



MILL DEVELOPMENT AND OPERATIONS PLAN

KENO HILL SILVER DISTRICT MINING OPERATIONS - DISTRICT MILL

Revision 4

November 2018

QML-0009

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Through its wholly owned subsidiary Alexco Keno Hill Mining Corp. (AKHM), Alexco Resource Corp. owns and operates the Keno District Mill, located in the Keno Hill Silver District. The Keno District Mill is approved to process silver/lead/zinc ores from the Bellekeno, Onek, Lucky Queen and Flame and Moth mines under the authorizations of Quartz Mining Licence (QML-0009) and Type 'A' Water Use Licence (QZ09-092). This document serves as the Mill Development and Operations Plan required under QML-0009 for the inclusion of the Bermingham Mine.

1.2 PROJECT LOCATION

The Keno Hill Silver District mine and mill operations are located in the vicinity of Keno City (63° 55'N, 135° 29'W), in central Yukon, 354 km (by air) due north of Whitehorse. Access to the property is via a paved, two-lane highway from Whitehorse to Mayo (407 km) and an all-weather gravel road northeast from Mayo to Elsa (45 km); a total distance of 452 km. Figure 1-1 shows the general project location within Yukon while Figure 1-2 shows the location on a smaller scale.

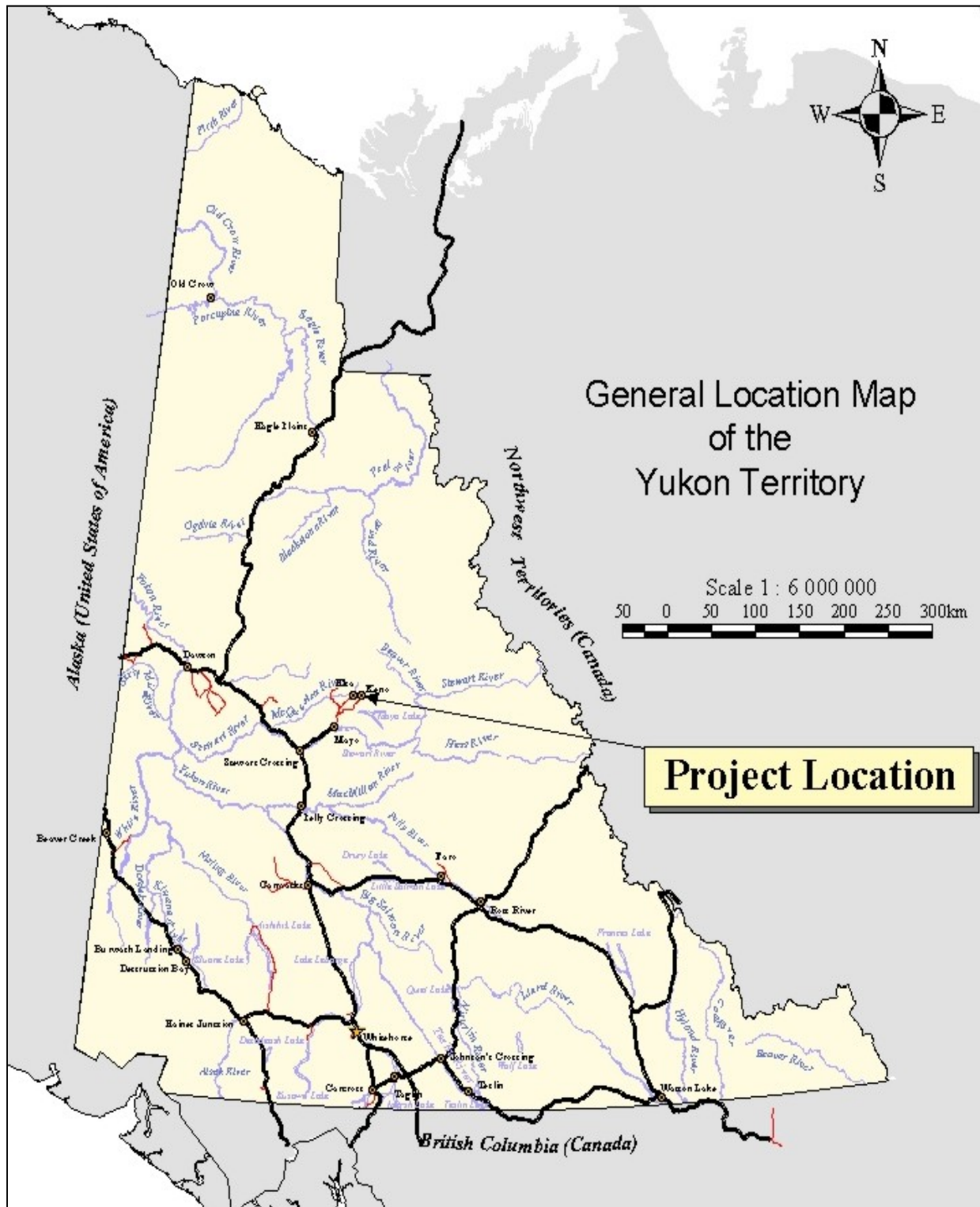
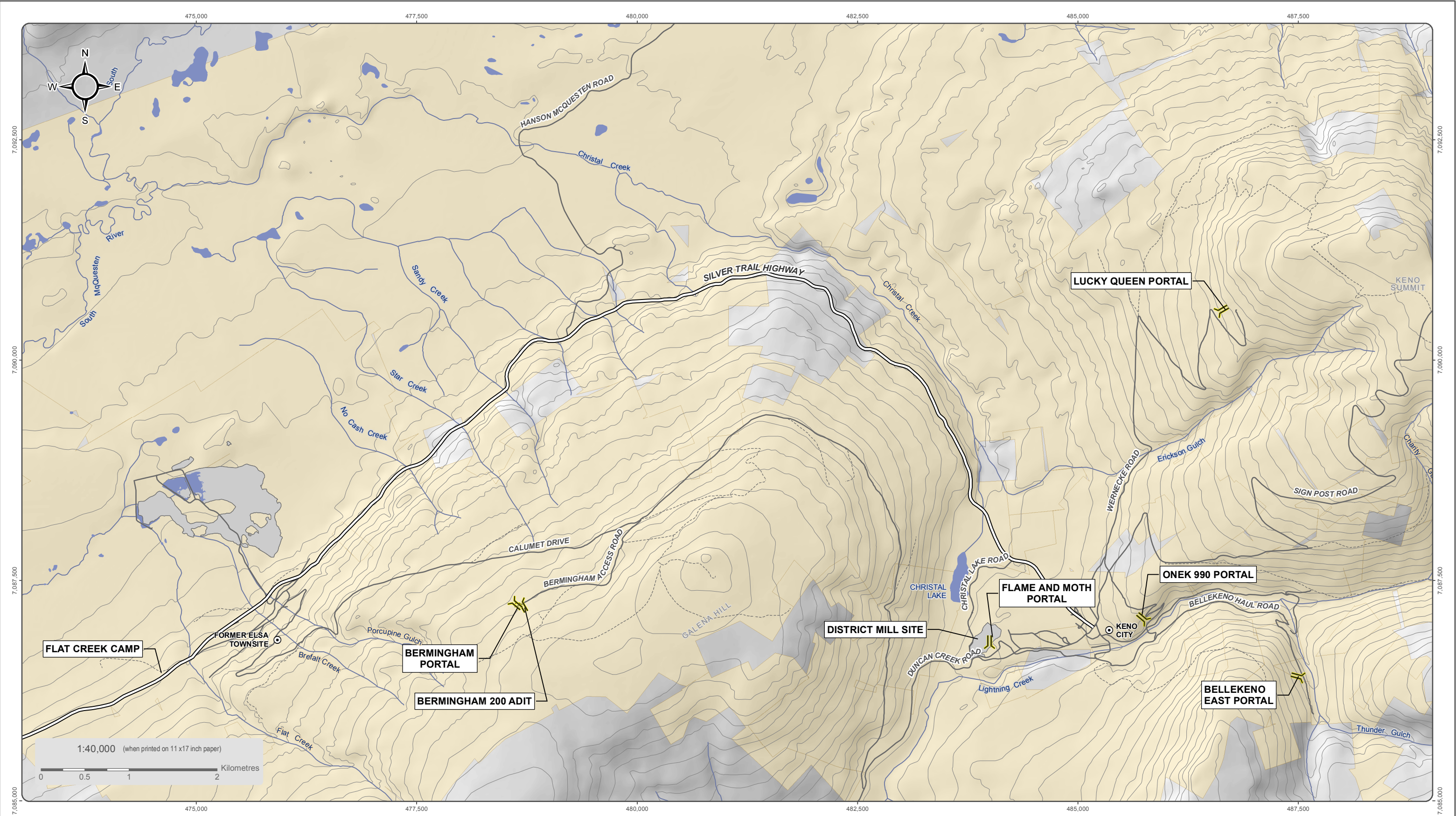


Figure 1-1 General Location Map



National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced under license from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Satellite imagery obtained from Yukon Geomatics map service <http://mapservices.gov.yk.ca/ArcGIS/services> on October 2017

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Place of Interest
- Adit

- Valley Tailings
- Alexco/ERDC Quartz Claims
- Waterbody

- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road



ALEXCO KENO HILL MINING CORP.
BERMINGHAM

FIGURE 1-2
KENO HILL SILVER DISTRICT MINING OPERATIONS
AREA OVERVIEW

OCTOBER 2017

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(Last edited by: amaleahavka, 26/10/2017 10:41 AM)

2 SITE DESCRIPTION

2.1 HISTORY

The Keno District Mill site is located approximately 1.1 km from the centre of Keno City and is within the upper Christal Creek drainage adjacent to the historic Flame and Moth open pit mine. The historic 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 1950's 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 viewed as a favourable location with regard to minimizing environmental impact of the project.

2.2 MILL SITE GEOLOGY

The Keno Hill Silver District is located in the northwestern part of the Selwyn Basin in an area where the northwest-trending Robert Service Thrust Sheet and the Tombstone Thrust Sheet overlap. The area is underlain by Upper Proterozoic to Mississippian rocks that were deposited in a shelf environment during the formation of the northern Cordilleran continental margin and underwent regional compressive tectonic stresses during the Jurassic and the Cretaceous, which produced thrusts, folds, and penetrative fabrics of various scales.

The Robert Service Thrust Sheet in the south is composed of Late Proterozoic to Devonian clastic sandstone, minor limestone, siltstone, argillite, chert, and conglomerate. The Tombstone Thrust Sheet to the north consists of Devonian phyllite, felsic meta-tuffs, and metaclastic rocks, overlain by Carboniferous quartzite, that are the main host for the silver mineralization in the Keno Hill Silver District. Four intrusive suites intrude the layered rocks:

- Late Triassic gabbro to diorite sills;
- Early Cretaceous Tombstone granite to granodiorite;
- Upper Cretaceous peraluminous porphyritic granite; and
- Late Cretaceous diabase dikes and sills.

Much of the Keno District Mill area is blanketed by a thick cover of fluvio-glacial overburden deposited on an irregular erosional surface that is in places up to 50 m in depth.

The north-northeast striking Flame Vein developed in an environment of competency contrasts caused by juxtaposition of quartzite, schist, and greenstone along the left lateral Flame vein-fault and was traced by drilling along a strike length of at least 600 m to a depth of at least 320 m. The structure dips moderately steeply to the east-southeast and, in the vicinity of the Keno District Mill, is offset at surface by approximately 90 m of right lateral oblique slip movement along the west-northwest trending post-mineral Mill Fault. The Mill Fault

dips approximately 66° to the southwest with the mineralization in the hangingwall section referred to as the Lightning Zone and that in the footwall section referred to as the Christal Zone.

2.3 GENERAL ENVIRONMENTAL CONDITIONS

Table 2-1 summarizes existing environmental conditions in the Keno District Mill project area. The Keno Hill Silver District lies within the Yukon Plateau – North Ecoregion, just south of the Wernecke Mountains. The terrain consists of concordant, rolling, upland areas separated by wide valleys. Alpine mountain peaks extend above the uplands locally. Many valleys include peatlands, palsas, fens and meadows of sedge tussocks. Upper slopes may be covered with scree material, with treeline occurring at 1,350 to 1,500 masl (metres above sea level). The area has been influenced by the latest glaciation but shows more subtle evidence of an earlier event as well.

Regional permafrost is irregularly distributed, and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, soil types, amount of vegetative cover, and presence of flowing underground and surface water. At high elevations and on slopes with a northern exposure it is generally present.

The Keno Hill Silver District supports a variety of wildlife including ungulates, fur-bearers, small mammals, upland game birds and waterfowl. Moose are the most important subsistence animal in the area. Repeated survey work over the last 15 years indicates a healthy, stable moose population that has in recent years reached a maximum level of harvest (Lortie, 2009). Woodland caribou are not presently found in the immediate study area with the exception of the appearance, in summer, of fewer than 10-12 caribou scattered in very small groups in the Mt. Hinton and Bunker Hill areas. Sheep are not known to inhabit the Keno Hill area.

The Keno District Mill site lies within the traditional territory of the First Nation of Na-cho Nyak Dun (FNNND) and near the community of Keno City (~ 1 km). The area has been shaped by mineral development over the past hundred years. Silver and lead ore deposits were discovered on Keno Hill in the early 1900s and the area has since seen fluctuating levels of ongoing quartz and placer mining and exploration. Today, the area supports not only mineral development, but also tourism, recreation, traditional pursuits, as well as the local people.

Keno City is a small community situated at the end of the Silver Trail Highway with a population of roughly 12 permanent residents. The community was originally established to support mining operations in the area and the community's population has fluctuated over the last hundred years in response to local mineral development activity. Today, Keno City is a quiet community with residences, a few small businesses, the Keno City Mining Museum, and the Keno City Alpine Interpretive Centre.

The community of Mayo is located approximately 50 km from the project site. Mayo has a population of roughly 450 people and serves as a distribution and service centre for the surrounding area, supporting mineral development, tourism and other activities. Mayo is also the administrative centre for the FNNND. In addition to being a tourist destination, the community is a base for wilderness and mining tourism, canoeing, hiking, big-game hunting and fly-in fishing.

Table 2-1. Keno Hill District Environmental Setting Summary

Drainage Region	Stewart River drainage region
Significant Watersheds	McQuesten River, Lightning Creek and Stewart River Watershed, Mayo River
Ecoregion	Yukon Plateau (North)
Study Area Elevation	900-1350 masl
Vegetation Communities	Northern boreal forests occupy lower slopes and valley bottom; spruce, pine and alder; grasses and sedges, mosses occupy forest floor; heavy moss and lichen growth resident as ground cover understory of shrub willow; open and forest fringe areas of willow and scrub birch, and various flowering plant species.
Wildlife Species	Moose, grizzly and black bear, caribou, beaver, wolf, lynx, marten, wolverine, western tanager, magnolia warbler, white-throated sparrow, bald eagle, furbearers and small animals. Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed species include: Common Nighthawk (Threatened); Rusty Blackbird and Olive-Sided Flycatcher (Special Concern).
Fish Species	Bering and Beaufort Sea salmonids and freshwater species, including: Arctic grayling, Arctic char, lake trout, trout perch, lake whitefish, broad whitefish, burbot, inconnu, Arctic Cisco, Northern pike, slimy sculpin

3 SITE PREPARATION

3.1 CLEARING

Clearing and stripping/grubbing of the area surrounding the Keno District Mill was required prior to construction of mill infrastructure including buildings, DSTF foundation and the process water pond. Stripping was accomplished by dozing surface organics into a stockpile until suitable soil foundation materials were present. Figure 4-1 shows the location of the stockpiles of organic material that were salvaged during the pre-construction clearing and stripping/grubbing of the mill footprint.

4 MILL AND ANCILLARY INFRASTRUCTURE

4.1 MILL FACILITIES

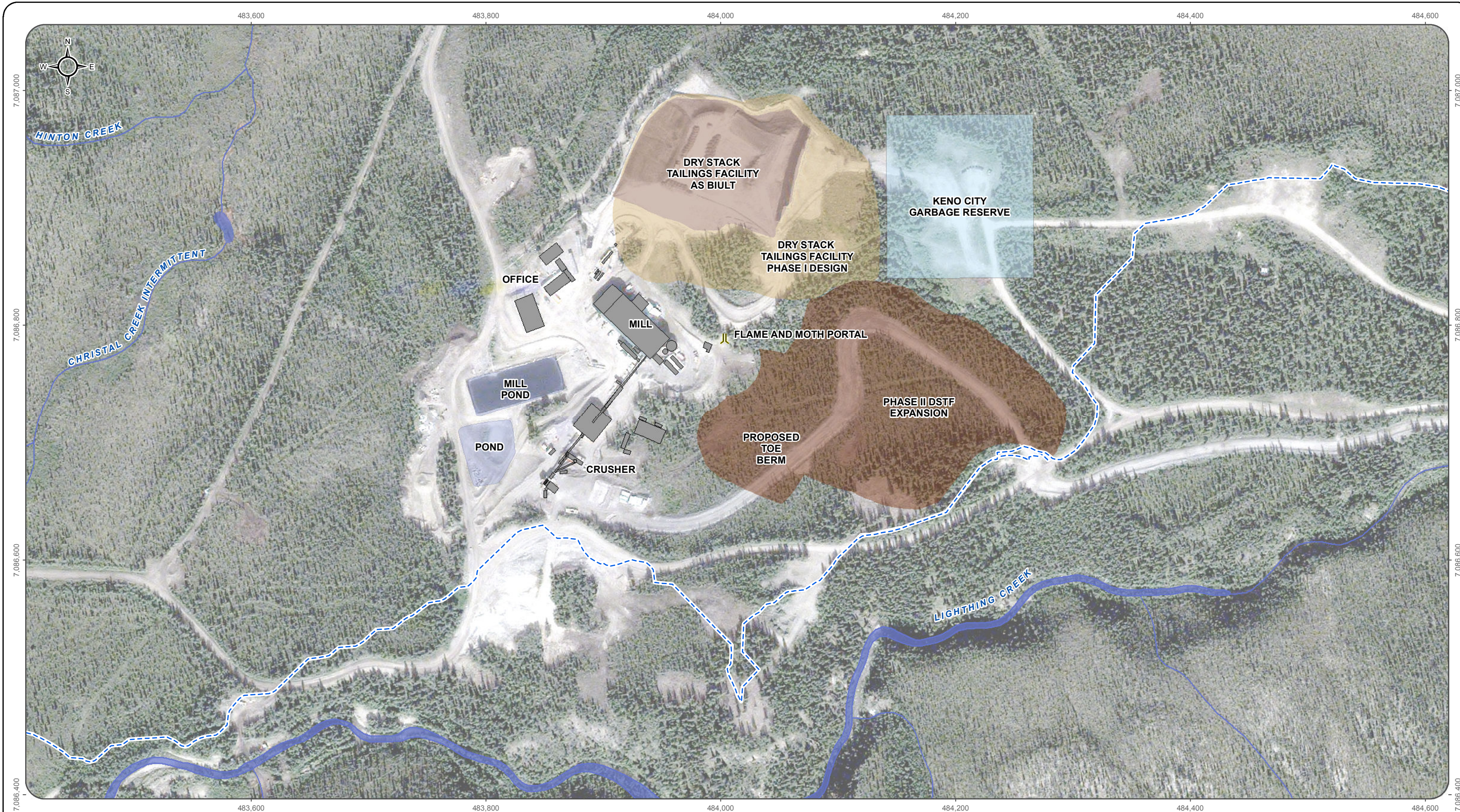
The Keno District Mill is a conventional differential flotation facility producing two separate metal concentrates that are shipped offsite for final processing. Initial construction including the mill concrete foundation began in September 2009 while full scale construction of the mill facilities began in earnest in April 2010 and initial mill commissioning commenced in December 2010. This Mill Development Plan is an update to reflect the current plan of operations that includes the milling of ore from the Bermingham, Bellekeno, Lucky Queen, Onek and Flame and Moth ore sources and will be amended as necessary to incorporate additional ore sources in the future.



Figure 4-1 Mill Infrastructure Overview

4.2 MILL GENERAL

The overall mill site general layout and as built is shown in Figure 4-2. Design criteria for the mill operations are summarized in Table 4-1.



Satellite imagery obtained from Yukon Geomatics map service <http://mapservices.gov.yk.ca/ArcGIS/services> on October 2017

Datum: NAD 83; Projection: UTM Zone 8N

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1:3,000 (when printed on 11 x17 inch paper)

0 25 50 100 150 Meters

 Adit	 Mill Pond	 Watershed Boundaries
 Existing Building	 DSTF Phase II Expansion	
 Land Disposition	 DSTF 322k Tonnes Design	
	 Current DSTF	




Table 4-1 Mill Design Criteria

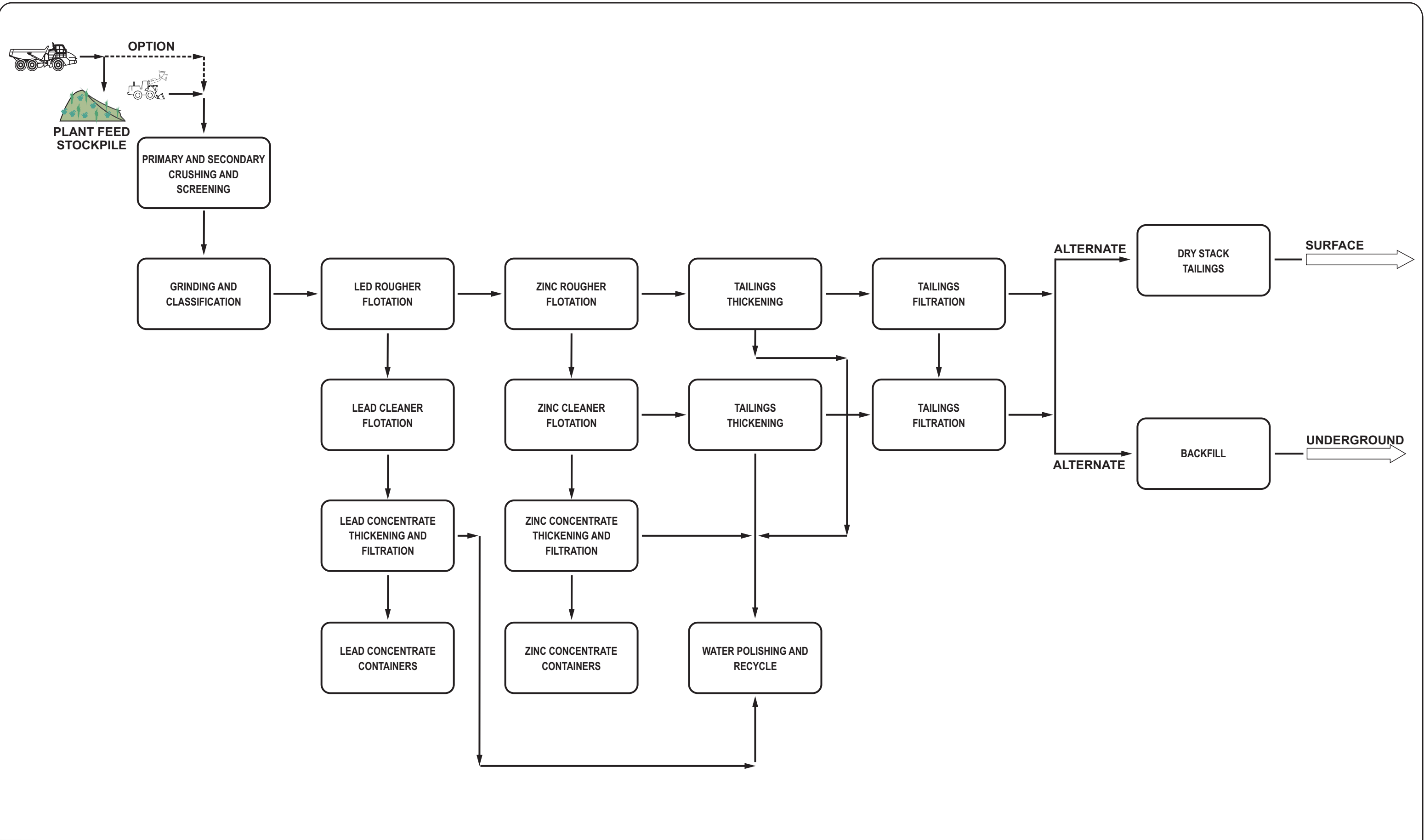
Description	Unit	Value
Type of Ore Processed		
Silver/Lead/Zinc sulphide mineralization Bermingham/Bellekeno/Lucky Queen/ Onek / Flame and Moth Mines		
<i>Ore Characteristics</i>		
Specific Gravity	g/cm ³	3.46
Bulk Density	t/m ³	2.1
Moisture Content	%	3-5
<i>Operating Schedule</i>		
<i>Crusher Plant</i>		
Shift/Day		1
Hours/Shift	h	12
Hours/Day	h	12
<i>Grinding and Flotation Plant</i>		
Shift/Day		2
Hours/Shift	h	12
Hours/Day	h	24
Days/Year	day	365
<i>Plant Availability/Utilization</i>		
Overall Plant Feed	mt/a	149,000
Overall Plant Feed	mt/d	250 - 400
Crusher Plant Availability	%	80.0
Grinding and Flotation Plant Availability	%	92.0
Crushing Process Rate	mt/h	63.8
Grinding/Flotation Process Rate	mt/h	18.5
Head Grades (LOM)	% Pb	4 - 10
	% Zn	5 -12
	g/t Au	0.42
	g/t Ag	500 – 1,000
Recovery (LOM)	Pb %	93
	Zn %	75
Recovery (LOM) including in Pb & Zn concentrates	Au %	70
Recovery (LOM) including in Pb & Zn concentrates	Ag %	92
Silver-Lead Concentrate Grade (LOM)	% Pb	65
	% Zn	2.3
	g/t Au	1.5
	g/t Ag	5,500
Zinc Concentrate Grade (LOM)	% Pb	0.5
	% Zn	45
	g/t Au	1.1
	g/t Ag	300
Silver-Lead Concentrate Mass Recovery (LOM)	%	13
Silver-Lead Concentrate Production (LOM)	t/a	19,000
Zinc Concentrate Mass Recovery (LOM)	%	9
Zinc Concentrate Production (LOM)	t/a	8,000

4.3 PROCESS DESCRIPTION

The Keno District Mill consists of the following process circuits;

- primary and secondary crushing circuits with a belt conveyor to transport the crushed ore to the covered fine ore stockpile;
- fine ore reclaim system feeding crushed ore from the covered fine ore stockpile;
- primary and secondary ball milling in a closed circuit with a high frequency screen and cyclone 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 lead rougher flotation concentrate being upgraded in three stages of cleaner flotation;
- the zinc rougher flotation concentrate being upgraded in three stages of cleaner thickening and pressure filtration of the lead and zinc concentrates; and
- thickening and pressure filtration of tailings, disposed either at underground as backfill or at the surface dry stack tailings facility.

The mill process flowsheet is presented in Figure 4-3.



4.3.1 ROM Ore Management

The Keno District Mill is capable of blending and processing ores from various mines throughout the Keno Hill Silver District. Ores from the Bermingham, Flame and Moth, Bellekeno, Lucky Queen and Onek mines are hauled and stored in the coarse ore stockpile prior to crushing. Blending of these ore sources are completed to target a consistent mill feed grade which improves overall operating efficiencies. The estimated volumes from Bermingham, Flame and Moth, Bellekeno, Lucky Queen and Onek are summarized in Table 4-2.

Table 4-2 Ore Management for Bermingham, Flame and Moth, Bellekeno, Lucky Queen and Onek

Ore Source	% Mill Feed	TPD Mill Feed
Bellekeno	25-65 %	100 – 250
Lucky Queen	10 -30 %	50 – 125
Onek	25 – 50 %	100 – 200
Flame and Moth	25-88 %	100 – 350
Bermingham	25-88 %	100 – 350

Run of Mine (ROM) ore from the Bermingham, Flame and Moth, Bellekeno, Lucky Queen and Onek deposits is stored at the coarse ore stockpile on a 0.5 meter concrete base pad surrounded by portable concrete containment blocks. Ore is mixed within this coarse ore stockpile area to provide a consistent feed blend. Photo 1 below shows the coarse ore stockpile with ore being delivered from a 30-tonne mine haul truck.



Photo 1: ROM Ore Crushing, Ore Storage and Reclaim

ROM ore crushing is completed through a standard two-stage crushing plant. ROM ore is dumped by 30 t haulage trucks into the jaw crusher feed hopper with a 47 t capacity. The hopper is equipped with a 450 mm opening stationary grizzly to prevent oversize ore entering the downstream jaw crusher.

The feed to the jaw crusher is controlled using a vibrating grizzly feeder. The 508 mm by 914 mm jaw crusher with a 75 kW motor crushes the ROM ore at a nominal rate of 63.8 t per operating hour. The jaw crusher reduces 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 discharges onto the crusher discharge conveyor belt. The ore is then transferred onto another conveyor belt, the sizing screen feed conveyor. This conveyor feeds 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 feeds the secondary cone crusher at a rate of approximately 54 t per operating hour. The crushing system operates in closed circuit. The crushed material (P80 of 12 mm) is conveyed to a fine ore stockpile with a 550 t live capacity.

The crusher will be covered with a sprung cover structure similar to the fine ore stockpile cover.



Photo 2: Primary, Secondary Crushing



Photo 3: Fine Ore Storage

Crushed ore is reclaimed via a draw down pocket located beneath the fine ore stockpile. Ore is reclaimed onto the ball mill feed conveyor belt at a nominal rate of 18.5 t per operating hour.

4.3.2 Primary Grinding Circuit

Ore from the ball mill feed conveyor discharges into the feed chute of the ball grinding mill which is 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 discharges through the slots in the discharge trommel.

The trommel undersize material is discharged into a pump box and fed to a high frequency screen. The coarse fraction from the high frequency screen returns to the ball mill. The finer product with size of 80% passing 174 µm, gravity flows to the flotation circuit.

Grinding media (steel balls) are added as required via the ball mill feed conveyor feed chute.



Photo 4: Primary Grinding

A spillage sump pump is located near the discharge pump box for the ball mill. Spillage is returned to the ball mill feed hopper.

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

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

4.3.3 Classification

The ball mill trommel undersize flows into the pump box which will feed a high frequency screen. The screen underflow material, at a nominal particle size of 80% passing 174 μm , flows by gravity to a lead conditioning tank. The high frequency screen coarse fraction discharges back to the grinding ball mill feed hopper.



Photo 5: Derrick Screen - Classification

4.3.4 Silver-Lead Flotation

Lead Rougher and Scavenger Flotation

The high frequency screen underflow fraction from the primary grinding circuit is 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 have a residence time of total 5 minutes at the design volumetric flow rate.

The conditioned slurry flows 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 is 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 flows by gravity to the first cleaner concentrate standpipe, while the concentrate from the last three rougher flotation cells reports by gravity to the second cleaner flotation tailings standpipe.

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



Photo 6: Flotation

4.3.4.1 Lead First Cleaner Flotation

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

The first cleaner tailings returns to the lead rougher flotation conditioning tanks, while the concentrate together with part of the rougher flotation concentrate feeds the second cleaner flotation stage.

The reagents sodium iso-butyl xanthate (SIBX), 3418A, and MIBC are 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 is 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.

4.3.4.2 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 are upgraded in the second cleaner flotation. The major equipment used in the second lead cleaner flotation circuit includes two 3 m³ conventional flotation cells.

The reagents SIBX, 3418A, sodium sulphite, zinc sulphate, and MIBC are added to the second cleaner flotation cells, as required. The second cleaner flotation feed gravity flows to the third cleaner flotation cell and the first cleaner and rougher concentrates are pumped into the feed box of the first of two 3 m³ second cleaner flotation cells. Blower air is 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 flows into a standpipe, which will transfer the slurry to the third cleaner flotation circuit.

4.3.4.3 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 is upgraded in the third cleaner flotation. The third cleaner tailings returns by gravity to the second lead cleaner flotation, while the concentrate is pumped to the lead concentrate thickener for dewatering. The major equipment used in the third lead cleaner flotation circuit includes one 3 m³ conventional flotation cell.

The reagent MIBC is added to the third cleaner flotation circuit, as required. The third cleaner flotation feed is pumped from the second cleaner circuit into the feed box of the 3 m³ cleaner flotation cell. Blower air is 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 transfers 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 is equipped with dedicated spillage sump and pump for clean-up purposes.

4.3.5 Zinc Flotation

4.3.5.1 Zinc Rougher Flotation

Prior to zinc flotation, lead flotation tailings are conditioned with copper sulphate to activate depressed zinc minerals. The flotation generates a zinc rougher concentrate in four 8 m³ flotation cells and subsequently rougher scavengers concentrate in one same size cell. SIPX is used as zinc mineral collector.

The scavenger concentrate returns to the zinc rougher circuit head conditioning tank while the rougher scavenger flotation tailings feeds the tailings dewatering circuit.

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

The conditioned slurry flows 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 is injected into each cell mechanism to generate the froth for the flotation of zinc minerals.

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

4.3.5.2 First Zinc Cleaner Flotation and First Zinc Cleaner Scavenger Flotation

The rougher flotation concentrate is further upgraded by three stages of cleaner flotation in six 3 m³ conventional flotation cells. The first cleaner flotation tailings is pumped back to the zinc circuit head conditioning tank. The second and third cleaner tailings are recycled to the preceding cleaning stages. The third cleaner concentrate is 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 is 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 is 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 flows into a standpipe, which will transfer the slurry to the second zinc cleaner flotation circuit.

4.3.5.3 Second Zinc Cleaner Flotation

The first zinc cleaner flotation concentrate is 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 is pumped from the first zinc cleaner flotation standpipe into the feed box of the first of two 3 m³ cleaner flotation cells. Blower air is 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 flows into a standpipe, which transfers the slurry to the third cleaner flotation circuit.

4.3.5.4 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 is pumped from the second zinc cleaner flotation standpipe into the feed box of the 3 m³ third cleaner flotation cell. Blower air is 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.

4.3.6 Lead and Zinc Concentrates Dewatering and Loadout

4.3.6.1 Lead Concentrate

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

A 25 m³ holding tank holds 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 is an 800 mm by 800 mm pressure filter unit with 22 plates and a 45 m² filtration area. Slurry is pumped into the filter chambers on a batch basis, and solution is squeezed out by pressure. Air is then blown through to dry the cake to attain the required moisture level of 8%. Filter cake is 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 is returned to the concentrate thickener.



Photo 7: Concentrate Storage

The dewatered lead concentrate is discharged to the lead concentrate stockpile, which has a storage capacity for approximately 5 days of lead concentrate production.

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

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

4.3.6.2 Zinc Concentrate

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

A 25 m³ holding tank holds 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 is an 800 mm by 800 mm pressure filter unit with 22 plates and a 45 m² filtration area. Slurry is pumped into the filter chambers on a batch basis, and solution is squeezed out by pressure. Air is blown through to dry the cake to attain the required moisture level of 8%. Filter cake is 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 is returned to the concentrate thickener.

The dewatered zinc concentrate discharges to the zinc concentrate stockpile, which has a storage capacity for approximately 7 days of zinc concentrate production.

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

The zinc concentrate dewatering and load-out area are equipped with dedicated spillage sump and pump for clean-up purposes. Spillage is 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.

4.3.6.3 Concentrate Transportation

Both lead and zinc concentrates are transported offsite to a smelting facility where final treatment is completed. On a daily basis, lead and zinc concentrate is loaded into specially designed and constructed container pots. The aluminum pots can hold nominally 17 tonnes of either lead or zinc concentrate. During normal operations, 3 pots are contained on a tractor/trailer arrangement while 2 pots are used during road restriction periods during the spring break-up period.



Photo 8: Concentrate Transportation

The volume of lead and zinc concentrate transported on a daily basis fluctuates based on a number of variables including mill throughput, ore grade and recovery. Based on estimated mill throughput rates, Table 4-3 summarizes the estimated volume of concentrate hauled from the mill to the port of Skagway on a monthly basis.

Table 4-3 Concentrate Shipped to Skagway

Mill Throughput TPD	Pb Concentrate DMT/month	Zn Concentrate DMT/month
250	870	530
325	1140	700
400	1400	860

4.3.7 Tailings Dewatering and Handling

Thickener overflow solution gravitates into the water polishing/ mill settling pond. Underflow slurry is pumped to the tailings storage tank and is then be pumped to the tailings filter presses for dewatering. The dewatered tailings will be discharged onto the filtered tailings belt conveyor. The tailings are dewatered to an 85 – 90 % solids content product, which is suitable for disposal by truck from the stockpile to the underground back fill facility or directly to the DSTF for long term storage. Filtrates from the filter presses are collected into a filtrate standpipe and returned to the thickener as dilution water.

The tailings thickening areas are equipped with one dedicated spillage sump pump for clean-up purposes. The spillage is returned to the tailings thickener.

The major equipment for tailings management includes:

- 1 (ea) 3.05 m diameter tailings thickener;
- 1 (ea) 6.01 m diameter tailings thickener;
- 1 (ea) 800 mm by 800 mm pressure filter with 30 plates and a 60 m² filtration area; and
- 1 (ea) 1000 mm by 1000 mm pressure filter with 50 plates and a 100 m² filtration area.



Photo 9: Tailings Thickener

Both 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.



Photo 10: Filter Press

4.4 DRY STACK TAILINGS FACILITY

Following dewatering through the plate and frame filter presses, the tailings are deposited onto a storage location outside the mill building via a conveyor belt. The tailings stockpile has a live capacity of approximately 4 – 6 hours and on a periodic basis the tailings are rehandled and loaded into a 30-tonne articulating haul truck and transported to the DSTF or to the mines for use as underground paste backfill and cemented tailings.

The dewatered tailings are transported onto a liner system designed to capture any residual porewater that may leave the pile. The tailings are laid down in 0.5 meter lifts and compacted with a vibratory roller compactor.

The DSTF is designed and will be constructed in 2 phases. The DSTF Phase 1 footprint has a current design capacity of 322,000 tonnes. The phase 2 footprint has a current design of additional 584,000 tonnes. Current design limitations beyond that footprint include geotechnical conditions (permafrost, ice lenses sub-surface) and general topography. Following completion of Phase 1, expansion of the DSTF Phase 2 will allow the remaining volume of tailings estimated in the LOM Plan to be stored. The Phase 2 expansion design is similar to Phase 1 and is located adjacent to the mill. The detailed design of the DSTF is presented in Figure 4-4, Figure 4-5, and Figure 4-6.



Photo 11: Compacted DSTF Lift

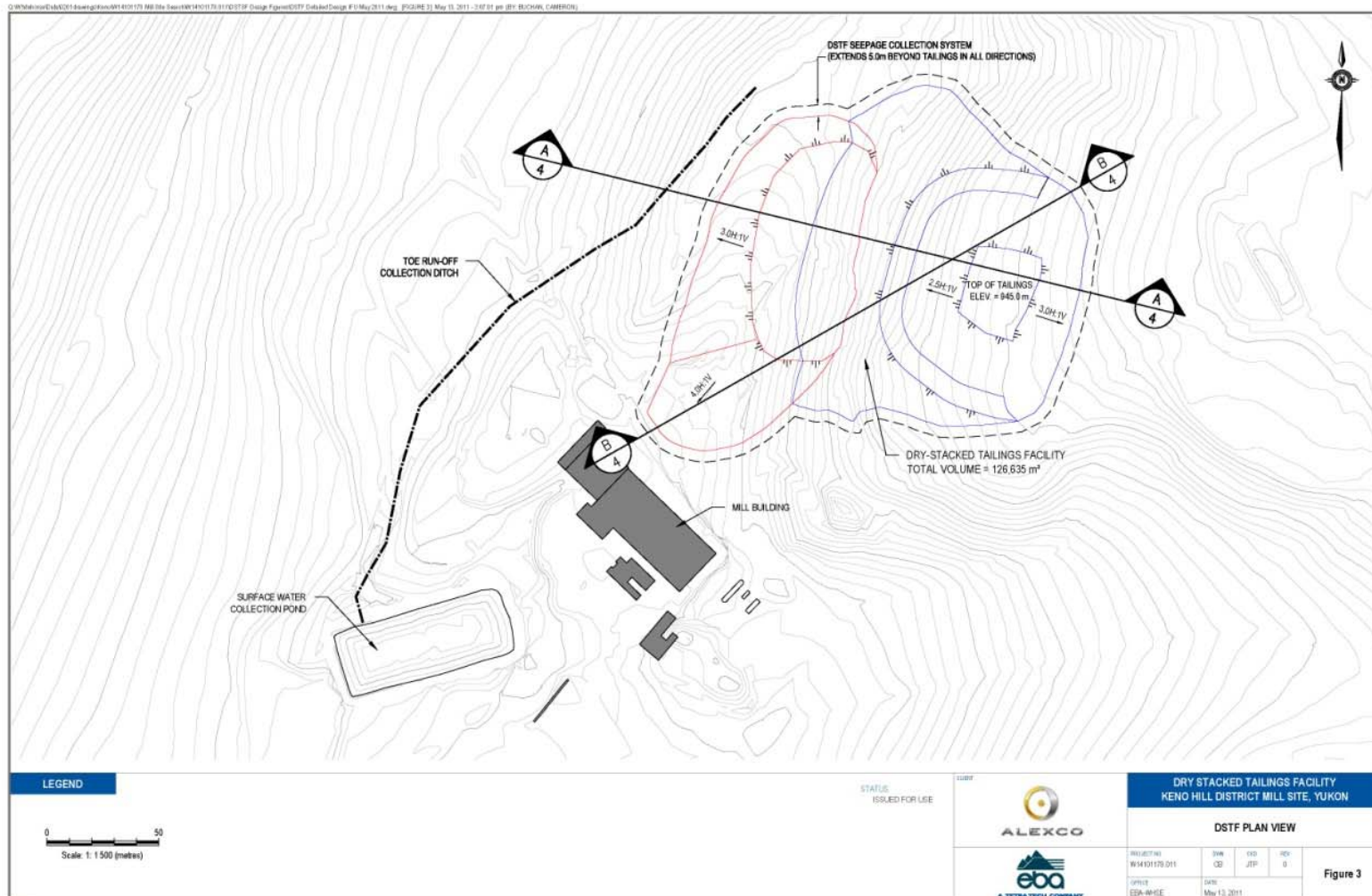


Figure 4-4 DSTF Phase 1 Plan View

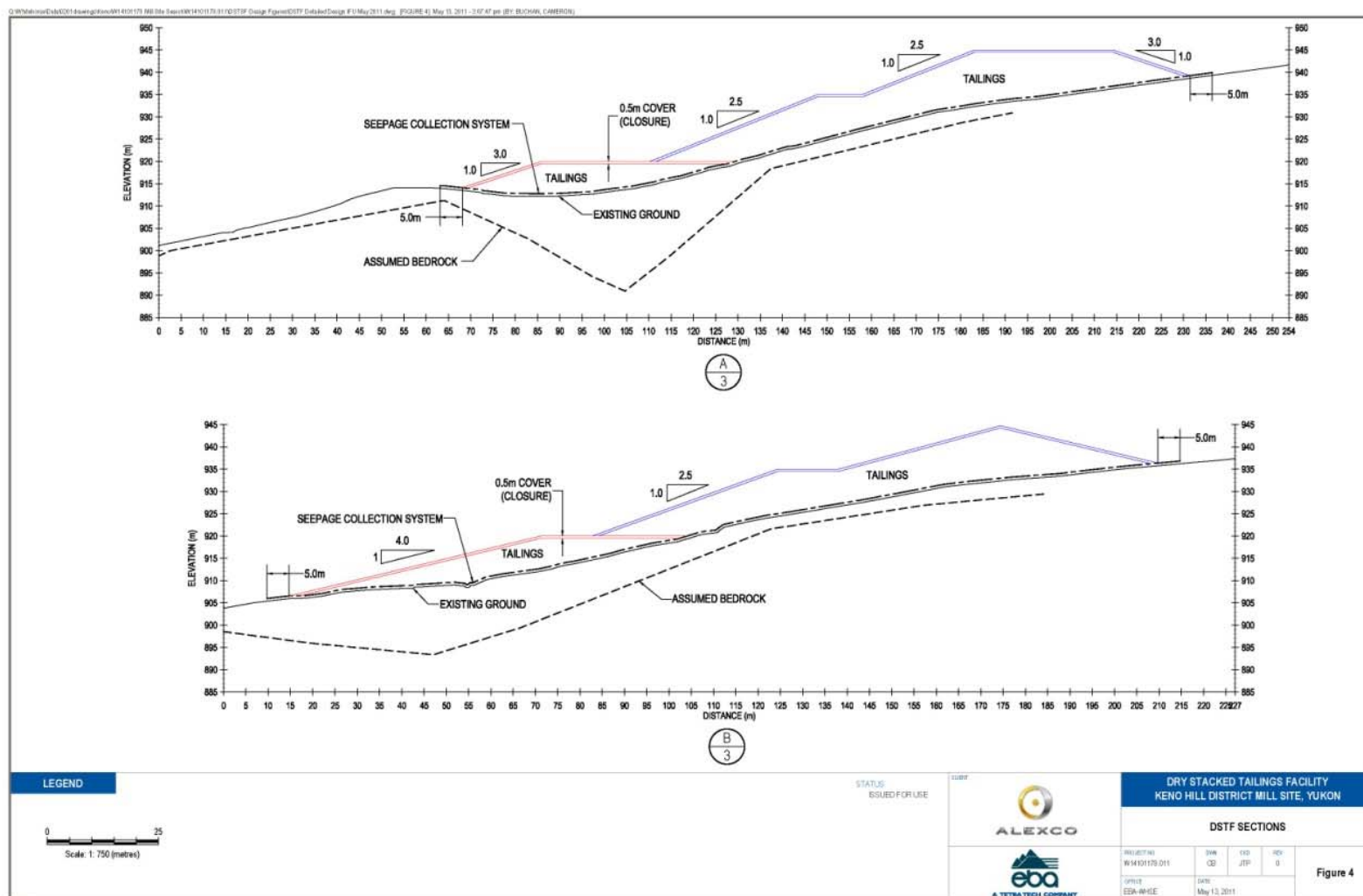


Figure 4-5 DSTF Sections

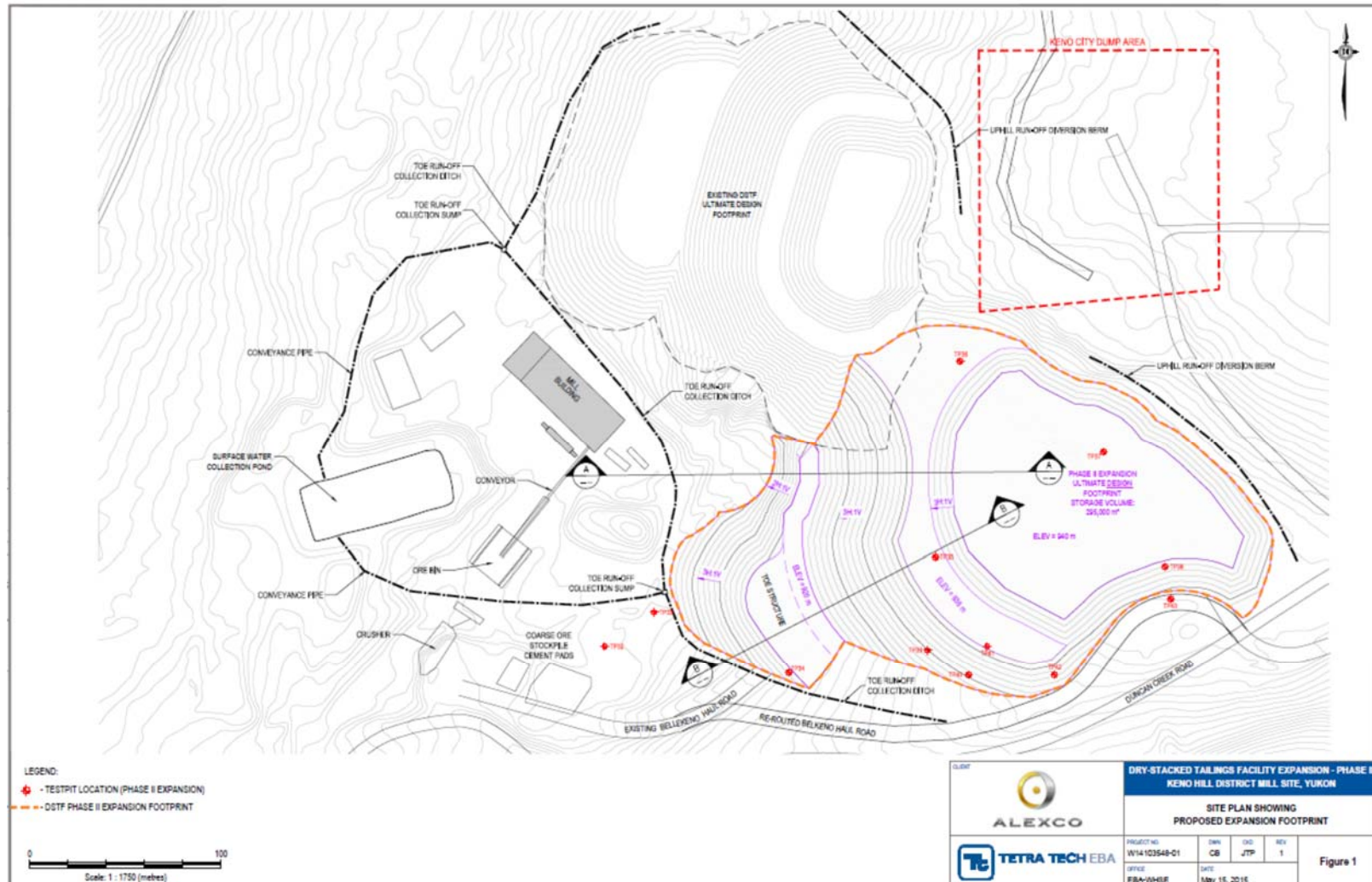


Figure 4-6 DSTF Phase 2 Expansion Design

4.4.1 Tailings Characterization

As the development of the Keno Hill Silver District progresses, additional tailings from other ore deposits will be stored in Dry Stack Tailings Facilities. The current and expanded DSTF design is suitable to store tailings from the Flame and Moth, Bellekeno, Lucky Queen and Onek deposits.

Following metallurgical testing of Bermingham samples, standard ABA analysis was completed on the remaining tailings samples, similar to the approach for Flame and Moth, Bellekeno, Onek and Lucky Queen samples during the previous assessment.

Table 4-4. District Tailings ABA Summary

Item	Sample ID	S _(T) %	S _(SO4) %	Paste pH	Acid Potential	Neutralization Potential (NP)		
						Actual	Ratio	Net
1	F7 Final tailing	0.17	0.03	7.8	4.4	36.8	8.4	32.4
2	F8 Final tailing	0.15	0.05	7.8	3.1	26.0	8.3	22.9
3	F9 Final tailing	0.18	0.04	8.2	4.4	20.4	4.7	16.0
4	F10 Final tailing	0.19	0.04	7.5	4.7	17.8	3.8	13.1
DUP	F7 Final tailing	0.17	0.03	7.8	4.4	37.1	8.5	32.8
Bellekeno Tailings, January to May 2011 Monthly Average		2.61	0.06	8.1	81.62	276.2	3.4	194.6
Flame and Moth Tailings F4+F5		0.45	0.02	8.0	14.1	100	7.11	86
Berm LCT2		1.39	0.01	8.2	43.1	56.3	1.3	13.2

The final tailings deposited in the DSTF will be a combination of Bermingham, Flame and Moth, Onek, Lucky Queen and Bellekeno ores, depending on the ratios of ore milled from these mines. Given the current performance of the Bellekeno tailings and the ABA testwork completed for Bermingham, Flame and Moth, Onek and Lucky Queen, bulk tailings stored on the DSTF are not a concern from an acid generating potential perspective. The Bermingham, Flame and Moth, Onek and Lucky Queen tailings are shown to be geochemically similar or better to Bellekeno in Table 4-4 and 4-5, and therefore the storage of the Flame and Moth, Onek and Lucky Queen tailings in the DSTF is appropriate.

Metals analysis of the tailings from the Bermingham, Flame and Moth, Lucky Queen and Onek metallurgical program was completed and the results are shown in Table 4-5.

Table 4-5. District Tailings Metallurgical Analysis

Elements	Units	Onok And Lucky Queen Sample ID				Bellekeno Tailings	F&M Tailings	Birmingham Tailings
		F7 Cut Tail	F8 Cut Tail	F9 Cut Tail	F10 Cut Tail	January to May 2011 Monthly Average	F4+F5 F&M Final Tailings	LCT2
C-Inorg	%	0.34	0.06	0.21	0.23	3.91	4.66	8.96
S(SO4)	%	0.03	0.05	0.04	0.04	0.06	0.02	0.01
Ag	ppm	3.2	9.6	9.6	23.2	53.08	12.35	56.4
Al	%	0.36	0.36	0.99	0.49	1.12	0.2	0.16
As	ppm	344	406	13	22	3526	699	401
Ba	ppm	18	30	169	80	180	11.5	30
Bi	ppm	<2	<2	<2	<2	3	6.59	0.04
Ca	%	0.65	0.28	0.48	0.27	1.55	0.59	0.73
Cd	ppm	14.4	131.1	4.9	3.0	255	7.19	23.4
Co	ppm	<1	2	3	<1	14.6	2.7	4.3
Cr	ppm	168	180	454	77	19	185.5	115
Cu	ppm	384	370	281	226	270	565	57.5
Fe	%	18.38	18.82	5.8	6.99	13.73	16.25	7.07
K	%	0.07	0.09	0.37	0.18	0.33	0.03	0.08
Mg	%	0.55	0.39	0.36	0.32	0.40	0.31	0.36
Mn	ppm	52200	51678	21651	27757	42420	4.28	4.43
Mo	ppm	<1	<1	2	<1	0.81	3.74	2.02
Na	%	0.02	0.02	0.03	0.02	0.074	0.006	<0.01
Ni	ppm	52	36	69	33	20	86.6	49.1
P	ppm	115	165	141	122	178	0.01	0.032
Pb	ppm	81	744	423	686	3498	789	2330
Sb	ppm	<5	<5	9.0	<5	60	41	44.6
Sr	ppm	10	12	20	10	42	4.81	15
Ti	%	<0.01	<0.01	0.02	<0.01	0.04	0.001	<0.005
Tl	ppm	15	20	<10	11	0.424	0.652	1.9
V	ppm	5	6	17	8	22	9.4	5
Zn	ppm	1937	15630	697	416	1749	1265	2080

4.4.2 Progressive DSTF Reclamation

Progressive reclamation of the DSTF is an important aspect of the operation of the DSTF. Once ample side slopes are available and filled to completion, the slopes are recontoured to a stable angle (i.e. 3:1) and a soil cover established and revegetation completed. As shown below a large portion of the DSTF was progressively reclaimed in 2012 and additional reclamation was completed in 2013 and 2014.



Photo 12: Aerial view of progressive reclamation of DSTF – 2012



Photo 13: Progressive reclamation of DSTF - 2012



Photo 14: DSTF September 2013

4.5 PLANT SERVICES

4.5.1 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; and
- gland service water supply.

4.5.1.1 Fresh Water Supply System

Fresh water is supplied to a 4 m diameter by 4 m high storage tank from Galkeno 900 water treatment plant, Bellekeno 625 water treatment plant or the fresh water well located immediately adjacent to the mill. 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 is stored in a 2 m diameter by 2 m high tank prior to delivery to various service points.

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. A fresh water well is also available for supply of fresh groundwater in use as gland water seal service and is located adjacent to the southeast corner of the mill building.

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.



Photo 15: Fresh Water Tank

4.5.1.2 Process Water Supply System

Process water is supplied to the plant via centrifugal pumps, one operating and one stand-by unit. This water supply is used for process stream dilution as well as by the plant clean-up hosing stations. The mill process pond is located downgradient from the mill building and contains and manages the process water balance required for the milling operation. Thickener overflow water from inside the mill building gravity flows via a 6" yellowmine insulated pipe into the mill process pond. Process makeup water is pumped from the pond to the process water tank for makeup and recycle in the milling process. The mill process pond is 32 x 79 meters in dimension with a total design capacity of 5,000 m³.

Process water consists primarily of reclaim water from the water polishing pond, as well as tailings thickeners overflow. From the process water pond, the reclaimed water is pumped to a 7 m diameter by 7 m high process water storage tank, from where the water is 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.



Photo 16: Process Water Pond

4.5.2 Reagent Requirements

The differential flotation process requires a number of chemical reagents to effectively separate the Ag/Pb/Zn from the primary minerals. Table 4-6 summarizes the reagents used in the flotation process and the primary purpose of each reagent. The reagents used in the Keno District Mill are supplied in a variety of packaging methods. Dry reagents are stored and mixed in an engineered reagent mixing system that provides positive ventilation and enclosure to ensure the safety and health of the employees handling these reagents. An MSDS summary for all reagents used is included in Appendix A.



Photo 17: Reagent Mixing Station

Table 4-6 Floatation Process Reagents

Reagent Name	Chemical Formula/Name	Packaging	Purpose
Zinc Sulphate	ZnSO ₄	25 kg bags – mixed with H ₂ O	Suppresses zinc from floating in the lead floatation process
Copper Sulphate	CuSO ₄	25 kg bags – mixed with H ₂ O	Activates zinc in the zinc floatation process
MIBC	Methyl Isobutyl Carbonal	55 gal. Drums liquid	Frother to promote bubbles in floatation circuit
SIPX	Sodium Isopropyl Xanthate	25 kg bags – mixed with H ₂ O	Collector for the sulphide minerals to attach to the air bubbles
Sodium Sulfide	Na ₂ SO ₃	25 kg bags – mixed with H ₂ O	Regulating agent to improve selectivity of mineral flotation
Sulfuric Acid	H ₂ SO ₄	55 gal Drums - liquid	Reduces pH of the floatation slurry
Lime	Ca(OH) ₂	Lime slurry delivered via truck	Increases pH of the floatation slurry
3418A	C ₈ H ₁₈ PS ₂ Na	55 gal Drums - liquid	Collector for the sulphide minerals to attach to the air bubbles

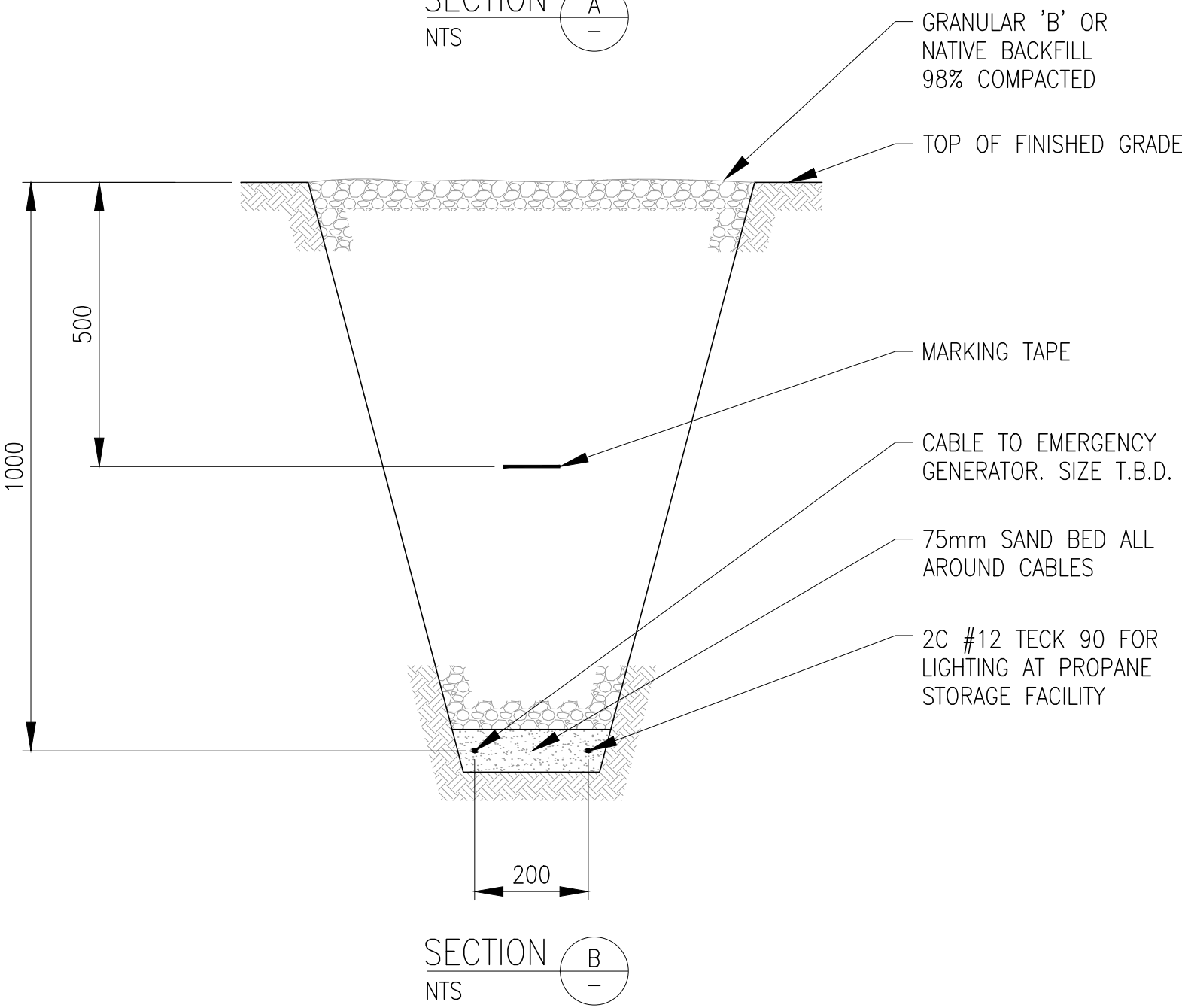
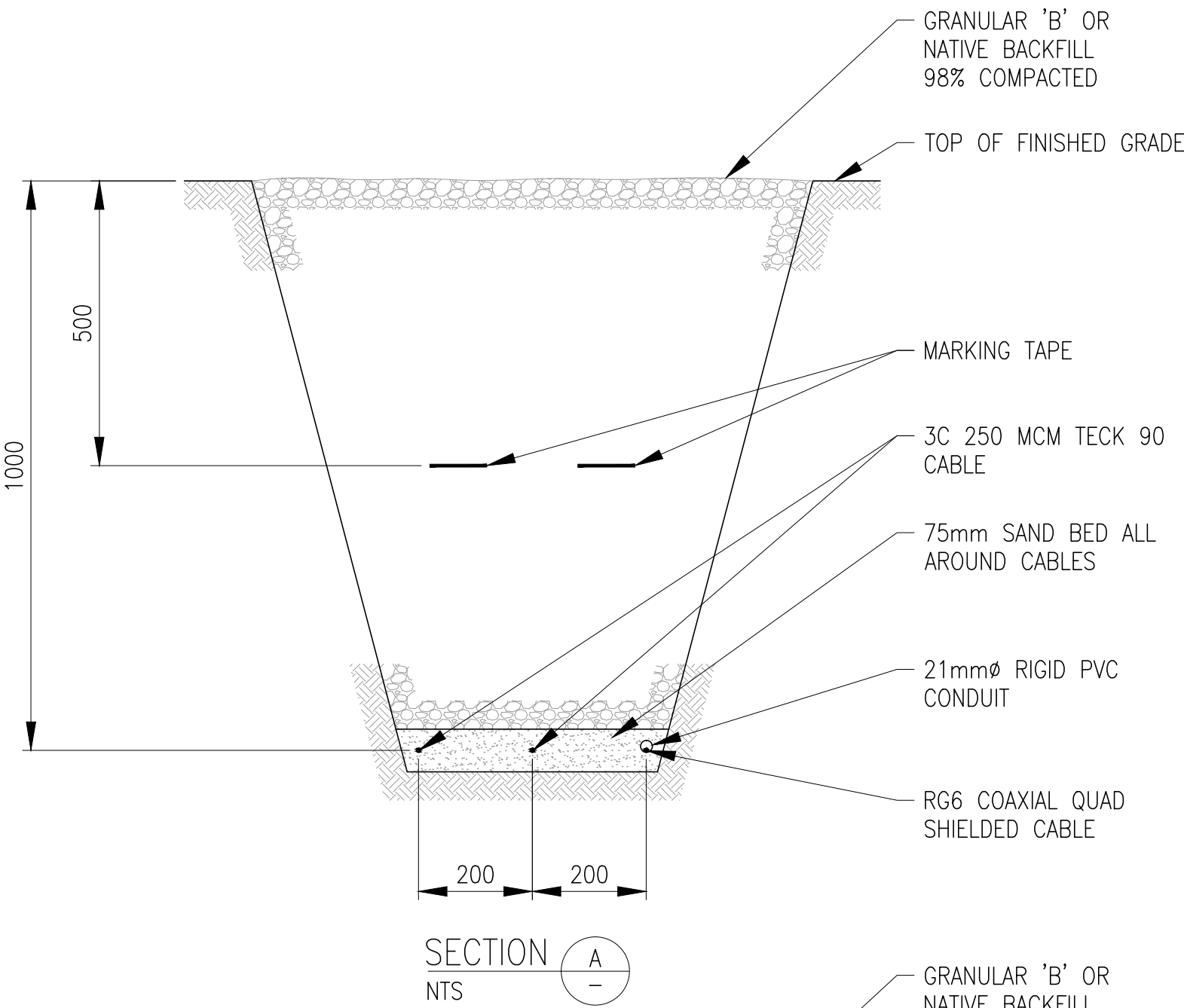
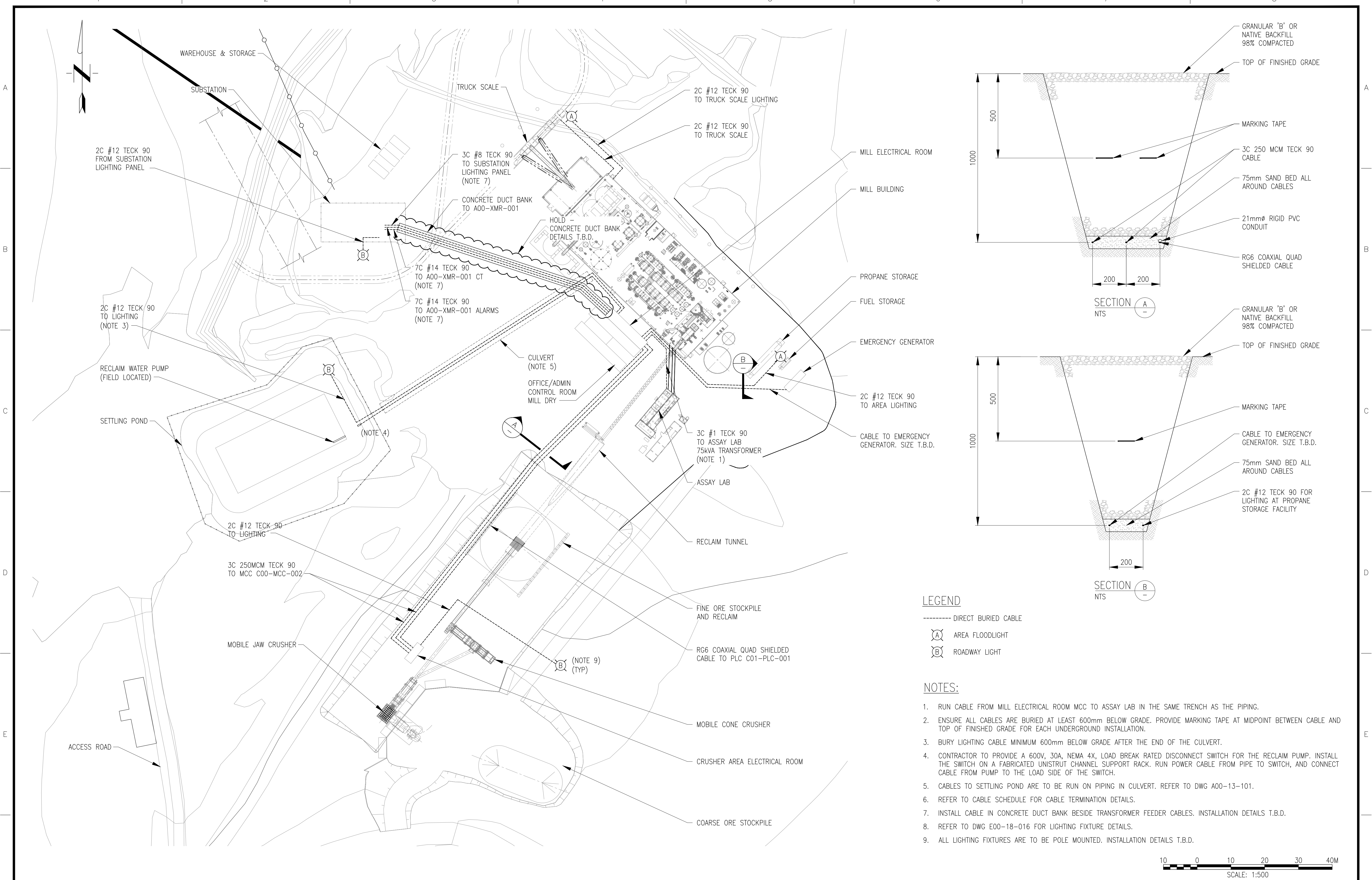
4.6 ELECTRICAL SUBSTATION

An electrical substation is located adjacent to the mill office/dry facility and houses a primary 69 KV – 600 V step down transformer and electrical distribution infrastructure. The substation is enclosed by a 28 m x 15.5 m security fence and is shown in Photo 18.



Photo 18: Electrical Substation

Engineering drawings for the mill electrical substation are included in Figure 4-7.



LEGEND

- DIRECT BURIED CABLE
- (A) AREA FLOODLIGHT
- (B) ROADWAY LIGHT

NOTES:

- RUN CABLE FROM MILL ELECTRICAL ROOM MCC TO ASSAY LAB IN THE SAME TRENCH AS THE PIPING.
- ENSURE ALL CABLES ARE BURIED AT LEAST 600mm BELOW GRADE. PROVIDE MARKING TAPE AT MIDPOINT BETWEEN CABLE AND TOP OF FINISHED GRADE FOR EACH UNDERGROUND INSTALLATION.
- BURY LIGHTING CABLE MINIMUM 600mm BELOW GRADE AFTER THE END OF THE CULVERT.
- CONTRACTOR TO PROVIDE A 600V, 30A, NEMA 4X, LOAD BREAK RATED DISCONNECT SWITCH FOR THE RECLAIM PUMP. INSTALL THE SWITCH ON A FABRICATED UNISTRUT CHANNEL SUPPORT RACK. RUN POWER CABLE FROM PIPE TO SWITCH, AND CONNECT CABLE FROM PUMP TO THE LOAD SIDE OF THE SWITCH.
- CABLES TO SETTLING POND ARE TO BE RUN ON PIPING IN CULVERT. REFER TO DWG A00-13-101.
- REFER TO CABLE SCHEDULE FOR CABLE TERMINATION DETAILS.
- INSTALL CABLE IN CONCRETE DUCT BANK BESIDE TRANSFORMER FEEDER CABLES. INSTALLATION DETAILS T.B.D.
- REFER TO DWG E00-18-016 FOR LIGHTING FIXTURE DETAILS.
- ALL LIGHTING FIXTURES ARE TO BE POLE MOUNTED. INSTALLATION DETAILS T.B.D.



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4.7 ASSAY LAB

The assay lab is located immediately adjacent to the mill building and consists of 3 skid mounted trailer units separated by a wooden deck and winter roof truss. The sample prep trailer is a skid mounted trailer used for preparation of mill and underground samples. The trailer is 13.47 x 3.05 meters in dimension.

The assay lab trailers consist of 2 separate skid mounted units that are joined together with assay capability for AA digestion and fire assay. The two assay trailers are 2.4 x 6.1 meters in dimension. The assay lab facility is shown in Photo 19.



Photo 19: Assay Lab

4.8 MILL MCC

A Motor Control Centre (MCC) for the mill building is located immediately adjacent to the mill and contains the motor control starters and distribution for the mill equipment. The main electrical substation distributes 600 V electrical power to the mill MCC. The mill MCC is a skid mounted unit mounted a steel support structure and has a dimension of 15.24 x 3.04 meters. The mill MCC is shown in Photo 20.



Photo 20: Mill MCC

4.9 DIESEL STORAGE TANKS

Two skid mounted double walled diesel storage tanks and a gasoline tank are located adjacent to the concentrate loadout area and are used for general fuelling of mobile equipment and vehicles. The diesel tanks are shown in Photo 21.



Photo 21: Diesel Storage Tanks

4.10 PROPANE STORAGE TANK

A tire mounted portable propane storage tank sits near the mill building with a capacity of 45,425 litres of propane. Propane is used at the mill for heating the mill building during winter conditions. The propane tank is shown in Photo 22.



Photo 22: Propane Storage Tank

APPENDIX A

MSDS SHEETS

**MATERIAL SAFETY DATA**

MSDS No: 01787
CAS No: 013360-78-6
Date: 03/13/2001
Supersedes: 10/14/1997

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **AEROPHINE® 3418A Promoter**

SYNONYMS: Sodium diisobutylidithiophosphinate, 50% aqueous solution

CHEMICAL FAMILY: Dithiophosphinate

MOLECULAR FORMULA: C₈H₁₈PS₂.Na

MOLECULAR WGT: 232

CYTEC INDUSTRIES INC., FIVE GARRET MOUNTAIN PLAZA, WEST PATERSON, NEW JERSEY 07424, USA

For Product Information call 1-800/652-6013. Outside the USA and Canada call 1-973/357-3193.

EMERGENCY PHONE: For emergency involving spill, leak, fire, exposure or accident call CHEMTREC: 1-800/424-9300. Outside the USA and Canada call 1-703/527-3887.

2. COMPOSITION/INFORMATION ON INGREDIENTS**OSHA REGULATED COMPONENTS**

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
Sodium diisobutyl-di thiophosphinate	013360-78-6	50-52	not established	

3. HAZARDS IDENTIFICATION**EMERGENCY OVERVIEW**

APPEARANCE AND ODOR: Colorless to light yellow mobile liquid; odorless

STATEMENTS OF HAZARD:

WARNING! CAUSES EYE IRRITATION
MAY CAUSE SKIN IRRITATION

POTENTIAL HEALTH EFFECTS**EFFECTS OF OVEREXPOSURE:**

The acute oral (rat) and acute dermal (rabbit) LD₅₀ values for this material are 3.35 g/kg and greater than 5.0 g/kg, respectively. Mild skin and moderate eye irritation were produced during primary irritation studies in rabbits. Skin irritation was increased after repeated exposures in rabbit studies.

4. FIRST AID MEASURES

If quantities greater than 15 cc are swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth or induce vomiting in an unconscious person.

In case of skin contact, immediately wash affected areas with soap and plenty of water. Remove contaminated clothing and shoes. Obtain medical attention. Destroy or thoroughly clean shoes before reuse. Do not reuse contaminated clothing without laundering.

In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention if irritation persists or if otherwise necessary.

Material is not expected to be harmful if inhaled. If inhaled, remove to fresh air.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: >200 F; 93 C

METHOD: Pensky-Martens Closed Cup

FLAMMABLE LIMITS

(% BY VOL): Not applicable

AUTOIGNITION TEMP: 819 F; 437 C

DECOMPOSITION TEMP: >662 F; 350C

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Use water spray, carbon dioxide or dry chemical to extinguish fires. Use water to keep containers cool.

Wear self-contained, positive pressure breathing apparatus and full fire-fighting protective clothing. See Section 8 (Exposure Controls/Personal Protection) for special protective clothing.

6. ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Where exposure level is not known, wear NIOSH approved, positive pressure, self-contained respirator. Where exposure level is known, wear NIOSH approved respirator suitable for level of exposure. In addition to the protective clothing/equipment in Section 8 (Exposure Controls/Personal Protection), wear impervious boots. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush area with water.

7. HANDLING AND STORAGE

Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure. Food, beverages, and tobacco products should not be carried, stored, or consumed where this material is in use. Before eating, drinking, or smoking, wash face and hands with soap and water. Avoid skin contact. Protective clothing such as impervious gloves, apron, workpants, long sleeve work shirt, or disposable coveralls are recommended to prevent skin contact. For operations where eye or face contact can occur, wear eye protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure. For operations where inhalation exposure can occur, a NIOSH approved respirator recommended by an industrial hygienist may be necessary. A full facepiece respirator also provides eye and face protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Colorless to light yellow mobile liquid; odorless

BOILING POINT: 223 F; 106 C

MELTING POINT: 23-32 F; -5-0 C; (crystallization point)

VAPOR PRESSURE: 17.5 mm Hg @ 20 C; (value for water)

SPECIFIC GRAVITY: 1.14 @ 24 C

VAPOR DENSITY: Not applicable

% VOLATILE (BY WT): ~50; (water)

pH: Slightly alkaline

SATURATION IN AIR (% BY VOL): Not applicable

EVAPORATION RATE: Not applicable

SOLUBILITY IN WATER: Complete

10. STABILITY AND REACTIVITY

STABILITY: Stable

CONDITIONS TO AVOID: None known

POLYMERIZATION: Will Not Occur

CONDITIONS TO AVOID: None known

INCOMPATIBLE MATERIALS: Strong mineral acids and strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: oxides of carbon; oxides of phosphorus; oxides of sulfur (includes sulfur di and tri oxides)

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under Section 3. HAZARDS IDENTIFICATION. Toxicological information on the OSHA regulated components of this product is as follows:

Sodium diisobutyldithiophosphinate causes moderate eye and mild skin irritation.

12. ECOLOGICAL INFORMATION

Algae (*Selenastrum capricornutum*), 96 hr EbC50 = 35.1 mg/L; 96 hr ErC50 = 115 mg/L

LC50

BLUEGILL, 96 HOUR: 375 mg/L

DAPHNIA, 48 HOUR: 149 mg/L

BOD

28 Day: 78.8 %

OCTANOL/H₂O PARTITION COEF.: Not applicable

13. DISPOSAL CONSIDERATIONS

The information on RCRA waste classification and disposal methodology provided below applies only to the Cytec product, as supplied. If the material has been altered or contaminated, or it has exceeded its recommended shelf life, the guidance may be inapplicable. Hazardous waste classification under federal regulations (40 CFR Part 261 et seq) is dependent upon whether a material is a RCRA "listed hazardous waste" or has any of the four RCRA "hazardous waste characteristics." Refer to 40 CFR Part 261.33 to determine if a given material to be disposed of is a RCRA "listed hazardous waste"; information contained in Section 15 of this MSDS is not intended to indicate if the product is a "listed hazardous waste." RCRA Hazardous Waste Characteristics: There are four characteristics defined in 40 CFR Section 261.21-61.24: Ignitability, Corrosivity, Reactivity, and Toxicity. To determine Ignitability, see Section 5 of this MSDS (flash point). For Corrosivity, see Sections 9 and 14 (pH and DOT corrosivity). For Reactivity, see Section 10 (incompatible materials). For Toxicity, see Section 2 (composition). Federal regulations are subject to change. State and local requirements, which may differ from or be more stringent than the federal regulations, may also apply to the classification of the material if it is to be disposed. Cytec encourages the recycle, recovery and reuse of materials, where permitted, as an alternate to disposal as a waste. Cytec recommends that organic materials classified as RCRA hazardous wastes be disposed of by thermal treatment or incineration at EPA approved facilities. Cytec has provided the foregoing for information only; the person generating the waste is responsible for determining the waste classification and disposal method.

14. TRANSPORT INFORMATION

This section provides basic shipping classification information. Refer to appropriate transportation regulations for specific requirements.

D.O.T. SHIPPING INFORMATION		IMO SHIPPING INFORMATION
SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED	NOT APPLICABLE/NOT REGULATED
HAZARD CLASS/ PACKING GROUP:	Not Applicable	Not Applicable
UN NUMBER:	Not Applicable	Not Applicable
IMDG PAGE:	Not Applicable	Not Applicable
D.O.T. HAZARDOUS SUBSTANCES:	(PRODUCT REPORTABLE QUANTITY) Not Applicable	Not Applicable
TRANSPORT LABEL REQUIRED:	None Required	None Required
ICAO/IATA		TRANSPORT CANADA
SHIPPING NAME:	NOT APPLICABLE/NOT REGULATED	NOT APPLICABLE/NOT REGULATED
HAZARD CLASS:	Not Applicable	Not Applicable
SUBSIDIARY CLASS:	Not Applicable	Not Applicable
UN / ID NUMBER:	Not Applicable	Not Applicable
PACKING GROUP:	Not Applicable	Not Applicable
TRANSPORT LABEL REQUIRED:	None Required	None Required
PACKING INSTR:	PASSENGER Not Applicable CARGO Not Applicable	Not Applicable
MAX NET QTY:	PASSENGER Not Applicable CARGO Not Applicable	Not Applicable
ADDITIONAL TRANSPORT INFORMATION		
TECHNICAL NAME (N.O.S.):	Not Applicable	

15. REGULATORY INFORMATION

INVENTORY INFORMATION

- US TSCA: All components of this product are included on the TSCA Inventory in compliance with the Toxic Substances Control Act, 15 U. S. C. 2601 et. seq.
- CANADA DSL: Components of this product have been reported to Environment Canada in accordance with subsection 25 of the Canadian Environmental Protection Act and are included on the Domestic Substances List.

EEC EINECS: All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) in compliance with Council Directive 67/548/EEC and its amendments.

**OTHER
ENVIRONMENTAL
INFORMATION**

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

COMPONENT	CAS. NO.	%	TPQ(lbs)	RQ(lbs)	S313	TSCA 12B
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This product does not contain any components regulated under these sections of the EPA

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA				
ACUTE (Y)	CHRONIC (N)	FIRE (N)	REACTIVE (N)	PRESSURE (N)

16. OTHER INFORMATION

NFPA HAZARD RATING (National Fire Protection Association)

Fire	FIRE: Materials that must be preheated before ignition can occur.
1	HEALTH: Materials that, under emergency conditions, can cause temporary
Health 2	incapacitation or residual injury.
0 Reactivity	REACTIVITY: Materials that in themselves are normally stable, even under fire
—	exposure conditions.
Special	

REASON FOR ISSUE:

Revised Section 15

Randy Deskin, Ph.D., DABT

This information is given without any warranty or representation. We do not assume any legal responsibility for same, nor do we give permission, inducement, or recommendation to practice any patented invention without a license. It is offered solely for your consideration, investigation and verification. Before using any product, read its label.

**OLD BRIDGE CHEMICALS, INC.
OLD WATERWORKS ROAD
OLD BRIDGE, NJ 08857**

Telephone: 732-727-2225

Facsimile: 732-727-2653

info@oldbridgechem.com

www.oldbridgechem.com

MATERIAL SAFETY DATA SHEET

October 25, 2006

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Product Name: COPPER SULFATE CRYSTALS

Manufacturer: Old Bridge Chemicals, Inc.
P.O. Box 194
Old Bridge, New Jersey 08857

Telephone: (732) 727-2225
Emergency Telephone: (800) 275-3924
24-hour Emergency Telephone: (800) 424-9300 Chemtrec

HAZARD CLASSIFICATION: NFPA: Health-3 / Fire-0 / Reactivity-0
HMIS: Health-3 / Fire-0 / Reactivity-0

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200).

SECTION I. MATERIAL IDENTIFICATION

Common Name: Copper Sulfate
Synonyms: Blue Vitrol, Bluestone, Cupric Sulfate
Molecular Formula: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
EPA Reg. Number: 46923-4
EPA Signal Word: **DANGER**
CAS Number: 7758-99-8
SIC Number: 28199 C 29

SECTION II. COMPOSITION/INFORMATION ON INGREDIENTS

Exposure Limits: ACGIH TLV TWA: 1.0 mg/m³ (as copper dust/mist)
OSHA PEL TWA: 1.0 mg/m³ (as copper dust/mist)

SECTION III. HAZARD INFORMATION

Emergency overview: Odorless blue crystals. Can cause irreversible eye damage and severe skin irritation. Harmful if swallowed or absorbed through the skin. Avoid

breathing dust or mist. Avoid contact with the skin, eyes or clothes. May cause skin sensitization in certain individuals.

Swallowing:	Toxic orally in accordance with FHSLA regulations. Acute oral LD50 (male rats) = 472 mg/Kg. Can cause irritation to the digestive tract and abdominal pain.
Skin :	Slight skin irritant. Excessive exposure may cause skin irritation. Repeated exposure may cause allergic dermatitis. May cause irritation or burns on wet skin.
Eyes:	Can cause severe eye irritation and may result in irreversible eye damage.
Inhalation:	Inhalation of dust may cause irritation to the mucous membranes and upper respiratory tract
Carcinogenicity:	None as per NTP, OSHA, and IARC.

SECTION IV. FIRST AID PROCEDURES

Ingestion:	Give large amounts of milk, egg white, gelatin solution, or if they are not available, large quantities of water. Do not induce vomiting or give anything to an unconscious person. Avoid alcohol. Call Poison Control Center or a physician.
Skin:	Wash thoroughly with soap and water. Remove and wash contaminated clothing before reuse.
Eyes:	Immediately flush eyes with plenty of water for 15 minutes. Hold eyelids apart during irrigation. Call a physician.
Inhalation:	Remove person to fresh air. If not breathing, administer artificial respiration. Get medical attention.
Carcinogenicity:	None.

SECTION V. FIRE AND EXPLOSION DATA

Flash Point:	Not applicable.
Flammable Limits:	Not flammable. If heated above 400° C it can decompose to emit toxic fumes of oxide and sulfur.
Auto Ignition Temperature:	Not determined.
Extinguishing Media:	Copper Sulfate does not burn nor will it support combustion. If stored with other combustible products use water, CO ₂ or dry chemical.
Special Fire Fighting Instructions:	If dry heated above 600° C, SO ₂ is evolved. If water is used it will solubilize the Copper Sulfate and care should be taken to keep such water out of streams or other water bodies.
Fire Fighting Equipment:	Wear self-contained breathing apparatus.

Fire and Explosion Hazards: None.

SECTION VI. ACCIDENTAL RELEASE MEASURES

Use clean-up measures that avoid dust generation. Wear NIOSH or MSHA approved respirator if dust will be generated. Cover spill with absorbent material such as seeping compound or lime. Sweep up and put into an appropriate container for proper disposal in an approved method. Prevent accidental entry of solution into streams or other bodies of water. Shovel spills into plastic bags and seal with tape.

SECTION VII. HANDLING AND STORAGE

Signal Word:

DANGER

Handling Information:

Avoid breathing dust or mist. Sweep up crystals. Eye wash stations should be available in work areas. Users should wash hands before eating, drinking, smoking or using the toilet. Remove PPE immediately after handling this product. Wash outside of gloves before removing. Wash and change into clean clothing as soon as possible. Store in closed containers in a cool, dry, well-ventilated area away from heat sources and reducing agents. Store in original containers. Keep away from galvanized pipe, aluminum and nylon. Place damaged containers in plastic bags.

Storage Information:

SECTION VIII. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ventilation:

TWA = 1 mg/l. for Copper Sulfate. When TWA exceeds this limit in the workplace, provide appropriate ventilation.

Respiratory Protection:

Wear an approved respirator for dusts or mists: MSHA/NIOSH approved number prefix TC-21C, or a NIOSH approved respirator with any R, P or HE filter. Alternatively, provide respiratory protection equipment in accordance with Paragraph 1910.134 of Title 29 of the Code of Federal Regulations.

Eye Protection:

Use safety glasses with side shields or goggles.

Skin Protection:

Applicators and other handlers should wear long-sleeved shirts and long pants, waterproof gloves, shoes plus socks and protective eyewear. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with product's concentrate. Do not reuse them. Keep and wash PPE separately from other laundry.

SECTION IX. PHYSICAL DATA

Physical State:

Blue crystals or powder

Boiling Point:

NA

Melting Point:	Decomposition above 110°C with $-4\text{H}_2\text{O}$
Vapor Density:	NA
Specific Gravity:	2.284
Solubility in H_2O :	22.37% @ 0°C 117.95% @ 100°C
Solubility in Other Solvents:	Soluble in methanol, glycerol and slightly soluble in ethanol.
Molecular Weight:	249.68
Appearance:	Transparent blue crystals
Odor:	Odorless

SECTION X. REACTIVITY DATA

Stability:	Stable
Conditions to Avoid:	Product is highly soluble, but does not react with water.
Incompatibility:	Solutions are mildly corrosive to steel. Store solutions in plastic or rubber or 304, 347 or 316 stainless steel. Iron and moisture should be avoided. Store in a dry area. Incompatible with aluminum powder, acetylene gas, hydroxylamine, magnesium and moisture. Contact with magnesium can generate dangerous levels of hydrogen gas. With exposure to air it will oxidize and turn whitish.
Hazardous Decomposition Products:	None at normal production temperatures and pressures. If dry heated above 600°C toxic sulfur may evolve.
Polymerization:	Will not occur.

SECTION XI. TOXICOLOGICAL INFORMATION

Inhalation:	$\text{LC}_{50} > 2.95 \text{ mg/L}$ (rat) Inhalation of dust can result in irritation of nasal mucous membranes and sometimes of the pharynx, on occasion ulceration with perforation of the nasal septum.
Skin:	$\text{LD}_{50} > 8.0 \text{ g/kg}$ (rabbit)
Ingestion:	$\text{LD}_{50} > 472.5 \text{ mg/kg}$ (rat)
Primary Eye Irritation:	Corrosive, irreversible eye damage.
Primary Skin Irritation:	No skin irritation.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be needed. Wilson's disease can be aggravated by excessive exposure. Symptoms include nausea, vomiting, epigastria pain, diarrhea, dizziness, jaundice, and general debility.

SECTION XII. ENVIRONMENTAL AND DISPOSAL INFORMATION

Aquatic LC_{50} :	Daphnia magna 0.182 mg/L.
----------------------------	---------------------------

	Rainbow Trout 0.17 mg/L. Blue Gill 1.5 mg/L.
Spills and Leaks:	All values are expressed as Copper Sulfate Pentahydrate. Test water was soft. Period 24 hours. Comply with Federal, State and local regulations on reporting spills. Do not wash away crystals or powder. Recover dry if possible. If product is in a confined solution, react with soda ash to form an insoluble Copper Carbonate solid that can be scooped up.
Waste Disposal:	Do not reuse container. Comply with Federal, State and local environmental control regulations. Sweep up crystals, powder or insoluble Copper Carbonate and dispose of in an approved landfill.
Environmental Effects:	May be dangerous if it enters the public water systems. Follow local regulation. Toxic to fish and plants. Fish toxicity critical concentration is 235 mg/l. and plant toxicity is 25 mg/l.

SECTION XIII. REGULATORY INFORMATION

NOTICE: The information herein is presented in good faith and believed to be accurate. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another. It is the buyer's responsibility to ensure that its activities comply with Federal, State, and local laws.

SARA 313 Information; This product contains the following substance subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372: COPPER COMPOUND > 1.0%

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following category:

ACUTE HEALTH HAZARD

OSHA: This product is considered hazardous under the OSHA Hazardous Communication Standard (29 CFR 1910.1200).

TSCA: Listed on the Chemical Inventory

CERCLA Hazardous Substances: RQ is not assigned to the broad class of copper compounds.

RCRA: When discarding this material as supplied, it does not meet RCRA characteristic definition if ignitability, corrosiveness, reactivity, and is not listed in 40CFR 261.33.

This product contains Copper Sulfate and is subject to the reporting requirements of Section 13 of the Emergency Planning and Community-Right-to-Know-Act of 1986 (40CFR372).

SECTION XIV. SHIPPING INFORMATION

DOT Shipping Name RQ, Environmentally Hazardous Substance, Solid, NOS, (CUPRIC SULFATE), 9, UN3077, PGIII, ERG 171

Reportable Quantity (RQ): 10 pounds (4.54 kg)

Not hazardous when shipping less than 10 pounds

Note: Marine pollutant

SECTION XV. MISCELLANEOUS INFORMATION

This is an NSF Certified Product to ANSI/NSF 60. Maximum use in potable water is not to exceed 2 mg. per liter.

SECTION XVI. MSDS PREPARATION INFORMATION

Prepared By: Joel L. Goldschmidt
Vice President



MATERIAL SAFETY DATASHEET
BULLETIN DE SÉCURITÉ DU PRODUIT

IN CASE OF EMERGENCY / EN CAS D'URGENCE: SARNIA (519)339-3711 - FORT SASKATCHEWAN (780)998-8282 - VARENNES (450)652-1000

PREPARATION INFORMATION / RENSEIGNEMENTS SUR LA PRÉPARATION:

Prepared for use in Canada by: / Pour utilisation au Canada, préparé par:
EH&S Product Regulatory Management Department
Dow Chemical Canada Inc. P.O. Box 1012, Sarnia, Ontario N7T 7K7 (800) 363-3500 EXT.2241

M A T E R I A L S A F E T Y D A T A S H E E T

1. CHEMICAL PRODUCT & COMPANY IDENTIFICATION

Page: 1

IN CASE OF EMERGENCY: Fort Saskatchewan, Alberta: (780) 998-8282
Sarnia, Ontario: (519) 339-3711
Varenes, Quebec: (450) 652-1000

Product: DOWFROTH* 250 FLOTATION FROTHER

Product Code: 23586

Effective Date: 01/15/99 Date Printed: 07/17/00 MSD: 002010

Dow Chemical Canada Inc.
P.O. Box 1012, Sarnia, Ontario N7T 7K7

Prepared for use in Canada by the EH&S Product Regulatory
Management Department; Phone: (800) 363-3500 EXT. 2241

2. COMPOSITION/INFORMATION ON INGREDIENTS

Propylene oxide methanol adduct	CAS# 037286-64-9	99%
Potassium hydroxide	CAS# 001310-58-3	1%

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

*
* Yellow to dark brown liquid. Low odor. Causes eye burns.
*

POTENTIAL HEALTH EFFECTS (See Section 11 for toxicological data.)

(Continued on page 2)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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EYE: Due to the pH of the material, it is assumed that exposure may cause severe irritation with corneal injury which may result in permanent impairment of vision, even blindness.

SKIN: Short single exposure not likely to cause significant skin irritation. Prolonged or repeated exposure may cause moderate skin irritation. May cause more severe response if confined to skin or skin is abraded (scratched or cut). Prolonged or repeated exposure to very large amounts of component(s) in this mixture may cause narcosis (drowsiness).

INGESTION: Single dose oral toxicity is considered to be low. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury. Observations in animals include tremors and convulsions.

INHALATION: At room temperature, vapors are minimal due to physical properties; a single exposure is not likely to be hazardous. If material is heated or mist is produced, concentrations may be attained that are sufficient to cause respiratory irritation and other effects. Signs and symptoms of excessive exposure may be anesthetic or narcotic effects.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Signs and symptoms of excessive exposure may be anesthetic or narcotic effects.

TERATOLOGY (BIRTH DEFECTS): Contains component(s) which did not cause birth defects in laboratory animals.

4. FIRST AID

(Continued on page 3)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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EYE: Wash eyes immediately and continuously for 30 minutes. Seek medical attention immediately. Wash eyes enroute if possible.

SKIN: Wash off in flowing water or shower.

INGESTION: If swallowed, seek medical attention. Do not induce vomiting unless directed to do so by medical personnel.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

NOTE TO PHYSICIAN: Eye irrigation may be necessary for an extended period of time to remove as much caustic as possible. Duration of irrigation and treatment is at the discretion of medical personnel. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: 300F, 149C

METHOD USED: Setaflash

AUTOIGNITION TEMPERATURE: Not determined.

FLAMMABILITY LIMITS

LFL: Not determined.

UFL: Not determined.

(Continued on page 4)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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HAZARDOUS COMBUSTION PRODUCTS: Under fire conditions polymers decompose. The smoke may contain polymer fragments of varying compositions in addition to unidentified toxic and/or irritating compounds. Hazardous combustion products may include and are not limited to: carbon monoxide and carbon dioxide.

OTHER FLAMMABILITY INFORMATION: Violent steam generation or eruption may occur upon application of direct water stream to hot liquids. Spills of these organic liquids on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion.

EXTINGUISHING MEDIA: Water fog or fine spray, carbon dioxide, dry chemical, foam. Alcohol resistant foams (ATC type) are preferred if available. General purpose synthetic foams (including AFFF) or protein foams may function, but much less effectively. Do not use direct water stream. Will spread fire.

MEDIA TO BE AVOIDED: Do not use direct water stream.

FIRE FIGHTING INSTRUCTIONS: Keep people away. Isolate fire area and deny unnecessary entry. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Burning liquids may be extinguished by dilution with water. Do not use direct water stream. May spread fire.

PROTECTIVE EQUIPMENT FOR FIRE FIGHTERS: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, pants, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

6. ACCIDENTAL RELEASE MEASURES (See Section 15 for Regulatory Information)

(Continued on page 5)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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PROTECT PEOPLE: Clear non-emergency personnel from area.

PROTECT THE ENVIRONMENT: Contain liquid to prevent contamination of soil, surface water or ground water.

CLEANUP: Soak up with suitable, non-reactive absorbent material. Collect into suitable containers for disposal.

7. HANDLING AND STORAGE

HANDLING: Avoid contact with vapors from head space of containers.

STORAGE: To avoid uncontrolled emissions vent vapor from container to storage tank.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guideline.

PERSONAL PROTECTIVE EQUIPMENT

EYE/FACE PROTECTION: Use chemical goggles. Eye wash fountain should be located in immediate work area.

SKIN PROTECTION: When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as faceshield,

(Continued on page 6)

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gloves, boots, apron, or full-body suit will depend on operation. If hands are cut or scratched, use gloves impervious to this material even for brief exposures.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. For most conditions, no respiratory protection should be needed; however, if material is heated or sprayed, use an approved air-purifying respirator.

EXPOSURE GUIDELINE(S): Dipropylene glycol methyl ether: ACGIH TLV and OSHA PEL are 100 ppm TWA, 150 ppm STEL.

Potassium hydroxide: ACGIH TLV and OSHA PEL are 2 mg/m³ Ceiling.

PELs are in accord with those recommended by OSHA, as in the 1989 revision of PELs.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Yellow to dark brown liquid.
ODOR: Not available.
VAPOR PRESSURE: <0.01 mmHg @ 20C
VAPOR DENSITY: Low
BOILING POINT: 473F, 245C
SOLUBILITY IN WATER: Completely miscible.
SPECIFIC GRAVITY: 0.98 25/25

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable under recommended storage conditions.
See Storage Section.

(Continued on page 7)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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CONDITIONS TO AVOID: None known.

INCOMPATIBILITY WITH OTHER MATERIALS: Avoid contact with
oxidizing materials.

HAZARDOUS DECOMPOSITION PRODUCTS: None known.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION (See Section 3 for Potential Health Effects. For detailed toxicological data, write or call the address or non-emergency number shown in Section 1)

SKIN: The dermal LD50 has not been determined.

INGESTION: The oral LD50 for rats is between 1260 - 2520 mg/kg.

MUTAGENICITY: In vitro mutagenicity studies were negative for component(s) tested.

12. ECOLOGICAL INFORMATION (For detailed Ecological data, write or call the address or non-emergency number shown in Section 1)

ENVIRONMENTAL FATE

MOVEMENT & PARTITIONING: Log octanol/water partition coefficient (log Pow) is estimated to be low. Based largely or completely on information for similar material.

DEGRADATION & PERSISTENCE: 20-Day biochemical oxygen demand

(Continued on page 8)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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(BOD20) is 0.18 p/p. Biodegradation under aerobic static laboratory conditions is low (BOD20 or BOD28/ThOD between 2.5 and 10%)

ECOTOXICITY: Acute LC50 for fathead minnow (*Pimephales promelas*) is > 100 mg/L. Material is practically non-toxic to fish on an acute basis (LC50 greater than 100 mg/L).

13. DISPOSAL CONSIDERATIONS (See Section 15 for Regulatory Information)

DISPOSAL: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. THE DOW CHEMICAL COMPANY HAS NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION 2 (Composition/Information On Ingredients).

FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: recycler, reclaimer, incinerator or other thermal destruction device.

As a service to its customers, Dow can provide names of information resources to help identify waste management companies and other facilities which recycle, reprocess or manage chemicals or plastics, and that manage used drums. Telephone Dow's Customer Information Center at 800-258-2436 or 517-832-1556 for further details.

14. TRANSPORT INFORMATION

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* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

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DEPARTMENT OF TRANSPORTATION (D.O.T.): For DOT regulatory information, if required, consult transportation regulations, product shipping papers, or your Dow representative.

CANADIAN TDG INFORMATION: For TDG regulatory information, if required, consult transportation regulations, product shipping papers, or your Dow representative.

15. REGULATORY INFORMATION (Not meant to be all-inclusive--selected regulations represented)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See other sections for health and safety information.

CANADIAN REGULATIONS

=====

WHMIS INFORMATION: The Canadian Workplace Hazardous Materials Information System (WHMIS) Classification for this product is:

E - corrosive to metal or skin
 Refer elsewhere in the MSDS for specific warnings and safe handling information. Refer to the employer's workplace education program.

(Continued on page 10)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

M A T E R I A L S A F E T Y D A T A S H E E T

Product: DOWFROTH* 250 FLOTATION FROTHER
Product Code: 23586

Page: 10

Effective Date: 01/15/99

Date Printed: 07/17/00

MSD: 002010

REGULATORY INFORMATION (CONTINUED)

- - - - -
CPR STATEMENT: This product has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

- - - - -
HAZARDOUS PRODUCTS ACT INFORMATION: This product contains the following ingredients which are Controlled Products and/or on the Ingredient Disclosure List (Canadian HPA section 13 and 14):

COMPONENTS:	CAS #	AMOUNT(%w/w)
Polypropylene glycol methyl ether	CAS# 037286-64-9	98%
Potassium hydroxide	CAS# 001310-58-3	1%

U.S. REGULATIONS

=====

SARA 313 INFORMATION: To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard

(Continued on page 11)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

M A T E R I A L S A F E T Y D A T A S H E E T

Product: DOWFROTH* 250 FLOTATION FROTHER
Product Code: 23586

Page: 11

Effective Date: 01/15/99

Date Printed: 07/17/00

MSD: 002010

REGULATORY INFORMATION (CONTINUED)

TOXIC SUBSTANCES CONTROL ACT (TSCA):

All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
POTASSIUM HYDROXIDE	001310-58-3	NJ1 NJ3 PA1 PA3
DIPROPYLENE GLYCOL METHYL ETHER	034590-94-8	NJ3 PA1

NJ1=New Jersey Special Health Hazard Substance (present at greater than or equal to 0.1%).

NJ3=New Jersey Workplace Hazardous Substance (present at greater than or equal to 1.0%).

PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%).

PA3=Pennsylvania Environmental Hazardous Substance (present at greater than or equal to 1.0%).

STATE RIGHT-TO-KNOW: This product is not known to contain any

(Continued on page 12)

* OR (R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

M A T E R I A L S A F E T Y D A T A S H E E T

Product: DOWFROTH* 250 FLOTATION FROTHER
Product Code: 23586

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Effective Date: 01/15/99

Date Printed: 07/17/00

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REGULATORY INFORMATION (CONTINUED)

substances subject to the disclosure requirements of

New Jersey
Pennsylvania

OSHA HAZARD COMMUNICATION STANDARD:

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

16. OTHER INFORMATION

MSDS STATUS: Revised Sections 3, 4, 8, 11, 12, 13, 15.
Canadian regulatory information revised.

(R) Indicates a Trademark of The Dow Chemical Company
The Information Herein Is Given In Good Faith, But No Warranty,
Express Or Implied, Is Made. Consult The Dow Chemical Company
For Further Information.

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

1. Identification of the Substance/Preparation and of the Company/Undertaking

Company Information

Company: Ciba Canada Ltd.
2626 Argentia Road
Mississauga, Ontario L5N 5N2
Canada
Customer Service / Product Information: 1-866-679-2422

Emergency information

Emergency 24-Hour Health/Environmental Phone: +1-800-873-1138
CANUTEC: (613) 996-6666 (24hrs)

Product information

Product: MAGNAFLOC 10
Use: flocculation agent

2. Hazards Identification

Emergency overview

Signal word: CAUTION: !
Colour: off-white
Appearance: powder
State of matter: solid
Odour: odourless
Health: This product has no known adverse effect on human health.
Physical/Chemical hazards: Organic powders may be capable of generating static discharges and creating explosive mixtures in air. Handle with caution., Slip hazard when wet.

Potential health effects

Primary routes of entry:

Eyes, Skin, Inhalation, Ingestion

Chronic exposure:

Eye contact may cause slight irritation and/or redness. Repeated or prolonged exposure may cause slight skin irritation.
Inhaled dust may cause respiratory irritation.

3. Composition/Information on Ingredients

This material does not contain any hazardous components that are reportable according to WHMIS criteria.

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

4. First-aid Measures

Inhalation:

Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.

Skin:

After contact with skin, wash immediately with plenty of water and soap.
Get medical attention if irritation occurs.
If clothing is contaminated, remove and launder before reuse.

Eyes:

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Ingestion:

Do not induce vomiting. If vomiting occurs naturally, have casualty lean forward to reduce the risk of aspiration.
Seek medical attention immediately.

5. Fire-fighting Measures

Suitable extinguishing media:

carbon dioxide, dry powder, foam

Unsuitable Extinguishing Media:

If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Hazardous combustion products:

Carbon and nitrogen oxides.

Hazards during fire-fighting:

Standard procedure for chemical fires.
The product becomes slippery when wet. Restrict pedestrian and vehicular traffic in areas where slip hazard may exist.
Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition.

Protective equipment for fire-fighting:

Wear self-contained breathing apparatus and chemical-protective clothing.

6. Accidental Release Measures

Cleanup:

Sweep up and shovel into suitable containers for disposal.
Avoid raising dust.
Wear suitable protective equipment.
Should not be released into the environment.

7. Handling and Storage

Handling

General advice:

As with all industrial chemicals, use good industrial practices when handling. Avoid eye, skin, and clothing contact.
Do not inhale. Do not taste or swallow. Use only with adequate ventilation.

Protection against fire and explosion:

Avoid creating dusty conditions. Risk of explosion if an air-dust mixture forms.

Storage

General advice:

Keep container tightly closed in a dry, cool and well-ventilated place.

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

> for industrial use only <

8. Exposure Controls and Personal Protection

Engineering Controls:

Work in well ventilated areas. Do not breathe dust.
Ensure good ventilation and local exhaust.

Personal protective equipment

Respiratory protection:

Wear a NIOSH-certified respirator as necessary.

Eye protection:

Wear safety goggles (chemical goggles) if there is potential for airborne dust exposures.

Body protection:

Wear chemical resistant gloves and protective clothing.

General safety and hygiene measures:

There are no OSHA or ACGIH exposure guidelines available for component(s) in this product.

9. Physical and Chemical Properties

Colour:	off-white	
Form:	powder	
State of matter:	solid	
Odour:	odourless	
pH value:	5 - 7	1% solution
Evaporation rate:		Not tested
Flash point:		Not applicable
Melting point:		Not applicable
Boiling point:		Not applicable
Vapour pressure:		Not tested
Density:		Not applicable
Bulk density:	0.8 g/cm3	
Vapour density:		Not tested
Partitioning coefficient n-octanol/water (log Pow):		Not applicable
Viscosity, dynamic:		Not tested
% Volatiles:		not determined
Solubility in water:		Forms a viscous solution
Solubility in other solvents:		Not tested

10. Stability and Reactivity

Stability:

Stable.

Conditions to avoid: Avoid temperature extremes. Avoid humidity.

Substances to avoid: Strong oxidizing agents., (may degrade polymer)

Possibility of Hazardous Reactions: No hazardous reactions known.

Hazardous decomposition products: No decomposition expected under normal storage conditions.

11. Toxicological Information

Acute oral toxicity:

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

LD50 / oral / rat: > 2,000 mg/kg

Acute inhalation toxicity:

Not determined.

Acute dermal toxicity:

dermal:

Not determined.

Skin irritation:

not determined

Eye irritation:

Not determined.

Skin Sensitization:

Not tested

Chronic toxicity:

not determined

Subacute Toxicity:

not determined

Subchronic Toxicity:

not determined

Genetic toxicity:

Not expected to be mutagenic

Carcinogenicity:

None of the components in this product at concentrations greater than 0.1% are listed by IARC; NTP, OSHA or ACGIH as a carcinogen.

Reproductive toxicity:

No data for product. No effects anticipated

Developmental toxicity/teratogenicity:

No data for product. No effects anticipated.

12. Ecological Information

Toxicity to fish:

Brachydanio rerio/96 h/LC50: 357 mg/l (OECD 203; ISO 7346; 92/69/EEC, C.1)

From tests on a product range

Toxicity to aquatic invertebrates:

Daphnia magna/48 h/EC50: 212 mg/l (OECD 202/EC C.2)

From tests on a product range

Toxicity to aquatic plants:

Chlorella vulgaris/72 h/EC50: > 1,000 mg/l (OECD 201/EC C. 3)

From tests on a product range

Toxicity to microorganisms:

Pseudomonas putida/24 h/EC50: 892 mg/l

From tests on a product range

Material Safety Data Sheet

WHMIS / ANSI Z400.1-2004 Compliant



Date / Revised: 04-17-2007

Release: 1.0

Product: MAGNAFLOC 10

Biodegradation:

Not tested

13. Disposal Considerations

Waste disposal of substance:

Dispose of in accordance with national, state and local regulations.

14. Transport Information

TDG (Canada) Road transport

Special shipping information: Not classified as a dangerous good under transport regulations.

International Air Transport Association (IATA)

Special shipping information: Not classified as a dangerous good under transport regulations.

International Maritime Dangerous Goods Code (IMDG)

Special shipping information: Not classified as a dangerous good under transport regulations.

15. Regulatory Information

US: Toxic Substances Control Act (TSCA):

All component(s) comprising this product are either exempt or listed on the TSCA inventory

Canada: Domestic Substances List (DSL):

All components either exempt or listed on the DSL

Canada Regulations

Workplace Hazardous Materials Information System (WHMIS Classification):

This product is not WHMIS controlled.

Significant New Activity Conditions (SNAC):

This product does not contain any components subject to a SNAC Notice.

International Regulations

Chemical Weapons Convention:

This product does not contain any component(s) listed under the Chemical Weapons Convention Schedule of Chemicals.

16. Other Information

Product Safety Contact:

Prepared by: Ginette Rambié (905) 812-7280

Phone number of preparer:

Date / Revised: 04-17-2007

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Disclaimer:

The information contained herein is based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to such data or information. The user is responsible for determining whether the product is suitable for its intended conditions of use.



SYSTEM FLOC-360™

Flocculant

Description SYSTEM FLOC-360™ polymeric flocculant is used to flocculate clays and shales encountered in drilling operations and facilitate disposal of water-based drilling fluids.

Applications/Functions

- Can flocculate and settle out dispersed formation solids in clear fluids and conventional drilling fluids

Advantages

- Product addition creates aggressive water/solids separation
- Residual fluids after treatment have improved clarity
- Effective in low to moderate concentrations

Typical Properties

• Appearance	Amber Liquid
• Specific gravity	1.14- 1.18
• Freeze point, °F, (°C)	20°F (-7°C)
• pH of 1% aqueous solution @ 25°C	5.5-6.5
• Viscosity* @ 25°C (*Brookfield LVT, 30 rpm, Spindle #1)	80-120 cP
• Solubility in water	100% miscible

Recommended Treatment

For flocculation treatment of fluid systems containing PHPA polymer:

- Recommended treatment concentration is between 1.0 - 2.0 % by volume
- Final product concentration can be influenced by method of introduction and efficiency of reaction created.
- SYSTEM FLOC-360 flocculant should be introduced with agitation to optimize speed and efficiency of reaction.
- Disposal of solids and water phase should always be done in accordance with all applicable federal, state and local regulations.
- Responsible handling and disposal of drilling fluids, water phase effluent and produced solids require that these materials should not be allowed to gain entry into any stream, waterway or body of water.

For clean-out of Drilled Shafts using PHPA polymers:

- Using the diameter of the drilled shaft calculate the volume of a 1-2 foot interval of the open hole.
- Add SYSTEM FLOC-360 flocculant at a concentration of 0.5 - 1.0 % by volume and place directly to the bottom of the shaft. Based on calculated volumes, the appropriate amount of SYSTEM FLOC-360 flocculant can be placed in collapsible bags allowing delivery to the bottom of the shaft or material can be tremied into place.
- After proper placement, use of the auger flights to create agitation is necessary for effective dispersion of the SYSTEM FLOC-360 flocculant and incorporation with existing solids.
- Crosslinked polymer and drilled solids can be removed using a vented clean-out bucket

Packaging	SYSTEM FLOC-360 flocculant is packaged in 55-gallon (208.2 L) non-returnable steel-drums and 5-gallon (18.9 L) resealable plastic containers.
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Availability	SYSTEM FLOC-360 flocculant can be purchased through any Baroid Industrial Drilling Products Retailer. To locate the Baroid IDP retailer nearest you contact the Customer Service Department in Houston or your area IDP Sales Representative.
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Baroid Industrial Drilling Products

Product Service Line, Halliburton

3000 N. Sam Houston Pkwy E.

Houston, TX 77032

Customer Service	(800) 735-6075 Toll Free	(281) 871-4612
Technical Service	(877) 379-7412 Toll Free	(281) 871-4613

MATERIAL SAFETY DATA SHEET

Product Trade Name: System Floc-360™

Revision Date: 08-Aug-2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: System Floc-360™
Synonyms: None
Chemical Family: Polymer in Aqueous Solution
Application: Flocculent
Manufacturer/Supplier: Baroid Fluid Services
a Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000
Prepared By: Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	> 200
Flash Point/Range (C):	> 100
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media All standard firefighting media.

Special Exposure Hazards Spills produce extremely slippery surfaces.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 0, Reactivity 0

HMS Ratings: Health 1, Flammability 0, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Material is slippery underfoot.

Storage Information Store in a cool, dry location. Keep container closed when not in use. Store at temperatures between 50 and 100 F (10 and 37.8 C). Do not freeze. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Hand Protection Impervious rubber gloves.

Skin Protection Rubber apron.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear amber
Odor:	Odorless
pH:	4.8-6.5 (1%)
Specific Gravity @ 20 C (Water=1):	1.14-1.18
Density @ 20 C (lbs./gallon):	9.5-9.8
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	> 212
Boiling Point/Range (C):	> 100
Freezing Point/Range (F):	20
Freezing Point/Range (C):	-7
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	80-85
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	80-120 (25C)
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	Hydrogen chloride. Carbon monoxide and carbon dioxide. Oxides of nitrogen.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhalation of mist or heated vapors may cause respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	In normal industrial use, ingestion is not considered a probable route of exposure.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Not determined
Other Information	None known.
Toxicity Tests	

Oral Toxicity:	LD50: > 2000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 2000 mg/kg (Rat)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Ames test: negative
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not readily biodegradable.
Bio-accumulation	Not expected to bioaccumulate.

Ecotoxicological Information

Acute Fish Toxicity:	LC50:(96 hour) >10 mg/l (Brachidanio rerio)
Acute Crustaceans Toxicity:	EC50(48): > 50 mg/l (Daphnia magna)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS

Not applicable

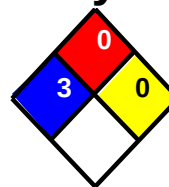
Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.
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Disclaimer Statement	This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.
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Copper Sulfate Pentahydrate

Date Prepared: May 17, 2002



NFPA RATING

HEALTH	3
FLAMMABILITY	0
REACTIVITY	0
PROTECTIVE EQUIPMENT	

HMIS RATING

MATERIAL SAFETY DATA SHEET

SECTION I. PRODUCT IDENTIFICATION

Product Name: Copper Sulfate Pentahydrate

Synonyms: Triangle Brand Copper Sulfate; Triangle Brand Copper Sulfate Crystal; Triangle Brand Copper Sulfate Instant Powder; Triangle Brand Copper Sulfate Pentahydrate; Triangle Brand Cupric Sulfate Pentahydrate Technical; Phelps Dodge Copper Sulfate; Phelps Dodge Refining Corporation Triangle Brand Copper Sulfate; Phelps Dodge El Paso Triangle Brand; Cupric Sulfate; Copper Sulfate; Copper Sulfate Pentahydrate; Blue Vitrol; Triangle Brand Cupric Sulphate Pentahydrate Technical; Triangle Brand Copper Sulphate Instant Powder; Triangle Brand Copper Sulphate Crystal

Product Use: Industrial manufacturing, animal feed, algicide, fungicide, herbicide, pesticide or as a fertilizer.

Manufacturer/Vendor Information: PHELPS DODGE REFINING CORP.
P.O. Box 20001
El Paso, Texas

Chemtrec 24-Hour Emergency Phone:
In USA or Canada (800)424-9300
Other Information Phone: (915)778-9881

SECTION II. COMPOSITION / INFORMATION ON INGREDIENTS

CAS No.	Chemical Name	Exposure Limits	% by wt.
7758-99-8	Copper sulfate pentahydrate (CuSO ₄ •5H ₂ O), (Cupric sulfate), (Blue Vitriol), (Bluestone)	ACGIH TLV TWA: 1.0 mg/m ³ (as copper dust/mist) OSHA PEL TWA: 1.0 mg/m ³ (as copper dust/mist)	99
	Anhydrous Cupric Sulfate (CAS# 7758-98-7)	Phelps Dodge Triangle Brand Copper Sulfate Copper Sulfate Pentahydrate (CAS 7758-99-8) Contains anhydrous copper sulfate Contains water of crystallization Metallic copper equivalent	=99% =63.3% =35.7% =25.2%

SECTION III. HAZARDS IDENTIFICATION

Emergency Overview: Odorless, transparent blue crystals, granules or powder. Can cause irreversible eye damage and slight skin irritation. Harmful if swallowed. Avoid breathing mist or dust and contact with skin, eyes or clothing.

Route(s) of Entry: Inhalation, eye contact, skin contact and ingestion.

Acute Exposure: Can cause skin, eye and respiratory irritation.

Chronic Exposure: Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated eye contact may cause conjunctivitis. Prolonged excessive inhalation of mists containing copper sulfate may cause adverse effects on the liver and kidneys.

Carcinogenicity (NTP) (IARC) (OSHA) (ACGIH): Not listed

Eye: Corrosive and may result in irreversible eye damage.

Skin Contact: Can cause slight skin irritation. May cause localized discoloration of the skin. Product specific tests in accordance with USEPA standards do not indicate skin sensitization is likely to occur.

Inhalation: Can result in irritation of the upper respiratory tract and in excessive quantities may cause ulceration and perforation of the nasal septum.

Ingestion: Can result in digestive tract irritation, nausea, vomiting, diarrhea and abdominal pain.

SECTION IV. FIRST AID MEASURES

Eyes: Immediately flush eyes with plenty of water. Hold eye open and rinse slowly and gently for at least 15-20 minutes. Contact physician for treatment advice.

Skin: Wash skin with soap and plenty of water. If irritation persists contact a physician.

SECTION IV. FIRST AID MEASURES (Continued)

Ingestion: Contact a poison control center or physician for treatment advice. Have person sip a glass of water if able to swallow. Do not give anything by mouth to an unconscious person. Do not induce vomiting unless told to do so by the poison control center or physician. If vomiting occurs spontaneously, avoid aspiration.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

SECTION V. FIRE FIGHTING MEASURES

Flash Pt: Not applicable
Flammable Limits in Air-Lower: Not applicable
Flammable Limits in Air – Upper: Not applicable
Auto Ignition Temperature: Not applicable
Fire Fighting Extinguishing Media: Does not burn or support combustion. Use extinguishing media appropriate for surrounding fire (CO₂, dry chemical or water).
Fire Fighting Equipment: As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.
Fire Fighting Instructions: Evacuate area and fight fire from a safe distance.
Fire and Explosion Hazards: Sealed containers may rupture when heated due to release of water from crystals.
Hazardous Combustion Products: Not applicable
Explosion Data - Mechanical Impact / Static Discharge: Not available
Unusual Hazards: Material is acidic when dissolved in water, contact with magnesium metal may evolve hydrogen gas. Anhydrous cupric sulfate formed on water loss (white color). Anhydrous salt will ignite hydroxylamine, if present.

SECTION VI. ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Use clean-up methods that avoid dust generation (vacuum, wet). Wear a NIOSH approved respirator if dust will be generated in clean-up. Use protective clothing if skin contact is likely. If material is diluted in a water solution, and a spill occurs in a confined area, introduce lime or soda ash to form insoluble copper salts and dispose of by approved method. Prevent accidental entry of solution into streams and other water bodies. Shovel any spills into plastic bags and seal with tape. Copper sulfate solution may deteriorate concrete.

SECTION VII. HANDLING AND STORAGE

Signal Word: Danger.

Handling Information: Avoid breathing dust or solution mist. Sweep up crystals or powder, vacuum is preferred. Eye wash stations should be available in work areas. Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Storage Information: Store in closed containers in a cool, dry, well-ventilated area away from heat sources and reducing agents. Store copper sulfate in stainless steel, fiberglass, polypropylene, PVC's or plastic equipment. Keep away from galvanized pipe and nylon equipment. If container or bag is damaged, place the container or bag in a plastic bag. Use good housekeeping practices to prevent dust accumulation.

SECTION VIII. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls: Use adequate general or local ventilation to keep airborne concentrations below the exposure limits.

Eye Protection: Use protective goggles or a face-shield.

Skin Protection: Use protective clothing to prevent repeated or prolonged skin contact. Applicators and other handlers must wear long-sleeved shirt and long pants, waterproof gloves, shoes plus socks, and protective eyewear. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with product's concentrate. Do not reuse them. Keep and wash PPE separately from other laundry.

SECTION VIII. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

Respiratory Protection: A respiratory protection program that meets OSHA 29 CFR 1910.134 requirements must be followed whenever workplace conditions warrant respirator use. For concentrations up to 10 times the exposure limit, use NIOSH approved half- or full-face, air-purifying respirator. For higher concentrations, consult a professional industrial hygienist.

SECTION IX. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Transparent blue crystals, granules or powder.
Melting Point:	Not available
Boiling Point:	-5H ₂ O @ 150 °C (760 mmHg)
Decomposition Temperature:	Decomposition above 110 °C with -4 H ₂ O
Density/Specific Gravity:	2.284 @ 15.6 °C
Odor/Odor Threshold:	Not available
Evaporation rate:	Not applicable
pH:	Not available
Coefficient of water/oil distribution:	Not available
Vapor Pressure:	Not applicable
Vapor Density:	Not applicable
Solubility in Water:	83.1 g/100 cc water @ 30 °C
Molecular Weight:	249.68

SECTION X. STABILITY AND REACTIVITY

Stability: Stable.

Incompatibility: Acetylene gas, aluminum powder, hydroxylamine, magnesium, moist air. Contact with magnesium metal can generate dangerous levels of hydrogen gas.

Conditions under which product is chemically unstable: Not applicable

Hazardous decomposition products: At temperatures >600 °C material decomposes to cupric oxide and sulfur dioxide.

Conditions of reactivity: Not applicable

Hazardous Polymerization: Will not occur.

SECTION XI. TOXICOLOGICAL INFORMATION**Toxicology Tests: (Triangle Brand Copper Sulfate Crystal)**

Test : 1

LD/LC : LD₅₀

Test Type : Acute

Test Route : Dermal

Test Species : Rabbit

Results Amounts : >5050 mg/kg

Test : 3

LD/LC : LC₅₀

Test Type : Acute, 4 hr

Test Route : Inhalation

Test Species : Rats

Results Amounts : >2.95 mg/L

Test : 2

LD/LC : LD₅₀

Test Type : Acute

Test Route : Oral

Test Species : Rat

Results Amounts : 352 mg/kg*

*Results based on toxicity evaluation of this product.

Primary Eye Irritation: Corrosive, irreversible eye damage

Primary Skin Irritation: Slightly irritating.

Skin Sensitization: Product-specific tests in accordance with USEPA standards did not indicate that this product would cause skin sensitization.

Respiratory Tract Sensitization: Not available.

Carcinogenicity: Not listed as a carcinogen by NTP, IARC, OSHA, or ACGIH.

SECTION XI. TOXICOLOGICAL INFORMATION (Continued)

Mutagenicity: A study performed with copper sulphate on mice showed mutagenicity in a chromosomal aberration test; however, the route of exposure (*i.e.*, intraperitoneal) is not likely to be applicable to workplace use of this product.

Reproductive Toxicity: No reproductive effects were shown in a feeding test performed with copper sulphate on rats and mice.

Teratogenicity: Embryotoxicity was not seen at non-maternally toxic doses of copper sulphate in the relevant studies reviewed.

Toxicologically Synergistic Materials: Not available.

Other Chronic Effects: Long term inhalation of copper sulfate containing mists (*i.e.*, Bordeaux mixture) may cause adverse effects to the liver and kidneys. A sub-chronic test performed on rats and mice showed that at high exposure levels in feed (>4000 ppm) cupric sulfate is toxic to the liver and kidneys.

Additional Information: Inhalation of dust and mists of copper salts can result in irritation of nasal mucous membranes, sometimes of the pharynx and, on occasion ulceration with perforation of the nasal septum. Exposure to copper dust causes discoloration of the skin.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be needed. Wilson's disease or G6PD deficiency (individual who absorbs, retains and stores copper) can be aggravated by excessive exposure. Symptoms may include nausea, vomiting, epigastric pain, diarrhea, dizziness, jaundice, and general debility.

SECTION XII. ECOLOGICAL INFORMATION

Subacute dietary LC₅₀: >10,000 ppm (quail and duck).

96 hr acute toxicity LC₅₀: 0.65 ppm (bluegill), 0.056 ppm (trout), 16 ppm (pink shrimp)

48 hr EC₅₀: 54 ppb (eastern oysters)

48 hr LC₅₀: 17 ppm (pink shrimp), 600 ppb (daphnia)

24 hr LC₅₀: 6.9 ppm (blue crab), 600 ppb (daphnia)

Bioaccumulation: Not available

Biodegradability: Not applicable

SECTION XIII. DISPOSAL CONSIDERATIONS

Waste Disposal Method: Waste must be disposed of in accordance with federal, state/provincial and local environmental control regulations. Improper disposal is a violation of law. Do not reuse empty container. If allowed by federal, state/provincial and local authorities, dispose of container in a sanitary landfill or by incineration.

SECTION XIV. TRANSPORT INFORMATION

	Proper Shipping Name:	Technical Name (If N.O.S.):	Hazard Class:	ID:	PG:
DOT:	<i>Environmentally Hazardous Substance, Solid, n.o.s., (Cupric Sulfate)*</i>		9	UN3077	III

Reportable Quantity (RQ) = 10 pounds (4.54 kg).

*Applicable when product is shipped in packaging of 10 pounds or greater.

SECTION XV. REGULATORY INFORMATION**US Federal**

Federal Drinking Water Standards: (*Copper*) EPA 1300µg/L (action level), 1000 µg/L

Clean Water Act: This product contains compounds identified in 40 CFR 116.4.

TSCA: Listed

EPCRA, SARA Title III, Section 313 (40 CFR 372) Chemicals subject to reporting requirements (see Section II for CAS number and percentage in mixture): Section 312 and/or 313 reporting may be required for this product, depending of the amount used and/or stored on site.

CERCLA Hazardous Substances: RQ is not assigned to the broad class of copper compounds.

DOT: RQ 10 pounds (4.54 kg), See Section XIV TRANSPORT INFORMATION

Canada

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* and the MSDS contains all of the information required by the *Controlled Products Regulations*.

SECTION XVI. OTHER INFORMATION

Prepared By:	Phelps Dodge Corporation Department of Occupational Health and Safety One North Central Avenue Phoenix, AZ 85004 Telephone number (602.366.8398)
Reason for Revision:	Added use statement in Section I. Revised Section III and XI to reflect recent toxicity tests, Updated/revised information in other Sections with addition of Section XII in accordance with WHMIS.

Disclaimer: This information is based on available scientific evidence known to the Phelps Dodge Corporation. The information contained in the MSDS is being disclosed as required pursuant to applicable law. However, Phelps Dodge does not guarantee its accuracy or completeness. Health and safety precautions in this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. This information is furnished without warranty, expressed or implicit.

MATERIAL SAFETY DATA SHEET

For Emergency Assistance
Involving Chemicals Call CHEMTREC
(800) 424-9300

WHMIS (Classification)
CLASS B-3: Combustible liquid with
a flash point between 37.8°C
(100°F) and 93.3°C (200°F).
CLASS D-2B: Material causing other
toxic effects (TOXIC).

Section I. Chemical Product Identification

Distributed by:
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC
V6X 1W5

Product Name	Methyl Isobutyl Carbinol	Code	LA1277
		CAS#	000108112
Synonym	Methyl Amyl Alcohol MIBC 2-Pentanol-4-Methyl		
		DSL	On the DSL list.
Chemical Name	dimethyl-1,3 butanol-1		
		CI#	Not available.
Chemical Family	Not available.		
Chemical Formula	C6H14O		
Material Uses	Industrial applications: Organic solvent		

Section II. Composition and Information on Ingredients

Name	CAS #	% by Weight	LC50/LD50
Methyl Isobutyl Carbinol	000108112	100	ORAL (LD50): Acute: >2590 mg/kg [Rat]. DERMAL (LD50): Acute: >3.5 mL/kg [Rabbit]. VAPOR (LC50): Acute: >2000 ppm 4 hours [Rat].

Section III. Hazards Identification

Potential Acute Very hazardous in case of ingestion. Hazardous in case of
Health Effects skin contact (irritant), of eye contact (irritant), of
inhalation.

Potential Chronic Health Effects	CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.
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****Section IV. First Aid Measures****

Eye Contact	IMMEDIATELY flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek medical attention.
Skin Contact	Flush affected skin with gently flowing lukewarm water for at least 20 minutes and remove contaminated clothing while rinsing. Wash contaminated skin with mild soap and water for 15 minutes. If irritation occurs and persists, obtain medical attention.
Hazardous Skin Contact	Flush affected skin with gently flowing lukewarm water for at least 20 minutes and remove contaminated clothing while rinsing. Wash contaminated skin with mild soap and water for 15 minutes. If irritation occurs and persists, obtain medical attention.
Inhalation	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Hazardous Inhalation	Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
Ingestion	Do not induce vomiting. Do not give anything by mouth to an unconscious person. Guard against aspiration into lungs by having the individual turn on to their left side. If vomiting occurs spontaneously keep head below hips to prevent aspiration of liquid into the lungs. Obtain medical attention immediately.
Hazardous Ingestion	Not available.

****Section V. Fire and Explosion Data****

The Product is: Flammable.

Auto-Ignition Temperature	338°C (640.4°F)
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Flash Points	CLOSED CUP: 44°C (111.2°F). (TAG) OPEN CUP: 51.7°C (125.1°F) (Cleveland).
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Flammable Limits LOWER: 1% UPPER: 5.5%

Products of Combustion	Carbon monoxide and carbon dioxide are produced on combustion.
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Fire Hazards in Presence of Various Substances	Flammable in presence of open flames and sparks, of heat, of oxidizing materials.
Explosion Hazards in Presence of Various Substances	Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of oxidizing materials.
Fire Fighting Media and Instructions	Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards	Vapour forms a flammable/explosive mixture with air between upper and lower flammable limits. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus. Containers exposed to intense heat from fires should be cooled with water to prevent vapour pressure buildup which could result in container rupture. Product will float and can be reignited on surface of water. Container areas exposed to direct flame contact should be cooled with large quantities of water as needed to prevent weakening of container structure. Caution - Combustible.
Special Remarks on Explosion Hazards	Not available.

****Section VI. Accidental Release Measures****

Small Spill	Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill	Issue warning "Combustible". Eliminate all ignition sources. Handling equipment must be grounded. Isolate hazard area and restrict access. Try to work upwind of spill. Avoid direct contact with material. Wear appropriate breathing apparatus (if applicable) and protective clothing. Stop leak only if safe to do so. Dike and contain land spills; contain water spills by booming. Use water fog to knock down vapours; contain runoff. For large spills remove by mechanical means and place in containers. Absorb residue or small spills with absorbent material and remove to non-leaking containers for disposal. Recommended materials: Clay or Sand Flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations. Notify appropriate environmental agency(ies).

****Section VII. Handling and Storage****

Precautions	Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. DO NOT ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the
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label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids. Hot surfaces may be sufficient to ignite liquid even in the absence of sparks or flames. Extinguish pilot lights, cigarettes and turn off other sources of ignition prior to use and until all vapours are gone. Vapours may accumulate and travel to distant ignition sources and flashback. Empty containers may contain hazardous product residues. Do not pressurize drum containers to empty them. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Do not cut, drill, grind, weld or perform similar operations on or near containers. Air-dry contaminated clothing in a well ventilated area before laundering. Launder contaminated clothing prior to reuse. Use good personal hygiene.

Storage	Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Use explosion-proof ventilation to prevent vapour accumulation.
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****Section VIII. Exposure Controls/Personal Protection****

Engineering Controls	Make up air should always be supplied to balance air exhausted (either generally or locally). Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Concentrations in air should be maintained below the recommended threshold limit value if unprotected personnel are involved. For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere. Electrical and mechanical equipment should be explosion-proof. Mechanical ventilation is recommended for all indoor situations to control fugitive emissions. Ensure that eyewash stations and safety showers are proximal to the work-station location.
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Personal Protection	Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Impervious gloves (neoprene) should be worn at all times when handling this product. Impervious clothing (apron, coveralls) should also be worn in confined workspaces or where the risk of skin exposure is much higher. Safety showers should be available for emergency use. If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.
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Personal Protection in Case of a Large Spill	Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Impervious gloves (neoprene) should be worn at all times when handling this product. Impervious clothing (apron, coveralls) should also be worn in confined workspaces or where the risk of skin exposure is much higher. Safety showers should be available for emergency
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use. If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

Exposure Limits TWA: 104 STEL: 167 (mg/m³) from ACGIH (TLV) [United States] SKIN
TWA: 25 STEL: 40 (ppm) from ACGIH (TLV) [United States] SKIN

Consult local authorities for acceptable exposure limits.

Section IX. Physical and Chemical Properties

Physical State and Appearance	Liquid.	Odor	Sweetish. Alcohol like.
		Taste	Not available.
Molecular Weight	102.17 g/mole		
pH (1% soln/water)	Not available.	Color	Colorless.
Boiling Point	130°C - 133°C (266°F - 271.4°F)		
Melting Point	-90°C (-130°F)		
Critical Temperature	Not available.		
Specific Gravity	0.808 (Water = 1)		
Vapor Pressure	>0.4 kPa (@ 20°C)		
Vapor Density	3.5 (Air = 1)		
Volatility	Not available.		
Odor Threshold	Not available.		
Evaporation rate	0.27		
Viscosity	Not available.		
Water/Oil Dist. Coeff.	The product is more soluble in oil; log(oil/water) = 26.9		
Ionicity (in Water)	Not available.		
Dispersion Properties	Not available.		
Solubility	Very slightly soluble in cold water, hot water. Soluble in Other Solvents: Alcohol, Ether, Organic Solvents		

Section X. Stability and Reactivity Data

Stability	The product is stable.
Instability Temperature	Not available.
Conditions of Instability	Do not use with aluminum equipment at temperatures above 49 degrees Celsius. Avoid excessive heat, open flames and all ignition sources.
Incompatibility with various substances	Reactive with oxidizing agents, acids.
Corrosivity	Not available.
Special Remarks on Reactivity	Not available.
Special Remarks on Corrosivity	Not available.
Hazardous Polymerization	Will not occur.

****Section XI. Toxicological Information****

Routes of Entry	Absorbed through skin. Eye contact. Inhalation. Ingestion.
Toxicity to Animals	Acute oral toxicity (LD50): >2590 mg/kg [Rat]. Acute dermal toxicity (LD50): >3.5 mL/kg [Rabbit]. Acute toxicity of the vapor (LC50): >2000 ppm 4 hours [Rat].
Chronic Effects on Humans	CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.
Other Toxic Effects on Humans	Very hazardous in case of ingestion. Hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation.
Special Remarks on Toxicity to Animals	Not available.
Special Remarks on Chronic Effects on Humans	Prolonged and repeated contact with skin can cause defatting and drying of the skin resulting in skin irritation and dermatitis. Prolonged exposure to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression. Pre-existing Conditions: Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.
Special Remarks	Vapours are moderately irritating to the respiratory

on	passages.
Other Toxic	Ingestion of this product may cause headache, dizziness,
Effects on Humans	fatigue and central nervous system depression. Vapours are moderately irritating to the eyes.

****Section XII. Ecological Information****

Ecotoxicity	Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities. MIBC is practically non-toxic to aquatic organisms and is expected to be slightly toxic to mammalian wildlife. MIBC may deoxygenate surface waters.
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BOD5 and COD	Not available.
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Products of Biodegradation	Biodegradable. Not likely to bioaccumulate.
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Toxicity of the Products of Biodegradation	Not available.
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Special Remarks on the Products of Biodegradation	Not available.
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****Section XIII. Disposal Considerations****

Waste Disposal	Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery (cement kilns, thermal power generation), 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site. Incinerate at a licenced waste disposal site with approval of environmental authority.
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****Section XIV. Transport Information****

TDG Classification	Class 3: Flammable liquid.
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Shipping name	Methyl isobutyl carbinol
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PIN	UN2053
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Packing Group	III
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Special Provisions for Transport	Not regulated under the Transportation of Dangerous Goods Act when transported by road or rail in packagings or containers of 454 L or less (waste excluded).
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****Section XV. Other Regulatory Information****

Other Regulations	OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
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****Section XVI. Other Information****

References -Manufacturer's Material Safety Data Sheet.

Other Special Not available.
Considerations

Validated by Hardev Bendick on 12/7/2000. Verified by Hardev Bendick.

Tel. number for non-emergency questions concerning MSDS: 1-866-686-4827

Notice to Reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Univar Canada Ltd. expressly disclaims all expressed or implied warranties of merchantability and fitness for a particular purpose with respect to the product provided.**

===== END OF MSDS =====



Material Safety Data Sheet

ORFOM ® SIPX (SODIUM ISOPROPYL XANTHATE)

September 30, 2001

MSDS #: 28990

Revision #0

CHEVRON PHILLIPS CHEMICAL COMPANY LP
10001 Six Pines Drive
The Woodlands, TX 77380

PHONE NUMBERS

HEALTH:

Chevron Phillips Emergency
Information Center 866.442.9628
(North America) and
1.832.813.4984(International)

TRANSPORTATION:

North America: CHEMTREC 800.424.9300
or 703.527.3887

ASIA: 1.703.527.3887

EUROPE: BIG .32.14.584545 (phone)
or .32.14.583516 (telefax)

SOUTH AMERICA SOS-Cotec

Inside Brazil: 0800.111.767

Outside Brazil: 55.19.3467.1600

Technical Services: (832) 813-4862

For Additional MSDSs: (800) 852-5530

A. Product Identification

Synonyms: Not Established

Chemical Name: Sodium Isopropyl Xanthate

Chemical Family: Dithiocarbonate

Chemical Formula: C₄H₇OS₂Na

CAS Reg. No.: 140-93-2

Product No.: Not Established

Product and/or Components Entered on EPA's TSCA Inventory: YES

This product is in U.S. commerce, and is listed in the Toxic Substances Control Act (TSCA) Inventory of Chemicals; hence, it may be subject to applicable TSCA provisions and restrictions.

Canadian Inventory Listing Status: DSL

All ingredients are listed in the Domestic Substances List (DSL).

Impurities are exempt in accordance with Section 3 of the Canadian Environmental Protection Act (CEPA).

B. Components

Ingredients	CAS Number	% By Wt.	OSHA PEL	ACGIH TLV
Sodium Isopropyl Xanthate	140-93-2	>84.0	NE	NE
Sodium Hydroxide	1310-73-2	< 3.0	2 mg/m ³	2 mg/m ³ (C)
Water	7732-18-5	Reminder	NE	NE

C. Personal Protection Information

Ventilation: Use adequate ventilation to control exposure below recommended level.

Respiratory Protection: Not generally required unless needed to prevent respiratory irritation.

Eye Protection: Use safety glasses with side shields.

Skin Protection: No special garments required. Avoid unnecessary skin contamination. Use impervious rubber gloves.

NOTE: Personal protection information shown in Section C is based upon general information as to normal uses and conditions. Where special or unusual uses or conditions exist, it is suggested that the expert assistance of an industrial hygienist or other qualified professional be sought.

D. Handling and Storage Precautions

Do not get in eyes, on skin or on clothing. Do not breathe vapors, mist, fume or dust. Wear protective equipment and/or garments described above if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Use only with adequate ventilation.

Store in a closed containers. Store in cool, well-ventilated area away from ignition sources. Protect from moisture and oxidants.

E. Reactivity Data

Stability: Stable
Conditions to Avoid: Acid; ignition sources.

Incompatibility (Materials to Avoid): Oxidants, organic or inorganic acids

Hazardous Polymerization: Will Not Occur

Conditions to Avoid: Not Applicable

Hazardous Decomposition Products: Sulfur oxides and carbon disulfides released on heating.

F. Health Hazard Data

Recommended Exposure Limits:

Control as Particulate Not Otherwise Classified (PNOC) or Regulated:

	OSHA PEL	ACGIH TLV*
Respirable Fraction	5 mg/m ³	3 mg/m ³
Total Dust	15 mg/m ³	10 mg/m ³

* The value is for inhalable (total) particulate matter containing no asbestos and

Acute Effects of Overexposure:

Eye: Irritation possible.

Skin: Mild irritation. Dermatitis may be possible with prolonged contact.

Inhalation: Dust may cause irritation to the nose, throat, and upper respiratory tract.

Ingestion: Low to moderate toxicity possible.

Subchronic and Chronic Effects of Overexposure:

Xanthates can decompose to release carbon disulfide (CAS # 75-15-0) which may cause dizziness, headache, fatigue, nervousness, loss of appetite, psychosis and nerve, heart, kidney or liver changes.

Other Health Effects:

No known applicable information.

Health Hazard Categories:

Animal Human

Animal Human

Known Carcinogen	___	___	Toxic	___	___
Suspect Carcinogen	___	___	Corrosive	___	___
Mutagen	___	___	Irritant	___	___
Teratogen	___	___	Target Organ Toxin	<u>X</u>	<u>X</u>
Allergic Sensitizer	___	___	Specify - Liver, Kidney, Heart &		
Highly Toxic	___	___	Nerve Toxin		

Canadian WHIMS:

CLASS D: POISONOUS AND INFECTIOUS MATERIAL CATEGORIES

1. Materials Causing Immediate and Serious Toxic Effects

- A. Very Toxic _____
 B. Toxic _____

2. Materials Causing Other Toxic Effects

A. Very Toxic

- | | |
|---------------------------------|-------|
| 1. Chronic Toxic Effects | _____ |
| 2. Teratogen/Embryo Toxin | _____ |
| 3. Carcinogen | _____ |
| 4. Reproductive Toxin | _____ |
| 5. Respiratory Tract Sensitizer | _____ |
| 6. Mutagen | _____ |

B. Toxic

- | | |
|--------------------------|----------|
| 1. Chronic Toxic Effects | <u>X</u> |
| 2. Skin or Eye Irritant | _____ |
| 3. Skin Sensitizer | _____ |
| 4. Mutagen | _____ |

Specify: Liver - Toxin; Kidney - Toxin; Heart - Toxin; Nerve - Toxin.

First Aid and Emergency Procedures:

Eye: Flush eyes with running water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Skin: Wash skin with soap and water for at least fifteen minutes. If irritation or adverse symptoms develop, seek medical attention.

Inhalation: Remove from exposure. If breathing is difficult, give oxygen. If breathing ceases, administer artificial respiration followed by oxygen. Seek immediate medical attention.

Ingestion: Give two glasses of water and induce vomiting, only if subject is conscious. Seek medical attention.

G. Physical Data

Appearance: Yellowish Powder or Pellets
Odor: Slight
Boiling Point: Not Applicable
Vapor Pressure: Not Applicable
Vapor Density (Air = 1): Not Applicable
Solubility in Water: Appreciable
Specific Gravity (H₂O = 1): Not Established
Percent Volatile by Volume: 14 maximum
Evaporation Rate (Butyl Acetate = 1): Not Applicable
Viscosity: Not Applicable

H. Fire and Explosion Data

Flash Point (Method Used): Not Applicable (solid or powder)
Flammable Limits (% by Volume in Air): LEL - Not Applicable
UEL - Not Applicable

Fire Extinguishing Media: Dry chemical, foam or carbon dioxide (CO₂)

Special Fire Fighting Procedures: Evacuate area of all unnecessary personnel. Shut off source, if possible. Use NIOSH/MSHA approved self-contained breathing apparatus and other protective equipment and/or garments described in Section C if conditions warrant. Water fog or spray may be used to cool exposed containers and equipment.

Fire and Explosion Hazards: Sulfur oxides and carbon disulfide released upon heating.

I. Spill, Leak and Disposal Procedures

Precautions Required if Material is Released or Spilled:

Evacuate area of all unnecessary personnel. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Shut off source, if possible and contain spill. Protect from ignition. Keep out of water sources and sewers. Follow normal clean-up procedures for solid spills. Control dust. Avoid breathing dust. Avoid contact with skin and eyes.

Waste Disposal (Insure Conformity with all Applicable Disposal Regulations):
Incinerate or place in permitted waste management facility.

J. DOT Transportation

Shipping Name: Self-heating, solid, organic, n.o.s., (Sodium isopropyl xanthate)
Hazard Class: 4.2
ID Number: UN 3088
Packing Group: II
Marking: Self-heating, solid, organic, n.o.s., (Sodium isopropyl xanthate), UN 3088
Label: Spontaneously combustible
Placard: Spontaneously combustible/3088
Hazardous Substance/RQ: Not Applicable
Shipping Description: Self-heating, solid, organic, n.o.s., (Sodium isopropyl xanthate), 4.2, UN 3088, PG II
Packaging References: 49 CFR 173.212, 173.241

K. RCRA Classification - Unadulterated Product as a Waste

Reactive (D003)

Prior to disposal, consult your environmental contact to determine if the TCLP (Toxicity Characteristic Leaching Procedure, EPA Test Method 1311) is required. Reference 40 CFR Part 261.

L. Protection Required for Work on Contaminated Equipment

Contact immediate supervisor for specific instructions before work is initiated. Wear protective equipment and/or garments described in Section C if exposure conditions warrant. Use NIOSH/MSHA approved respiratory protection, such as air-supplied mask, in confined spaces or other poorly ventilated areas.

M. Hazard Classification

☒ This product meets the following hazard definition(s) as defined by the Occupational Safety and Health Hazard Communication Standard (29 CFR Section 1910.1200):

☐ Combustible Liquid	☐ Flammable Aerosol	☐ Oxidizer
☐ Compressed Gas	☐ Explosive	☐ Pyrophoric
☐ Flammable Gas	☒ Health Hazard (Section F)	☐ Unstable
☐ Flammable Liquid	☐ Organic Peroxide	☐ Water Reactive
☐ Flammable Solid		

— Based on information presently available, this product does not meet any of the hazard definitions of 29 CFR Section 1910.1200.

Canadian WHIMS:

Class D: Poisonous and Infectious Material
Division 2. Materials Causing Other Toxic Effects

N. Additional Comments

SARA 313

This product contains the following chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
(See Section B).

Sodium Hydroxide
Carbon Disulfide

NFPA 704 Hazard Codes - - - - - Signals

Health	: 1	Least	- 0
Flammability	: 0	Slight	- 1
Reactivity	: 0	Moderate	- 2
Special Haz.	: -	High	- 3
		Extreme	- 4

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by EHS Product Stewardship Group, Chevron Phillips Chemical Company LP, 10001 Six Pines Drive, The Woodlands, TX 77380

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name:		Hi-Cal Hydrate	
Synonym/s:		Hydrate, High Calcium Hydrated Lime, Type N Hydrated Lime, HL	
Manufacturer:	US Operations: Chemical Lime Co. 3700 Hulen St. Fort Worth, TX 76107 817-732-8164	Canadian Operations: Chemical Lime Co. of Canada Inc. 20302-102B Ave. Langley, BC V1M 3H1 604-888-4333	
Emergency Phone:		Chemtrec 1-800-424-9300	
Chemical Name:	Calcium Hydroxide	WHMIS Classification: D2A, E	
Chemical Family:	Alkaline Earth Hydroxide		
Chemical Formula:	Ca(OH) ₂		
Product Use/s:		Water treatment, pH adjustment, FGT, Construction, Pulp/Paper	
Prepared By:		Chemical Lime Co. R&D/Technical Services, KSA	

SECTION 2: COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient	CAS	OSHA PEL, TWA 8/40h (mg/m3)	ACGIH TLV, TWA 8/40h (mg/m3)	NIOSH REL, TWA 8/40h (mg/m3)	NIOSH IDLH (mg/m3)	Conc. (%)
Calcium Hydroxide, Ca(OH) ₂ (Hydrated Lime)	1305-62-0	15 (total dust) 5 (respirable)	5	5	N.A.	> 90
Magnesium Hydroxide, Mg(OH) ₂ (Brucite)	1309-42-8	N.A.	N.A.	N.A.	N.A.	< 5
Magnesium Oxide, MgO (Periclase)	1309-48-4	10	10	N.A.	N.A.	< 5
Calcium Carbonate, CaCO ₃ (Limestone)	1317-65-3 (471-34-1)	15 (total dust) 5 (respirable)	10	10 (total dust) 5 (respirable)	N.A.	< 3
Crystalline Silica, SiO ₂ (Quartz)	14808-60-7	10/(SiO ₂ % + 2) (respirable)	0.025 (respirable)	0.05 (respirable)	50	< 2

OSHA Regulatory Status: This material is subject to 29 CFR 1910.1200 (Hazard Communication).

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 3: HAZARDS IDENTIFICATION

Emergency Overview: Hydrate is an odorless white or grayish-white powder. Contact can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract.

Potential Health Effects

Eyes: Contact can cause severe irritation or burning of eyes, including permanent damage.

Skin: Contact can cause irritation of skin.

Ingestion: This product can cause severe irritation of gastrointestinal tract if swallowed.

Inhalation: This product can cause severe irritation of the respiratory system. Long-term exposure may cause permanent damage. Hydrate is not listed by MSHA, OSHA, or IARC as a carcinogen. However, this product may contain trace amounts of crystalline silica in the form of quartz or cristobalite, which has been classified by IARC as a Group I carcinogen to humans when inhaled. Inhalation of silica can also cause a chronic lung disorder, silicosis.

Medical

Conditions Aggravated

by Exposure: Contact may aggravate disorders of the eyes, skin, gastrointestinal tract, and respiratory system.

Potential

Environmental Effects: This material is alkaline and if released into water or moist soil will cause an increase in pH.

SECTION 4: FIRST AID MEASURES

Eyes: Immediately flush eyes with generous amounts of water or eye wash solution if water is unavailable. Pull back eyelid while flushing to ensure that all lime dust has been washed out. Seek medical attention promptly if the initial flushing of the eyes does not remove the irritant. Do not rub eyes.

Skin: Brush off or remove as much dry lime as possible. Wash exposed area with large amounts of water. If irritation persists, seek medical attention promptly.

Inhalation: Move victim to fresh air. Seek medical attention. If breathing has stopped, give artificial respiration.

Ingestion: Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth unless instructed to do so by medical personnel.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 5: FIRE FIGHTING MEASURES

Fire Hazards:	Hydrate is not combustible or flammable. However, hydrate reacts vigorously with acids, and may release heat sufficient to ignite combustible materials in specific instances. Hydrate is not considered to be an explosion hazard, although reaction with acids or other incompatible materials may rupture containers.
Hazardous Combustion Products:	None
Extinguishing Media:	Use dry chemical fire extinguisher. Do not use water or halogenated compounds, except that large amounts of water may be used to deluge small quantities of hydrate.
Fire Fighting Instructions:	Keep personnel away from and upwind of fire. Avoid skin contact or inhalation of dust. Wear full fire-fighting turn-out gear (full Bunker gear), and respiratory protection (SCBA).

SECTION 6: ACCIDENTAL RELEASE MEASURES

Spill / Leak Procedures:	Do Not use water on bulk material spills. Use proper protective equipment.
Small Spills:	Use dry methods to collect spilled materials. Avoid generating dust. Do not clean up with compressed air. Store collected materials in dry, sealed plastic or non-aluminum metal containers. Residue on surfaces may be water washed.
Large Spills:	Use dry methods to collect spilled materials. Evacuate area downwind of clean-up operations to minimize dust exposure. Store spilled materials in dry, sealed plastic or non-aluminum metal containers.
Containment:	Minimize dust generation and prevent bulk release to sewers or waterways.
Clean-up:	Residual amounts of material can be flushed with large amounts of water. Equipment can be washed with either a mild vinegar and water solution, or detergent and water.

SECTION 7: HANDLING AND STORAGE

Handling:	Keep in tightly closed plastic or non-aluminum metal containers. Protect containers from physical damage. Avoid direct skin contact with the material.
Storage:	Store in a cool, dry, and well-ventilated location. Do not store near acids or other incompatible materials. Keep away from moisture. Do not store or ship in aluminum containers.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls:	Provide ventilation adequate to maintain PELs.
Respiratory Protection:	Use NIOSH/MSHA approved respirators if airborne concentration exceeds PELs.
Skin Protection:	Use appropriate gloves and footwear to prevent skin contact. Clothing should fully cover arms and legs. Should lime get inside clothing or gloves, remove the clothing and the lime promptly.
Eye Protection:	Use safety glasses with side shields or safety goggles. Contact lenses should not be worn when working with lime products.
Other:	Eye wash fountain/stations and emergency showers should be available.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance: White or grayish-white powder	Odor: Odorless	Physical State: Solid
Boiling Point (°C/°F): 2850 / 5162	Melting Point (°C/°F): dec 580 / 1076	Specific Gravity (Apparent) g/cc: 0.4 - 0.55 (True) g/cc: 2.2 - 2.4
Vapor Pressure (mm Hg): N.A.	Vapor Density: N.A.	Evaporation Rate: N.A.
Solubility in Water Slightly soluble in water.	pH (25°C/77°F): 12.4	

SECTION 10: STABILITY AND REACTIVITY

Stability:	Chemically stable, but slowly reacts with carbon dioxide to form calcium carbonate. See also Incompatibility below.								
Incompatibility/ Conditions to Avoid:	Hydrate should not be mixed or stored with the following materials, due to the potential for vigorous reaction and release of heat: <table><tr><td>Acids (unless in a controlled process)</td><td>Organic Acid Anhydrides</td></tr><tr><td>Reactive Fluoridated Compounds</td><td>Nitro-Organic Compounds</td></tr><tr><td>Reactive Brominated Compounds</td><td>Reactive Phosphorous Compounds</td></tr><tr><td>Reactive Powdered Metals</td><td>Interhalogenated Compounds</td></tr></table>	Acids (unless in a controlled process)	Organic Acid Anhydrides	Reactive Fluoridated Compounds	Nitro-Organic Compounds	Reactive Brominated Compounds	Reactive Phosphorous Compounds	Reactive Powdered Metals	Interhalogenated Compounds
Acids (unless in a controlled process)	Organic Acid Anhydrides								
Reactive Fluoridated Compounds	Nitro-Organic Compounds								
Reactive Brominated Compounds	Reactive Phosphorous Compounds								
Reactive Powdered Metals	Interhalogenated Compounds								
Hazardous Decomposition Products:	None								
Hazardous Polymerization:	None								

SECTION 11: TOXICOLOGICAL INFORMATION

ORL-RAT LD50: 7,340 MG/KG
ORL-MUS LD50: 7,300 MG/KG

Hydrated Lime is not listed by MSHA, OSHA, or IARC as a carcinogen, but this product may contain trace amounts of crystalline silica, which has been classified by IARC as carcinogenic to humans when inhaled in the form of quartz or cristobalite.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity: Because of the high pH of this product, it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems in high concentrations.

Environmental Fate: This material shows no bioaccumulation effect or food chain concentration toxicity.

SECTION 13: DISPOSAL CONSIDERATIONS

Dispose of in accordance with all applicable federal, state, and local environmental regulations. If this product as supplied, and unmixed, becomes a waste, it will not meet the criteria of a hazardous waste as defined under the U.S. Resource Conservation and Recovery Act (RCRA).

SECTION 14: TRANSPORTATION INFORMATION

Hydrate is not classified as a hazardous material by US DOT and is not regulated by the Transportation of Dangerous Goods (TDG) when shipped by any mode of transport.

Material Safety Data Sheet

HYDRATED LIME

Rev. Date:5/1/2008

SECTION 15: REGULATORY INFORMATION

U.S. EPA Regulations: RCRA Hazardous Waste Number (40 CFR 261.33): not listed
RCRA Hazardous Waste Classification (40 CFR 261): not classified
CERCLA Hazardous Substance (40 CFR 302.4) unlisted specific per RCRA, Sec. 3001;
CWA, Sec. 311(b)(4); CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ), not listed
SARA 311/312 Codes: not listed
SARA Toxic Chemical (40 CFR 372.65): not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): not listed, Threshold
Planning Quantity (TPQ): not listed
All chemical ingredients are listed on the USEPA TSCA Inventory List.

**OSHA/MSHA
Regulations:**

Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): 5mg/M³ TWA-8
MSHA: not listed
OSHA Specifically Regulated Substance (29 CFR 1910): not listed

State Regulations:

Consult state and local authorities for guidance. Components found in this product may contain trace amounts of inherent naturally occurring elements (such as, but not limited to arsenic and cadmium) that may be regulated.

Canada:

WHMIS Classification: "D2A" Materials Causing Other Toxic Effects
WHMIS Classification: "E" Corrosive Materials (listed due to corrosive effect on aluminum)
Canada DSL: Listed

NFPA Hazard Class:

Health: 1

Flammability: 0

Reactivity: 0

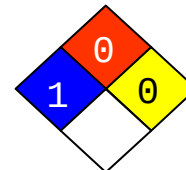
HMIS Hazard Class:

Health: 1

Flammability: 0

Reactivity: 0

Personal Protection: E



SECTION 16: OTHER INFORMATION

Prepared By:

Chemical Lime Company, R&D/Technical Services, KSA

Chemical Lime Company provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person. Individuals receiving this information must consult their own technical and legal advisors and/ or exercise their own judgment in determining its appropriateness for a particular purpose. Chemical Lime Company makes no representations or warranties, either express or implied, including without limitation and warranties of merchantability or fitness for a particular purpose with respect to the information set forth herein or the product(s) to which the information refers. Accordingly, Chemical Lime Company will not be responsible or liable for any claims, losses or damages resulting from the use of or reliance upon or failure to use this information.



Cutler-Magner Company
12th Avenue West and Waterfront
P.O. Box 16807
Duluth, Minnesota 55816-0807

Material Safety Data Sheet

PRODUCT IDENTIFICATION

**CALCIUM OXIDE -
Quicklime**

CHEMICAL ABSTRACT NO.

CAS No. 1305-78-8

DATE REVISED

01/03/2006

Section I

MANUFACTURER

Cutler-Magner Company
Foot of Hill Avenue
Superior, WI 54880

24 Hour Emergency Contact
Number: (715) 392-5146
Ask for Supervisor On Call

Telephone Number for
Information: (800) 232-1302

HMIS II SAFETY RATING

Health - **3**
Flammability - **0**
Physical Hazard - **2**
Personal Protective Equip - **E**

Other Common Names: Pebble Lime, Unslaked Lime
Trade Names: Rockport

Section II – Hazardous Ingredients / Identity Information

Specific Chemical Identity; Common Names	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (Optional)
Calcium Oxide; Lime; Quicklime	5 mg/m ³	2 mg/m ³		
Crystalline Silica (Quartz)	0.1 mg/m ³	0.05 mg/m ³	Respirable	0.1 to 0.3 %

Calcium oxide is not listed on the NTP, IARC, or OSHA lists of carcinogens. Crystalline silica, a component of this product, is listed by IARC and NTP but not by OSHA. In 1997, IARC determined that "crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1). OSHA requires that products containing 0.1% of a known carcinogen must be labeled. NTP states that "silica, crystalline (respirable)" may reasonably be anticipated to be a carcinogen (1991). Cutler-Magner Company recommends using personal protection equipment when handling this product.

Section III – Physical / Chemical Characteristics

Boiling Point (Calcium Oxide)	2850 °C	Specific Gravity (H ₂ O=1)	3.2-3.4
Vapor Pressure (mm Hg)	NA	Melting Point	2570 °C
Vapor Density (Air = 1)	NA	Evaporation Rate	NA
Solubility in Water	Reacts to form calcium hydroxide		
Appearance and Color	White to gray lumps, pebbles, granules, powder; faint earthy odor		

Section IV – Fire and Explosion Hazard Data

Flash Point	NA	Flammable Limits – NA
Extinguishing Method	NA	
Special Fire Fighting Procedures	Reaction with water may produce enough heat to ignite combustible material.	
Unusual Fire and Explosion Hazards	Material is an explosion hazard when wet and confined.	

Section V – Reactivity Data

Stability	Unstable		Conditions to Avoid – NA
	Stable	X	
Incompatibility (Materials to Avoid)		Water, Acid, Interhalogen, Phosphorus (V) Oxide	
Hazardous Decomposition or Byproducts		None	
Hazardous Polymerization	May Occur		Conditions to Avoid – NA
	Will Not Occur	X	

Section VI – Health Hazard Data

Route(s) of Entry	Inhalation? - YES	Absorption Through Skin? – YES	Ingestion (swallowing)? - YES
Health Hazards	Acute	Causes irritation and inflammation to mucous membrane and respiratory passages.	
	Chronic	Long-term exposure can cause irritation, ulceration and perforation of nasal septum.	
Toxicological Information	No LD50 / LC50 have been identified for this product. Quicklime is not listed by MSHA, OSHA, or IARC as a carcinogen, but this product may contain trace amounts of crystalline silica, which has been classified by IARC as (Group 1) carcinogenic to humans when inhaled in the form of quartz or cristobalite.		
Signs and Symptoms of Exposure		Irritation of skin, eyes, and respiratory tract.	
Medical Conditions Generally Aggravated by Exposure		Respiratory disease, skin condition.	
Emergency and First Aid Procedures		Remove to fresh air. Wash dust with soap and water. Flush out eyes with generous amounts of water. Drink plenty of water if swallowed. See Physician.	

Section VII – Precautions for Safe Handling

Steps to Be Taken in Case Material is Released or Spilled	Normal clean-up procedures. Care should be taken to avoid causing dust to become airborne. Vacuum cleaning systems are recommended.		
Waste Disposal Method	Dispose of product in accordance with Federal, State and Local regulations.		
Precautions to Be Taken in Handling	Store away from water and acids.		
Other Precautions	Waste should not be discarded with combustible material where the possibility exists of getting the mixture wet – FIRE HAZARD!		

Section VIII – Control Measures

Respiratory Protection - Dust filter mask is recommended as minimal protection		
Ventilation	Local Exhaust – To maintain TLV and PEL Mechanical – To maintain TLV' and PEL	Special – None Other – None
Protective Gloves – Cloth or leather gloves will protect skin		
Eye Protection – Fitted goggles will reduce eye injury		
Other Protective Clothing – Long sleeve shirts and pants		
Work / Hygienic Practices – Maintain dust exposure limits below TLV and PEL. If not possible – use respiratory protection		

Section IX – Ecological Information

Ecotoxicity: Because of the high pH of this product, in high concentrations it would be expected to produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.

Environmental Fate: This material shows no bioaccumulation effect or food chain toxicity.

Section X – Regulatory Information

EPA

RCRA Hazardous Waste Classification (40 CFR 261): Not Listed
RCRA Hazardous Waste Number (40 CFR 261.33): Not Listed
ERCLA Hazardous Substance (40 CFR 302.4): Unlisted specific per RCRA,
Sec. 3001; CWA, Sec.311 (b)(4); CWA, Sec. 307(a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ): Not Listed
SARA 311/312 Codes: Not Listed
SARA Toxic Chemical (40 CFR 372.65): Not Listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355): Not Listed;
Threshold Planning Quantity (TPQ): Not Listed
All chemical ingredients are listed on the USEPA TSCA Inventory List

OSHA / MSHA

Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A): 5 mg/M³ TWA-8
MSHA: Not Listed
OSHA Specifically Regulated Substance (29 CFR 1910): Not Listed

Canada

WHIMS Classification: "E" Corrosive Materials (Listed due to corrosive effect of aluminum)
WHIMS Classification: "D2A" Materials Causing Other Toxic Effects
CANADA DSL: Listed

State Regulations

Consult state and local authorities for guidance

Other

HMIS: Health Risk 3, Flammability 0, Reactivity 1, Personal Protection E
NFPA: Health Hazard 3, Fire Hazard 0, Reactivity 1
DOT: For aircraft transport only, Calcium Oxide is classified as Hazard Class 8
– Corrosive, UN 1910, Packing Group 3

The above information is believed to be correct as of the date hereof. However, no warranty of merchantability, fitness for any use, or any other warranty is expressed or is to be implied regarding the accuracy of these data, the results to be obtained from the use of the material, or the hazards connected with such use. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the data hereof may suggest modification of the information, we do not assume responsibility for the results of its use. This information is furnished on the condition that the person(s) receiving it shall make their own determination as to the suitability of the material for their particular purpose and on the condition that they assume the risk of use thereof.



MATERIAL SAFETY DATA SHEET

Sodium Sulphide

Section 01 - Chemical And Product And Company Information

Product Identifier Sodium Sulphide

Product Use Depilatory for hides and skins, manufacture of rubber, sulphur dyes, rayon denitrating, paper pulp, ore floatation, metal refining, cotton printing, as chemical intermediate and laboratory reagent.

Supplier Name ClearTech Industries Inc.
2303 Hanselman Avenue
Saskatoon SK S7I 5Z3
Canada

Prepared By ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date 10/25/04

24-Hour Emergency Phone 306-664-2522



Section 02 - Composition / Information on Ingredients

Hazardous Ingredients Sodium Sulfide 59-62%

CAS Number Sodium Sulfide 1313-82-2

Synonym (s) Sodium Monosulfide; Sulfur Compounds; Na₂S



Section 03 - Hazard Identification

- Inhalation**..... Hazard is highly toxic (50-100 ppm in air) hydrogen sulfide which may accumulate in confined spaces due to the decomposition of sodium sulfide or from its reaction with acids. Symptoms include painful conjunctivitis, headache, nausea, dizziness, coughing and, in extreme cases, pulmonary edema and possible death.
- Skin Contact / Absorption**..... Contact with skin can produce serious caustic burns with painful inflammation and possible destruction of tissue. May cause irritation, severe burns and corrosion to the skin. This material may be absorbed through the skin producing toxicity typical of hydrogen sulfide poisoning.
- Eye Contact**..... Inflammation, tearing and pain may be expected. Severe contact can cause destruction of tissue. This product has similar effects as alkalies following direct exposure to the eye and can cause lacrimation, sensitivity to light, tearing and irreversible damage, including blindness.
- Ingestion**..... Sodium sulfide is a strong base and can cause severe burns on the mucous membrane. Hydrolysis by gastric fluids releases toxic hydrogen sulfide. The symptoms and effects are similar to those under inhalation, above.
- Exposure Limits**..... No occupational exposure limits have been established by OSHA & ACGIH for this product. The limits for hydrogen sulphide have been established:
- OSHA/TWA: 10ppm
OSHA/STEL: 15ppm
ACGIH/TWA: 10ppm
OSHA/STEL: 15ppm

Section 04 - First Aid Measures

- Inhalation**..... Hydrogen sulfide has a characteristic "rotten egg" odor. Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.
- Skin Contact / Absorption**..... Remove contaminated clothing. Wash affected area with soap and water. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.
- Eye Contact**..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention as further treatment will be necessary.
- Ingestion**..... Gently wipe or rinse the inside of the mouth with water. Sips of water may be given if person is fully conscious. Never give anything by mouth to an unconscious or convulsing person. Do not induce vomiting. Contact a poison control center, emergency room or physician right away as further treatment will be necessary.



Additional Information..... Contact with acid and excessive heat liberates flammable and poisonous hydrogen sulfide gas.

Section 05 - Fire Fighting

Conditions of Flammability..... Non-flammable

Means of Extinction..... Not available

Flash Point..... Not available

Auto-ignition Temperature..... 260°C

Upper Flammable Limit Not available

Lower Flammable Limit..... Not available

Hazardous Combustible Products... Contact with all acids or excessive heat will liberate poisonous, flammable hydrogen sulfide gas.

Special Fire Fighting Procedures..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing. Fire-fighters must wear NIOSH approved, pressure demand, self-contained breathing apparatus with full face piece for possible exposure to hazardous gases. Hydrogen sulfide vapors are heavier than air and may travel a considerable distance to source of ignition and flash back.

Explosion Hazards..... Not available



Section 06 - Accidental Release Measures

- Leak / Spill**..... Immediately evacuate the area. Remove sources of ignition. Provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and eye/skin protection should be permitted in the area. Carefully shovel or sweep up spilled material and place into closed containers. Spilled material should be reclaimed if possible. Product must not come in contact with acids. After all visible traces have been removed, thoroughly wet vacuum the area. Do not flush to sewer. At the first sign of a hydrogen sulfide leak, a planned emergency program should be put into operation. Emergency drills should be made periodically. If a hydrogen sulfide leak occurs, all persons must promptly leave the area. A wind sock or other wind direction indicator should be within sight. Move crossways to the wind from the contaminated area. Insure that the entire area is evacuated. Only persons wearing NIOSH approved self-contained breathing apparatus or full facepiece airline respirators with auxiliary SCBA's operated in the pressure/demand mode and eye/skin protection should be permitted in area. Each hydrogen sulfide leak should be dealt with immediately. Lead acetate strips or portable monitoring instruments can be used to locate a hydrogen sulfide leak. If hydrogen sulfide is leaking, the lead acetate paper will turn brown. When working on a leak, employees should take a position so that escaping hydrogen sulfide moves away from them. Supplied air equipment must be working no matter how small the leak.
- Deactivating Materials**..... Not available

Section 07 - Handling and Storage

- Handling Procedures**..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.
- Storage Requirements**..... Store away from strong oxidizing agents. Do not allow contact with acids and excessive heat. Will liberate poisonous, flammable hydrogen sulfide gas. Do not store in zinc, aluminum or copper containers. Wear respiratory protection whenever exposure to vapor is likely. Wear appropriate personal protective equipment when handling this product. Store in a cool, dry, well-ventilated place. Store only in closed, properly labeled containers. Keep container closed when not in use.

Section 08 - Personal Protection and Exposure Controls

Protective Equipment

- Eyes**..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.



Respiratory	If exposure of hydrogen sulfide gas could exceed the exposure limits, use NIOSH approved full face airline and/or self-contained breathing apparatus operated in a positive pressure demand mode. The respiratory use limitations made by NIOSH or the manufacturer must be observed. Respiratory protection programs must be in accordance with 29 CFR 1910.134.
Gloves	Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing with soap and water, dry thoroughly before reuse.
Clothing	Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing with soap and water, dry thoroughly before reuse.
Footwear	Impervious boots of chemically resistant material should be worn at all times

Engineering Controls

Ventilation Requirements	Mechanical ventilation (dilution or local exhaust), process or personnel enclosure, and control of process conditions. Supply sufficient replacement air to make up for air removed by exhaust systems.
Other	Use local exhaust or general room/dilution ventilation as appropriate to control employee exposures in the work place.

Section 09 - Physical and Chemical Properties

Physical State	Flakes
Odor and Appearance	Slight rotten egg, white to yellow.
Odor Threshold	1-5 ppm for hydrogen sulfide.
Specific Gravity (Water=1)	1.858 (flake)
Vapor Pressure (mm Hg, 20C)	Not available
Vapor Density (Air=1)	Not available
Evaporation Rate	Not available
Boiling Point	174°C
Freeze/Melting Point	92°C
pH	Strongly alkaline



Water/Oil Distribution Coefficient.... Not available

Bulk Density..... 40 lbs/ft³(flake)

% Volatiles by Volume..... Very low

Solubility in Water..... 15% @ 20°C

Molecular Formula..... Na₂S

Molecular Weight..... 78.04

Section 10 - Stability and Reactivity

Stability..... Stable

Incompatibility..... Avoid contact with strong oxidizing agents and acids. Avoid concentrating solutions, could cause spontaneous ignition. Solutions attack zinc, copper, aluminum and alloys of these metals. Avoid heat, flames, sparks and other sources of ignition.

Hazardous Products of Decomposition.. Oxides of sulfur, oxides of sodium, hydrogen sulfide.

Polymerization..... Will not occur

Section 11 - Toxicological Information

Irritancy..... Strong irritant, corrosive.

Sensitization..... Not available



Chronic/Acute Effects..... ACUTE: Irritation of mucous membranes, eyes, and respiratory tract is possible following exposure to the decomposition product, hydrogen sulfide gas, which is potentially lethal.

CHRONIC: The effects of long-term, low level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the prevention of all contact with this material to avoid any effects from repetitive acute exposures.

Hydrogen sulfide is a toxic and irritant gas whose effects are exerted on the respiratory system, gastrointestinal tract, eyes and central nervous system. Acute effects on the respiratory system, in order of increasing severity, can be a runny nose with anosmia (loss of the sense of smell), tracheobronchitis with pain, cough, pulmonary edema with dyspnea (shortness of breath), delayed bronchopneumonia, respiratory paralysis and terminal asphyxial convulsion. Acute effects may occur without warning as a result of olfactory fatigue. While the odor of hydrogen sulfide is distinct at 0.3ppm, olfactory fatigue occurs rapidly with continuous inhalation. Gastrointestinal effects can be profuse salivation, nausea, vomiting or diarrhea. Nervous system effects may be giddiness, headache, vomiting, vertigo, amnesia, confusion and unconsciousness. Eye irritation is the most common low exposure effect of hydrogen sulfide and is characterized by irritation of the conjunctiva with photophobia to severe conjunctivitis with keratitis. A possible warning sign of eye exposure is the appearance of halos around light sources and increased sensitivity to light.

Synergistic Materials..... Not available

Animal Toxicity Data..... LD₅₀(Oral, Rat)= 200mg/kg
LD₅₀(Dermal, Rabbit)= 177.8mg/kg

Carcinogenicity..... This product is NOT listed as a carcinogen or suspected carcinogen by NTP, IARC, or OSHA.

Reproductive Toxicity..... Not available

Teratogenicity..... Not available

Mutagenicity..... Not available

Section 12 - Ecological Information

Fish Toxicity..... LC50(48 hrs, Bluegill Sunfish)= 61ppm

Biodegradability..... Not available

Environmental Effects..... This product is highly toxic to aquatic life.



Section 13 - Disposal Consideration

Waste Disposal.....Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class..... 8

Group..... II

PIN Number..... UN 1849

Other..... Secure containers (full and/or empty) with suitable hold down devices during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....E, D1A

NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

ClearTech Industries Inc. - Locations

Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3

Phone: 306-664-2522

Fax: 306-665-6216

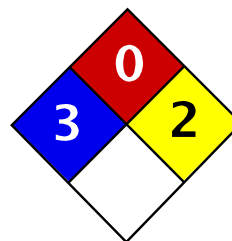
www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond BC	12431 Horseshoe way	V7A 4X6	604-272-4000	604-272-4596
Calgary AB	5516E - 40 th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton AB	11750 - 180 th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon SK	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282



Regina SK	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg MB	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga ON	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522



Health	3
Fire	0
Reactivity	2
Personal Protection	

Material Safety Data Sheet

Sulfuric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sulfuric acid

Catalog Codes: SLS2539, SLS1741, SLS3166, SLS2371, SLS3793

CAS#: 7664-93-9

RTECS: WS5600000

TSCA: TSCA 8(b) inventory: Sulfuric acid

CI#: Not applicable.

Synonym: Oil of Vitriol; Sulfuric Acid

Chemical Name: Hydrogen sulfate

Chemical Formula: H₂-SO₄

Contact Information:

Sciencelab.com, Inc.

14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	95 - 98

Toxicological Data on Ingredients: Sulfuric acid: ORAL (LD50): Acute: 2140 mg/kg [Rat.]. VAPOR (LC50): Acute: 510 mg/m 2 hours [Rat]. 320 mg/m 2 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH.

MUTAGENIC EFFECTS: Not available.

TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.

The substance may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion:

Products of combustion are not available since material is non-flammable. However, products of decomposition include fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas. Reacts with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Fire Hazards in Presence of Various Substances: Combustible materials

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.

Slightly explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Metal acetylides (Monocesium and Monorubidium), and carbides ignite with concentrated sulfuric acid.

White Phosphorous + boiling Sulfuric acid or its vapor ignites on contact.

May ignite other combustible materials.

May cause fire when sulfuric acid is mixed with Cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phosphorous (III) oxide, and oxidizing agents such as chlorates, halogens, permanganates.

Special Remarks on Explosion Hazards:

Mixtures of sulfuric acid and any of the following can explode: p-nitrotoluene, pentasilver

trihydroxydiaminophosphate, perchlorates, alcohols with strong hydrogen peroxide, ammonium tetraperoxychromate, mercuric nitrite, potassium chlorate, potassium permanganate with potassium chloride, carbides, nitro compounds, nitrates, carbides, phosphorous, iodides, picrates, fulminates, dienes, alcohols (when heated)

Nitramide decomposes explosively on contact with concentrated sulfuric acid.

1,3,5-Trinitrosohexahydro-1,3,5-triazine + sulfuric acid causes explosive decomposition.

Section 6: Accidental Release Measures

Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Corrosive liquid. Poisonous liquid.

Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:

Hygroscopic. Reacts. violently with water. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 1 STEL: 3 (mg/m³) [Australia] Inhalation

TWA: 1 (mg/m³) from OSHA (PEL) [United States] Inhalation

TWA: 1 STEL: 3 (mg/m³) from ACGIH (TLV) [United States] [1999] Inhalation

TWA: 1 (mg/m³) from NIOSH [United States] Inhalation

TWA: 1 (mg/m³) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Thick oily liquid.)

Odor: Odorless, but has a choking odor when hot.

Taste: Marked acid taste. (Strong.)

Molecular Weight: 98.08 g/mole

Color: Colorless.

pH (1% soln/water): Acidic.

Boiling Point:

270°C (518°F) - 340 deg. C

Decomposes at 340 deg. C

Melting Point: -35°C (-31°F) to 10.36 deg. C (93% to 100% purity)

Critical Temperature: Not available.

Specific Gravity: 1.84 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 3.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:

Easily soluble in cold water.

Sulfuric is soluble in water with liberation of much heat.

Soluble in ethyl alcohol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability:

Conditions to Avoid: Incompatible materials, excess heat, combustible material materials, organic materials, exposure to moist air or water, oxidizers, amines, bases.

Always add the acid to water, never the reverse.

Incompatibility with various substances:

Reactive with oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of stainless steel(316).

Highly corrosive in presence of stainless steel(304).

Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Hygroscopic. Strong oxidizer. Reacts violently with water and alcohol especially when water is added to the product.

Incompatible (can react explosively or dangerously) with the following: ACETIC ACID, ACRYLIC ACID, AMMONIUM HYDROXIDE, CRESOL, CUMENE, DICHLOROETHYL ETHER, ETHYLENE CYANOHYDRIN, ETHYLENEIMINE, NITRIC ACID, 2-NITROPROPANE, PROPYLENE OXIDE, SULFOLANE, VINYLIDENE CHLORIDE, DIETHYLENE GLYCOL MONOMETHYL ETHER, ETHYL ACETATE, ETHYLENE CYANOHYDRIN, ETHYLENE GLYCOL MONOETHYL ETHER ACETATE, GLYOXAL, METHYL ETHYL KETONE, dehydrating agents, organic materials, moisture (water), Acetic anhydride, Acetone, cyanohydrin, Acetone+nitric acid, Acetone + potassium dichromate, Acetonitrile, Acrolein, Acrylonitrile, Acrylonitrile+water, Alcohols + hydrogen peroxide, ally compounds such as Allyl alcohol, and Allyl Chloride, 2-Aminoethanol, Ammonium hydroxide, Ammonium triperchromate, Aniline, Bromate + metals, Bromine pentafluoride, n-Butyraldehyde, Carbides, Cesium acetylene carbide, Chlorates, Cyclopentanone oxime, chlorinates, Chlorates + metals, Chlorine trifluoride, Chlorosulfonic acid, 2-cyano-4-nitrobenzenediazonium hydrogen sulfate, Cuprous nitride, p-chloronitrobenzene, 1,5-Dinitronaphthlene + sulfur, Diisobutylene, p-dimethylaminobenzaldehyde, 1,3-Diazidobenzene, Dimethylbenzylcarbinol + hydrogen peroxide, Epichlorohydrin, Ethyl alcohol + hydrogen peroxide, Ethylene diamine, Ethylene glycol and other glycols, , Ethylenimine, Fulminates, hydrogen peroxide, Hydrochloric acid, Hydrofluoric acid, Iodine heptafluoride, Indane + nitric acid, Iron, Isoprene, Lithium silicide, Mercuric nitride, Mesityl oxide, Mercury nitride, Metals (powdered), Nitromethane, Nitric acid + glycerides, p-Nitrotoluene, Pentasilver trihydroxydiaminophosphate, Perchlorates, Perchloric acid, Permanganates + benzene, 1-Phenyl-2-methylpropyl alcohol + hydrogen peroxide, Phosphorus, Phosphorus isocyanate, Picrates, Potassium tert-butoxide, Potassium chlorate, Potassium Permanganate and other permanganates, halogens, amines, Potassium Permanganate + Potassium chloride, Potassium Permanganate + water, Propiolactone (beta)-, Pyridine, Rubidium acetylene carbide, Silver permanganate, Sodium, Sodium carbonate, sodium hydroxide, Steel, styrene monomer, toluene + nitric acid, Vinyl acetate, Thallium (I) azidodithiocarbonate, Zinc chlorate, Zinc iodide, azides, carbonates, cyanides, sulfides, sulfites, alkali hydrides, carboxylic acid anhydrides, nitriles, olefinic organics, aqueous acids, cyclopentadiene, cyano-alcohols, metal acetylides, Hydrogen gas is generated by the action of the acid on most metals (i.e. lead, copper, tin, zinc, aluminum, etc.). Concentrated sulfuric acid oxidizes, dehydrates, or sulfonates most organic compounds.

Special Remarks on Corrosivity:

Non-corrosive to lead and mild steel, but dilute acid attacks most metals.

Attacks many metals releasing hydrogen.

Minor corrosive effect on bronze.

No corrosion data on brass or zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.

Acute oral toxicity (LD50): 2140 mg/kg [Rat.].

Acute toxicity of the vapor (LC50): 320 mg/m³ 2 hours [Mouse].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH.

May cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth.

Other Toxic Effects on Humans:

Extremely hazardous in case of inhalation (lung corrosive).

Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L

Reproductive effects: May cause adverse reproductive effects based on animal data. Developmental abnormalities (musculoskeletal) in rabbits at a dose of 20 mg/m³ for 7 hrs.(RTECS)

Teratogenecity: neither embryotoxic, fetotoxic, nor teratogenetic in mice or rabbits at inhaled doses producing some maternal toxicity

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects:

Skin: Causes severe skin irritation and burns. Continued contact can cause tissue necrosis.

Eye: Causes severe eye irritation and burns. May cause irreversible eye injury.

Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the stomach, GI bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse(similar to acute inhalation). It may also cause systemic toxicity with acidosis.

Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Cause corrosive action on mucous membranes. May affect cardiovascular system (hypotension, depressed cardiac output, bradycardia). Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow. Circulatory shock is often the immediate cause of death. May also affect teeth(changes in teeth and supporting structures - erosion, discoloration).

Chronic Potential Health Effects:

Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart (ischemic heart leisons), and respiratory system/lungs(pulmonary edema, lung damage), teeth (dental discoloration, erosion).

Skin: Prolonged or repeated skin contact may cause dermatitis, an allergic skin reaction.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 49 mg/l 48 hours [bluegill/sunfish].

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Sulfuric acid may be placed in sealed container or absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Be sure to consult with local or regional authorities (waste regulators) prior to any disposal. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sulfuric acid UNNA: 1830 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information**Federal and State Regulations:**

Illinois toxic substances disclosure to employee act: Sulfuric acid
New York release reporting list: Sulfuric acid
Rhode Island RTK hazardous substances: Sulfuric acid
Pennsylvania RTK: Sulfuric acid
Minnesota: Sulfuric acid
Massachusetts RTK: Sulfuric acid
New Jersey: Sulfuric acid
California Director's List of Hazardous Substances (8 CCR 339): Sulfuric acid
Tennessee RTK: Sulfuric acid
TSCA 8(b) inventory: Sulfuric acid
SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid
SARA 313 toxic chemical notification and release reporting: Sulfuric acid
CERCLA: Hazardous substances.: Sulfuric acid: 1000 lbs. (453.6 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:**WHMIS (Canada):**

CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):

R35- Causes severe burns.
S2- Keep out of the reach of children.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S30- Never add water to this product.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection:**National Fire Protection Association (U.S.A.):****Health:** 3**Flammability:** 0**Reactivity:** 2**Specific hazard:****Protective Equipment:**

Gloves.

Full suit.

Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Face shield.

Section 16: Other Information**References:**

- Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
- The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
- Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

Other Special Considerations: Not available.**Created:** 10/09/2005 11:58 PM**Last Updated:** 11/06/2008 12:00 PM

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**MADISON INDUSTRIES, INC.
OLD WATERWORKS ROAD
OLD BRIDGE, NJ 08857**

Telephone: 732-727-2225

Facsimile: 732-727-2653

info@oldbridgechem.com

www.oldbridgechem.com

MATERIAL SAFETY DATA SHEET

October 25, 2006

Page 1 of 4

Common Name: ZINC SULFATE

Manufacturer: Madison Industries, Inc.
P.O. Box 175
Old Bridge, New Jersey 08857

Telephone: 732-727-2225

Emergency Telephone: 800-275-3924

24 Hour Emergency Telephone: 800-424-9300 (Chemtrec)

HAZARDOUS CLSSIFICATION: NFPA: Health-2 / Fire-0 / Reactivity-0
HMIS: Health-2 / Fire-0 / Reactivity-0

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200).

ATTENTION: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

SECTION I. MATERIAL IDENTIFICATION

Common Name:	Zinc Sulfate
Trade Name:	Zinc Sulfate Monohydrate
Molecular Formula:	$\text{ZnSO}_4 \cdot \text{H}_2\text{O}$
Molecular Weight:	179
CAS Number:	7446-19-7

SECTION II. HAZARDS

This material or the components of this material are included in the Toxic Chemical Inventory as required in Section 8 (b) of the Toxic Substance Control Act (Public Law 94-469) and is codified in 40 CR 720.

Superfund Amendments & Reauthorization Act - Title III Applicability Section 312 40 CFR 370.40:

Health X Acute
Hazard X Chronic

Section 313 Zinc Compounds 40 CFR 372-85

SECTION III. PHYSICAL DATA

Physical State:	White powder or granules
Boiling Point:	NA
Melting Point:	No data
Crystallization Point:	70°F
Vapor Density:	0 (water = 1)
Specific Gravity:	3.28
Solubility in H ₂ O:	30% at 70°F
Appearance:	White powder or granules
Evaporation Rate:	NA

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point:	Not flammable.
Extinguishing Media:	Dry chemical, Carbon Dioxide or Foam. Water may be ineffective, but water spray or fog may be used as a cooling agent.
Fire and Explosion Hazards:	May release toxic Oxides of Zinc and Sulfur in a fire.

SECTION V. REACTIVITY DATA

Stability:	Stable at normal temperatures and pressures.
Thermal Decomposition:	May release toxic and hazardous Oxides of Zinc and Sulfur.
Polymerization:	Will not occur.

SECTION VI. HEALTH AND HAZARD INFORMATION

Route of Entry:	Ingestion or inhalation.
Target Organs:	Respiratory system, eyes and skin.
Acute Exposure:	May cause skin irritation. May cause eye irritation, possible corneal burn. May cause gastrointestinal disturbance. May cause irritation to nose and throat.
Chronic Exposure:	May cause skin dermatitis. May cause eye conjunctivitis. No known ingestion reaction anticipated. May cause inhalation reflex bronchial constriction.

SECTION VII. FIRST AID PROCEDURES

Swallowing:	If person is conscious induce vomiting. Call Poison Control Center or a physician. Do not give anything by mouth to an unconscious person.
Skin:	Immediately wash skin with soap and plenty of water. Remove contaminated clothing and shoes. Call a physician. Wash contaminated clothing before reuse.
Eyes:	Immediately flush eyes with plenty of water for 15 minutes. Hold eyelids apart during irrigation. Call a physician.
Inhalation:	Immediately remove person to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped administer artificial respiration. Keep person warm and calm. Call a physician.
Carcinogenicity:	None

SECTION VIII. HANDLING PRECAUTIONS

Personal Protective Equipment:	Respirators - If exposure cannot be maintained at or below established OSHA guidelines, respiratory protection must be provided in accordance with 29 CFR 1910.134 requirements. Skin Protection - Wear appropriate protective clothing and chemical resistant gloves as needed to prevent skin contact. Consult manufacturer to determine appropriate type of gloves or clothing for your particular application. Clean contaminated clothing and protective equipment before reuse. Wash thoroughly after handling material. Eye Protection - Wear splash proof or dust proof safety goggles wherever there is a potential for eye contact.
Ventilation:	Provide local exhaust or process enclosing ventilation to maintain exposures below OSHA guidelines 29 CFR 1910.1000 subpart 7.

SECTION IX. SPILL OR LEAK PROCEDURES

Spills or Leaks:	Comply with Federal, State and Local regulations on reporting spills. Flush with plenty of water to an approved chemical sewer.
Waste Disposal:	Comply with Federal, State and Local regulations. Zinc Sulfate can be carefully reacted with Sodium Carbonate to form an insoluble Zinc Carbonate solid that can be scooped up and sent to a disposal contractor.

SECTION X. SPECIAL PRECAUTIONS

Storage:	Heated storage is necessary to prevent crystallization. Keep containers closed.
Other Precautions:	Do not take internally.

SECTION XI. REGULATORY INFORMATION

NOTICE: The information herein is presented in good faith and believed to be accurate. However, no warranty, expressed or implied, is given. Regulatory requirements are subject to change and may differ from one location to another. It is the buyer's responsibility to ensure that its activities comply with Federal, State and local laws.

U.S. REGULATIONS: SARA 313 Information; this product contains the following substance subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372: **Zinc Compound 40.5%**

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following category:

AN IMMEDIATE HEALTH HAZARD

SECTION XII. SHIPPING INFORMATION

QUANTITIES OF 1000 POUNDS OR MORE: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, NOS, (Zinc Sulfate) 9, UN3082, PGIII, RQ, ERG 171

QUANTITIES OF LESS THAN 1000 POUNDS: NON-HAZARDOUS AND NON-REGULATED IN THAT PACKAGE

SECTION XIII. MSDS PREPARATION INFORMATION

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Material Safety Data Sheet

Document: 9030003

Date of issue: July 10, 2001

Version: 07/2001

Supersedes: Version 05/98

Status: released

according to EC Directive 91/155/EEC

1. Product and Company Identification

Trade name: **Drägersorb® 400 S**
Order numbers: 6737228 (40 kg), etc.

Part nos.:

2. Composition / Information on Ingredients

2.1 Chemical Characterization (Constituent):

n. a.

2.2 Chemical Characterization (Preparation):

Soda lime containing calcium dihydroxide, sodium hydroxide and 19 - 23 % water.

CAS No.	Designation acc. to EC Directive	Content	Unit	Symbol	R-Phrases
1305-62-0	Calcium dihydroxide / Calcium hydroxide (Ca(OH) ₂) (EINECS-Nr. 215-137-3)	78 - 84	w/w per cent	X _i	R 41
1310-73-2	Sodium hydroxide	2 - 4	w/w per cent	C	R 35

2.3 Additional Information:

Drägersorb® 400 S contains no ozone-depleting chemicals and no volatile organic chemicals (VOCs). During the manufacturing process for Drägersorb® 400 S no ozone-depleting chemicals and no volatile organic chemicals (VOCs) were used.

3. Hazards Identification

Nature of Hazard:

X_i, Irritant

Particular Hazards for Man and Environment:

R 41 Risk of serious damage to eyes.

4. First-Aid Measures

After inhalation:

Fresh air. Consult physician.

After skin contact:

Wash with plenty of water, then dab with polyethylene glycol 400.

After eye contact:

Flush open eye with plenty of water (for at least 15 minutes). Consult ophthalmologist immediately. Danger of corneal clouding.

After ingestion:

Administer lemon juice and afterwards plenty of water. Avoid vomiting (Danger of perforation!). Consult physician immediately.

Information to the physician:

After ingestion there is a danger of the oesophagus and the stomach becoming perforated.

Material Safety Data Sheet according to EC Directive 91/155/EEC
Product: Drägersorb® 400 **revised on July 10, 2001**

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5. Fire-Fighting Measures

Appropriate Extinguishing Media:

Drägersorb® 400 S does not burn. Adapt extinguishing media to the environment.

Extinguishing Media Not Appropriate for Reasons of Safety:

n. a.

Special Dangers Due to the Material, Its Products of Combustion or Resulting Gases:

When using water as an extinguishing media, take care of the resulting alkaline firefighting water. In case of high temperatures CaO may be released.

Special Protective Clothing or Equipment:

n. a.

6. Accidental Release Measures

Health Precautions:

Do not inhale released dust. Use dust mask with FFP2 filter. Take care to avoid eye contact, use safety goggles. Avoid skin contact.

Environmental Precautions:

Do not discharge into the sewer system.

Procedures for Cleaning / Collection:

Sweep up dry while avoiding formation of dusts. Wash away residues with large amounts of water.

Additional Information:

n. a.

7. Handling and Storage

7.1 Handling:

Information for Safe Usage:

Use dust extractor device if necessary.

Information for Fire and Explosion Protection:

Drägersorb® 400 S does not burn.

7.2 Storage:

Requirements for Storage and Containers:

Keep containers tightly closed. Drägersorb® 400 S must only be stored in its original containers at temperatures ranging from -30 °C to +50 °C. Drägersorb® 400 S must not be allowed to desiccate!

Information on Storage Together with Other Materials:

Observe VCI concept for storing chemicals.

Additional Information on Storage Conditions:

n. a.

Storage Class:

10 - 13 (VCI concept).

8. Exposure Controls / Personal Protection

Additional information on designing technical plants

Components having workplace-related limit values:

CAS No.	Designation of the Material	Type	Value	Unit
1305-62-0	Calcium dihydroxide	MAK*	5 E**	mg/m³
1310-73-2	Sodium hydroxide	MAK*	2 E**	mg/m³
	Total dust	MAK*	6	mg/m³
*German TLV **measured as inhaleable dust				

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Additional Information:

n. a.

General Safety and Hygiene Precautions:

Prophylactic skin care to protect faintly acid skin against Drägersorb® 400 S which reacts mildly alkaline.

Respiratory Protection:

Not necessary as Drägersorb® 400 S is delivered in pelletform. When dust occurs, use a dustmask with FFP2 filter.

Hand Protection:

Prophylactic skin protection is recommended. Wash thoroughly after handling. Skin care.

Eye Protection:

Safety goggles necessary.

Body Protection:

n. a.

9. Physical and Chemical Properties

9.1 Appearance:

Form:	hemispherical pills
Colour:	white
Odour:	odourless

9.2 Safety-Relevant Data:

Mass Density:			(930 +/- 100) g/l (bulk density)
Solubility of the Pellets:	in water	T = 20 °C	approx. 1 g/l
pH Value of the Pellets:	at approx. 1 g/l	T = 20 °C	approx. 12
Further Information:			Decomposition in CaO and H ₂ O at ~ 500 °C (930 °F)

10. Stability and Reactivity

Conditions to Avoid:

Avoid contact with concentrated acids. With acids vigorous reactions are possible. Do not use with trichloroethylene and chloroform.

Materials to Avoid:

In case of contact with light metals (aluminium) the formation of hydrogen is possible.

Dangerous decomposition products:

In case of high temperatures CaO may be formed.

Additional Information:

Aqueous solutions and suspensions react alkaline.

11. Toxicological Information

11.1 Acute Toxicity

Data for Component Ca (OH)₂

Classification-relevant LD/LC₅₀ values:

Type	Values/Range of Values	Species	Method
oral	7340 mg/kg	rat	
dermal	./.		
inhalational	./.		

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Specific Symptoms in Tests on Animals:

./.

Primary Irritant Action:

Data for Drägersorb® 400 S

Action	Species	Method
on the skin		
non irritant	rabbit	OECD 404, 91/325 EWG
at the eye		
> 3 after 72 h cornea opacity	rabbit	OECD 405, 91/325 EWG

Sensitization through skin contact

./.

Additional Information (on experimental toxicology)

NaOH LD₅₀ oral, rabbit - 500 mg/kg

11.2 Subacute to Chronic Toxicity:

Experiments:

Species ./.

11.3 Effects on the Human Body:

Ca (OH)₂ may provoke caustic reaction on skin/mucosae, Ca (OH)₂ dust provokes irritation of the respiratory organs.

Additional Toxicological Information (esp. for preparation):

12. Ecological Information

12.1 Elimination Information (Persistence and Degradability):

Procedure	n. a.	Analytical method	n. a.
Degree of Elimination	./.	Classification	./.
Additional Information	./.		

12.2 Behaviour in Environmental Compartments:

12.3 Ecotoxic Action:

Note

Drägersorb® 400 S can be toxic for aquatic organisms.

Behaviour in Waste Treatment Plants:

n. a.

Remark

./.

12.4 Additional Information:

n. a.

Additional Ecological Information:

As an inorganic, non-reducing substance Drägersorb® 400 S has neither a COD nor a BOD. It must not be discharged into lakes and rivers or the sewer system quantities.

12.5 General Information:

Drägersorb® 400 S suspensions react alkaline. Drägersorb® 400 S should not released into water, trouble through increasing pH-value. When handled and used properly Drägersorb® 400 S is not likely to prove detrimental to the environment.

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13. Disposal Considerations

13.1 Product / Recommendations:

Unused soda lime can be disposed of as commercial solid waste similar to household waste in accordance with local waste disposal regulations. Utilized soda lime can be disposed of in the same way as unused soda lime.

Waste category (EAK, European waste catalogue):
150201

Waste designation:

Absorbent and filtering material, wiping cloth and protective clothing

Obligation to prove correct disposal:

n. a.

13.2 Not Cleaned Packaging Material / Recommendations:

Rinse PE-HD cans with water and recycle as one-type plastic. Rinse PE bags with water and recycle as one-type plastic. Alternatively the disposal of completely discharged plastic containers and flexible packages is possible by EAK 150102, metal containers by EAK 150104, and fibre board boxes by EAK 150101.

Recommended Cleaning Agent

n. a.

14. Transport Information

14.1 Overland transport ADR/RID and GGVS/GGVE (cross-border/domestic)

ADR/RID-GGVS/E-class

n. a.

Figure/Letter

./.

Warning notice:

Hazard No. ./.

Substance No.

./.

Designation of the freight:

./.

Remarks:

Drägersorb® 400 S is not a dangerous good. Drägersorb® 400 S is not hygroscopic and contains less than 4 % NaOH. Therefore it is not classified under UN No. 1907.

14.2 Inland waterway transport ADN/ADR

ADN/R class

n. a.

Figure/Letter

./.

Category

./.

Designation of the freight:

Remarks:

./.

14.3 Maritime transport IMDG/GGVSee

IMDG/GGVSee class

n. a.

UN No.

PG

EMS No.

MFAG

Marine pollutant

Correct technical name

Remarks:

Drägersorb® 400 S is not a dangerous good. Drägersorb® 400 S is not hygroscopic and contains less than 4 % NaOH. Therefore it is not classified under UN No. 1907.

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14.4 Air transport ICAO-TI and IATA-DGR

ICAO/IATA class

n. a.

UN No.

./.

PG

./.

Correct technical name

Remarks:

Drägersorb® 400 S is not a dangerous good. Drägersorb® 400 S contains less than 4 % NaOH and is therefore not classified under UN No. 1907.

14.5 Transport/Further Indications

May be sent by post.

15. Regulatory Information

15.1 Identification in Accordance with EC Directive:

Identification symbol and indication of danger:

X_i, Irritant

Dangerous component determining labelling:

Sodium hydroxide

R-Phrases:

R 41

Risk of serious damage to eyes.

S-Phrases:

S 2

Keep out of the reach of children.

S 26

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S 37/39

Wear suitable gloves and eyes/face protection.

Special identification of certain preparations (acc. to Annex II of the preparations directive 88/379/EEG)

n. a.

15.2 National Regulations:

Additional classification acc. to GefStoffV Annex II No.:

n. a. (only if differing from EC classification)

Information on employment restrictions:

n. a.

Störfallverordnung (Accident Regulation):

n. a.

Classification acc. to VbF (Flammable Liquids Regulation):

n. a.

Technische Anleitung Luft (Technical Instruction Air):

Class

n. a.

Figure

Percentage (in case of liquids)
(self-classification)

Water hazard class:

1

Further regulations, restrictions, and restrictive injunctions

(such as principles of industrial medicine and health and safety regulations (VBG, ZH-1/...instruction sheets etc.)

Instruction Sheet BG-Chemie: M 004 Irritating Substances/Caustic Substances: ZH 1/229

16. Other Information

Reasons for alterations:

Adoption of EC Material Safety Data Sheet format

The above information represents our current state of experience and describes the product only with respect to safety requirements. It is the responsibility of the customer to test whether the product is suitable for the purpose intended by the customer.

Any questions of warranty and liability for this product are subject to our General Terms and Conditions unless legislation imperatively provides otherwise.

Data-sheet issued by:

ag-cas

Contact:

Dr. Hans-Christoph Bechthold

The data in the heading and sections 1, 6, 8, 13 have been changed.