W, Class C A500, 50 ksi (345 MPa)

END OF SPECIFICATION

	INSTRUMENTATION 40 90 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Checked By	Approved By	Project Manager	Client
A	26 May 2009	Issued for Internal Review	LD	JP		JA	
B	09 July 2009	Issued for Information	LD	JP		JA	



	INSTRUMENTATION 40 90 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0 SCOPE AND BATTERY LIMITS	3
2.0 CODES AND STANDARDS	3
3.0 INSTRUMENTATION DESIGN AND CONSTRUCTION.....	4
3.1 General.....	4
3.2 Local Control Stations.....	4
3.3 Grounding.....	5
3.4 Mounting and Location of Field Instruments.....	5
3.5 Field Mounted Instruments and Equipment.....	5
3.6 Instrument Electrical Wiring	6
3.7 Instrument Air Tubing.....	7


 ALEXCO	INSTRUMENTATION 40 90 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

1.0 SCOPE AND BATTERY LIMITS

- .1 Electronic instrumentation and a local control system shall be provided in three distinct areas of the Bellekeno Plant:
- Primary Crushing, Conveying and Crushed Ore Storage
 - Process Plant
 - Paste Backfill Area
- .2 A local operator control station shall be provided for the Primary Crushing, Conveying and Crushed Ore Storage operation and for the Paste Backfill Area.
- .3 Local operator control stations shall be provided for Process Plant control and monitoring.
- .4 All control is to be locally operated, no DCS or PLC is required for overall site.

2.0 CODES AND STANDARDS

- .1 The design and manufacture of electrical, instrumentation and controls equipment shall conform to the latest versions of the following codes and standards:
- Canadian Electric Code (C22.1)
 - Canadian Standards Association (CSA)
 - Local Codes and Standards
 - American National Standards Institute (ANSI)
 - Instrument Society of America (ISA)
- .2 All equipment shall be rated for a minimum elevation of 45 meters feet above sea level and an ambient temperature range of 0°C to 40°C and shall have CSA Approval Marking.
- .3 Manufacturer's recommended design, installation practices and procedures shall be adhered to whenever such practices and procedures are available.

	INSTRUMENTATION 40 90 00	Project Number: 09539601.00
WARDROP Engineering Inc.	Design Criteria	Project Name: Bellekeno Project


3.0 INSTRUMENTATION DESIGN AND CONSTRUCTION

3.1 GENERAL

- .1 Electrical Supply – Electrical supply to field instruments, relays, solenoids where required shall be 120V-60Hz. Electrical supply to Control Systems, panel and back of panel Instruments shall be 120V-60Hz.
- .2 Pneumatic transmitters shall have an output signal of 3-15 psig. Electronic transmitters shall have an output signal of 4-20 mA DC. Where possible, electronic transmitters shall be smart, programmable, microprocessor based 2-wire and powered by the signal receiver. If the electronic transmitter is externally powered (4-wire), its output signal must be isolated or floating with respect to ground so that the 4-20 mA DC signal could be transmitted to receiver without ground loop problem. If ground loop is a problem, then a signal isolator must be used.
- .3 The materials of components that come into contact with process fluids (instrument wetted parts) shall be resistant to stress resulting from pressure, temperature, corrosion and erosion, and shall be made of 316 stainless steel minimum unless the process and piping specifications require a different or higher grade material.
- .4 Control valves shall have integrally mounted smart electro-pneumatic positioners.
- .5 Instrument Air – Instrument air supply shall be dust-free, oil-free and dry. The minimum instrument air dew point at line pressure shall be at least -40°C or -10°C below the minimum locally recorded ambient temperatures at the plant site, whichever is lower. No condensation shall occur in the distribution system or in the instruments. The minimum instrument air supply pressure on the header shall be 700 kPag.
- .6 The capacity of the instrument air system shall be rated for all the connected loads plus 20%. An air receiver shall be provided for protection against loss of air. A low-pressure alarm shall be provided to indicate that the air pressure has fallen below 500 kPag. The air receiver shall be sized such that, 15 minutes after the low air pressure alarm, the instrument air header pressure shall not be below 250 kPag.
- .7 Field Wiring – In general, multi-conductor cables shall be used between each local control station and field junction boxes. Single pair cables shall be used between field junction boxes and individual instruments or electrical devices.

3.2 LOCAL CONTROL STATIONS

- .1 Local control stations shall be in accordance with the requirements of the associated electrical area classification. In an unclassified area the enclosures shall be NEMA 4X corrosion resistant, non-metallic, watertight and dust tight construction. Hinges and latches shall be 316 stainless steel. Cable entries shall be through cable

	INSTRUMENTATION 40 90 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

glands in the rear of the box or side of box where feasible. Watertight seals shall be used. Terminal rails shall be mounted vertically, complete with sufficient grounding terminals. All connections within the control station shall be made via terminal blocks. Splicing of wires is not permitted.

- .2 All cables, wires, terminals and any other device shall be tagged uniquely in each station. A control station layout and wiring diagram shall be provided and placed in a pocket in the rear side of the front door. Control Stations shall be tagged uniquely with a lamacoid nameplate attached to the front panel. Lamacoids shall be white with black lettering.
- .3 Local control stations shall provide 120VAC-60Hz power to instrumentation where needed. Local control stations shall also house two sources of 24VDC power supply to be used for 24VDC loop powered devices (2-wire) and 24VDC powered devices (4-wire).

3.3 GROUNDING


- .1 Plant electronic instrument system shall have its own dedicated grounding system. In the event that several instrument systems exist, these grounding systems shall be connected in common.
- .2 Manufacturer's recommended grounding procedures and installations shall take precedence over all grounding designs and installations.
- .3 All signal cable shields shall only be grounded at the local control station end of the circuit. The field end shall be trimmed flush with the cable jacket and taped to prevent accidental ground contact.

3.4 MOUNTING AND LOCATION OF FIELD INSTRUMENTS

- .1 All field instruments shall be mounted at grade or platform to provide easy access for operation and maintenance.
- .2 All field mounted remote transmitters with indicators shall be mounted so that the transmitter is 54" above grade or platform and shall be located as close to the primary connection/element as possible consistent with instrument accessibility.
- .3 Dial thermometers and pressure gauges that are line mounted shall be plainly visible and accessible from grade or platform.

3.5 FIELD MOUNTED INSTRUMENTS AND EQUIPMENT


- .1 All field instruments shall meet the electrical classification of the area. Field mounted instrument electrical devices shall be supplied in weatherproof enclosures NEMA 4, watertight and dust-tight as a minimum.

	INSTRUMENTATION 40 90 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .2 Instruments shall be installed with flanges or unions and isolation valves to permit removal without process shutdown. Isolation valves shall be provided so that inline valves and instruments can be removed for maintenance without draining tanks and equipment.
- .3 Separate process connections are required for each instrument including pressure gauges. Process connections for instruments on vessels shall be dedicated to the instrument and not shared with process piping.
- .4 Junction boxes shall be in accordance with the requirements of the associated electrical area classification. In an unclassified area the enclosures shall be NEMA 4X corrosion resistant, non-metallic, watertight and dust tight construction. Hinges and latches shall be 316 stainless steel. Cable entries shall be through cable glands in the bottom of the box where feasible. Watertight seals shall be used. Terminal rails shall be mounted vertically complete with sufficient grounding terminals. All connections within the junction box shall be made via terminal blocks. Splicing of wires is not permitted.
- .5 All cables, wires, terminals and any other device shall be tagged uniquely in each box. A junction box layout and wiring diagram shall be provided and placed in a pocket in the rear side of the front door. Junction boxes shall be tagged uniquely with a lamacoid nameplate attached to the front panel. Lamacoids shall be white with black lettering.

3.6 INSTRUMENT ELECTRICAL WIRING

- .1 Armored multi-pair instrument cables shall be individually twisted shielded pairs of stranded #16 AWG copper conductors with drain wire, cable overall shield with drain wire, FRPVC inner jacket, aluminum interlock armour, FRPVC outer jacket, Wire pairs shall be coloured black and white. Black is positive, white is negative. The number of pairs shall be as per drawings.
- .2 Armored control and instrument power cables shall be Teck cable with stranded copper conductors, aluminum interlock armour, and PVC outer jacket. The number of conductors and conductor size shall be as per drawings.
- .3 Power cables shall be supplied with bare copper grounding conductor.
- .4 All wiring shall be clearly identified at every termination with a permanent marking system. Wire markers shall be the heat-shrunk type unless otherwise specified. The preferred method of identification is the loop number as specified on the loop diagrams.

	INSTRUMENTATION 40 90 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

3.7 INSTRUMENT AIR TUBING

- .1 Instrument air tubing to an instrument shall be 1/4" OD 316 SS seamless unless specified larger on drawings. Instrument air tubing fittings shall be 316 SS compression type.

END OF SECTION

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

Revision No.	Date Revised	Engineering Specification	Signatures				
			Prepared By	Checked By	Approved By	Project Manager	Client
A	09 May 2009	Issued for Internal Review	SS	SAA		JA	BT
B	09 July 2009	Issued for Information	SS	SAA		JA	BT

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

TABLE OF CONTENTS

1.0 GENERAL	3
1.1 Scope.....	3
2.0 CODES AND STANDARDS	3
3.0 POWER SYSTEM	4
3.1 General.....	4
3.2 Emergency Power.....	4
3.3 System Voltage.....	4
4.0 POWER DISTRIBUTION	5
4.1 General.....	5
4.2 Voltage Drop and Power Factor.....	5
5.0 EQUIPMENT DESIGN CRITERIA	6
5.1 Enclosures.....	6
5.2 Cables.....	6
5.3 Electric Motors.....	6
5.4 Low Voltage Power Distribution Centres.....	6
5.5 Medium Voltage Distribution.....	7
5.6 Low Voltage Motor Control Centres.....	7
5.7 Electric Space Heaters.....	8
5.8 Lighting.....	8
5.9 Grounding.....	9

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

1.0 GENERAL

1.1 SCOPE

.1 This design document establishes the criteria for electrical engineering design for Bellekeno Project Mill Plant. The specification defines applicable codes and standards, design loads, serviceability and materials of construction.

.2 The distinct areas of the project are:

Main plant areas:

- Mill Process Area
- Coarse Ore Storage Location

.3 Critical loads (defined as those which require power upon normal electrical supply failure) including power supplies if any, are identified during project design by area and shown on the project equipment list. These critical loads will be further defined as requiring uninterruptible power or interruptible power (i.e. time needed to start any standby generators). See Emergency power Section 3.2.1.

These loads shall be connected to the power system in such a manner that the failure of any bus or power supply would not prevent the safe shutdown of the related equipment.

2.0 CODES AND STANDARDS

.1 The design and manufacture of electrical equipment will conform, as a minimum, to the latest versions of the following International codes and standards:

- | | |
|-------------|---|
| CSA M421-00 | Use of Electricity in Mines |
| CEC C22.1 | Canadian Electrical Code |
| ANSI | American National Standards Institute |
| IEEE | Institute of Electrical and Electronics Engineers |
| CSA | Canadian Standards Association |
| NEMA | National Electrical Manufacturer's |

.2 The codes and laws of the country, state, province, municipality or jurisdiction in which a project occurs may take precedence over the aforementioned codes.

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

- .3 In case of conflict between the referred codes, specifications, standards and manufacturer's preferred procedures, conflicts shall be resolved in consultation with the Owner and/or the Owner's Representative before equipment selection or manufacture.

3.0 POWER SYSTEM

3.1 GENERAL

- .1 Main power will be provided from a overhead powerline at 69 kV. There will be a 69kV/4.16kV step down transformer at the substation. The power system will have the capacity and characteristics to support the plant electrical load and equipment.

3.2 EMERGENCY POWER

- .1 A preliminary assement of critical loads in Mill building shows a 500 kW generator is sufficient to provide back-up power for such loads.

3.3 SYSTEM VOLTAGE

- .1 Frequency is 60 Hz.
- .2 AC voltage levels will be as follows:

Equipment

All drives from 0.5 HP to 250 HP
Small drives below 0.5 HP
Electrical heaters over 2 kW
Electrical heaters 2.0 kW or less
Lighting 120 or 347 V
Small power & controls 120 V
Heat tracing short lengths 208 V
Heat tracing long lengths 600 V

Distribution System Voltage

600 V, 3-phase, high resistance grounded.
120/208 V, 3- or 1-phase, solidly grounded.
600 V, solidly grounded.
120/208 V, 3- or 1-phase, solidly grounded
1-phase solidly grounded
1-phase solidly grounded
1-phase solidly grounded
3- or 1- phase solidly grounded

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

4.0 POWER DISTRIBUTION

4.1 GENERAL

.1 Electrical distribution necessary for the processing facility will consist of:

- Medium voltage switchgear, power cables for step down power transformers.
- Step down power transformers to suit the physical and electrical characteristics of the various plant areas.
- Low voltage power distribution will generally be provided by power distribution centers.
- In general, power for motors will be supplied from factory assembled motor control centers. A local “Start/Stop” pushbutton and H-O-A selector will be used. Lockout is to be done at the motor control center by qualified electricians in accordance with Owner developed lockout procedures. Remote disconnect switches will not be installed at motor locations, this fact will be included by the Owner in the above mentioned lock out procedure development.
- Power for lighting and receptacles will be supplied from lighting and power panel boards.
- Overhead power lines will be 4.16 kV.

.2 Transformers shall be design loaded to not more than load to 80 % of full capacity and 25% future expansion allowance. Dedicated purpose transformers which are part of specific equipment systems (e.g. conveyor or pump variable frequency drive systems) shall be sized according to the duty anticipated.

.3 The need for harmonic mitigation will be managed by including requirements in the overall design and in equipment specifications to address the harmonic generation limits and control outlined in IEEE 519 Guide for Harmonic Control and Reactive Compensation in Electric Power Systems. Smaller variable speed drives will be provided complete with built in reactor and dv/dt filtering while larger VFDs must be provided with minimum 12 pulse drive systems and/or isolation transformer. The need for a harmonic study will be evaluated in conjunction with identifying any harmonic limits relevant to the generation system. The harmonic tolerance (spectrum and magnitude) must be provided by the generation system vendor.

4.2 VOLTAGE DROP AND POWER FACTOR

.1 Overall voltage drop from source distribution transformer secondary to the end of last feeder shall not be more than 3 %. Overall voltage drop from the supply to point of utilization shall not exceed 5 %. Where required, capacitors for power factor correction will be concentrated at logical load centers.

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

5.0 EQUIPMENT DESIGN CRITERIA

5.1 ENCLOSURES

.1 Equipment and device enclosures will have the following ratings:

Location	Rating
Control Room, Electrical Rooms	NEMA 1A
All other areas (Non-classified)	NEMA 12, 4 or 4X as needed.

5.2 CABLES

.1 All power and control cables will be copper and will generally be installed in **underground** non-metallic ducts or above ground in ladder type cable trays. Cables will have interlocking aluminium armour with a PVC FT4 rated jacket and as follows:

4.16 kV System	5 kV rated, 133% Insulation
600 V System	1,000 V rated, #12 AWG minimum
Controls	600V rated, #14 AWG minimum. A minimum of 15% spare conductors will be left in each control cable where possible.
Color Coding	All power wiring will be color coded to suit local standards.

5.3 ELECTRIC MOTORS

.1 All motors supplied shall be suitable for inverter duty, IEEE 841 rated for severe industrial duty including protection from corrosive washdown liquids. (Note: No areas are anticipated to be classified as hazardous due to the presence of an explosive dust or gas concentration under normal or process upset conditions.)

5.4 LOW VOLTAGE POWER DISTRIBUTION CENTRES

.1 Low voltage power distribution centres shall be rated for use at the site elevation. Enclosure type shall be equivalent to NEMA 1A for installation indoors.

.2 Each low voltage switchboard shall be complete with an incoming main breaker section and suitable digital protective relaying including ground fault detection and alarms. Main breakers will be complete with features to allow a maintenance mode to reduce any fault

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

duration time in order to limit the arc flash hazard. Arc flash will otherwise be managed by maintenance use of suitable personal protective equipment and appropriate lock-out and maintenance procedures.

- .3 Individual distribution feeder cells will be circuit breaker type with digital protective relaying.
- .4 Design loading for low voltage distribution centres shall not exceed 75% of calculated running loads including spares.

5.5 MEDIUM VOLTAGE DISTRIBUTION

- .1 Medium voltage distribution equipment shall be metal-clad and rated for use at the elevation of utilization. Enclosure type shall be equivalent to NEMA 1A for indoor electrical room applications.

5.6 LOW VOLTAGE MOTOR CONTROL CENTRES

- .1 MCCs shall be 600 V, 3 phase, 3 wire complete with copper bus, top mounted ground bar and bus bracing as noted on other design documents. Enclosures shall be NEMA 1A for installation in indoor modular electrical rooms or major building electrical rooms.
- .2 MCCs shall have incoming sections with digital meter display of instantaneous three phase voltage, current and power parameters. All transformer fed MCCs require a main breaker sized to the transformer secondary current complete with a digital protection relay. Main breakers will be complete with features to allow a maintenance mode to reduce any fault duration time in order to limit the arc flash hazard. Arc flash will otherwise be managed by maintenance use of suitable personal protective equipment and appropriate lock-out and maintenance procedures.
- .3 Where specified, individual MCC starters shall be complete with door mounted H-O-A selector switches, start-stop push buttons and LED type pilot lights.
- .4 MCCs shall have smart starters and be connected to local plant control system I/O racks for control purposes where control is not strictly manual. The preferred communications system will be determined as further progress is made in plant control system design.

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

5.7 ELECTRIC SPACE HEATERS

- .1 Electric space heaters where provided shall be complete with built-in contactors and thermostats and will have a local manual disconnect switch for isolation purposes.

5.8 LIGHTING

- .1 High intensity discharge lighting will be provided in exterior locations, for roadway lighting and where specified indoors. Fluorescent lighting will be provided in the control rooms, motor control centre rooms, offices and other plant buildings. Note that, where possible at the design stage, steps will be taken to reduce energy use in all areas by:
 - Use of two level switches for larger lighting area – activated by personnel entering area when needed for operations or maintenance.
 - Use of detection type switches to turn off lights in office areas after periods of room being empty.
 - Photocell controlled exterior lighting.
- .2 Control room lighting will be electronically dimmable and fixtures shall be complete with louvers to minimize glare from operating monitors. Lighting for offices and control rooms will be via 120 V, high efficiency fluorescent type fixtures.
- .3 Battery powered emergency lights and exit signs will be included for offices, labs, electrical rooms, the control room and major egress routes indoors.
- .4 Where required by the nature of the process, lighting fixtures shall be of the corrosion resistant type. Outdoor floodlight circuits will be automatically controlled by photocells with a "Manual-Off-Auto" bypass selector switch. Main indoor lighting circuits will be supplied from 600/347 V lighting panels. In general, plant lighting will be switched from the supply panels, in all other areas local switching will be provided.

.5 Lighting Illumination Levels

Illumination levels shall meet the following requirements:

Areas	Level
Electrical Room	300 lux
Control Room	500 lux
Offices	600 lux
Process Areas	300 lux
Loading Areas	30lux
Yard	10 lux

 ALEXCO	ELECTRICAL 26 00 00 Design Criteria	Project Number: 09539601.00 Project Name: Bellekeno Project
WARDROP Engineering Inc.		

5.9 **GROUNDING**

- .1 The main generation system grounding method will be designed by using the generation system future planned fault levels and details of soils in the area.

- .2 Building ground references will be provided by using the UFER grounding method, where concrete foundation exists. Depending on the native soil conditions, additional perimeter ground rods and conductor systems may be employed. All column footings will be bonded by welding anchor bolts to the rebar.

- .3 The ground conductor will be connected to building steel, tanks, and equipment and the ground wire will be installed exposed wherever possible. Where corrosion presents a problem, ground wire shall have green PVC insulation. All underground connections will be exothermic type. Exposed connections and taps will be made with pressure type connectors.

- .4 Grounding provisions shall be provided to limit the Ground Potential Rise (GPR) to 100V.

- .5 Ground current return paths will be provided within individual cables, within discrete cable tray runs and by use of separate conductors on overhead lines.

- .6 Motor control centres, medium and low voltage switchgear, unit substations, transformers, etc., will be provided with two connections to the ground grid. All medium voltage motors, control panels, tanks, vessels, and other equipment will have at least one direct connection to the ground grid. All 120 V receptacles will be grounded by means of a separate green coloured insulated wire. Ground fault circuit interrupter type receptacles will be located in areas as required throughout the plant site. A #2/0 AWG bare ground cable will be installed in all cable trays. The ground cable will be connected to all sections and fittings at intervals of not less than 15 m. Final resistance of the grounding system will be in accordance with the local codes and standards.

END OF SPECIFICATION