Myra Falls Waste Discharge Permit Amendment – Technical Report

Application Authorization # 2408
Application Tracking # 363131

Prepared for:
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Project No.: 123220917

August 31, 2017

Executive Summary

This technical assessment report was prepared in support of the Nyrstar Myra Falls Ltd. (Nyrstar) Waste Discharge Permit Amendment Application Authorization #2408 (PA-2408) and Application Tracking # 363131. Nyrstar is submitting the application to the British Columbia Ministry of Environment (BC MOE) to amend the discharge of air emissions from its existing activities at the Myra Falls mine (the Project) located about 90 kilometres southwest of Campbell River, BC. The Project is a multi-metals mine producing zinc, copper and lead concentrates with silver and gold as by-products. The sources of air emissions to the receiving environment include wet scrubbers, exhaust vents and fans and fugitive sources of dust.

The report format follows the Guidelines on Applications for Permits under the *Environmental Assessment Act* (BC MOE 2010) and the Project-specific Information Requirements Table for Air Emissions finalized by the BC MOE on August 15, 2017 (BC MOE 2017). This report includes sections that describe the following: the project, environmental setting, air discharge and treatment, impact assessment, proposed monitoring and management plans.

Table of Contents

EXECUTIVE SUMMARY ..... **I**

1.0 INTRODUCTION **1**

2.0 PROJECT DESCRIPTION **1**
2.1 COMPANY OVERVIEW 1
2.2 PROJECT LOCATION 2
2.3 PROJECT PERMITTING HISTORY 4
2.4 PROJECT FACILITIES AND PROCESSES 5
2.4.1 Project Activities and Infrastructure 5
2.4.2 Production 9
2.4.3 Power Requirements and contingency plans 12
2.4.4 Project Closure 12

3.0 ENVIRONMENTAL SETTING **13**
3.1 METEOROLOGY 13
3.2 AMBIENT AIR QUALITY 18

4.0 SENSITIVE RECEPTORS **20**

5.0 AIR DISCHARGE AND TREATMENT **21**
5.1 POLLUTION CONTROL WORKS 21
5.2 POINT-SOURCE DISCHARGE DETAILS 22
5.3 FUGITIVE DUST EMISSION DISCHARGE DETAILS 28

6.0 IMPACT ASSESSMENT **31**

7.0 MONITORING PLANS **31**

8.0 MANAGEMENT PLANS **32**

9.0 PROFESSIONAL QUALIFICATIONS **32**

10.0 CLOSURE **33**

11.0 REFERENCES **34**

LIST OF TABLES

Table 1: Meteorological Station Details....13
Table 2: Rainfall Trends....15
Table 3: Wind Speed at the Myra Creek Station....15
Table 4: Ambient Air Quality Monitoring Stations....18
Table 5: Ambient PM_{10}, $PM_{2.5}$, SO_2 and NO_2 Concentrations....19
Table 6: Sensitive Receptors....20
Table 7: Point Source Pollution Control Works....21
Table 8: Point Source Air Discharge Details....25
Table 9: Maximum Point Source Concentrations....26
Table 10: Maximum Point Source Emission Rates....27
Table 11: Areas of Disturbance Subject to Fugitive Dust Emissions and Control Works Effectiveness....29

LIST OF FIGURES

Figure 1:Project Location....3
Figure 2:Project Site Plan....7
Figure 3:Project Mill Area....8
Figure 4:Production Flow Diagram....11
Figure 5:Daily Maximum, Average, Minimum Temperature and Total Precipitation....14
Figure 6:Annual Wind-rose Note: calm winds are defined as winds with wind speed equal or smaller than 1km/hr....16
Figure 7:Spring, Summer, Autumn and Winter Wind-roses....17

LIST OF APPENDICES

APPENDIX A AIR QUALITY MANAGEMENT PLAN....A.1

APPENDIX B ENGINEERING SPECIFICATIONS....B.1

1.0 INTRODUCTION

This technical report supports the application for a Waste Discharge Permit Amendment for the Myra Falls Mine, operated by Nyrstar Myra Falls Ltd. (Nyrstar). Nyrstar owns and operates the Myra Falls mine (the Project) located about 50 kilometres southwest of Campbell River (90 km by road), British Columbia. The Project is a multi-metal underground mine producing zinc, copper and lead concentrates with silver and gold as by-products. The Project originally commenced operations in 1966 and has been active under several different company ownerships. Although mining operations started with two open pits, site activities quickly converted to strictly underground mining operations with the discovery of new ore areas which include the Lynx, Myra, HW and Price mining areas. At peak production, the Project will process about 782,000 tonnes of run of mine (ROM) ore and produce 0.4 tonnes gold, 99,500 tonnes zinc, 7,300 tonnes lead, 21,300 tonnes copper and 653,800 tonnes of tailings per year.

Under the *Environmental Management Act* Waste Discharge Regulation, Nyrstar requires an authorization to discharge air emissions. Stantec Consulting Ltd. (Stantec) was retained by Nyrstar to prepare the Waste Discharge Permit (WDP) amendment for the mine to address changes in permitted air emissions. The WDP amendment application package includes this Technical Report developed in discussion with the British Columbia Ministry of Environment (BC MOE). The Technical Report was developed in accordance with the Guidance on Applications for Permits under the *Environmental Assessment Act* (BC MOE 2010) and the Myra Falls-specific Information Requirements Table for Air Emissions issued by BC MOE on August 15, 2017 (BC MOE 2017). This report includes the Air Quality Management Plan (AQMP, Appendix A) as requested by BC MOE in the IRT (BC MOE 2017). This report provides technical details in support of the Nyrstar WDP application authorization #2408 and application tracking #363131.

2.0 PROJECT DESCRIPTION

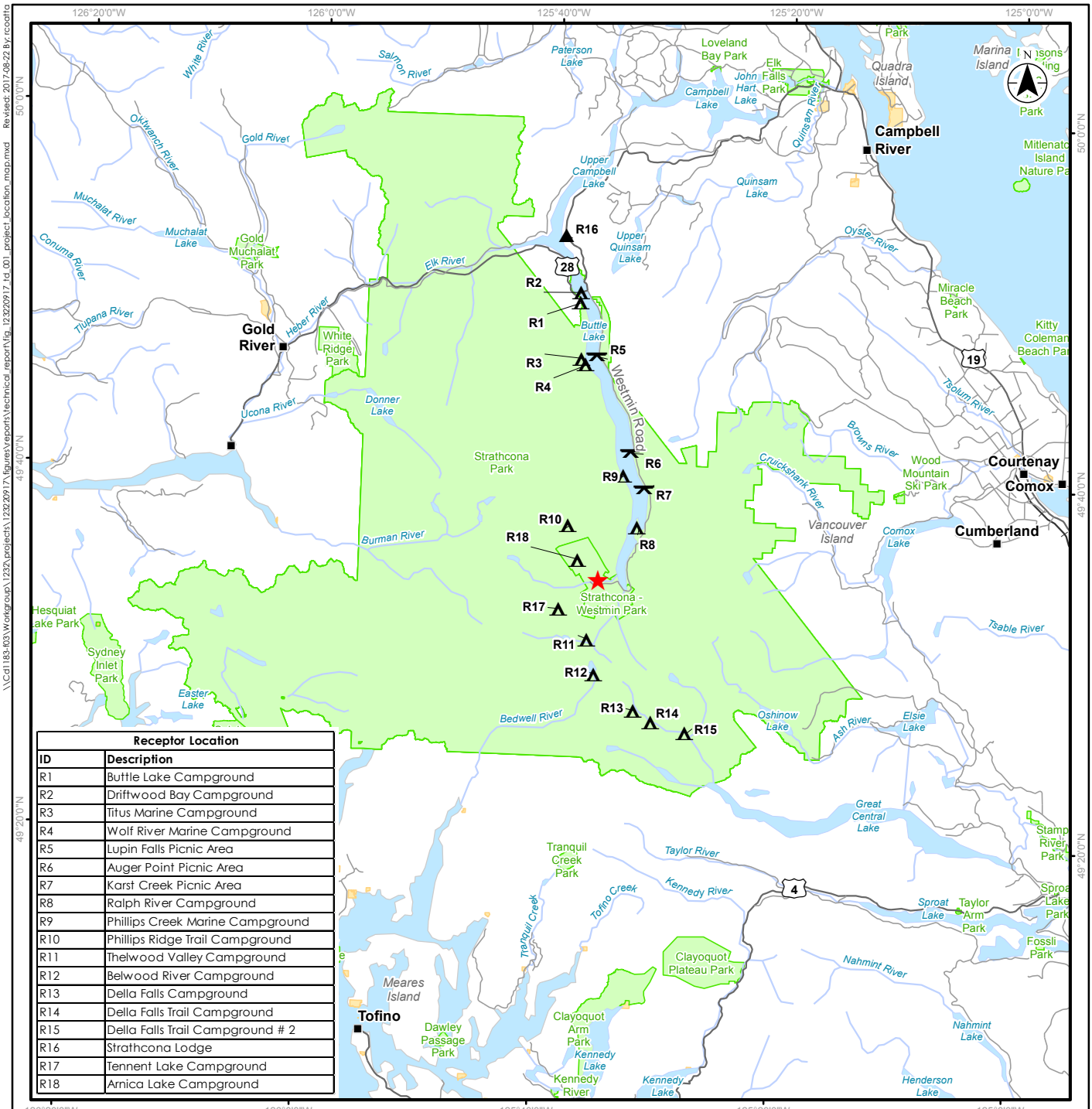
2.1 COMPANY OVERVIEW

Registered legal name:	Nyrstar Myra Falls Ltd.
Site office location:	2451 Spit Road, P.O. Box 8000, Campbell River, BC, V9W 6E3
Head office contact:	Nicole Pesonen, Environmental Advisor
	Tel: 250-287-9271 ext 3316; Email: nicole.pesonen@nyrstar.com

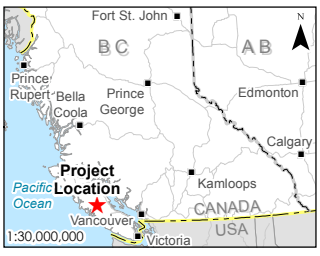
2.2 PROJECT LOCATION

The Project is in the Strathcona-Westmin Provincial Park (SWPP) and surrounded by the Strathcona Provincial Park (SPP), approximately 50 km southwest (or 90 km by road) from Campbell River in central Vancouver Island, BC (Figure 1). The mine site is situated on the south end of Buttle Lake and is accessible via the paved, publicly-accessible, Westmin Road.

Given that the Project is surrounded by the SWPP and the SPP, land use outside Project boundaries is strictly recreational. The SWPP and the SPP are dominated by mountain peaks. The area is considered as a rugged mountain wilderness, undeveloped, and far removed from residential communities or urban centers.



Receptor Location	
ID	**Description**
R1	Buttle Lake Campground
R2	Driftwood Bay Campground
R3	Titus Marine Campground
R4	Wolf River Marine Campground
R5	Lupin Falls Picnic Area
R6	Auger Point Picnic Area
R7	Karst Creek Picnic Area
R8	Ralph River Campground
R9	Phillips Creek Marine Campground
R10	Phillips Ridge Trail Campground
R11	Thelwood Valley Campground
R12	Belwood River Campground
R13	Della Falls Campground
R14	Della Falls Trail Campground
R15	Della Falls Trail Campground # 2
R16	Strathcona Lodge
R17	Tennent Lake Campground
R18	Arnica Lake Campground



City, Town, Village, or District Municipality
Highway
Road
Railway
Watercourse
Waterbody
First Nations Reserve
Park, Ecological Reserve, or Protected Area

Project Location

Receptor Location

Campground
Picnic Area
Lodge

0 5 10 15 20 25 km

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Notes
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Stantec

Project Location
NTS Grid: 092F12
BCGS Grid: 92F.053
UTM: 10 E312718 N5494600

Project Number 123220917
Prepared by SSUN 20170802
Discipline Review MKINGSLEY 20170802
GIS Review RCOATTA 20170822

Client/Project
Nyrstar Myra Falls
Technical Report

Figure No. 1
Page No. 1 of 1

Title
Project Location

2.3 PROJECT PERMITTING HISTORY

The Project commenced operations in 1966 and has been active under several different company ownerships. Although mining operations started with two open pits, site activities quickly converted to an underground mine with the discovery of new ore areas.

The original air emissions discharge permit PA-2408 was issued to Westmin Resources Ltd. (Westmin) by the Department of Lands, Forests and Water Resources on June 21, 1974. The permit underwent a series of amendments which were authorized by the Ministry of Environment or equivalent at the time of issue. The last amendment was issued by BC MOE on June 13, 1997 to Westmin and includes authorizations to discharge air emissions from the following point-sources:

- No. 1 crusher
- Assay/environmental laboratory
- Coarse ore bin
- Crushing/screening plant
- Transfer house
- Fine ore bins
- Reagent mix and storage facility
- Three continuous use and ten backup diesel-powered generators

Nyrstar purchased the Myra Falls mine in 2011 from Breakwater Resources. On March 6, 2014, Nyrstar received permissions from the BC MOE to temporarily bypass the 6-7 transfer house and the coarse ore bin scrubbers until May 31, 2014. Nyrstar operated the mine until June 2015 when mining/milling ceased. Mine operations were fully suspended in October 2015 due to changing market conditions. In early 2017, Nyrstar announced its plans to restart operations and contacted BC MOE to discuss potential changes to Permit PA-2408. These changes reflect upgrades to existing infrastructure, requiring an amendment to the following permitted sources of air emissions:

- No. 1 crusher – crusher and wet scrubber decommissioned
- Assay/environmental laboratory – upgrades to wet scrubber and baghouse
- Coarse ore bin – revisions to emission estimates based on latest air emission factors and material throughput details
- Crushing/screening plant – revisions to emission estimates based on latest air emission factors and material throughput details
- Transfer house – revisions to emission estimates based on latest air emission factors and material throughput details

- Fine ore bins – revisions to emission estimates based on latest air emission factors and material throughput details
- Reagent mix and storage facility – upgrades to ventilation systems
- Diesel generators – equipment replacement and relocation

On April 13, 2017, BC MOE issued a draft Information Requirements Table for Air Emissions (IRT) to guide the development of the Myra Falls Technical Report required in support of the proposed amendment. Nyrstar submitted the Preliminary Application for an Authorization Amendment package to BC MOE on July 18, 2017 for review and approval. The package included:

- Preliminary Application for Amendment Form
- Clause Amendment Form
- Draft Discharge Factor Amendment Form

The IRT was finalized on August 15, 2017 and the requirements were used to inform this Technical Report.

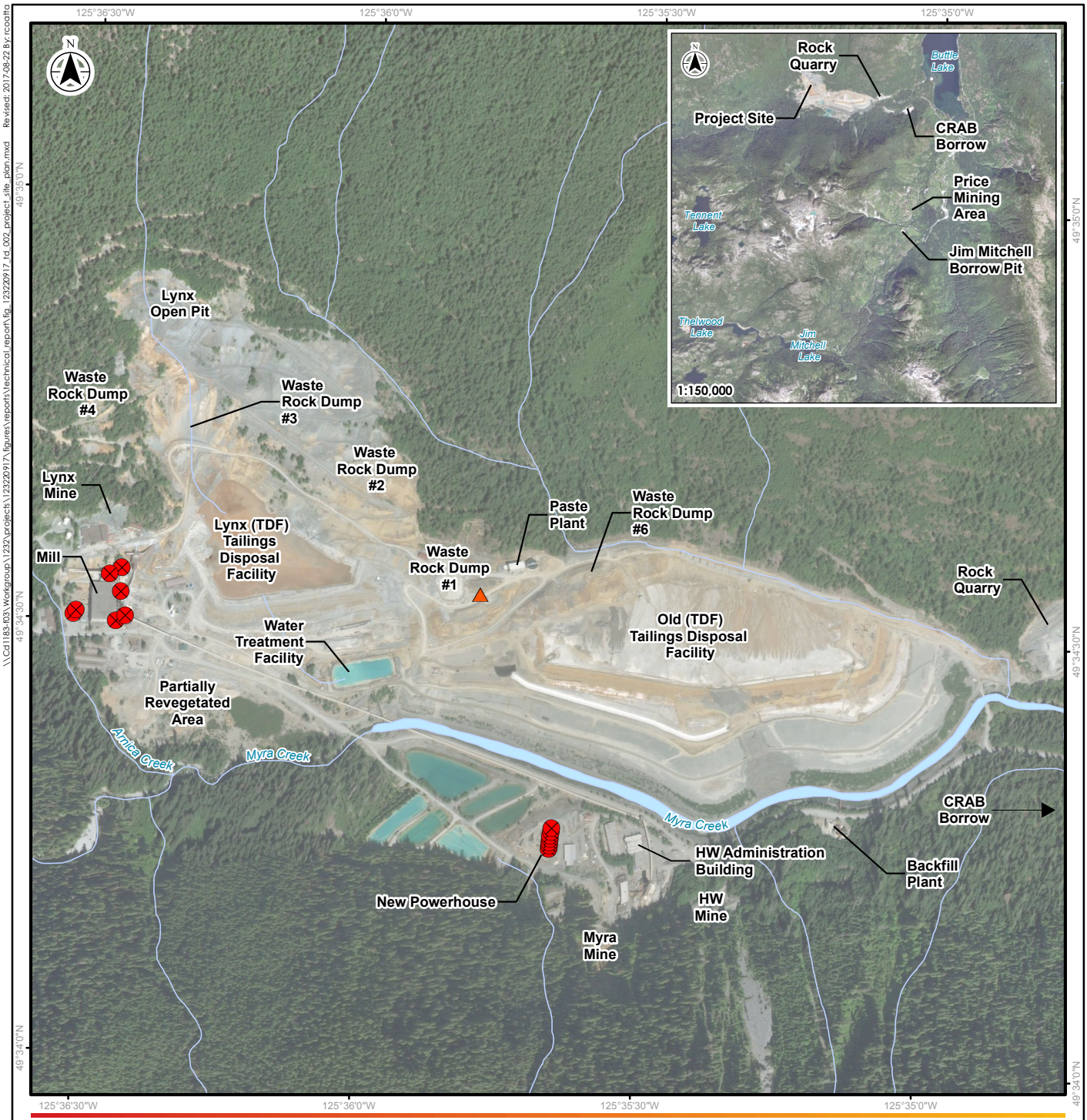
2.4 PROJECT FACILITIES AND PROCESSES

2.4.1 Project Activities and Infrastructure

Project mining activities occur within the following areas, with key features shown in Figure 2 and Figure 3:

- Two underground mining areas (see Figure 2):
  - The Myra, the Lynx, the H W Mining Area
  - The Price Mining Area
- The following mining-related structures, installations and related improvements (see Figure 2):
  - Various roads within the Myra Valley and the Thelwood Valley areas
  - Mill area (detailed below)
  - Hydroelectric power house with associated emergency diesel generators
  - Rock waste dumps (#1, 2, 3, 4 and 5)
  - Old Lynx open mine (not active)
  - Lynx tailings disposal facility
  - Old tailings dam facility (not active)
  - Jim Mitchell till borrow area (not active)
  - Rock quarry and Core Rack Area Borrow (CRAB) till borrow areas

  - Covered conveyor systems
  - Administrative infrastructure (staff house, cookhouse, bunkhouses, recreational hall)
  - Various water bridges, diversions and treatment systems
  - Myra Creek weather station
- The mill area (see Figure 3):
  - No.1 crusher (only enclosure and conveyor used to transfer material)
  - Coarse ore bin
  - Multi-phase coarse ore stockpile
  - Mobile crusher and mobile conveyor (Year 1 only)
  - Covered conveyor systems
  - Crushing/screening plant (Mill, maintenance, processing and concentrate load-out facilities)
  - Transfer house (Conveyor 6 to 7 transfer tower)
  - Two fine ore bins
  - Mill building (reagent mix and storage facility)
  - Lynx office and compressor building
  - Assay laboratory
  - Lime silos



- Watercourse
- Waterbody
- Strathcona - Westmin Park
- Air Emission Location
- Myra Creek Weather Station

0 100 200 300 400 500 m

1:12,500 (at original document size of 8.5x11)

Stantec

Project Location
NTS Grid: 092F12
BCGS Grid: 92F.053
UTM: 10 E312718 N5494600

Project Number 123220917
Prepared by SSUN 20170802
Discipline Review MKINGSLEY 20170802
GIS Review RCOATTA 20170822

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Technical Report

Figure No. 2
Page No. 1 of 1

Title
Project Site Plan

Notes
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Air Emission Location

Future Infrastructure

- Multi-phase Stockpile
- Mobile Crusher
- Conveyor

0 10 20 30 40 50 m

1:1,500 (at original document size of 8.5x11)

Stantec

Project Location	Project Number 123220917
NTS Grid: 092F12	Prepared by SSUN 20170802
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Client/Project
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Technical Report

Figure No.	Page No.
3	1 of 1

Title
Project Mill Area

Notes
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2.4.2 Production

At peak production, the Project will annually process about 782,000 tonnes of run of mine (ROM) ore and produce:

- 0.4 tonnes of gold
- 99,500 tonnes of zinc concentrate
- 7,300 tonnes of lead concentrate
- 21,300 tonnes of copper concentrate
- 653,800 tonnes of tailings

Project operations include the following activities:

- Underground mining activities at the Lynx, Myra, HW and Price mining areas
- Ore and mineral exploration including land preparation
- Milling of rock and processing of ore but not smelting
- Transport, storage and treatment of crushed rock, processed ore, tailings, water, and waste (including waste rock, garbage, sewage and waste water)
- Transmission of hydroelectric power to carry out site operations
- Transportation, maintenance and storage of vehicles and equipment

A simplified production flow diagram is provided in Figure 4 and includes material throughput rates in units of tonnes per hour (tph). All mining activities will occur underground. During the first year of operations, Lynx run of mine (ROM) will be sent to the mill area by 30 t trucks and crushed by the mobile crusher. ROM from the Myra/HW/Price mines will be sent to an underground HW jaw crusher using covered conveyor systems. For the remainder of project life, Lynx ROM will be hauled over surface from the underground mine to the HW jaw crusher for processing along with ROM ore from the other three mines. Once crushed, ore will be transferred using covered conveyors to the Coarse Ore Bin and/or Multiphase stockpile for temporary overflow storage. The Coarse Ore Bin will discharge to conveyor #4 which will transfer the ore to the Crushing/Screening Plant for cone crushing and fine milling. Crushed material will be screened for size and either fed through the Transfer House and back to the Crushing/Screening Plant for further crushing or fed to conveyor #8, 9 and 10 for transfer to the Fine Ore Bin and eventually the mill.

The mobile crusher at the mill will be active only during the first year of operation and will only process ROM from the Lynx underground mine at a nominal rate of 7 tph. The crusher will be equipped with appropriate pollution control works which will reduce fugitive dust emissions either through fogging or water sprays. Given that this equipment has not been purchased, engineering specifications are not available. Since this equipment will be mobile and not

enclosed, the mobile crusher is assumed to be an uncontrolled source of fugitive dust emissions for the duration of its operation.

A multiphase stockpile will be developed adjacent to the Coarse Ore Bin to decouple mining and milling activities such that both can function independently. Although stockpile options are still being refined, Nyrstar can confirm that the desired maximum stockpile size will be 65,000 t. The stockpile capacity is intended to provide buffer capacity should production rates change or if there is a planned mill shutdown.

Once material is crushed, it will be conveyed to the mill (reagent mix and storage facility) for processing. The mill is where the ore separation process will occur and include:

- Fine ore bin grinding consisting of a primary rod mill and a secondary ball mill
- Gold, copper, lead, zinc separation circuits
- Concentrate dewatering will rely on conventional thickeners and polymer flocculants to accelerate the process. Thickened concentrate slurry will be pumped to Lorax pressure filters for final dewatering.
- Concentrate load-out where product is stored prior to transportation off-site
- Mill tailings will be pumped to a paste plant.

Given that mill grinding and ore separation are conducted in a wet environment, particulate matter emissions are not expected from the ventilation systems at the mill. Nyrstar plans to retrofit ventilation systems for the mill and as such, air emission characteristics are currently not known. The typical reagent consumption rates (in units of kg/t of ore processed) will be 0.06 xanthate, 0.04 methyl isobutyl carbinol (MIBC), 0.03 Cytex 5100, 0.01 Cytex 3418A, 0.3 copper sulphate, 2.3 sodium metabisulphate (MBS), 0.3 zinc sulphate, 0.005 anionic floc, and 0.04 dextrin (DEX)/ monosodium phosphate (MSP).

Filtered copper and zinc concentrate will be loaded onto 38 t tractor-trailer trucks and transported to the Campbell River storage facility for storage and subsequent loading onto bulk carrier ships. Filtered lead concentrate will be bagged on site and then trucked to a storage facility in Vancouver. All concentrate trucks will pass through a truck-wash station before departing the site.

Figure 4 shows the general discharge locations of air emissions. The Coarse Ore Bin, Crushing/Screening Plant, Transfer House and the Fine Ore Bin will rely on wet scrubber technology to manage dust emissions from ore production. Details specific to these and other point and fugitive sources of air emissions, and associated control works are provided in Section 5.0.

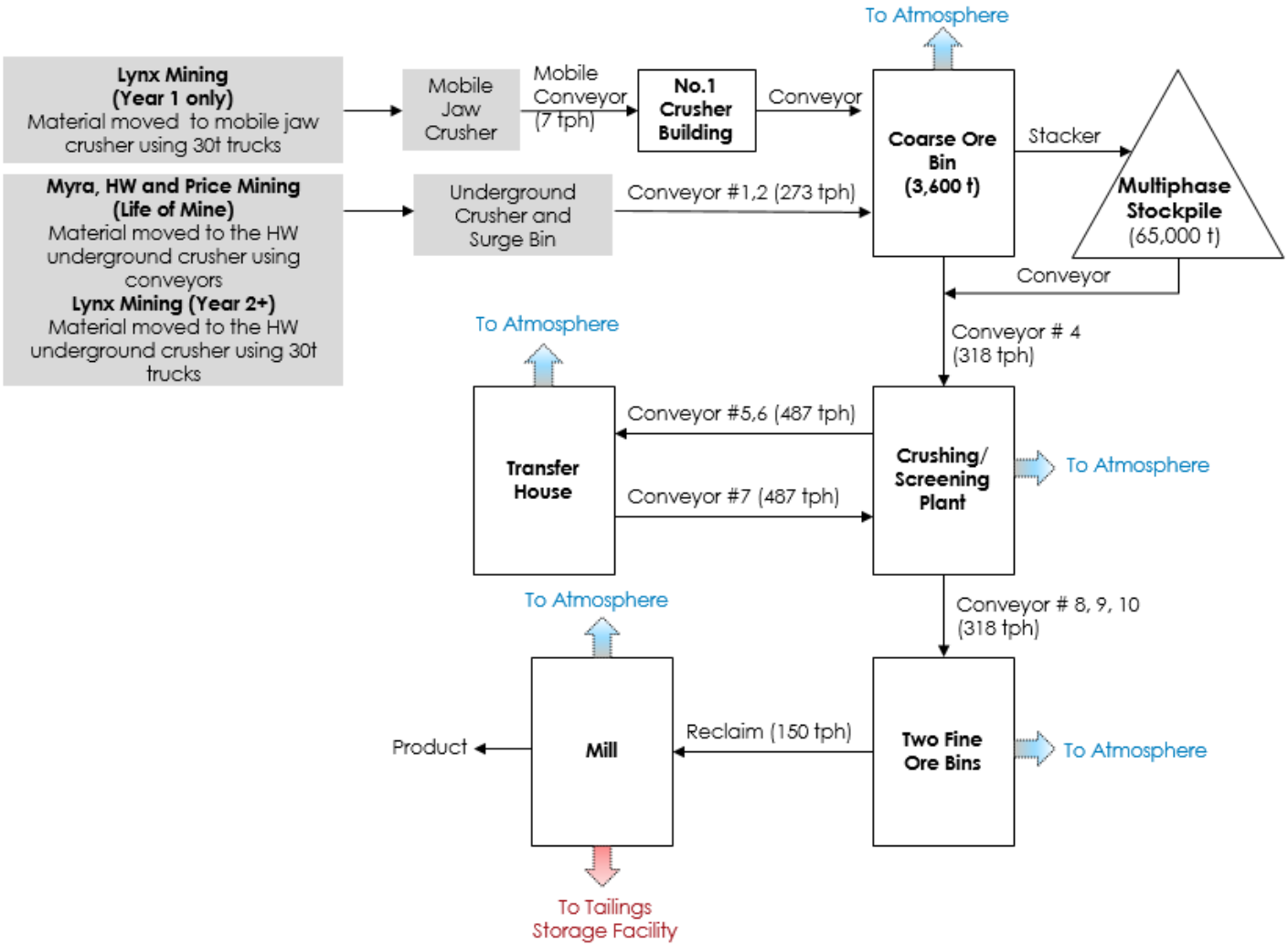

Figure 4: Production Flow Diagram

2.4.3 Power Requirements and Contingency Plans

The Project relies on hydroelectric power generation to support site activities. Historically, the powerhouse was located adjacent to the mill, next to the lime silos (Figure 3). Nyrstar plans to relocate the powerhouse to a new location shown in Figure 2, adjacent to the HW Administration building.

Hydroelectric power will be generated from existing infrastructure installed at the Tennent Lake, Thelwood Lake and Jim Mitchell Lake (see Figure 2). Hydroelectric power has the capacity to provide 11 MW of the total 14 MW required. Two diesel generators (each rated at 1,600 kW each) will be used to provide the remaining swing load.

In the event of a power outage due to loss of on-site hydro, power will be generated using emergency diesel generators. The Project will rely on standby diesel generators (three rated at 2,000 kW and three rated at 1,250 kW) to support hydroelectric outages during emergencies.

The make and model of the replacement power generating equipment is not yet available. As such, these engineering details are not provided in Appendix B and generic engineering details are used as input for air emissions calculations in Section 5.2.

2.4.4 Project Closure

Nyrstar is in the process of developing the site-specific Project closure plans. Draft closure plans are currently under review by applicable regulatory jurisdictions. Site closure and reclamation details specific to this Project are provided in the following submissions:

- Interim Site-Wide Closure & Reclamation Plan submitted on July 31, 2017 (Robertson GeoConsultants 2017)
- Addendum to the Nyrstar Myra Falls Interim Closure and Reclamation Plan submitted in December 2016 (Nyrstar 2016)

3.0 ENVIRONMENTAL SETTING

3.1 METEOROLOGY

To characterize the local meteorology, data were obtained from the Myra Creek meteorological station from January 2006 to July 2016 (Nyrstar 2017). Station details are provided in Table 1. This station is located on site and is considered representative of site conditions.

Table 1: Meteorological Station Details

Parameter	Details
Location	Latitude: 49.5756 N Longitude: 125.6058 W Elevation: 353.9 m above sea level
Temperature	Monitoring period: January 2006–April 2017, 90% data completeness
Precipitation	Monitoring period: • January 1979–December 2016 (total monthly precipitation), 92% data completeness • January 2006–April 2017 (total daily rainfall), 90% data completeness
Wind	Monitoring period: January 2006–July 2016, 84% data completeness
Myra Creek station photo	

Daily maximum, average, and minimum temperatures, and total precipitation trends for the period of record are shown in Figure 5.

On average, July and August are the warmest months with temperatures ranging between 12.8°C and 24.3°C. The highest recorded temperature was 38.9°C (July 30, 2009). Months of November through February are usually the coldest months with average temperatures between 0.10°C and 3.0°C. The lowest recorded temperature was -12.6°C (December 20, 2008).

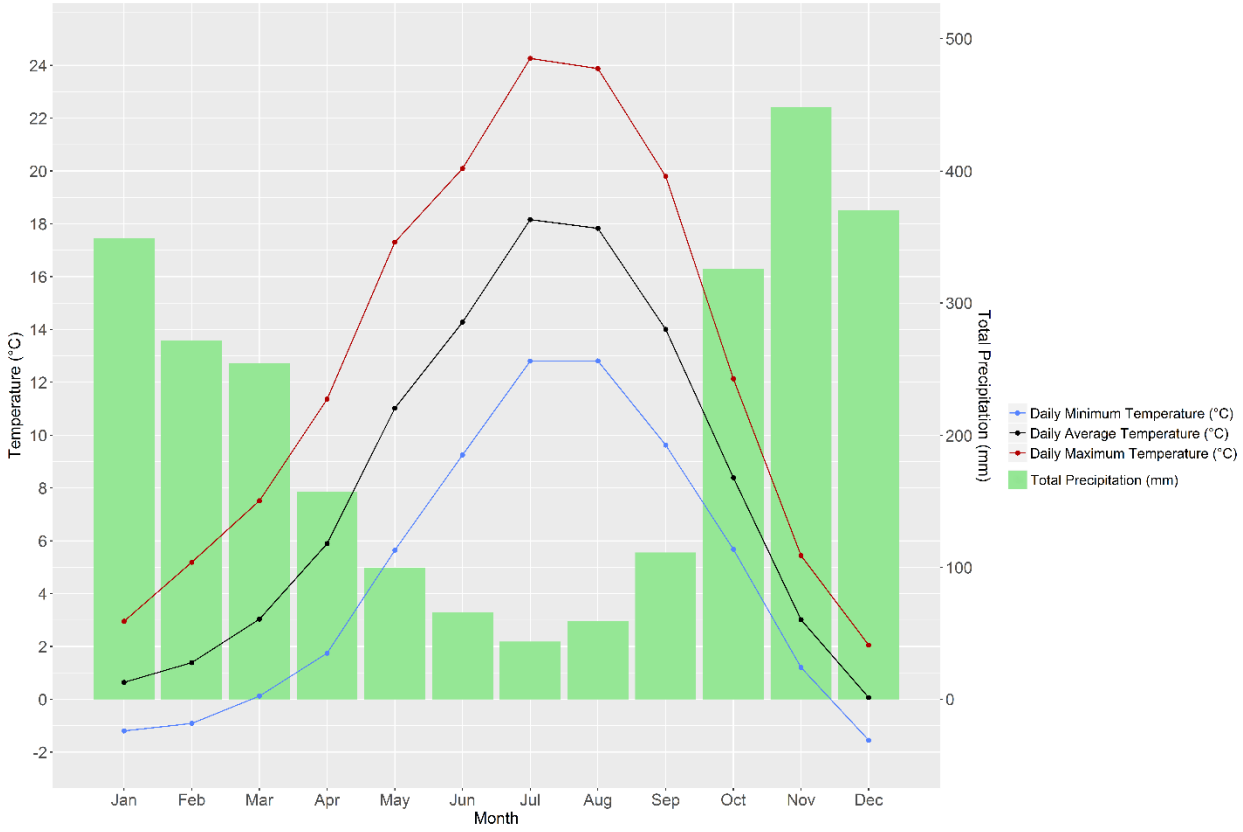

Figure 5: Daily Maximum, Average, Minimum Temperature and Total Precipitation

Monthly precipitation trends are summarized in Table 2 and shown in Figure 5. The months of October through January are the wettest months, with total monthly precipitation ranging from 326 mm to 448 mm. Table 2 also includes average daily rainfall amounts and total days with rainfall (> 2 mm). On average, rainfall (> 2 mm) is observed 109 days a year (or 30 % of the time).

Table 2: Rainfall Trends

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (mm)	349	272	254	157	99	66	44	59	111	326	448	370	2,556
Average Daily Rain (mm)	11.8	7.5	9.3	3.7	1.6	1.1	0.6	1.7	4.3	10.8	18.4	20.7	7.6
Average days with rainfall > 2 mm	12	10	13	8	4	4	2	4	6	14	17	14	109

Average hourly wind speeds for each month are provided in Table 3. Average hourly wind speeds range from 1.9 to 5.9 kilometres per hour (km/h). The maximum recorded wind speed is 34.6 km/h, from east south east on September 25 in 2010. 25% of all the valid wind data is considered calm with wind speeds below 1km/h.

Table 3: Wind Speed at the Myra Creek Station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average 1-hour Wind Speed (km/h)	1.9	2.3	2.8	3.7	4.6	5.3	5.6	4.9	3.7	2.8	2.6	2.4

Overall and seasonal wind-roses are illustrated in Figure 6 and Figure 7, respectively. Wind-roses are a graphic means of depicting joint frequency distributions of wind direction and wind speed data. The orientation of a wind-rose petal indicates the direction the wind blows from, and the length of the petal indicates the frequency of occurrence for the indicated direction. The colours represent wind speed classes as defined in the legend.

Data from the Myra Creek location indicates wind direction at the Project site is strongly influenced by terrain features with winds generally from the West to West-north-west and East to East-south-east throughout the year. Calm conditions (i.e., winds below 1 km/h) vary throughout the year: winter (34.9% calm), autumn (24.1% calm) and spring (24.0% calm) and summer (16.9%).

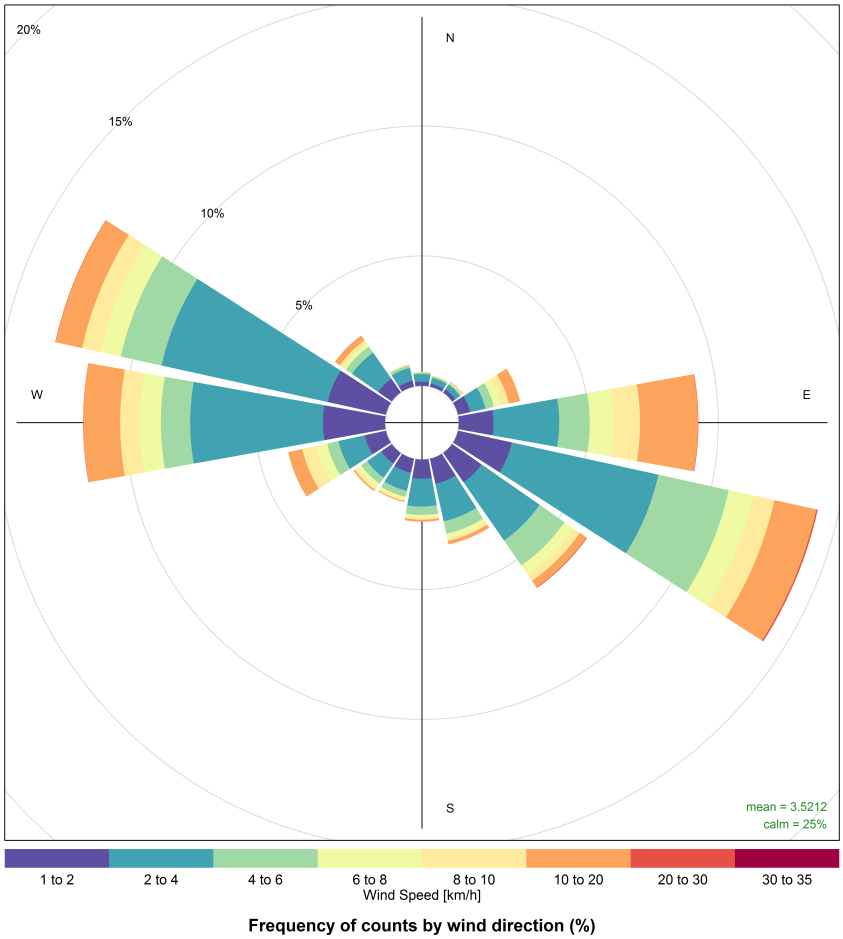

Figure 6: Annual Wind-rose
Note: calm winds are defined as winds with wind speed equal or smaller than 1km/hr

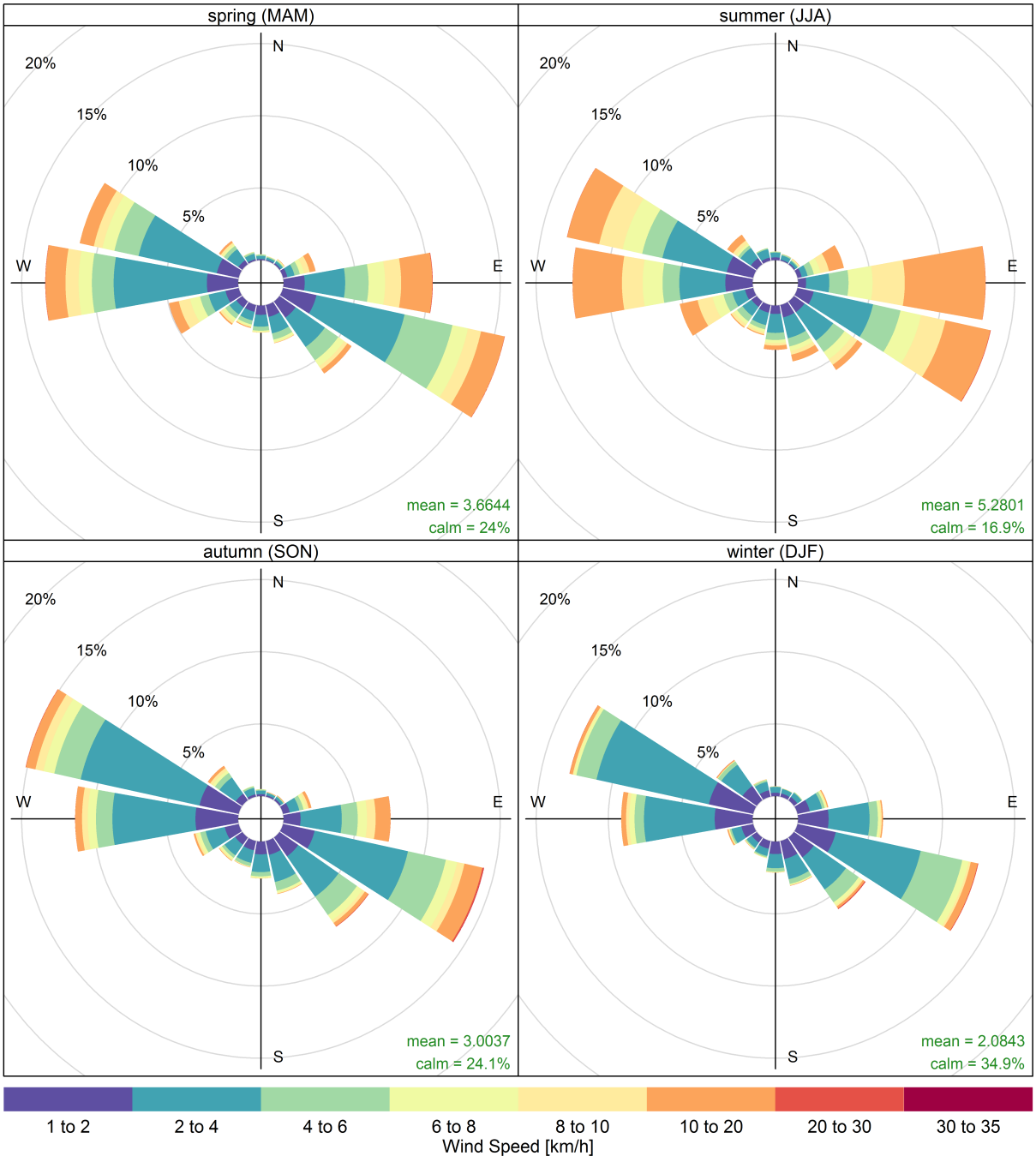

Figure 7: Spring, Summer, Autumn and Winter Wind-roses

3.2 AMBIENT AIR QUALITY

Preliminary review indicates there are no existing ambient air quality monitoring stations near the Project. Nyrstar conducted an on-site dustfall monitoring program in 2014 to monitor local air quality relative to scrubber maintenance activities (Nyrstar 2014). This information was reviewed but is not considered representative of site conditions and for this reason is not presented in this report.

The stations nearest to the site are listed in Table 4. The data were obtained from the BC MOE database which contained ambient monitoring data processed and quality checked by BC MOE for the monitoring period of 1996 to 2016 (BC MOE 2017b). Available data includes ambient concentrations of respirable particulate matter (PM_{10}), inhalable particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). Of the stations listed, data collected at the Ucluelet Amphitrite Point station (about 70 km southwest of Project) is considered most representative of site conditions as it is located in a relatively remote, rural area.

Table 4: Ambient Air Quality Monitoring Stations

Station Name	Location		Distance to Project (km)	Parameters	Data Period
	Latitude (N)	Longitude (W)			
Campbell River Tyee Spit	50.0486	125.2560	58	PM_{10}	1998–2009
				$PM_{2.5}$	2007–2009
Courtney Elementary School	49.6825	124.9960	45	$PM_{2.5}$	2011–2016
Port Alberni Townsite	49.2344	124.8150	65	PM_{10}	1998–2010
Port Alberni Elementary	49.2608	124.8060	65	$PM_{2.5}$	2011–2016
Ucluelet Amphitrite Point	48.9217	125.5410	70	$PM_{2.5}$	2011–2016
				SO_2	2015
				NO_2	2011, 2014–2015

Ambient PM_{10}, $PM_{2.5}$, SO_2 and NO_2 concentrations are summarized in Table 5 in comparison to existing BC Ambient Air Quality Objectives (BC MOE 2017c). In general terms, ambient concentrations are well below applicable objectives for PM_{10}, SO_2 and NO_2.

Ambient $PM_{2.5}$ concentrations are below the applicable objective (25 µg/m^3) at the Campbell River Tyee Spit and the Ucluelet Amphitrite Point, but exceed the applicable objective at the Courtney Elementary School and the Port Alberni Elementary locations. Data collected in Campbell River, Port Alberni and Courtney is representative of small west-coast urban communities whereas data collected in Ucluelet is more remote than the other locations. As such, observed $PM_{2.5}$ concentrations likely are a result of urban activities as well as sea salt particulates from the adjacent Pacific Ocean.

Given its geographic setting, existing meteorological influences, and ambient air quality data trends from nearby monitoring stations, it is reasonable to assume local ambient air quality is good.

Table 5: Ambient PM_{10}, $PM_{2.5}$, SO_2 and NO_2 Concentrations

Station Name	Ambient Concentration (µg/m³)			
	24-hour PM_{10}	**24-hour $PM_{2.5}$**	**1-hour SO_2**	**1-hour NO_2**
Campbell River Tyee Spit	38.7	9.4	-	-
Courtney Elementary School	-	32.5	-	-
Port Alberni Townsite	32.9	-	-	-
Port Alberni Elementary	-	27.1	-	-
Ucluelet Amphitrite Point	-	21.6	2.0	9.0
Ambient Air Quality Objective (BC MOE 2017c)	50	25[1]	196[2]	188[3]

NOTES:

[1] Achievement based on 98th percentile of daily average, averaged over one year.

[2] Achievement based on 99th percentile of 1-hour maximum, averaged over one year.

[3] Achievement based on 98th percentile of daily 1-hour maximum, over one year.

4.0 SENSITIVE RECEPTORS

Sensitive receptors nearest to Project site are listed in Table 6 and associated locations are shown in Figure 1. These receptors include known campsites (14), picnic areas (3) and the Strathcona Lodge (1). The receptors were identified following a review of the applicable SWPP and SPP park maps (BC Parks 2017). The closest sensitive receptor is R18 (Arnica Lake Campground) located about 1.2 km northwest and about 350 m higher in elevation from site. Permanent residents exist only at R16 (Strathcona Lodge), located about 35 km north of the Project.

Table 6: Sensitive Receptors

Receptor ID	Location		Description
	Latitude (N)	Longitude (W)	
R1	49.8304	125.6254	Buttle Lake Campground
R2	49.8395	125.6249	Driftwood Bay Campground
R3	49.7787	125.6215	Titus Marine Campground
R4	49.7734	125.6152	Wolf River Marine Campground
R5	49.7807	125.6014	Lupin Falls Picnic Area
R6	49.6924	125.5487	Auger Point Picnic Area
R7	49.6596	125.5282	Karst Creek Picnic Area
R8	49.6248	125.5345	Ralph River Campground
R9	49.6720	125.5561	Phillips Creek Marine Campground
R10	49.6246	125.6323	Phillips Ridge Trail Campground
R11	49.5194	125.6006	Thelwood Valley Campground
R12	49.4880	125.5891	Belwood River Campground
R13	49.4555	125.5311	Della Falls Campground
R14	49.4455	125.5060	Della Falls Trail Campground
R15	49.4365	125.4573	Della Falls Trail Campground #2
R16	49.8919	125.6524	Strathcona Lodge
R17	49.5471	125.6415	Tennent Lake Campground
R18	49.5931	125.6172	Arnica Lake Campground

5.0 AIR DISCHARGE AND TREATMENT

5.1 POLLUTION CONTROL WORKS

Nyrstar will apply specific best management practices (BMPs) to air discharge points to reduce air emissions. Table 7 identifies each point source authorized to discharge to air in permit PA-2408 (BC MELP 1997). The table lists point sources according to a source ID listed in PA-2408 and includes a description of the associated pollution control equipment. The manufacturer specifications for the wet scrubber, baghouse (e.g., fabric filter) and ventilation fans are provided in Appendix B. New pollution control equipment will be installed at the assay/environmental laboratory (wet scrubber and baghouse). New exhaust fans will be installed at the mill (reagent mix and storage facility). The old diesel power generators will be replaced with new ones. However, given that the engineering equipment make and model are currently not available, generic engineering information for the diesel generators is used to estimate associated air emissions.

Table 7: Point Source Pollution Control Works

PA-2408 Source ID	Description	Type of Pollution Control Equipment	Collection Efficiency [1] (%)
01	No. 1 Crusher	• Wet Scrubber and crusher permitted under PA-2408 no longer in use. • Enclosure and conveyor will be used to transfer run of mine material to a stockpile.	• Not applicable as the wet scrubber is not in use.
08 (a-b)	Assay/ Environmental Laboratory	• New equipment: Wet Scrubber (Profile Systems, Limited #40). • Baghouse (4,800 cfm, AAF ArrestAll Dust Collector or equivalent) authorized under PA-2408 will be replaced with an equivalent air pollution control device.	• Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm. • Baghouse (fabric filter) – 99.5% for particle size 6 to 10 µm and 2.5 to 6 µm, 99% for 0 to 2.5 µm.
09	Coarse Ore Bin	• Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 56) authorized under PA-2408.	• Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
10	Crushing/ Screening Plant	• Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 102) authorized under PA-2408.	• Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.

PA-2408 Source ID	Description	Type of Pollution Control Equipment	Collection Efficiency [1] (%)
11	Transfer House	• Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 36) authorized under PA-2408.	• Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
12	Fine Ore Bin	• Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 60) authorized under PA-2408.	• Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
13 (a-i)	Reagent Mix and Storage Facility	• New equipment: 1 fume exhaust fan, 1 MBS fan, 1 dump station exhaust fan, 2 fume exhaust fans, 4 wall exhaust fans.	• There is no air pollution control equipment for this source of emissions.
14 (a-b)	Two Diesel Powered Generators	• New equipment: Replacement of equipment permitted under PA-2408 with two diesel generators rated at 1,600 kW. • Low-sulphur diesel.	• There is no air pollution control equipment for the two new diesel generators.
15 (a-e)	Five Emergency Diesel Powered Generators	• New Equipment: Replacement of equipment permitted under PA-2408 with three diesel generators rated at 2,000 kW and two diesel generators rated at 1,200 kW. • Low-sulphur diesel.	• There is no air pollution control equipment for the emergency diesel generators.

NOTES:

[1] Collection efficiency for the baghouse is from US EPA 1995b. Collection efficiency for the wet scrubbers is from Table 3.2 in Rosemont Copper Company 2011.

5.2 POINT-SOURCE DISCHARGE DETAILS

Table 8 summarizes the point source air discharge details. The table includes:

- Source identification number (as per Permit PA-2408)
- Source description (as per Permit PA-2408 or amended as required)
- Location (latitude and longitude in units of degrees to the fourth decimal place)
- Discharge flow rate (in units of standard cubic metres per min or Sm^3/min)
- Operating period (hours per day, days per week)
- Changes to emissions permitted under PA-2408

The point source locations are shown in Figure 2 and Figure 3. The Project will operate 24 hours a day, seven days a week (including holidays). As such emissions associated with point-sources will be continuous with exception of:

- Crushing and screening, transfer house, and the assay/environmental lab operations will occur 12 hours a day and 7 days a week
- Emergency diesel generators will be used in the event of a power outage due to loss of the on-site hydroelectric generation capacity.

Table 9 and Table 10 summarize air emission discharge concentrations (in units of milligrams per cubic metre or mg/m^3) and emissions rates (in units of kilograms per hour or kg/h) for:

- Total Particulate matter (TPM)
- Inhalable PM (PM less than 10 µm in diameter, PM_{10},)
- Respirable PM (PM less than 2.5 µm in diameter, $PM_{2.5}$)
- Sulphur dioxide (SO_2)
- Nitrogen dioxide (NO_2).

The PM emissions from the assay/environmental laboratory's wet scrubber and baghouse were calculated using emission factors from the United States Environmental Protection Agency (US EPA) AP-42 Compilation of Air Pollutant Emission Factors (US EPA 1995a).

Section 11.24 of the AP-42 document provides the emissions factors for metallic minerals processing. Section 11.24 provides two sets of emissions factors, one set for low-moisture ore and one set for high moisture ore. The emissions factors are higher for low-moisture ore. The moisture content of the Myra Falls ore is unknown; therefore, it was conservatively assumed that Myra Falls ore was low-moisture. The PM emission factor provided for primary crushing was used to calculate emissions from the coarse ore bin. The PM emissions factor provided for secondary crushing was used to calculate emissions from the crushing/screening plant. The PM emission factor provided for tertiary crushing was used to calculate emissions from the fine ore bin and the assay/environmental laboratory. The PM emission factor provided for material handling and transfer was used to calculate emissions from the transfer house. The PM emissions factors in Section 11.24 are for uncontrolled sources i.e., they do not account for a reduction of emissions from use of a pollution control system such as a wet scrubber or a baghouse (fabric filter).

To estimate the uncontrolled PM emission rates the PM emission factors provided in Section 11.24 were multiplied by the material throughput (tonnes of material processed per hour). The material throughput for the various locations in the Myra Falls minerals processing were taken from the historical process flow drawings in Appendix B Engineering Specifications. The material throughput for the assay/environmental lab was unknow so it was conservatively estimated to be 0.5% of the material throughput for the coarse ore bin (273 tonnes per hour).

The controlled PM emissions from the baghouse were calculated based on a particle size distribution given in AP-42 Appendix B.2 (Category 3, Process: Mechanically Generated, Material: Aggregate, Unprocessed Ores) and the typical control efficiencies provided for a baghouse (fabric filter – med temperature). The controlled PM emissions from the various wet scrubbers were calculated based on a on a particle size distribution given in AP-42 Appendix B.2 (Category 3, Process: Mechanically Generated, Material: Aggregate, Unprocessed Ores) and the typical control efficiencies provided for a wet scrubber in Table 3.2 in a permit application for the Rosemont Copper Project in Arizona (Rosemont Copper Company 2011). The wet scrubbers used for the Rosemont Copper Project are the same make and model number that are proposed for the Myra Falls Project (e.g., Ducon Dynamic UW-4 Model IV).

The TPM, PM_{10}, $PM_{2.5}$ and NO_2 emissions calculated for the diesel generators were based upon information supplied by Nyrstar (pers. comm. 2017) for a typical 2001 Caterpillar 3516B diesel generator rated at 2,000 kW and operating at 100% load. No emissions data was available for a 1,600 kW diesel generator, therefore, the emissions calculated for the 2,000 kW generator were multiplied by a factor of 0.80 (e.g. 1,600/2,000). The Project requires three emergency diesel generators rated at 2,000 kW and two rated at 1,200 kW. No air emission data was available for a diesel generator rated at 1,200 kW. For calculating the air emissions from the 1,200 kW generator, the emissions from the 2,000 kW generator were multiplied by 0.67 (e.g., 1,200/2,000).

The SO_2 emissions from the diesel generators were calculated from the fuel consumption for a Caterpillar 3516B 2,000 kW generator (510 l/h) and the Sulphur in Diesel Fuel Regulation that limits the sulphur content of diesel fuel to 15 mg/kg (Ministry of Justice 2017). The SO_2 emissions from the 1,600 kW and 1,200 kW generators were linearly scaled from the SO_2 emissions calculated for the 2,000 kW generator. The calculation also considered the density of diesel fuel (0.8245 g/mL at 15°C and 101.325 kPa, EC 2006).

Table 8 indicates that the relative change, with respect to flow rate, for the new emission sources is lower than Permit PA-2408 for most of the sources. There are two exceptions. Significantly more (1,249%) exhaust ventilation will be required for the reagent mix and storage facility, although there are no air contaminants emitted through these systems. An additional 7% of flow is required for the coarse ore bin.

Table 9 summarizes the emission concentrations (mg/m^3) calculated for the new permit application. Permit PA-2408 did not specify an TPM emission concentration or rate for all the sources. The TPM emission concentrations calculated for the wet scrubbers at the coarse ore bin, crushing/screening plant, transfer house and fine ore bin are lower than Permit-2408. The rate of reduction for the TPM concentrations varies between 7.4% and 92%.

Table 10 summarizes the emission rates (kg/h) calculated for the new permit application. The TPM emission rate calculated for the wet scrubbers at the coarse ore bin, crushing/screening plant, transfer house and fine ore bin are lower than Permit-2408. The rate of reduction for the TPM emission rates varies between 18% and 93%.

Table 8: Point Source Air Discharge Details

Source ID	Description	Location		Flow Rate (Sm^3/min)[1]		Operations (Hours/Days per week)		Change Relative (% change) to PA-2408
		Latitude (N)	Longitude (W)	PA-2408	Amendment	PA-2408	Amendment	
01	No. 1 Crusher	n/a	n/a	198	Decommissioned	24/7	12/7	Not applicable because the crusher building will only be used for transferring ore from underground to the mobile crusher.
08 (a-b)	Assay/Environmental Laboratory	49.5752	125.6085	566	113 (wet-scrubber)	Intermittent	12/7	Decrease of 56%
		49.5750	125.6073		136 (baghouse)		12/7	
09	Coarse Ore Bin	49.5751	125.6070	85	91	24/7	24/7	Increase of 7%
10	Crushing/Screening Plant	49.5760	125.6072	849	792	24/7	12/7	Decrease of 7%
11	Transfer House	49.5755	125.6072	85	82	24/7	12/7	Decrease of 3%
12	Fine Ore Bin	49.5759	125.6075	340	302	24/7	24/7	Decrease of 11%
13 (a-i)	Reagent Mix and Storage Facility	49.5750	125.6073	57	769	24/7	24/7	Increase of 1,249%
14 (a-b)	Two Diesel Powered Generators	49.5709	125.5942	333	240	24/7	24/7	Decrease of 28%
		49.5709	125.5942					
15 (a-e)	Five Emergency Diesel Powered Generators	49.5710	125.5942	1,081	631	Intermittent (backup)	Intermittent (backup)	Decrease of 42%
		49.5710	125.5942					
		49.5711	125.5942					
		49.5712	125.5942					
		49.5713	125.5942					

Table 9: Maximum Point Source Concentrations

Source ID	PA-2408 Concentration (mg/m^3) [1]	Amended Concentration (mg/m^3) [1]					Relative Change for TPM Compared to PA-2408 (%)
	TPM	TPM	PM_{10}	$PM_{2.5}$	SO_2	NO_2	
01	230	n/a	n/a	n/a	n/a	n/a	Not applicable because this No. 1 crusher will no longer be used.
08a	[2]	0.35	0.35	0.31	n/a	n/a	Not applicable because PA-2408 did not specify a concentration for the emissions from the assay/environmental lab
08b	[2]	0.77	0.77	0.35	n/a	n/a	Not applicable because PA-2408 did not specify a concentration for the emissions from the assay/environmental lab
09	230	87.6	86.6	76.9	n/a	n/a	Reduction of 62%. There are no SO_2 or NO_2 emissions from the wet scrubber at the coarse ore bin
10	230	17.4	17.3	15.4	n/a	n/a	Reduction of 92%. There are no SO_2 or NO_2 emissions from the wet scrubber at the crushing/screening plant
11	230	25.6	25.4	22.6	n/a	n/a	Reduction of 89%. There are no SO_2 or NO_2 emissions from the wet scrubber at the transfer house (now the conveyor 6 to 7 transfer tower)
12	230	213	212	188	n/a	n/a	Reduction of 7.4%. There are no SO_2 or NO_2 emissions from the wet scrubber at the fine ore bin
13	[2]	n/a	n/a	n/a	n/a	n/a	The exhaust fans for the reagent mix and storage facility do not discharge air contaminants to the atmosphere
14	[2]	41.3	40.5	38.9	1.4	3,181	Not applicable because PA-2408 did not specify a concentration for diesel generator emissions
15	[2]	41.3	40.5	38.9	1.4	3,181	Not applicable because PA-2408 did not specify a concentration for diesel generator emissions

NOTES:

n/a = not applicable because this source will no longer be functioning or this type of air emission is not emitted by the source.
[1] Permit PA-2408 discharge limits for these sources are set to 230 mg/m^3.
[2] Characteristics of discharge are permitted to be "equivalent to, or better than, typical emissions from" source of discharge

Table 10: Maximum Point Source Emission Rates

Source ID	PA-2408 Emission Rate (kg/h) [1]	Amended Emission Rate (kg/h) [1]					Relative Change for TPM Compared to PA-2408 (%)
	TPM	TPM	PM_{10}	$PM_{2.5}$	SO_2	NO_2	
01	2.73	n/a	n/a	n/a	n/a	n/a	Not applicable because Crusher No. 1 will no longer be used.
08 (wet scrubber)	Not available because no TPM concentration was specified	0.0024	0.0024	0.0021	n/a	n/a	There are no SO_2 or NO_2 emissions from the assay/environmental lab's wet scrubber.
08 (baghouse)	Not available because no TPM concentration was specified	0.0063	0.0063	0.0029	n/a	n/a	There are no SO_2 or NO_2 emissions from the assay/environmental lab's baghouse.
09	1.17	0.476	0.471	0.418	n/a	n/a	Reduction of 59%. There are no SO_2 or NO_2 emissions from the coarse ore bin's wet scrubber.
10	11.7	0.827	0.822	0.730	n/a	n/a	Reduction of 93%. There are no SO_2 or NO_2 emissions from the crushing/screening plant's wet scrubber.
11	1.17	0.127	0.126	0.112	n/a	n/a	Reduction of 89%. There are no SO_2 or NO_2 emissions from the transfer house (conveyor 6 to 7 transfer tower) wet scrubber.
12	4.69	3.86	3.84	3.41	n/a	n/a	Reduction of 18%. There are no SO_2 or NO_2 emissions from the fine ore bin's wet scrubber.
13	Not available because no TPM concentration was specified	n/a	n/a	n/a	n/a	n/a	There are no TPM, PM_{10}, $PM_{2.5}$ SO_2 or NO_2 emissions from the reagent mix and storage facility's exhaust fans.
14	Not available because no TPM concentration was specified	0.60	0.58	0.56	0.020	45.9	n/a
15	Not available because no TPM concentration was specified	1.56	1.53	1.47	0.053	120	n/a

NOTE:
n/a = not applicable because the source does not emit this type of air emission.

5.3 FUGITIVE DUST EMISSION DISCHARGE DETAILS

Project activities will result in fugitive dust emissions. Areas of disturbance associated with the Project are summarized in Table 11. The table identifies:

- Area of disturbance and associated surface area (in units of squared kilometres, or km^2)
- Natures of sources of fugitive dust emissions (i.e., vehicle traffic, materials handling, wind erosion)
- Applicable control works and associated dust mitigation efficiencies

Control works rely on the following best management practices (BMPs) and mitigation measures:

- Road dust will be suppressed using water and dust suppression conditioner
- Buildup dirt will be swept from roadways and paved areas
- Conveyors will be covered
- Stockpile dust will be suppressed using water or tarp covering material
- Arid surfaces will be managed through soil compaction and concurrent re-vegetation
- Material drop height will be kept as low as practical

Additional details on BMPs and mitigation measures adopted by Nyrstar on site are provided in the Air Quality Management Plan (AQMP, Appendix A).

The Project is in an area that has significant precipitation throughout the year (see Section 3.0). The total annual precipitation is 2,556 mm and typically a total of 109 days are reported to experience rainfall greater than 2 mm (Table 2). As such, natural mitigation through rainfall is a significant factor in controlling fugitive dust emissions from the various Project activities.

Table 11: Areas of Disturbance Subject to Fugitive Dust Emissions and Control Works Effectiveness

Source ID	Area	Surface Area (km^2)	Nature of Source of Fugitive Emissions	Control Works	Control Works Efficiency [1]
FS1	Unpaved roads in Myra Valley	0.01	• Vehicle traffic along unpaved roads (6–8 m wide) in Myra Valley including Lynx ROM and excluding waste dumps • Wind Erosion	• Road dust suppression using water and road dust conditioner • Ground compaction	75% for road watering 84% for use of dust suppressant
FS2	Mill Area (including multiphase stockpile and mobile crusher)	0.11	• Vehicle traffic • Materials handling • Wind erosion	• Road dust suppression using water and road dust conditioner • Sweeping paved surfaces • Conveyor covers • Stockpile dust suppressed using water or cover material • Soil compaction • Drop height kept low • Mobile crusher – fogging or water spraying	75% for road watering 84% for use of dust suppressant 4 to 26% for sweeping paved surfaces 75% for crusher fogging or water spraying
FS3	Waste Dumps 1, 2, 3, 4, 5	0.39	• Material handling • Vehicle traffic • Wind erosion	• Road dust suppression using water and road dust conditioner	75% for road watering 84% for use of dust suppressant
FS4	Partially vegetated areas	0.15	• Wind erosion	• Re-vegetation • Soil compaction	90% for re-vegetation
FS5	Lynx Tailings Dam	0.10	• Wind erosion	• Soil compaction	90% if the compacted area is re-vegetated
FS6	Old Tailings Dam Facility	0.43	• Wind erosion	• Soil compaction	90% if the compacted area is re-vegetated
FS7	Jim Mitchell till borrow - not active	0.07	• Wind erosion	• Soil compaction	90% if the compacted area is re-vegetated

Source ID	Area	Surface Area (km^2)	Nature of Source of Fugitive Emissions	Control Works	Control Works Efficiency [1]
FS8	Thelwood Valley road areas	0.01	• Vehicle traffic • Wind erosion	• Road dust suppression using water and road dust conditioner	75% for road watering 84% for use of dust suppressant
FS9	HW/Warehouse yard, hard-packed and paved laydown	0.06	• Vehicle traffic	• Road dust suppression using water and road dust conditioner • Sweeping paved surfaces • Soil compaction	75% for road watering 4 to 26% for sweep paved surface 90% if the compacted area is re-vegetated
FS10	Rock Quarry - active in short periods (spring)	0.05	• Vehicle traffic • Materials handling • Wind erosion	• Road dust suppression using water and road dust conditioner	75% for road watering
FS11	CRAB till borrow - active in short periods	0.11	• Vehicle traffic, materials handling, wind erosion	• Road dust suppression using water and road dust conditioner	75% for road watering

NOTES:

[1] The control works efficiency for application of water on unpaved roads is from Section 13.2.2 Unpaved Roads in AP-42 (US EPA 1995a). The remaining fugitive dust control efficiencies are from the WRAP Fugitive Dust handbook (Countess Environmental 2006).

6.0 IMPACT ASSESSMENT

The emissions from the Myra Falls mining operations will be reduced through the application of design pollution control works (e.g., wet scrubbers or a baghouse) at specific air emissions sources, best management practices (BMPs) and the application of fugitive dust mitigations that have proven effective at other mine projects. Hence, the air emissions from the proposed point source and fugitive dust discharges will be adequately controlled and not adversely affect public health and the environment.

7.0 MONITORING PLANS

Air quality will be monitored to confirm compliance with permit requirements and assess the effectiveness of adopted BMPs and mitigation measures. Proposed monitoring plans are summarized in the AQMP (Appendix A). Specifically, Nyrstar will:

- Develop and implement a monitoring program in compliance with regulatory permit requirements for the Project
- Conduct monitoring as outlined in the permits required for the Project and if necessary, revise mitigation measures to achieve conformance with approval conditions
- Develop an inspection process to evaluate the use and effectiveness of the and other component plans
- Commit to reporting the findings to interested parties.

The implemented monitoring program will validate adopted BMPs and assist in determining the need for additional mitigation if implemented measures are not effective at reducing fugitive dust emissions.

Nyrstar will implement air quality monitoring by conducting the following:

- Visual inspections (daily or as needed on seasonally)
- Design inspections (regular maintenance checks and pressure drop checks)
- Ambient monitoring (meteorology and air quality)

8.0 MANAGEMENT PLANS

The AQMP was developed as a requirement of the IRT issued by BC MOE (BC MOE 2017) and is provided in Appendix A. The AQMP focuses on management of particulate matter air emissions from discrete sources (here in referred to as point sources) and fugitive sources associated with Project activities. AQMP content includes recommendations of the Draft Fugitive Dust Management Plan Guidance issued by the Ministry of Energy and Mines and the Ministry of Environment in April 2017 (MEM 2017).

9.0 PROFESSIONAL QUALIFICATIONS

This technical assessment report was prepared by undersigned qualified professionals. Brief bios of key personnel preparing this technical report are provided.

Ms. Magda Kingsley, M.Sc., B.Sc., is an atmospheric scientist with Stantec Consulting Ltd. and holds an honors bachelor's degree in Chemical Physics and a Master's degree, specializing in atmospheric chemistry. She has worked in the atmospheric field for over 12 years. Ms. Kingsley specializes in air quality environmental assessments, permitting and greenhouse gas management. She has experience with plume dispersion model simulations (AERMOD, ISCPRIME) assessing air emission effects from a range of industrial sectors. In addition, Ms. Kingsley has experience characterizing ambient air quality conditions and developing emissions inventories, for port facilities, railway, oil and gas, waste incineration, and mining activities. While with Stantec, Ms. Kingsley participated in numerous environmental assessments, permit applications, public consultation, and has taken a discipline lead role in the atmospheric environment components. She also oversees emergency preparedness and response for situations affecting the atmospheric environment.

Mr. Dan Jarratt is a professional engineer and has 26 years of environmental consulting experience, most which has focused on environmental baseline studies and impact/effects assessments for proposed hydroelectric projects, mines (open pit and underground), natural gas transmission pipelines and power transmission lines. He has managed the air quality, climate, noise and meteorology studies for numerous recent mine Environmental Impact Assessment projects, including recently proposed developments such as the Springbank Off-stream Reservoir Project Environmental Impact Assessment (EIA) for Alberta Transportation. Dan has also worked on many EIAs for proposed mine projects in British Columbia. He recently assisted with the air quality and climate assessments for the proposed Sukunka Coal Mine near Chetwynd, British Columbia for Glencore and the Ajax Copper-Gold Mine near Kamloops, British Columbia for KGHM Ajax Mining Inc. He was the discipline lead for the atmospheric assessments for the proposed Prince Rupert Gas Transmission Project in British Columbia. He recently was the atmospheric discipline lead for the Medicine Hat Compressor Station Project Section 58 Environmental and Socio-Economic Assessment report prepared for the National Energy Board (NEB) on behalf of Nova Gas Transmission Ltd.

10.0 CLOSURE

This technical report was prepared in support of the Nyrstar Myra Falls Ltd. Waste Discharge Permit amendment (application authorization #2408 and application tracking #363131). Should you have any questions or require additional information, please contact Magda Kingsley at 250-216-6515 or email Magdalena.Kingsley@stantec.com.

Regards,

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AIR QUALITY MANAGEMENT PLAN

Appendix A AIR QUALITY MANAGEMENT PLAN

Myra Falls Waste Discharge Permit Amendment – Air Quality Management Plan

Authorization No.: 2408

Prepared for:
Nyrstar Myra Falls Ltd.
P.O. Box 8000
Campbell River, BC V9W 5E2

Prepared by:
Stantec Consulting Ltd.
11-2042 Mills Rd.
Sidney, BC V8L 5X4

Project No.: 123220917

August 31, 2017

Table of Contents

1.0 INTRODUCTION 1

2.0 REGULATORY CONTEXT 1

3.0 SOURCES OF AIR EMISSIONS 2

4.0 BEST MANAGEMENT PRACTICES 8
4.1 WET SCRUBBERS 12
4.2 BAGHOUSE 12
4.3 EXHAUST FANS 13
4.4 ROAD USE 13
4.5 DISTURBANCE OF ARID SURFACES AND MATERIAL HANDLING 14
4.6 POWER GENERATION 14

5.0 MONITORING AND REPORTING 15
5.1 MONITORING 15
5.1.1 Visual Inspections 16
5.1.2 Design Inspections 16
5.1.3 Ambient Monitoring 16
5.1.4 Trigger Action Response Plan 19
5.2 REPORTING 22

6.0 PLAN IMPLEMENTATION 23
6.1 ROLES AND RESPONSIBILITIES 23
6.2 TRAINING 23
6.3 RECORD KEEPING 23

7.0 CLOSURE 24

8.0 REFERENCES 25

LIST OF TABLES

Table 1: Point Sources of Air Emissions 3
Table 2: Fugitive Sources of Air Emissions 4
Table 3: Best Management Practices for Point Sources of Air Emissions 9
Table 4: Best Management Practices for Fugitive Dust 10
Table 5: Triggers for Mitigative Action 20
Table 6: Air Quality Monitoring and Reporting Frequency 22

LIST OF FIGURES

Figure 1:Project Site Plan 6
Figure 2:Project Mill Area 7

1.0 INTRODUCTION

This Air Quality Management Plan (AQMP) was prepared in support of the Nyrstar Myra Falls Ltd. (Nyrstar) Waste Discharge Permit Amendment (WDPA) Application # 2408 (Application). Nyrstar is submitting the Application to the British Columbia Ministry of Environment (BC MOE) to amend the discharge of air emissions from its existing activities at the Myra Falls mine (the Project) located approximately 50 kilometres southwest of Campbell River, BC. Sources of air emissions include the mine infrastructure associated with ore handling and processing and areas with disturbed surface material.

The AQMP was developed in response to the Project-specific Information Requirements Table (IRT) for Air Emissions finalized by BC MOE on August 15, 2017 (MOE 2017). The AQMP focuses on management of particulate matter air emissions from discrete sources (herein referred to as point sources) and fugitive sources associated with Project activities. The AQMP includes recommendations made in the Draft Fugitive Dust Management Plan Guidance issued by the Ministry of Energy and Mines and the Ministry of Environment in April 2017 (MEM 2017).

This report discusses the following: regulatory context, summary of sources of air emissions, site-specific best management practices and mitigation measures, monitoring, reporting, and administrative AQMP implementation details. Project-specific facility details including site activities, infrastructure and process flow diagram are provided in the Myra Falls Waste Discharge Permit Amendment – Technical Report (Stantec 2017).

2.0 REGULATORY CONTEXT

The AQMP was developed based on the following regulatory documents:

- Project-specific Information Requirements Table for Air Emissions (BC MOE 2017)
- Draft Ministry of Energy and Mines & Ministry of Environment Fugitive Dust Management Plan Guidance (MEM 2017)
- Pollution Control Objectives for the Mining, Smelting and Related Industries (BC MOE 1979)
- Guidance Document on Continuous Improvement (CI) and Keeping Clean Areas Clean (KCAC) (CCME 2007)
- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016a)
- British Columbia Ambient Air Quality Objectives (BC AAQOs, BC MOE 2016b).

3.0 SOURCES OF AIR EMISSIONS

Point and fugitive sources of air emissions from the Project are summarized in Table 1 and Table 2, respectively. Each summary table also includes:

- The activities with potential to generate air emissions (e.g., vehicle traffic, material handling) at each location
- Type of dust generating material (e.g., waste rock, fugitive road dust)
- Factors influencing generation of dust (e.g., wind conditions, operations)

The Project will operate 24 hours a day, seven days a week (including holidays). Exceptions to this include crushing and ore transfer activities at the mill which will be restricted to 12 hours per day and use of emergency diesel generators in the event of a hydroelectric power outage. Operation of the assay/environmental laboratory will be 12 hours per day.

Locations of key mine features including point sources of air emissions are shown in Figure 1 and Figure 2. Additional air emissions discharge details (i.e., flow rates, discharge rates, potential effects) are provided in the Myra Falls Waste Discharge Permit Amendment – Technical Report (Stantec 2017).

Table 1: Point Sources of Air Emissions

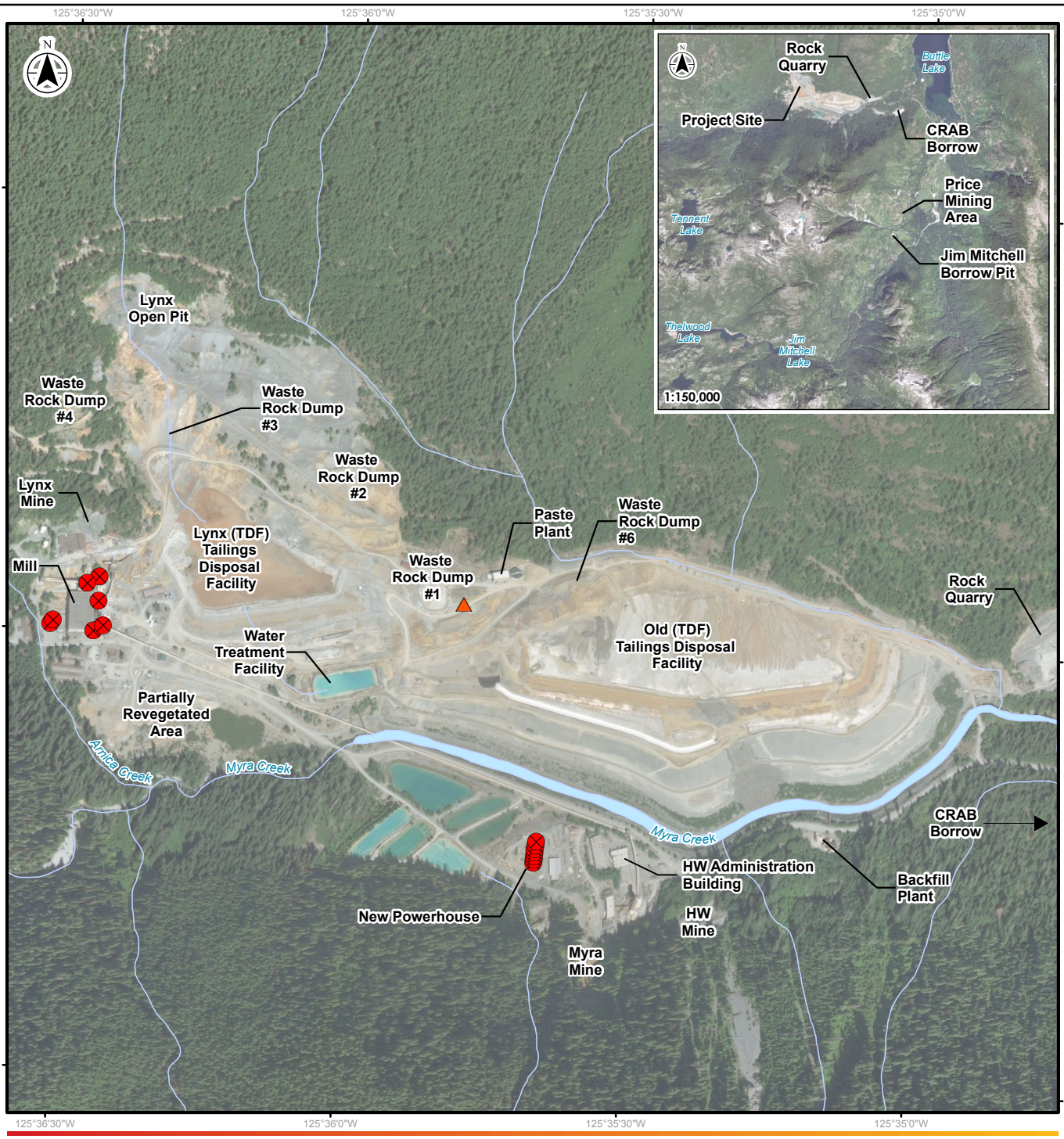
Source ID	Source Description	Dust-Generating Activity	Dust-Generating Material	Generation Conditions for Amendment
01	No. 1 Crusher	Material handling	Run of mine (ROM) ore	Operations (12/7). The crusher building will only be used for transferring ore from underground to the mobile crusher.
08	Assay/Environmental Laboratory	Small sample crushing Laboratory analysis (assay)	ROM ore samples	Operations (12/7)
09	Coarse Ore Bin	Material handling	ROM ore	Operations (24/7)
10	Crushing/Screening Plant	Crushing Material handling	ROM ore	Operations (12/7)
11	Transfer House	Material handling	ROM ore	Operations (12/7)
12	Fine Ore Bin	Material handling	ROM ore	Operations (24/7)
13	Reagent Mix and Storage Facility	Bulk storage	Not applicable	Operations (24/7)
14	Three Diesel Powered Generators	Diesel fuel combustion	Not applicable	Operations (24/7)
15	Five Emergency Diesel Powered Generators (Intermittent operation)	Diesel fuel combustion	Not applicable	Intermittent, emergency backup power generation

Table 2: Fugitive Sources of Air Emissions

Source ID	Description	Potential Dust-Generating Activity	Dust-Generating Material	Generation Conditions
FS1	Unpaved roads in Myra Valley	Vehicle traffic along unpaved roads in Myra Valley including Lynx ROM and excluding waste dumps Wind Erosion	Road surface material,	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed
FS2	Mill Area (including multiphase stockpile and mobile crusher)	Vehicle traffic Material handling and transfer Wind erosion	ROM ore, road surface material	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed. Stockpile silt and moisture content, mean wind speed, frequency of disturbance. Mobile crusher operations.
FS3	Waste Dumps 2, 3 and 4	Material handling and transfer Vehicle traffic Wind erosion	Road surface material, aggregate	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed. Waste dump surface silt and moisture content, mean wind speed, frequency of disturbance.
FS4	Partially vegetated areas	Wind erosion	Disturbed surficial materials	Surface silt and moisture content, mean wind speed, frequency of disturbance.
FS5	Lynx Tailings Dam	Wind erosion Material handling and transfer	Fine-grained surface materials	Surface silt and moisture content, mean wind speed, frequency of disturbance.
FS6	Old Tailings Dam Facility	Wind erosion	Fine-grained surface materials	Surface silt and moisture content, mean wind speed, frequency of disturbance.
FS7	Jim Mitchell till borrow - not active	Wind erosion	Surface material, aggregate	Surface silt and moisture content, mean wind speed, frequency of disturbance.
FS8	Thelwood Valley road areas	Vehicle traffic Wind erosion	Road surface material, aggregate	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed.
FS9	HW/Warehouse yard, hard-packed and paved laydown	Vehicle traffic	Road surface material, aggregate	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed.

Sources of Air Emissions
August 31, 2017

Source ID	Description	Potential Dust-Generating Activity	Dust-Generating Material	Generation Conditions
FS10	Rock Quarry - active for short periods	Vehicle traffic Material handling and transfer Wind erosion	Road surface material, aggregate	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed. Quarry surface silt and moisture content, mean wind speed, frequency of disturbance.
FS11	Core Rack Area Borrow (CRAB) till borrow - active for short periods	Vehicle traffic Material handling and transfer Wind erosion	Road surface material, aggregate	Road surface material silt content and moisture, traffic volume, mean vehicle weight, mean vehicle speed, wind speed. Borrow area surface silt and moisture content, mean wind speed, frequency of disturbance.



Watercourse
Waterbody
Strathcona - Westmin Park
Air Emission Location
Myra Creek Weather Station

0 100 200 300 400 500 m
1:12,500 (at original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Source: DataBC, Government of British Columbia; Natural Resources Canada; ESRI World Imagery
3. This document is provided by Nyrstar Myra Falls for use by the intended recipient only.
This information is confidential and proprietary to Nyrstar Myra Falls and is not to be provided to any other recipient without the written consent of Nyrstar Myra Falls.

Stantec

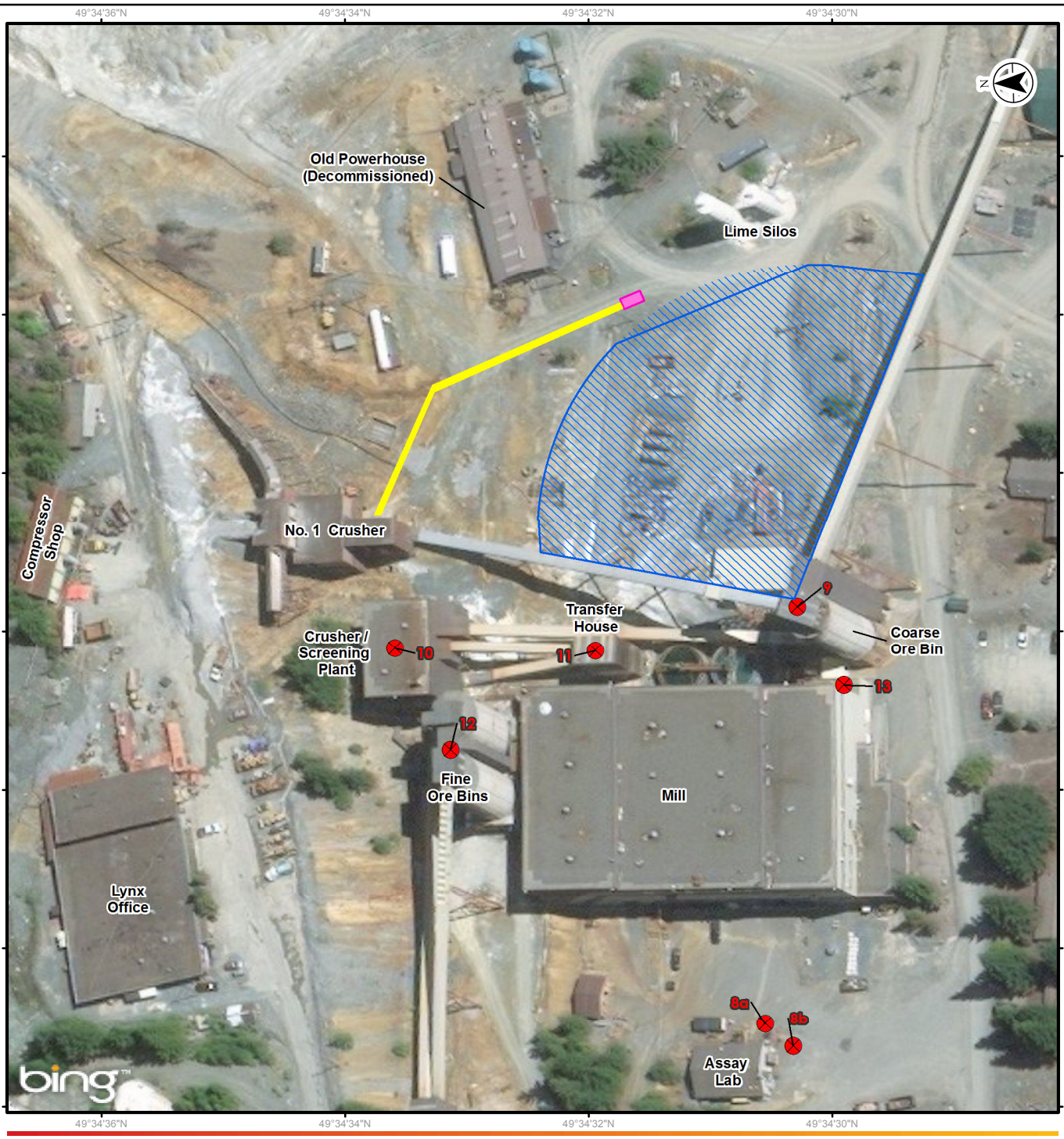
Project Location
NTS Grid: 092F12
BCGS Grid: 92F.053
UTM: 10 E312718 N5494600

Project Number 123220917
Prepared by SSUN 20170802
Discipline Review MKINGSLEY 20170802
GIS Review RCOATTA 20170822

Client/Project
Nyrstar Myra Falls
Air Quality Management Plan

Figure No. 1
Page No. 1 of 1

Title
Project Site Plan



Air Emission Location

Future Infrastructure

- Multi-phase Stockpile
- Mobile Crusher
- Conveyor

0 10 20 30 40 50 m

1:1,500 (at original document size of 8.5x11)

Stantec

Project Location
NTS Grid: 092F12
BCGS Grid: 92F.053
UTM: 10 E312718 N5494600

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GIS Review RCOATTA 20170822

Client/Project
Nyrstar Myra Falls
Air Quality Management Plan

Figure No. 2
Page No. 1 of 1

Title
Project Mill Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Source: DataBC, Government of British Columbia; Natural Resources Canada; BING Imagery
3. This document is provided by Nyrstar Myra Falls for use by the intended recipient only.
This information is confidential and proprietary to Nyrstar Myra Falls and is not to be provided to any other recipient without the written consent of Nyrstar Myra Falls.

4.0 BEST MANAGEMENT PRACTICES

Project-related air emissions will be managed in accordance with federal and provincial legislation, regulations, standards and guidelines. Nyrstar will apply best management practices (BMPs) in all aspects of Project operations to reduce air emissions from Project activities. BMPs associated with specific point source and fugitive dust sources are summarized in Table 3 and Table 4, respectively. The table lists BMPs associated with each source of emissions, the frequency of use and associated reduction efficiency.

General BMPs include road watering, application of natural dust suppressants as required, sweeping of roadways and removal of built-up sand and dirt from paved areas. Drop heights will be minimized at active stockpiles. In addition, low-sulphur diesel fuel will be used when diesel generators are required for swing loads (two generators operating continuously) or power interruptions (five generators on standby).

Precipitation in the form of rain and snow provides natural mitigation for fugitive road dust and areas susceptible to wind erosion. Site meteorological data indicate that October through January are the wettest months, with total monthly precipitation ranging from 326 mm to 448 mm (Stantec 2017; see Table 2 Rainfall Trends in the Technical Report). Furthermore, rainfall greater than 2 mm is observed on site for 109 days per year on average (or 30% of the time). As such, management of fugitive dust emissions through watering will vary with site conditions with greater emphasis during the drier summer months.

The effectiveness of proposed and implemented BMPs will be monitored using practices outlined in Section 5.1. If the data collected by the ambient air quality monitor exceed the BC AAQOs for particulate matter (i.e., TPM, PM_{10} and $PM_{2.5}$), the effectiveness of adopted BMPs will be reassessed and steps will be taken to implement suitable mitigation measures, as required (i.e., adaptive management).

Table 3: Best Management Practices for Point Sources of Air Emissions

Source ID	Description	BMPs	Frequency of Use	Reduction Efficiency (%) [1]
01	No. 1 Crusher	Wet Scrubber and crusher permitted under PA-2408 no longer in use. Enclosure and conveyor will be used to transfer run of mine material to a stockpile	No longer in use, but transfer of ore from underground to mobile crusher will be 12 h/d, 7 d/wk.	Not applicable as the wet scrubber is not in use
08	Assay/ Environmental Laboratory	New equipment: Wet Scrubber (Profile Systems, Limited #40) Baghouse (4800 cfm AAF ArrestAll Dust Collector or equivalent) authorized under PA-2408 will be replaced with an equivalent air pollution control device	12h/d, 7 d/wk	Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm. Baghouse (fabric filter) – 99.5% for particle size 6 to 10 µm and 2.5 to 6 µm, 99% for 0 to 2.5 µm.
09	Coarse Ore Bin	Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 56) authorized under PA-2408	24/7	Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
10	Crushing/ Screening Plant	Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 102) authorized under PA-2408	12 h/d, 7 d/wk	Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
11	Transfer House	Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 36) authorized under PA-2408	12 h/d, 7 d/wk	Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
12	Fine Ore Bin	Wet Scrubber (Ducon Dynamic UW-4 Model IV, Size 60) authorized under PA-2408	24/7	Wet scrubber – 99.99% for TPM, 99.99% for particle size 6 to 10 µm, 99.5% for 2.5 to 6 µm and 94.9% for 0 to 2.5 µm.
13	Reagent Mix and Storage Facility	New equipment: 1 fume exhaust fan, 1 MBS fan, 1 dump station exhaust fan, 2 fume exhaust fans, 4 wall exhaust fans	24/7	There is no air pollution control equipment for this source of emissions.

Source ID	Description	BMPs	Frequency of Use	Reduction Efficiency (%) [1]
14	Two Diesel Powered Generators	New equipment: Replacement of equipment permitted under PA-2408 with two diesel generators rated at 1,600 kW Low-sulphur diesel	24/7	There is no air pollution control equipment for the two new diesel generators.
15	Five Emergency Diesel Powered Generators	New Equipment: Replacement of equipment permitted under PA-2408 with three diesel generators rated at 2,000 kW and two diesel generators rated at 1,250 kW Low-sulphur diesel	Emergency back-up, Intermittent	There is no air pollution control equipment for the emergency diesel generators.
NOTES: [1] Reduction efficiency for the baghouse is from US EPA 1995. Reduction efficiency for the wet scrubbers is from Table 3.2 in Rosemont Copper Company 2011.				

Table 4: Best Management Practices for Fugitive Dust

Source ID	Description	BMPs	Frequency of Use	Reduction Efficiency (%) [1]
FS1	Unpaved roads in Myra Valley	Road dust suppression using water and road dust conditioner Ground compaction	Operations, Continuous	75% for road watering 84% for use of dust suppressant
FS2	Mill Area (including multiphase stockpile and mobile crusher)	Road dust suppression using water and road dust conditioner Sweeping paved surfaces Conveyor covers Stockpile dust suppressed using water or cover material Soil compaction Drop height kept low Mobile crusher – fogging or water spraying	Operations, Continuous	75% for road watering 84% for use of dust suppressant 4 to 26% for sweeping paved surfaces 75% for crusher fogging or water spraying

Source ID	Description	BMPs	Frequency of Use	Reduction Efficiency (%) [1]
FS3	Waste Dumps 1, 2, 3 and 4, 5	Road dust suppression using water and road dust conditioner	Operations, Continuous	75% for road watering 84% for use of dust suppressant
FS4	Partially vegetated areas	Re-vegetation Soil compaction	Not active	90% if the area is re-vegetated
FS5	Lynx Tailings Dam	Soil compaction	Intermittent	90% if the area is re-vegetated
FS6	Old Tailings Dam Facility	Soil compaction	Not active	90% if the area is re-vegetated
FS7	Jim Mitchell till borrow - not active	Soil compaction	Not active	90% if the area is re-vegetated
FS8	Thelwood Valley road areas	Road dust suppression using water and road dust conditioner	Operations, Continuous	75% for road watering 84% for use of dust suppressant
FS9	HW/Warehouse yard, hard-packed and paved laydown	Road dust suppression using water and road dust conditioner Sweeping paved surfaces Soil compaction	Intermittent	75% for road watering 84% for use of dust suppressant 4 to 26% for sweeping paved surfaces
FS10	Rock Quarry - active for short periods (spring)	Road dust suppression using water and road dust conditioner	Intermittent	75% for road watering 84% for use of dust suppressant
FS11	CRAB till borrow - active for short periods	Road dust suppression using water and road dust conditioner	Intermittent	75% for road watering 84% for use of dust suppressant

NOTES:
[1] The control works efficiency for application of water on unpaved roads is from Section 13.2.2 Unpaved Roads in AP-42 (US EPA 1995a). The remaining fugitive dust control efficiencies are from the WRAP Fugitive Dust handbook (Countess Environmental 2006).

4.1 WET SCRUBBERS

Wet scrubbers are effective air pollution control devices which remove particulates and/or gases from industrial exhaust streams. A wet scrubber operates by pushing the air stream through a "scrubbing" liquid, typically water, and in doing so removing particulates and/or gases from the air. Engineering design varies depending on the source of air emissions. Nyrstar uses wet scrubbers to control emissions at the following sources:

- Assay/Environmental Laboratory
- Coarse ore bin
- Crushing/screening plant
- Transfer house
- Fine ore bin.

The wet scrubber at the No. 1 Crusher is currently decommissioned. Once mining operations commence, the building will only be used to convey and transfer ROM ore from the underground and surface mining to the mobile crusher and multi-phase stockpile.

The typical control efficiencies provided for a wet scrubber in Table 3 are taken from Table 3.2 in a permit application for the Rosemont Copper Project in Arizona (Rosemont Copper Company 2011). The wet scrubbers used for the Rosemont Copper Project are the same make and model number that are proposed for the Myra Falls Project (e.g., Ducon Dynamic UW-4 Model IV).

Wet scrubber engineering specifications are provided in the Technical Report (Appendix B).

4.2 BAGHOUSE

A baghouse is an air pollution control device that removes particulates by passing industrial air stream through a filtering media or bag with dust accumulating on the filter media surface. If air can no longer move through the media, the system is cleaned after which air filtration resumes. Baghouses typically have a particulate collection efficiency of 99% or better (US EPA 1995 and Countess Environmental 2006).

Given its age, Nyrstar will replace the existing fabric baghouse at the assay/environmental laboratory with newer technology which is equivalent to or better than the equipment currently onsite. Baghouse reduction efficiencies will meet industry standards. The engineering specifications were not available for the existing baghouse.

4.3 EXHAUST FANS

At the mill (also known as the reagent mix and storage facility building), indoor air quality is managed through ventilation systems which direct indoor air to the outside through air vents (see Figure 2). The outdated ventilation systems permitted under Permit PA-2408 are undergoing upgrades. The new ventilation systems will consist of nine exhaust fans. Preliminary engineering details are provided in the Technical Report (Appendix B).

4.4 ROAD USE

When a vehicle travels on an unpaved road, the force of the wheels on the road surface pulverizes the contacted surface material. Particles are lifted then dropped from the rolling wheels, while the road surface is exposed to turbulent air currents. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. During Project operations, management of fugitive dust emissions from unpaved roads will use a combination of proactive measures, including:

- Surfacing the unpaved roads with low silt materials: Fugitive dust emissions depend on the amount of silt (particles less than 75 microns in diameter) contained within the material on the road surface. For any maintenance or construction of new but unpaved roads, low silt waste rock will be selected as the surfacing material
- Road Watering: Water trucks will be used to control potential fugitive dust emissions during dry conditions. Water will be applied to unpaved roads. Watering of unpaved roads can result in 75% reduction of dust emissions if the moisture ratio is maintained at two. The moisture ratio is found by dividing the surface moisture content of the watered road by the surface moisture of the uncontrolled road (US EPA 1995.)
- Dust Conditioner: If road watering is found to be insufficient, Nyrstar will apply the Haulage DC ™ Road Conditioner, which reduces road water requirements by up to 50%, allowing a greater area of road surface to be treated with the same amount of water and promoting rapid penetration into the haul road surface (Nalco 2014)
- Sweeping: Paved surfaces and roadways will be swept regularly to remove sand and dirt built-up

Although natural mitigation is not a formal BMP, the frequency of precipitation onsite will play a significant role in reducing fugitive dust emissions from unpaved roads. Given that the ambient meteorological data reports daily rainfall for an average of 30% of the year, active management of fugitive dust emissions will vary with site conditions with greater emphasis during the drier summer months.

4.5 DISTURBANCE OF ARID SURFACES AND MATERIAL HANDLING

Significant fugitive dust emissions can be generated through materials handling or disturbance of arid surfaces, especially during dry periods and high winds. To reduce fugitive dust emissions, the following BMPs will be implemented, when applicable:

- Conveyors used to transport run of mine or ore will be covered
- The heights from which materials are dropped onto the stockpile will be kept as low as practical to reduce dust generated by dumping
- Stockpiles will be covered with tarp material and/or watered, if required
- Earthworks will include soil compaction and concurrent re-vegetation, where practical
- Undisturbed arid open surfaces will be managed with dust suppressants (i.e., application of water or dust conditioner).

Rapid reclamation of disturbed land is an important mitigation strategy for minimizing fugitive dust emissions. Exposed ground surfaces will be re-vegetated through a progressive reclamation program as soon as the areas are no longer needed for mine operations or construction activities.

4.6 POWER GENERATION

The project relies on hydroelectric power to support the mining and mineral processing activities. Hydroelectric power will be generated from existing infrastructure installed at the Tennent Lake, Thelwood Lake and Jim Mitchell Lake (see Figure 1). Hydroelectric power has the capacity to provide 11 MW of the total 14 MW required. Two diesel generators (rated 1,600 kW each) will be used to provide the remaining swing load. In the event of a hydroelectric power outage, the Project will rely on standby diesel generators (three rated at 2,000 kW each and two rated at 1,250 kW each). BMPs associated with the use of this equipment will include use of low-sulphur fuel (Sulphur in Diesel Fuel Regulation) and regular maintenance work.

5.0 MONITORING AND REPORTING

Air quality will be monitored to confirm compliance with permit requirements and assess the effectiveness of adopted BMPs and mitigation measures. Monitoring results will be used to determine whether additional mitigative action is required. This section outlines Nyrstar's monitoring and reporting plans. Monitoring will be conducted relative to the Trigger Action Response Plan (TARP) to meaningfully incorporate adaptive mitigation action to address areas of concern.

5.1 MONITORING

The AQMP relies on concurrent monitoring to ensure that selected BMPs reduce air emissions, and to provide clearly-defined mitigation measures. Specifically, Nyrstar will:

- Develop and implement a monitoring program in compliance with regulatory permit requirements for the Project
- Conduct monitoring as outlined in the permits required for the Project and, if necessary, revise mitigation measures to achieve conformance with approval conditions
- Develop an inspection process to evaluate the use and effectiveness of the various mitigations used to reduce emissions
- Use adaptive management to implement meaningful triggers for additional mitigative action
- Commit to reporting the findings to interested parties

The recommended air quality monitoring program will validate the adopted BMPs and assist in determining the need for additional mitigations if the active mitigation measures are not effective at reducing fugitive dust emissions. Where necessary, improvements will be implemented through adaptive management to minimize air emissions. The appropriate regulatory authorities will be informed of changes to the AQMP, and personnel training will be updated, as appropriate.

Nyrstar will monitor the effectiveness of the AQMP by conducting the following:

- Visual inspections (daily or as needed)
- Design inspections (regular maintenance checks and pressure drop checks)
- Ambient monitoring (meteorology and air quality)

This section summarizes each monitoring approach and outlines triggers for mitigative action.

5.1.1 Visual Inspections

Daily visual inspections for fugitive dust emissions at the Project will be conducted by the trained Environmental Technician. Additional visual inspections will be conducted if Nyrstar receives public complaints or reports from site personnel specific to fugitive dust emissions associated with the various site activities.

The Environmental Technician will inspect areas of disturbance identified as potential sources of fugitive dust in Table 4. The Environmental Technician will record visual inspections using an Air Quality Inspection form or equivalent and document the following:

- Current weather conditions (i.e., precipitation and wind)
- Any visible dust emissions from areas of disturbance (e.g., unpaved roads, stockpile, tailings management facility). This may take the form of a checkmark list with details provided if necessary
- Status of active mitigation measures (e.g., road watering)
- If required, follow-up recommendations

The Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (Cheminfo 2006) contains a good example of the daily inspection form for fugitive dust emissions, including the observations to assess the effectiveness of the mitigation measures.

5.1.2 Design Inspections

Engineered mitigation measures (i.e., wet scrubbers, baghouses, exhaust vents) will undergo regular design inspections and maintenance to confirm that they are functioning properly. Daily design inspections will be conducted in tandem with the visual inspections by the Environmental Technician. The Environmental Technician will visit each permitted source of air emissions listed in Table 3 to confirm that the BMPs are being followed. The Environmental Technician will record site observations using the Air Quality Inspection form or equivalent and document the following:

- Equipment status (i.e., optimal operation or malfunction)
- Maintenance record keeping check (i.e., filter exchanges, pressure drop, automated alarm systems, malfunctions)
- If required, follow-up recommendations, if required

5.1.3 Ambient Monitoring

Ambient monitoring will include continuous monitoring of meteorological and air quality conditions.

5.1.3.1 Meteorological Station

An automated meteorological station has been in operation at the Project site since 1979. Historical records are not available to confirm that meteorological station siting and instrumentation meets the applicable monitoring guidelines (BC MOE 2013). The existing Myra Creek station provides hourly measurements of the following parameters:

- Temperature
- Relative humidity
- Net radiation
- Precipitation
- Snow depth
- Wind speed and direction.

Data are downloaded from the station regularly and reviewed for quality. As part of the AQMP, the meteorology station siting and sensors/instrumentation will be reviewed and updated to ensure compliance with applicable guidance and permit requirements (BC MOE 2013).
The meteorological station requirements are detailed in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016) and include:

- Unobstructed siting location, the horizontal distance between the instrument and any obstruction should be at least 10 times the height of that obstruction
- Wind speed and direction should be measured 10 m above the ground surface
- The collection orifice of the all-weather precipitation gauge (by design or by use of a winter adapter) should be surrounded by a wind screen to prevent under-catch

5.1.3.2 Ambient Air Quality Monitoring

The AQMP will include the deployment of a continuous ambient air quality monitoring station that complies with the siting and instrumentation recommendations given in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016). Data will be collected to:

- Assess the effectiveness of adopted BMPs (Section 4.0)
- Trigger additional mitigation action if the measured ambient concentrations for particulate matter (PM) exceed their applicable ambient air quality objectives.

Monitoring of ambient air quality at the Project will be initiated when the mine operations are restarted. The new ambient air quality monitoring station should have the following capabilities:

- Measurement of continuous, near real-time PM concentrations
- Measurement of multiple size fractions of PM, specifically Total Suspended Particulate (TSP), inhalable particulates (PM_{10}, or PM less than 10 µm in diameter) and respirable particulates ($PM_{2.5}$, or PM less than 2.5 µm in diameter)

An example of an instrument with these capabilities is the GRIMM 180+ Continuous Environmental Dust Monitor with model 187 Spectrometer. This instrument measures multiple particulate matter size fractions without the need for a filter medium or external laboratory analysis. Another possible instrument is the Met One E-BAM, but a separate instrument would be needed for each PM size fraction, and filter tape changes are required. Since both instruments require a continuous source of AC power (120 VAC, 60 Hz), the monitoring location/siting will be restricted to areas where AC power is available.

The station instrumentation and siting location will be determined through consultation with the BC MOE. The station location will comply with the recommendations provided in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016) and include the following considerations:

- Prevailing winds relative to location of mine activities and nearest sensitive receptors
- Proximity to the meteorological station to document the wind speed and direction that can be paired in time with the ambient PM concentrations
- Proximity to man-made (i.e., stockpiles) or natural physical barriers (i.e., dense vegetation)
- Proximity to active arid surfaces (i.e., park roads)
- Access to continuous AC power

Ambient air quality monitoring data will be downloaded on a weekly basis and reviewed for quality assurance (QA) purposes by the Environmental Technician. The Environmental Technician will also be responsible for instrument calibration and maintenance, including replacement of parts and manufacturer servicing, as required.

More frequent data downloads will be conducted if air quality concerns are identified during daily site inspections or in other circumstances as determined by the Environmental Manager.

5.1.4 Trigger Action Response Plan

The Draft Fugitive Dust Management Plan Guidance (MEM 2017) recommends the development of a site-specific Trigger Action Response Plan to:

- Establish which information/conditions/situation will trigger a response
- Define specific measurable and reportable triggers for additional mitigative action relative to existing site conditions and ambient meteorology and air quality monitoring results
- Identify and implement additional mitigative action(s)
- Conduct follow-up monitoring to confirm adopted mitigations have addressed the situation

Table 5 summarizes the triggers for additional mitigation action(s) based on the results from the visual and design inspections and the ambient meteorology and air quality monitoring results. The table lists which situations will prompt an action/response and the corresponding measurable and reportable triggers. The mitigative action will include conducting an inspection of the area of concern to identify the most suitable mitigation measures. The Environmental Technician will rely on site-specific ambient data to determine whether areas of concern affect air quality outside the Project boundary. If additional mitigative measures are required, Nyrstar will address the area of concern through adaptive management. The following mitigation measures will be implemented if the monitoring results exceed the established thresholds for mitigative action:

- Increasing watering frequency of arid surfaces and unpaved roads during dry conditions
- Applying dust suppressants to unpaved roads (e.g., Haulage DC ™ Road Conditioner)
- Decreasing the drop height at the stockpile and/or covering unused stockpiles with a tarp
- Increasing housekeeping activities (i.e., sweeping) along paved roads affected by Project activities
- Coordinating repair or replacement of malfunctioned air pollution control equipment in a timely manner

Once the additional mitigation measures are applied to the area of concern, the Environmental Technician will conduct follow-up visual and/or design inspections to assess their effectiveness and to confirm that the issue has been resolved. This will be documented and reported annually to applicable agencies, or as required by the waste discharge permit conditions.

Table 5: Triggers for Mitigative Action

Activity or Location	Trigger	Mitigative Action
Visual Inspections		
Issues identified during a daily inspections or reports filed by site personnel	Environmental Technician or on-site personnel identifies persistent visible fugitive dust emissions	• Environmental Technician will investigate the site of concern and identify a suitable mitigative action. • Environmental Technician will download, review and compare the site ambient air quality data to the applicable objectives to determine whether site conditions exceed the objectives.
Public outreach	Public complaint	• Environmental Technical will conduct a visual and/or design inspection addressing the complaint received from the public to identify and implemented a suitable mitigative action, if required.
Design Inspections		
Issues identified during a daily design inspection or reports filed by site personnel	Failure of the engineered mitigation measures (e.g., wet scrubber or baghouse)	• Environmental Technician will investigate the equipment failure and identify a suitable mitigative action. • Environmental Manager will coordinate repair or replacement of malfunctioned equipment in a timely manner. • Environmental Technician will download, review and compare the site ambient air quality data to the applicable objectives to determine whether site conditions exceed the objectives.

Activity or Location	Trigger	Mitigative Action
Ambient Monitoring		
Meteorological Monitoring	Persistent dry weather conditions, wind erosion	• Environmental Technician will investigate effectiveness of existing BMPs associated with fugitive dust emissions relative to the site-specific meteorological data. • If dry conditions persist, additional mitigative action will be applied to the exposed arid surfaces that have high potential to generate fugitive dust emissions
Ambient Air Quality Monitoring	Ambient Air Quality Monitor shows an exceedance of the applicable objectives	• Environmental Technician will download, review and compare ambient air quality data relative to applicable objectives on a by-weekly basis or as dictated by visual or design inspection triggers • If the ambient air quality concentration(s) exceeds their applicable objectives (specifically BC's 24-hour ambient air quality objectives for TSP, PM_{10}, $PM_{2.5}$), the Environmental Technician will investigate to determine whether the measured concentrations are associated with Project activities or attributable to other sources such as forest fires or windblown dust from non-Project areas, including reviewing the available meteorological and available regional air quality data (e.g., during a regional-scale air quality event). • If Project activities are determined or suspected to cause or significantly contribute to the measured exceedances, the Environmental Technician will investigate existing BMPs relative to daily visual and design inspection logs and known meteorological conditions to determine whether additional mitigative action is required. • Environmental Technician will identify and implement suitable mitigation measures and conduct follow-up inspections including data analysis to determine whether the additional mitigative action(s) has been effective and ambient air quality concentrations have been reduced to a level that is below the applicable objectives

5.2 REPORTING

The Environmental Technician will maintain systematic records and facilitate timely and consistent reporting. Routine documentation will take the form of a daily Air Quality Inspection form. This daily form will summarize the status of active BMPs and mitigative actions relative to the ambient conditions (i.e., ambient meteorology and air quality data). Daily inspections will be compiled into a single report presented to the BC MOE on an annual basis, or as required by the waste discharge permit conditions. The annual report will include a summary of the incident reporting specific to the Trigger Action Response Plan.

The annual report will include a review and analysis of ambient meteorological and air quality data collected during the reporting period. Ambient air quality will be assessed relative to applicable objectives (BC MOE 2017).

The National Pollutant Release Inventory (NPRI), administered by Environment and Climate Change Canada (ECCC), is a database of information on annual releases to air, water, and land, and off-site transfers for disposal or recycling. Established in 1992, the NPRI is legislated under the *Canadian Environmental Protection Act 1999*. Under the NPRI, facilities with more than 20,000 person hours per year ("large facilities") must consider all NPRI substances and determine which substances must be reported. Nyrstar has been reporting the Myra Falls Project air emissions since 2011 and will continue to do so on an annual basis if it triggers the reporting requirement under NPRI regulation. NPRI reporting is completed annually by June 1 by submitting reports to ECCC through the Single Window Information Manager.

Table 6: Air Quality Monitoring and Reporting Frequency

Reportable Activity	Parameters	Monitoring Frequency	Reporting
Visual inspections	Fugitive dust	Once per day	Annual
Design Inspections	Particulate matter (TSP, PM_{10} and $PM_{2.5}$)	Once per day	Annual
Ambient Monitoring	Meteorology (Temperature, relative humidity, wind, precipitation); Particulate matter (TSP, PM_{10} and $PM_{2.5}$)	Continuous, Weekly download	Annual
National Pollution Release Inventory	Substances tracked by the NPRI that exceed their respective reporting threshold	Annual	Annual

6.0 PLAN IMPLEMENTATION

6.1 ROLES AND RESPONSIBILITIES

The Environmental Manager has the overall responsibility for the implementation of the AQMP. The Environmental Manager and Mine Manager are responsible for the implementation of specific mitigation measures. The Environmental Manager is also responsible for compliance with the AQMP. Responsibility for the monitoring program lies with the Environmental Technician, under the supervision of the Environmental Manager.

The point and fugitive sources of air emissions will be reviewed annually to reflect the current Project conditions. This review will be conducted by the Environmental Manager in consultation with technical experts, if necessary. If the configuration of the sources of air emissions change, the Environmental Manager will consult with the appropriate regulatory authorities as to whether an amendment to the Waste Discharge Permit or changes to the AQMP will be required. If required, the AQMP will be updated to address changes to the sources of air emissions.

6.2 TRAINING

All personnel with identified responsibilities will receive training on the implementation of the AQMP. This training will be provided at the start of employment and refreshed annually. All employees should be aware of the existence of the AQMP and know that the Environmental Manager is the appropriate contact person in the event of a potential concern related to air quality. All employees with job activities that have the potential to cause fugitive dust emissions will receive training on the SOPs for their job activities with specific reference to procedures that minimize fugitive dust emissions (e.g., vehicle speeds on unpaved roads and drop heights for materials).

Personnel with monitoring and maintenance duties, as previously described, will receive training on the required equipment and SOPs.

6.3 RECORD KEEPING

Records created through the implementation of the AQMP will be retained by Nyrstar Myra Falls Ltd. for the purposes of auditing and compliance. These records include the daily inspection reports, tracking of events and responses related to the TARP, ambient air quality data from the automated monitoring equipment, meteorological data from the automated meteorological station and records of correspondence and complaints from the public and the regulatory authorities.

7.0 CLOSURE

This Air Quality Management Plan was prepared in support of the Nyrstar Myra Falls Ltd. Waste Discharge Permit amendment (application authorization #2408). Should you have any questions or require additional information, please contact Magda Kingsley at 250-216-6515 or email Magdalena.Kingsley@stantec.com.

Regards,

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ENGINEERING SPECIFICATIONS

Appendix B ENGINEERING SPECIFICATIONS

This section provides engineering specifications for wet scrubbers and exhaust fans which include latest modifications and upgrades adopted by Nyrstar.

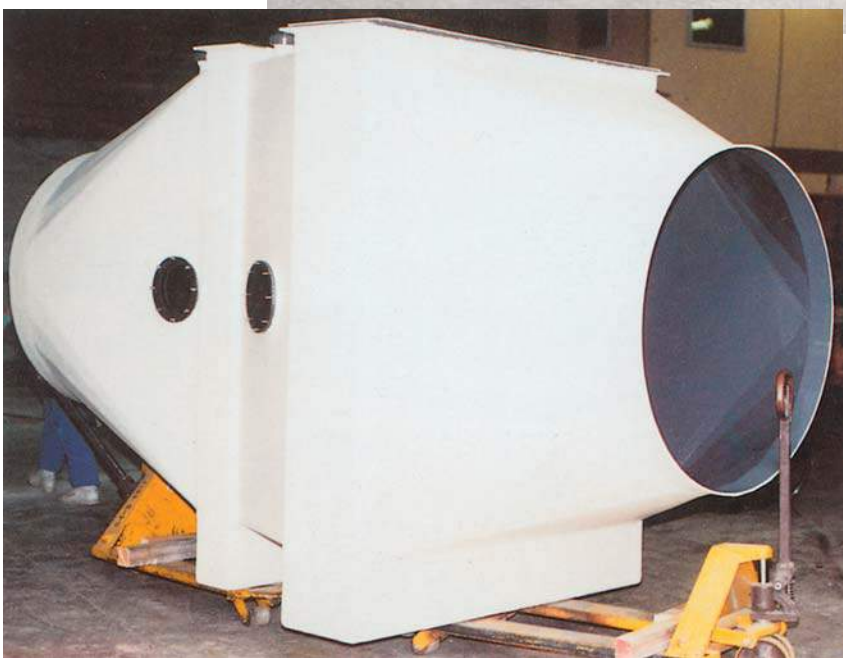
- Assay/Environmental Laboratory wet scrubber
- Coarse ore bin wet scrubber (decommissioned)
- Crushing/screening plant wet scrubber
- Transfer house wet scrubber
- Fine ore bin wet scrubber
- Reagent mix and storage facility fans

PROLITE SYSTEMS INC.
PLASTICS DIVISION

CUSTOM FABRICATORS & DISTRIBUTORS OF CORROSION RESISTANT PRODUCTS

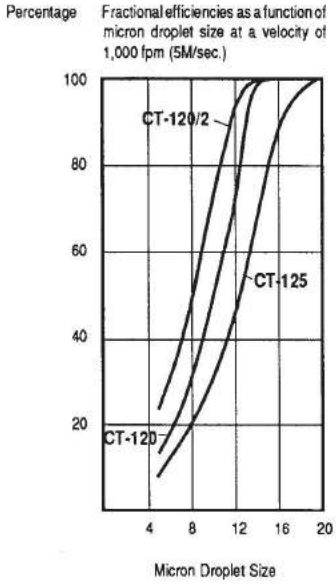
POLLUTION CONTROL EQUIPMENT FOR INDUSTRY

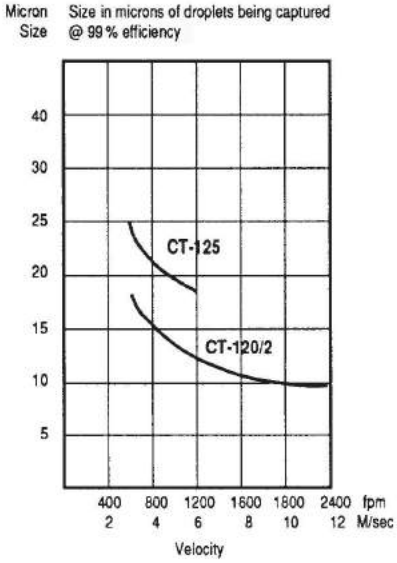
SIDE ACCESS LMITS & C-CLONE 3 SCRUBBERS

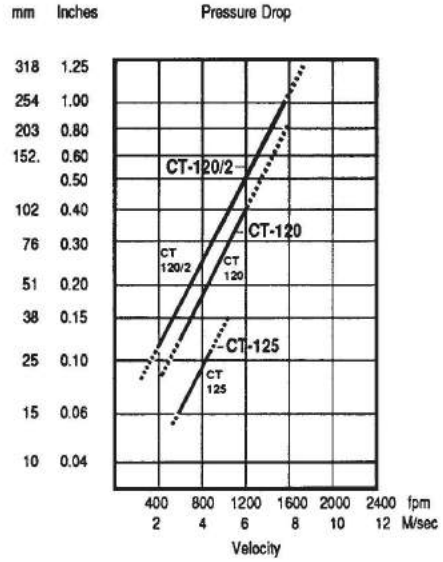


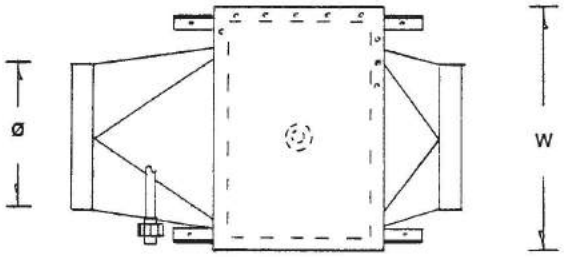
LMITS
(The Low Micron Scrubber)

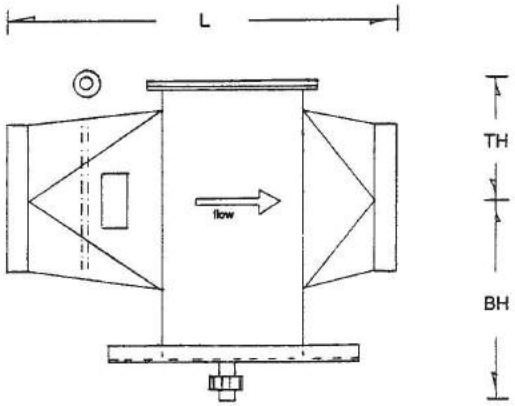
PROLITE CT-120/2 ELIMINATORS
For Horizontal Air Flows











Model	Airflow in CFM	DIMENSIONS in inches Dia	W	TH	BH	L
5	500	6	14	6	16	31
7	750	7	15	7	16	33
10	1,000	8	16	8	17	34
12	1,250	9	19	8	17	35
15	1,500	10	20	8	18	37
20	2,000	11	19	11	20	39
25	2,500	12	23	11	20	39
30	3,000	14	25	11	20	39
35	3,500	15	25	13	21	40
40	4,000	16	27	13	21	42
50	5,000	18	32	13	21	47
60	6,000	20	37	13	21	53
70	7,000	21	30	18	28	55
80	8,000	22	33	18	28	55
90	9,000	24	36	18	28	52
100	10,000	25	40	18	28	55
125	12,500	28	38	23	33	64
150	15,000	31	44	23	33	62
175	17,500	33	50	23	33	67
200	20,000	35	56	23	33	74
250	25,000	39	52	32	40	84

IMPORTANT

Prolite eliminators are provided with computer designed inlet and outlet transitions. The length of these transitions is important as they are designed not only to distribute the airstream over the blade surfaces but also to reduce pressure losses. For smaller duct diameters than those shown, the transition lengths MUST be increased.

It is also recommended that, where possible, a straight run of duct of min. 3 x diameter should preceed the eliminator.

The above CFM figures represent recommended normal maximum airflows for a pressure drop of 0.93" in a clean airstream at normal atmospheric pressures.

The aluminum or the polymer coated mild steel sump supports are designed so that the eliminator can be either supported from underneath or held from above.

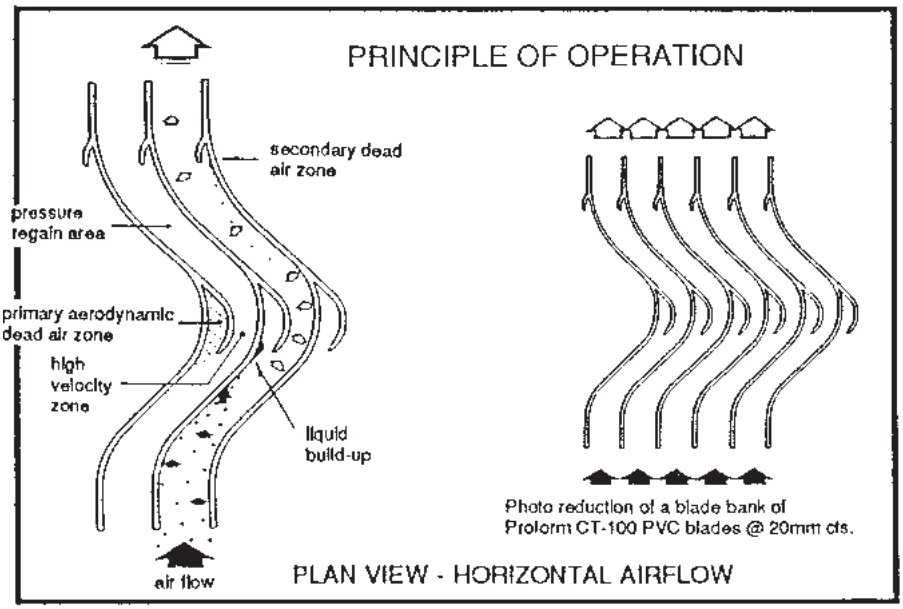
Available with top entry access or with side access.

Consult Prolite for larger or smaller airflows than those shown.

PROLITE ELIMINATOR RANGE

High Performance Eliminators for horizontal air flows

CT-125
CT-120
CT-120/2
C-Clone-2



GENERAL INFORMATION - CT-120 Series

The Prolite CT-120/2 dual stage horizontal mist eliminator represents a simple yet ultra efficient method of removing mist and airborn droplets from gas streams. Unlike mesh eliminators, The CT-120/2 is very compact, does not tend to plug up, can be easily cleaned, has a very wide operating velocity range and is designed to be simple to maintain.

The Prolite CT-120/2 embodies total airflow casing design with both eliminator banks internally separated AND independently baffled from each other. Inlet and outlet transitions are streamlined and NO baffles extend into the airstream to generate turbulence.

Fume Scrubbing: The CT-120/2 has often been used as a scrubber. Many so-called 'gas streams & fumes', particularly in the Surface Finishing Industry (e.g. Plating) consist mainly of ultra small acid/alkali droplets that can be captured by the CT-120/2. In the case of hard chrome fumes, Air Management emission levels have been easily met in the past. Removal of battery plant sulphuric acid fumes to under 0.6 mg/m^3 has been achieved.

FEATURES

- Using the highly sophisticated Prolite designed 'C' blade
- High face velocity, hence very compact
- Very high efficiency (up to 12 microns) yet at a low pressure drop
- Dual blade banks (CT-120/2), the primary bank acting also as a flow straightener.
- Far less prone to plugging up than any mesh design
- Extremely corrosion resistant construction ... NO metals in the airstream
- Interwelded modular blade banks for rigidity and maximum strength
- Quick, simple and easy maintenance. Blades are easily cleaned.
- Computer designed inlet and outlet transition lengths to achieve good flow distribution across the entire blade area and to prevent channelling.
- See-through ports to view spray action
- Wide angle and full coverage wide angle spray jets
- Horizontal airflow design; also to 45º entry angle (upward inclination only)
- Construction entirely of PVC or Polypropylene. Top or side access designs.
- Max. continuous temperature of 140º F (60º C) for PVC and 175º F (80º C) for Polypropylene.

METHOD OF OPERATION - Proform Eliminators

The capture mechanism is obtained by deflecting gas streams containing particles of one micron and larger from their original path as they pass through a series of parallel deflector blades. This achieves a differential movement between droplets and gases and causes a film of liquid to form on the sides of the blades.

The liquid is then forced by the airstream towards the side of the main phase separators (i.e. the major hooks). In their immediate vicinity, the force of the airstream becomes ineffective and the liquid runs off by gravity.

In between the blades the main hook induces a very high velocity yet at minimal turbulence. After the main hook, the gas stream smoothly expands to give excellent pressure-regain characteristics.

When allied to a properly engineered casing design, these principles account for the high efficiency of 99.9% for known and very low micron droplet sizes yet at low pressure losses.

APPLICATIONS

- Capturing emissions from droplet generators such as packed bed scrubbers, absorption columns & spray towers.
- Removal of carry-over from air conditioning units.
- Fan protection due to removal of particulates that would build up on fan blades.
- DRY SCRUBBING of hard chrome fumes along with quick unit amortization due to acid reclaim. Case histories since 1971 are available.
- Complete or major removal of low temperature fumes from plating and laboratory acid/alkali processes.
- Removal and capture of wood treating preservatives (i.e. PCP, PQ8, TCMTB).

TECHNICAL DATA

		CT-125	CT-120	CT-120/2
Blade gap spacing		25 mm	20 mm	20 mm
Velocity Range	fpm	500 - 1,200	400 - 1,600	400 - 2,400
	M/s	2-1/2 – 6	2 – 8	2 – 12
OptimumVelocity Range	fpm	600 - 800	600 - 1,200	600 - 1,600
	M/s	3 – 4	3 – 6	3 – 8
Pressure Drop	inches	0.06 - 0.10	0.10 - 0.40	0.15 - 1.03
@ Optimum Values	mm	2 – 4	3 – 10	4 – 26
@ Optimum Values	mm			
Max. liquid loading	gpm/profile	–	0.4 **	0.8 **
@ 1,100 fpm/ 5-1/2 M/sec	Lpm/profile		1-1/2**	3**
Droplet Limit Diameter @ 99.9% efficiency	Microns	20 *	16 *	12

Figures are based on a gas density of 0.074 lbs/ft^3 (1.2 Kg/M^3) at 20° C and at normal atmospheric pressure.

* Laminar non-turbulent flow

** To prevent excessive liquid overload (common occurence on outer blade profiles adjacent to duct walls particularly on large units), consult Prolite for Schicane weir design.

INSTALLATION

We recommend that the eliminator is located before the fan. In the case of hard chrome fumes (Chromic-Sulphuric acids), the fan can be made of mild steel due to the protection and acid removal that the CT-120/2 provides.
However, if the eliminator is located after a (centrifugal) fan, an improvement in micron capture should occur. This is due to the process of dynamic precipitation inside the fan volute. This efficiency will be further enhanced by spraying into the fan inlet. Tests have indicated equivalent efficiencies of 5 micron capture when using this method.

SPECIAL DESIGNS

The Prolite C-Clone-2 is a special design. It is nearly identical to the CT-120/2 except that both blade banks are entirely separated and each has its own wash-down system. Large C-Clone 2 eliminators have integrated vertical & horizontal schicanes and are provided with complete header controls, proportioning valves, ball valves, pressure gauges + gauge guards.
The C-Clone-2 was designed to provide high efficiency capture of ultra fine, low micron dust emissions from cyclones by using water spraying and to replace costly and fire prone dry filter bag systems. It has also been successfully used for acid fumes containing a high proportion of solids, eg. Sulphuric acid descaling operations.

NOISE

There are no known noise contributing factors whatsoever about Prolite inertial eliminators and scrubbers. Noise is not a factor of any consequence.

MATERIALS OF CONSTRUCTION

Internals of PVC or Polypropylene. Casings can be externally reinforced with Fibreglass or even made of stainless

SHORT FORM SPECIFICATIONS ON PROFORM ELIMINATOR BLADES

CT-100 blades shall be made of type 1, grade 1 PVC and have a minimum thickness of 2 mm. Blade spacing is to be 20 mm or 13/16". Blades shall be straight, totally smooth and apart from a major and a minor hook they shall have no riffles, ledges nor other parts that protude into the airstream and will cause turbulence.

Blades are to be welded into strong, rigid modular blocks. Unsupported blade lengths exceeding 23" (600 mm) must have horizontal stiffeners interwelded to prevent deflection. Blades shall have matte surfaces to promote wetting out and not glossy surfaces which promote tracking.

The LMITS – Low Micron Inertia Type Scrubber

GENERAL INFORMATION

The "LMITS" (1971 Invention by Prolite's Freeman Newton) is an extremely high efficiency mist eliminator. It was originally conceived as an alternative to conventional NaOH sprayed packed bed scrubbers for BRIGHT DIP (Nitric-Phosphoric) fumes where it was reported to be highly successful using plain water spraying. The LMITS has also replaced packed bed column scrubbers for heavy Assay fumes of HF, HNO_3, H_2SO_4, $HCl0_4$ & Aqua-Regia.

METHOD OF OPERATION

The LMITS has 3 stages. In the first stage the capture mechanism is identical to the CT-120. Thereafter, any by-pass aerosols and submicron droplets drift onto a dense mesh coalescer. Due to the fine mesh of the coalescer, these droplets merge (principle of impact & contact) and coagulate into larger droplets. These larger droplets are intentionally re-entrained into the airstream but then are immediately recaptured by the last CT-120 eliminator blade bank. The first CT-120 eliminator stage serves also to protect the mesh against build-up and to evenly distribute the airstream onto the coalescer section. The S-LMITS has a CT-120/2 first stage, ie. two blade banks instead of the normal one. This is specifically for use as a Dry Scrubber for hard chrome and to meet today's demanding pollution requirements.

FEATURES

- Droplet removal to 3 microns @ 3" pressure drop @ 99% efficiency
- Scrubbing of 1/2 micron droplets has been achieved using inbuilt sprays
- Coalescer has 40 sq. ft. / sq. ft. of surface area
- Liquid consumption is normally around 2 gpm / 1,000 CFM
- Top or side access designs available
- Compact dimensions
- Simple maintenance - very quick access to blade banks and jets.
- Sophisticated overlapping solid cone spray system

APPLICATIONS

Troublesome areas in the Surface Finishing Industry, eg. Bright Dip scrubbing; elimination of Chromic fumes to under 0.5 mg / M³; removal of machine oil mists; capture of Stannic Chloride low micron dusts (where wet scrubbers have failed): sewage plant odour removal; Perchloric and Aqua Regia scrubbing in Assaying laboratories in downtown built-up area.

CASE HISTORIES

On file are case histories of over 2-1/2 million cfm covering a wide range of applications (CT-120/2, C-CLONE-2 & LMITS)

BJ SERVICES
Alberta, Canada

Tank Ventilation and Scrubbing Equipment for HCL
2005

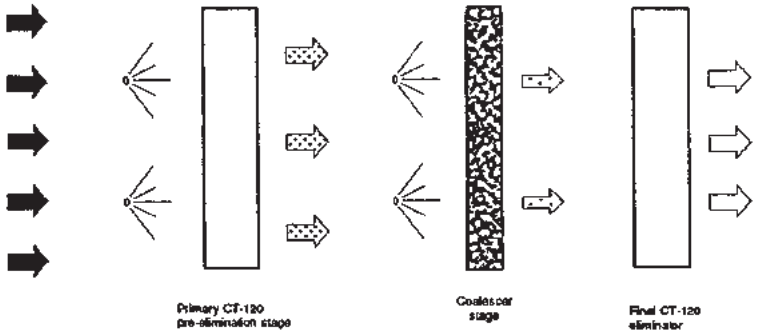
RUSSIA ASSAY LAB PROJECT
2006

LMITS Model 60 Side Access Scrubber

Scrubbing Perchloric Acid and Mineral Acid

HNO_3, H_2SO_4, HCl, Aqua Regia and HF fumes

The LMITS - Principal of droplet growth and subsequent intentional re-entrainment followed by inertial capture.



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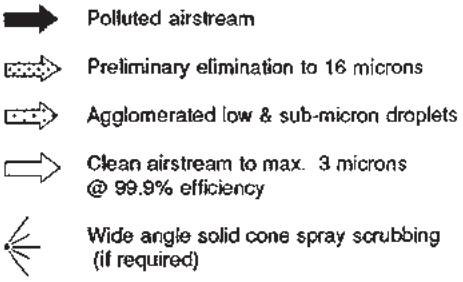
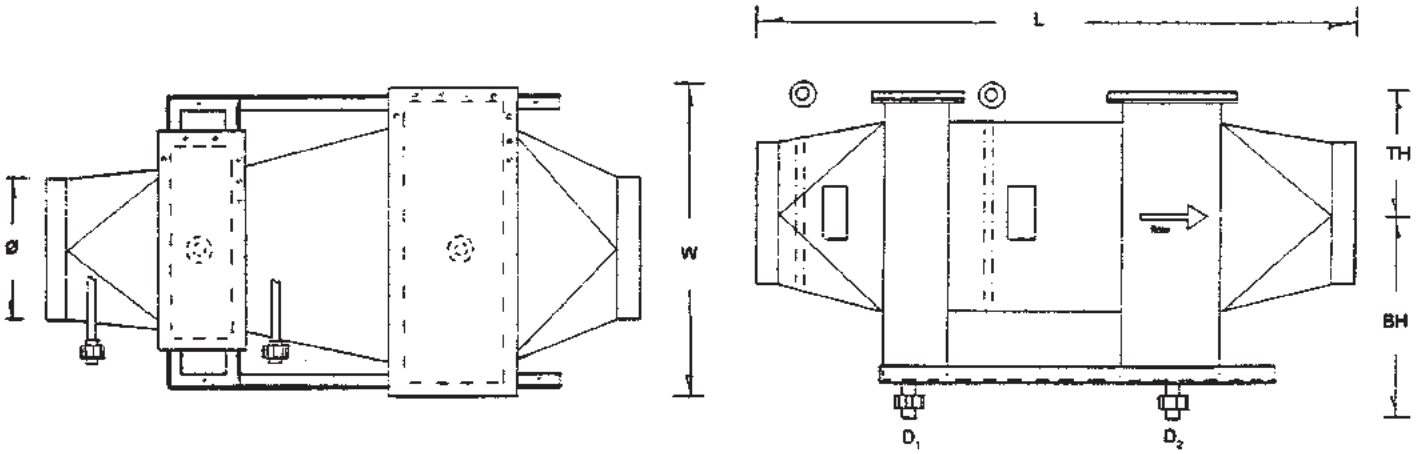




AVAILABLE LITERATURE (FOR CT-120/2, C-Clone-2 and LMITS)

- Installation/maintenance/operational data
- Schematic of sump trap design
- Layout drawings for standard top access or side access
- Case histories

OTHER PROLITE LITERATURE

- MV series laboratory fans
- Perchloric and Assay PER-LAB fumehoods
- PROLAB air make-up PVC/PP fumehoods
- Thermoplastic valves & flow controls
- FRP pipe support systems

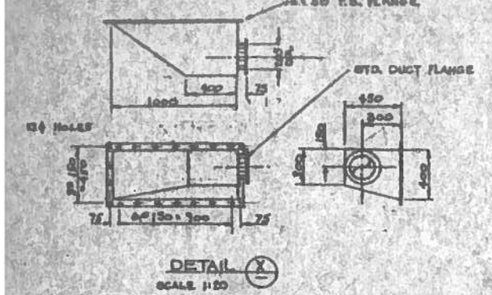
LMITS can be made for any size of airflow.
Given dimensional data refers only to smaller units.

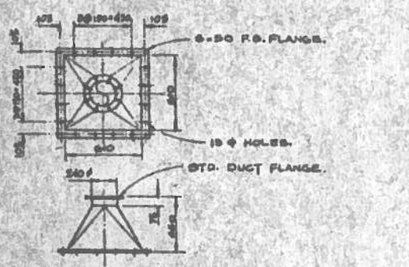
DIMENSIONAL DATA

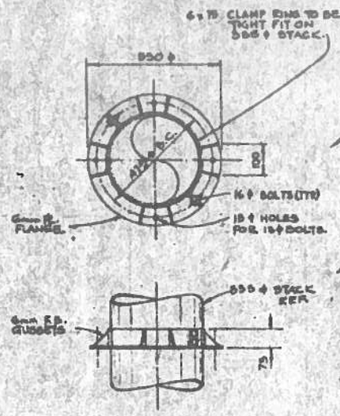
Model	CFM	L	TH	BH	W	D1	D2	Dia
10	1,000	4'-6"	8	18	20	1	1	8
15	1,500	4'-8"	10	19	23	1-1/4	1	10
20	2,000	5'-2"	12	21	23	1-1/4	1	12
30	3,000	5'-2"	12	21	31	1-1/2	1-1/4	15
40	4,000	5'-5"	13	23	35	1-1/2	1-1/4	18
50	5,000	5'-7"	15	25	37	2	1-1/2	20
60	6,000	6'-4"	18	26	36	2	1-1/2	21
70	7,000	6'-4"	18	26	41	2	1-1/2	23
80	8,000	7'-2"	22	32	38	2-1/2	2	25
90	9,000	7'-2"	22	32	42	2-1/2	2	26
100	10,000	7'-4"	22	32	50	2-1/2	2	27
125	12,500	7'-3"	22	32	60	3	2-1/2	30

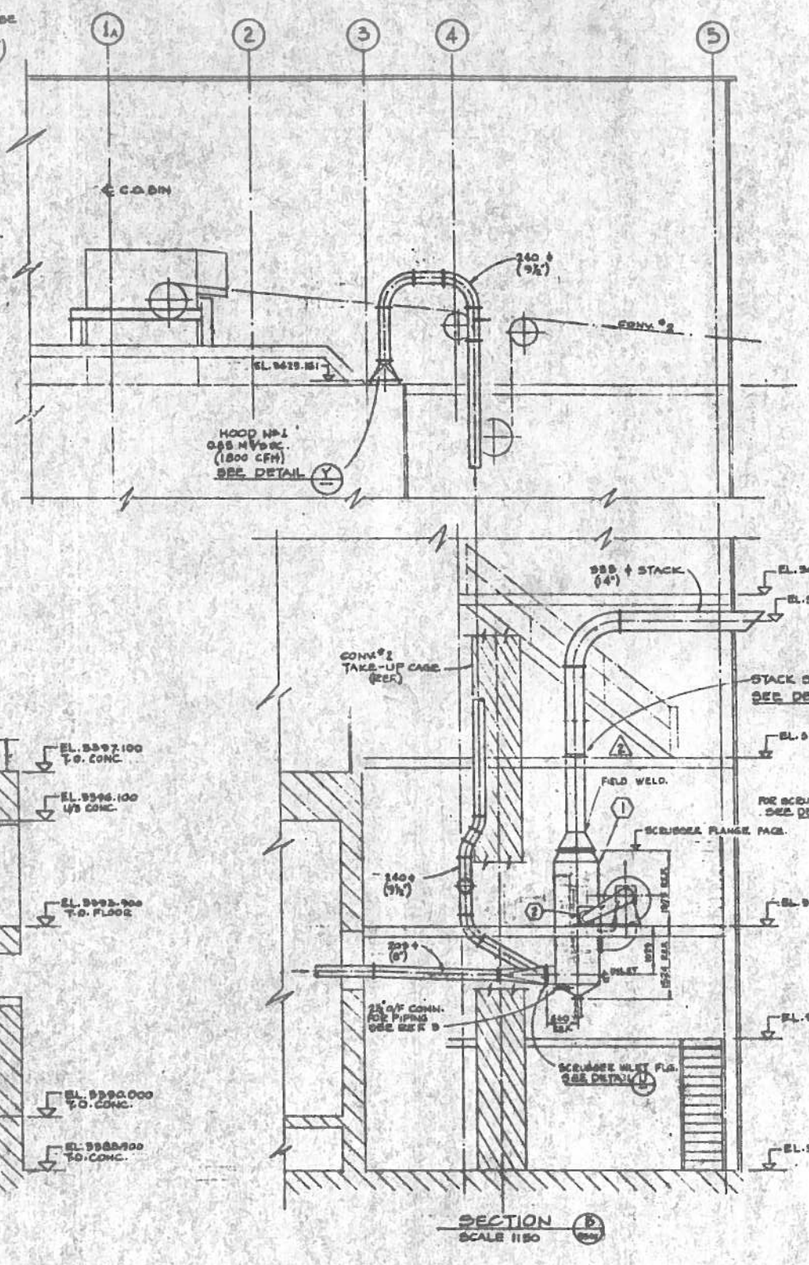
BRITISH COLUMBIA
20127 - 113 B Ave., Maple Ridge, BC, Canada V2X 0Z1
TEL **604.460.8250** • FAX 604.460.8254 • Email info@prolitepiping.com • www.prolitepiping.com

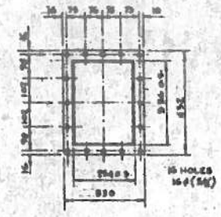
ALBERTA
Distributed by **Hy-Pro Plastics Inc.**
2628 58 Ave. SE, Calgary, AB T2C 1G5
TEL **403.263.4373** • FAX 403.236.1051 • CELL 403.604.5808 • Email wes@hyproplastics.com

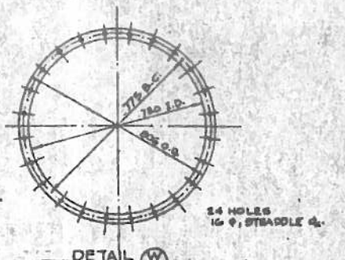


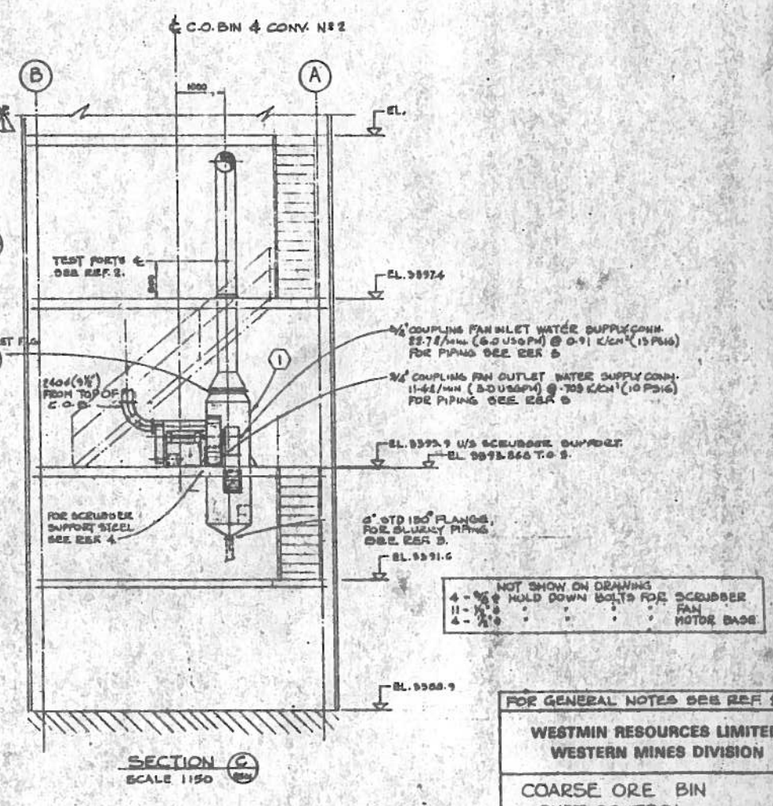












FOR GENERAL NOTES SEE REF 1

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

COARSE ORE BIN DUST CONTROL SECTIONS & DETAILS

ISSUED FOR	DATE	DES.	DRN.	CHK.	APPROVAL
QUOTATION 10-5-1	10-5-1	RKW	RK	TM	
QUOTATION 10-5-1	10-5-1	RKW	RK	TA	
QUOTATION 10-5-1	10-5-1	RKW	RK	TM	
CONSTRUCTION 10-5-1	10-5-1	RKW	RK	TM	

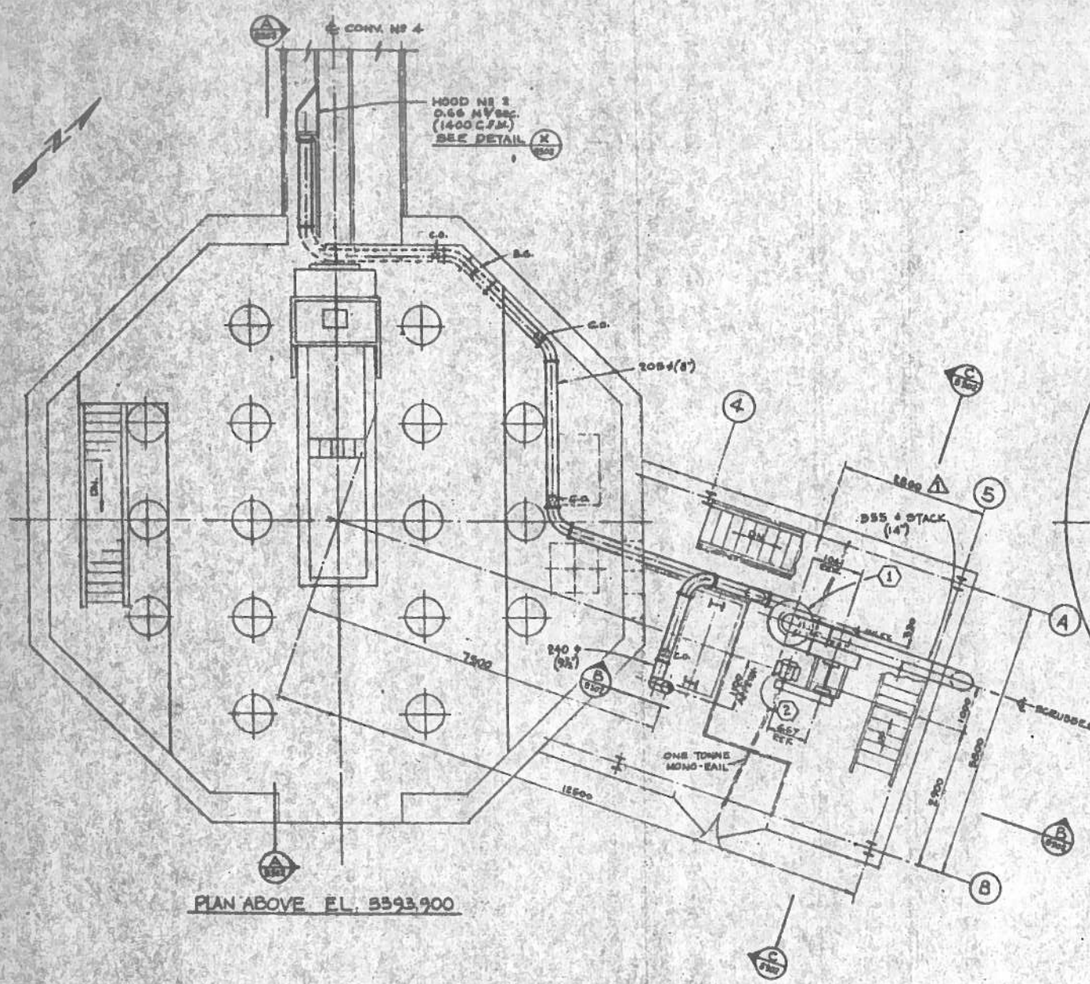
NO.	DESCRIPTION OF REVISION	DATE	APPROVAL
—			
1	3400.230 and 3400.238		
2	HOLE REMOVED		
A	NO CHANGE		

NO.	REFERENCE	DWG. NO.
1	PIPING G.A.	1218-73-5701
2	DUST CONTROL STANDARDS	1218-74-8503
3	C.O.B. GE PLANS	1218-73-8501
4	STRUCT PLANS & DETAILS.	1218-73-5606

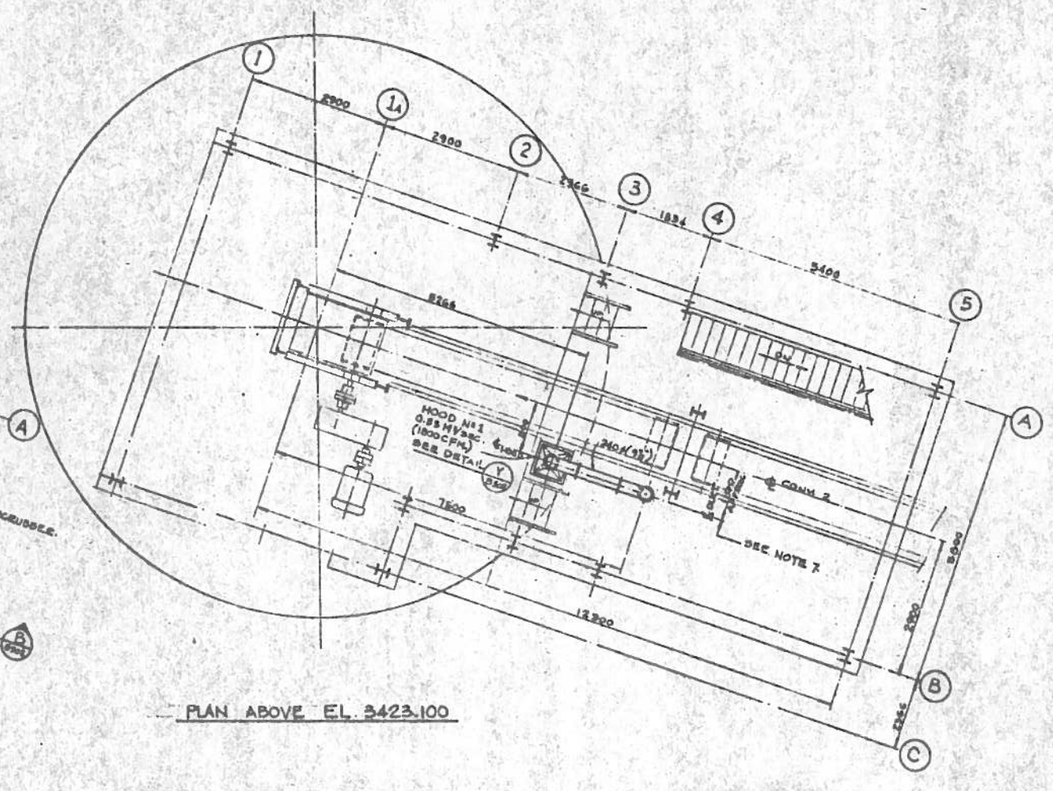
SCALE: AS NOTED

WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

DWG. NO. E 1218 73 8502 A



PLAN ABOVE EL. 3393.900



PLAN ABOVE EL. 3423.100

EQUIPMENT:

(1) SCRUBBER: EQ Nº 73-8-001
WESTMIN EQ Nº HW 0328
DUCON MIKROPUL DYNAMIC SCRUBBER
SIZE 86 TYPE UW-4 MODEL IV
RATED FOR 1.91 M³/sec. (3200 C.F.M.)
@ 1.24 kPa (-5" W.G.) INLET STATIC PRESSURE.
FAN R.P.M. 1992, B.H.P 11.6
C/W - INLET WEAR LINER.
- GACOTE NA-62 NEOPRENE ASPHALT LINING.
- INTEGRAL FAN & 19 H.P DRIVE (LESS MOTOR.)
- INLET WATER NOZZLES.
- FAN / SCRUBBER INTERCONNECTING DUCTING.

(2) MOTOR: EQ Nº 73-092
15 H.P 1800 R.P.M. 575V. 3PH. 60 Hz
T.E.F.C. FRAME 254-T.

NOTES:
UNLESS NOTED OTHERWISE ON THIS DRAWING THE FOLLOWING SHALL APPLY:

1 ALL MATERIALS & WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPEC. Nº 19444, CONTRACT 10-3-1.

2 ALL ELBOWS AND BLAST GATES SHALL BE RUBBER LINED.

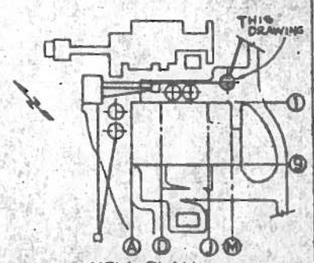
3 B.G. DENOTES BLAST GATE
C.O. DENOTES CLEAN-OUT.

4 FOR STANDARD BLAST GATES, CLEAN-OUTS & DUCT FLANGES SEE REF 2.

5 SCRUBBER, FAN, MOTOR & DRIVE WILL BE SUPPLIED BY WESTMIN RESOURCES LTD. FOR INSTALLATION BY THE CONTRACTOR.

6 FOR ELEVATION, SECTION AND DETAILS SEE REF Nº 2.

7 2404 DUCT TO BE ATTACHED TO CONV. TAKE-UP FRAMING. CONTRACTOR TO CHECK WITH OVERLAND CONVEYOR FOR CORRECT LOCATION.



KEY PLAN

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

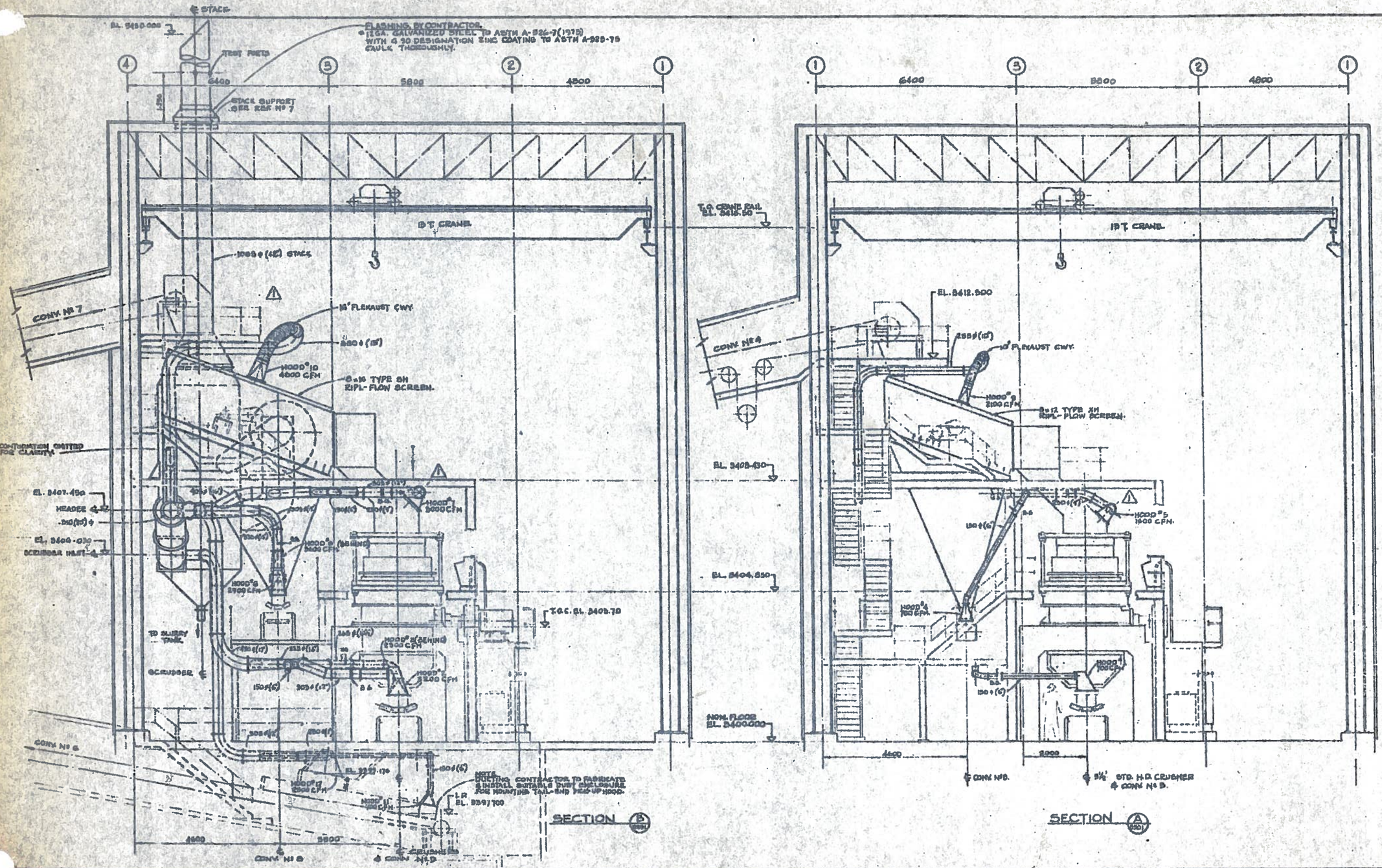
COARSE ORE BIN
DUST CONTROL
PLANS

ISSUED FOR	DATE	No.
QUOTATION 10-7-73		
CONSTRUCTION 10-8-73		A

DESCRIPTION OF REVISION	DATE	No.
ELEV. LINE 3000, NO CHANGE		A

No.	DWG. No.	REFERENCE	No.	DWG. No.
11			7	
10			6	
9		STRUCT. STEEL	5	1218-73-
8		DUST CONTROL STANDARDS	4	1218-74-8505
7		C.O.D. DIC ELEV. SECT & DETAILS	3	1218-73-8502
6		PIPING G.A.	2	12-5-73-8701
		SCALE: 1:50	1	

WRIGHT ENGINEERS LIMITED
VANCOUVER——CANADA
DWG. No. E 1218 73 8501 A



FOR GENERAL NOTES SEE REF Nº 1

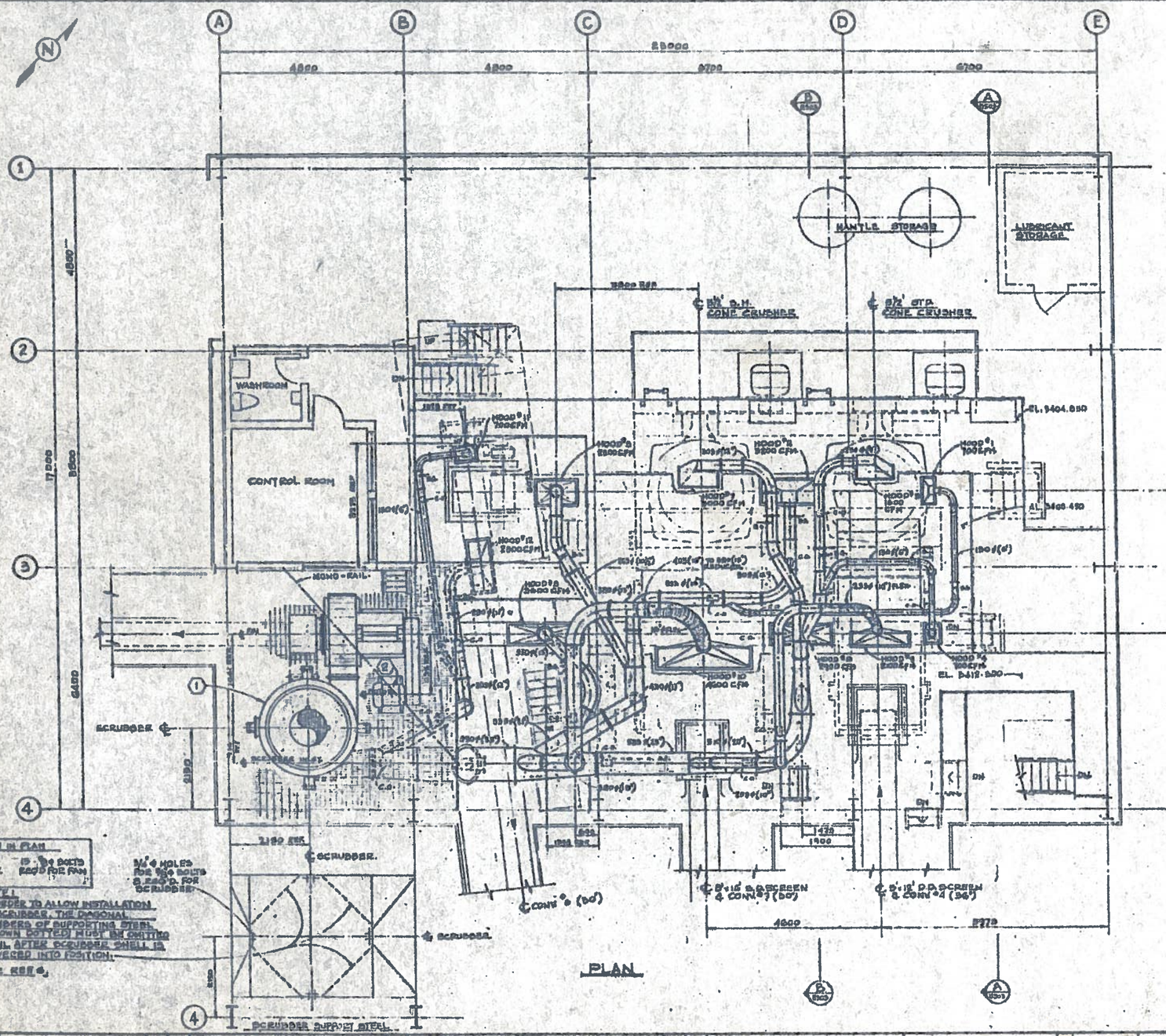
WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

CRUSHING PLANT DUST CONTROL SECTIONS

ISSUED	APPROVAL	ISSUED FOR	DATE	BY	DESCRIPTION OF REVISION	ISSUED	APPROVAL	ISSUED FOR	DATE	BY	DESCRIPTION OF REVISION	REFERENCE	No.	DWG. No.	REFERENCE	No.	DWG. No.	REFERENCE	No.	DWG. No.
RCW	RJH	TN	QUOTATION 10-3-1										11		CR. PLT. ROOF PLAN SHT 2 DETAILS	9	218-74-8502	CR. PLANT DIC DETAILS & DOORS	5	218-74-8561
RCW	RJH	TN	QUOTATION 10-5-1	10/5	1	"HOLD" (3 PLACES) & EL. 3412.300 REMOVED.							10		CR. PLT. FLATWORK SHS PLAN & DET.	6	218-74-8508	CR. PLANT DIC ELEVATION	3	218-74-8552
		RS	CONSTRUCTION 10-5-2	10/5	A	NO CHANGE							9		CR. PLT. DUST CONTROL DETAILS SH 3	8	218-74-8506	CR. PLANT DIC PLAN	1	218-74-8501
													8		TR. HS DUST CONTROL STANDARDS	4	218-74-8509	SCALES:		

WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

DWG. No. E 1218 74 8503



PLAN

EQUIPMENT SUPPLIED BY OWNER

(1) SCRUBBER | EQ Nº 1218-074-S-012
WESTMIN P.O. Nº NW 0329

DUCON DYNAMIC SCRUBBER SIZE 102 TYPE NW4 MODEL IV RATED FOR 18.2 MM³/SEC (37400 CFM) AT 4.74 kPa (19" W.C.) INLET STATIC PRESSURE.
C/W- INLET WEAR LINER.
- GACOTE NA 62 NEOPRENE ASPHALT LINING.
- INTEGRAL FAN & 150 H.P. DRIVE. (LESS MOTOR.)
- INLET WATER NOZZLES.
- FAN/SCRUBBER INTERCONNECTING DUCTING.

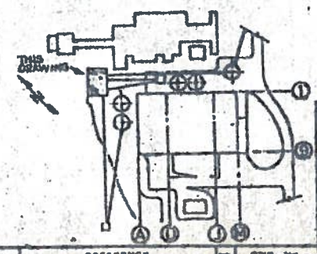
FAN RPM 888 BHP. 117.5

(2) MOTOR | EQ Nº 24-087

150 H.P. 1800 R.P.M. T.E.F.C. FR. 445 T 575 V. 3PH. 60Hz.

NOTE S:
UNLESS NOTED OTHERWISE ON THIS DRAWING, THE FOLLOWING SHALL APPLY.

1. ALL MATERIALS & WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPECIFICATION Nº 15844, CONTRACT 10-S-1
2. ALL ELBOWS & BLAST GATES SHALL BE RUBBER-LINED UNLESS OTHERWISE NOTED.
3. BG. ON DWG. DENOTES BLAST GATE. C.O. ON DWG. DENOTES CLEAN-OUT.
4. FOR ELEVATIONS, SECTIONS, DETAILS STANDARDS & SCHEMATIC SEE REFERENCES 1, 2, 3, 4 & 5.
5. FOR CONVENIENCE HOOD VOLUMES ARE SHOWN IN C.F.M. ON PLANS & SECTIONS M³/SEC & (C.F.M.) ARE SHOWN ON THE SCHEMATIC REF 5.



WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

CRUSHING PLANT DUST CONTROL PLAN

WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

DWG. No. E 1218 74 8501

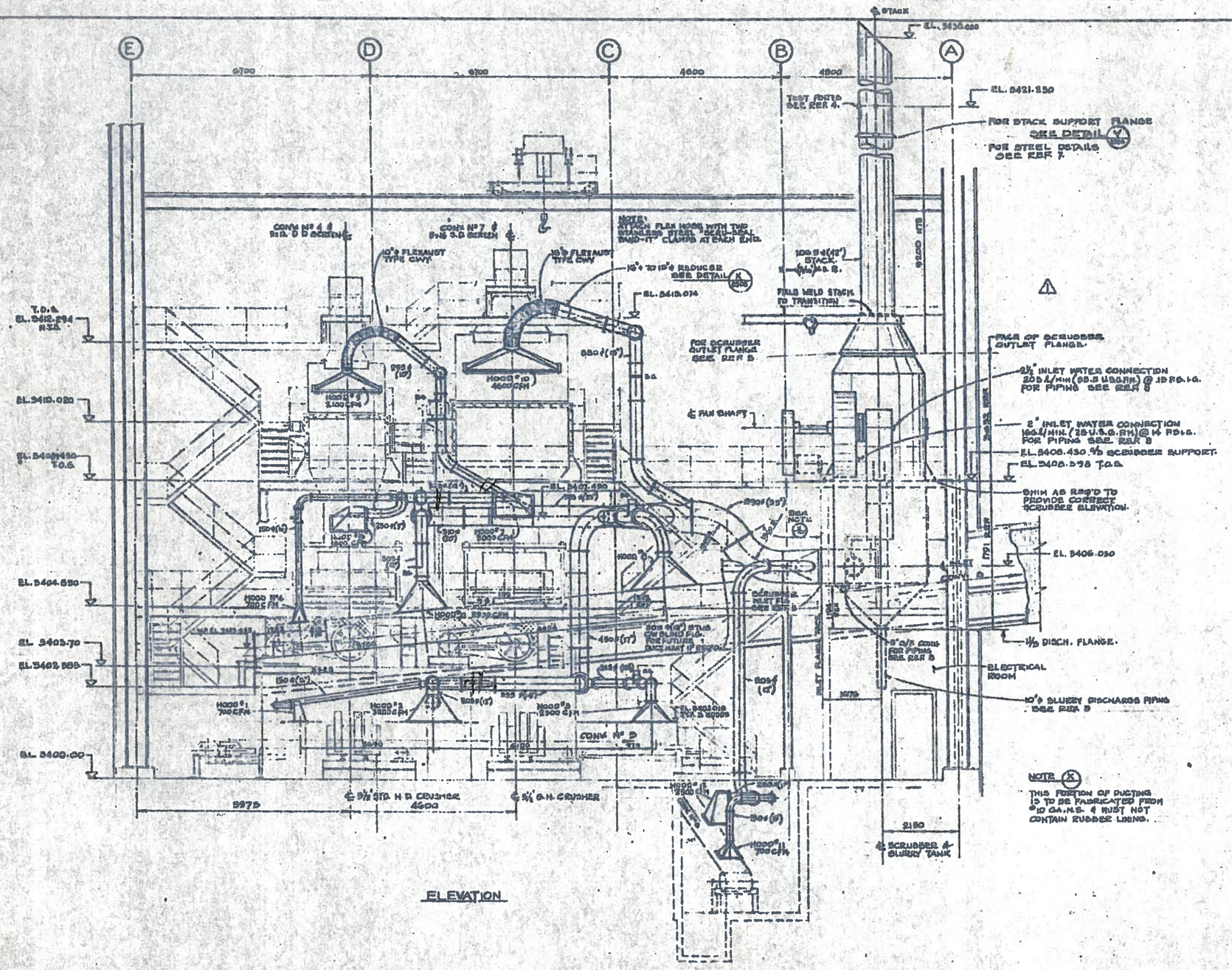
ISSUED FOR	DATE	ITEM
QUOTATION (0-S-1)		
APPROVAL (0-S-1)		
CONSTRUCTION (0-S-1)		

DESCRIPTION OF REVISION	DATE	ITEM
CONTRACT NO. ADDED		1
NO CHANGE		A

ISSUED FOR	DATE	ITEM

DESCRIPTION OF REVISION	REFERENCE	ITEM

REFERENCES	DWG. NO.	REFERENCE	ITEM	DWG. NO.
		2B PLT. DUST CONTROL DIST. & CONN	8	218-74-8504
C.B. PLT. PLATFORMS AND PLANS 1 DIST	6	218-74-8503	2B PLT. DUST CONTROL SECTIONS	5	218-74-8503
2B PLT. DUST CONTROL DETAILS SH. 2	5	218-74-8506	2B PLT. DUST CONTROL ELEVATION	1	218-74-8502
2B PLT. DUST CONTROL STANDARDS	4	25-74-8509	SCALE: 1:50		



ELEVATION

FOR GENERAL NOTES SEE REF. Nº 1

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

CRUSHING PLANT
DUST CONTROL
ELEVATION.

ISSUED FOR	DATE	BY	DESCRIPTION OF REVISION
QUOTATION 10-5-1	10-5-1		
BASE STUDY 10-5-1	10-5-1	1	ELEVATION 9/16 AIR REMOVED
(DUST SUPPRESSION) 10-5-1	10-5-1	A	NO CHANGE

ISSUED FOR	DATE	BY	DESCRIPTION OF REVISION

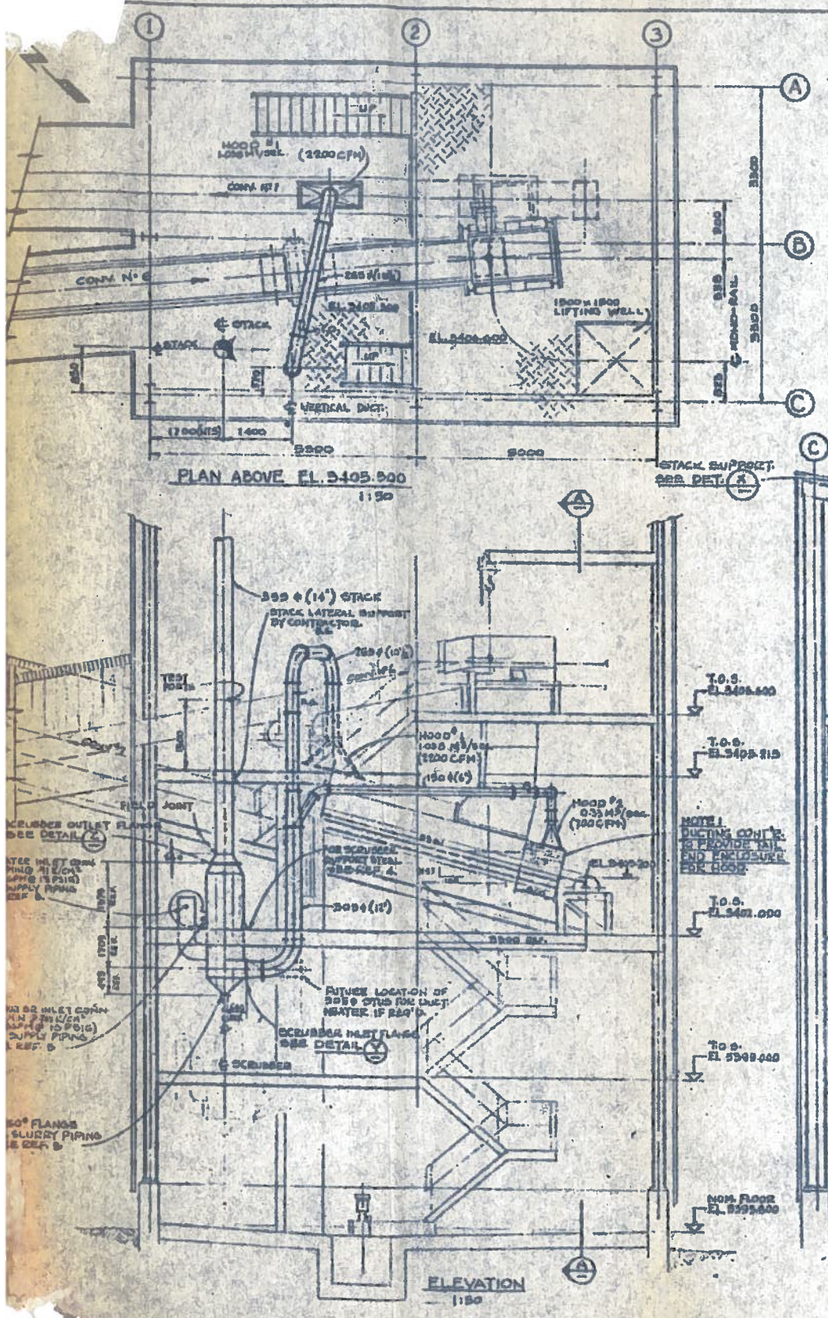
REFERENCE	NO.	DWG. No.
PIPING ARRANGEMENT PLAN	0	218-74-9701

REFERENCE	NO.	DWG. No.
CR. PLT ROOF PLAN SECT. & DETAILS	9	218-74-8002
CR. PLT PLATFORMS NO. 9 PLANS & SECT	6	218-74-8008
CR. PLT. DUST CONTROL DETAILS NO 8	6	218-74-8108
CR. PLT. DUST CONTROL SCHEDULE STANDARDS	6	218-74-8109

REFERENCE	NO.	DWG. No.
CR. PLT DUST CONTROL DET & SCHED	8	218-74-8104
CR. PLT D/C SECTIONS	8	218-74-8105
CR. PLT D/C PLAN	1	218-74-8101
SCALE: 1:50		

WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

DWG. No. E 1218 74 8502

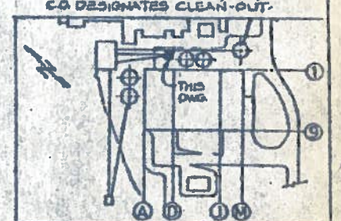


EQUIPMENT

1. SCRUBBER, EQ N° M-A-017
   WESTMIN RQ N° HW 0316
   DUCON DYNAMIC SCRUBBER SIZE 54 TYPE DW4 MODEL 10
   RATED FOR 1.57 M³/sec. (2900 CFM) @ 0.998 KPa. (-4" WG.) INLET STATIC PRESSURE.
   FAN RPM. 1849 BHP 9.7
   C/W - INLET WEAR LINER.
   - GACOTE NA-62 NEOPRENE ASPHALT LINING.
   - INTEGRAL FAN & 15 HP DRIVE (LESS MOTOR)
   - INLET WATER NOZZLES.
   - FAN/SCRUBBER INTERCONNECT DUCTING.
2. MOTOR EQ N° 74-039
   15 HP 1800 RPM. 575V. 3PH 60 Hz. TEFC FRAME 254-T

NOTES:
UNLESS NOTED OTHERWISE ON THIS DRAWING, THE FOLLOWING SHALL APPLY:

1. ALL MATERIALS & WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPEC. N° 15844, CONTRACT 80-9-1.
2. SCRUBBER, FAN, MOTOR & DRIVE SHALL BE SUPPLIED BY WESTMIN RESOURCES LTD FOR INSTALLATION BY CONTRACTOR.
3. ALL ELBOWS & BLAST GATES ARE TO BE RUBBER-LINED CONSTRUCTION
4. FOR STANDARD BLAST GATES, CLEAN-OUTS, FLEXIBLE CONNECTIONS & DUCT FLANGES SEE REF 1.
5. B.G. DESIGNATES BLAST GATE. C.O. DESIGNATES CLEAN-OUT.



WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

TRANSFER HOUSE CONV. 6 TO 7
DUST CONTROL
PLANS, ELEV., SECT. & DETAILS

WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

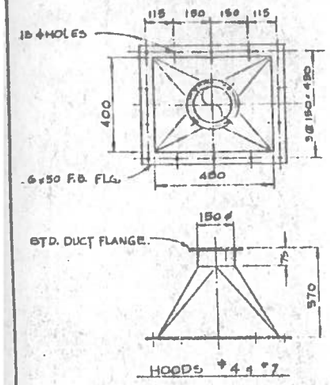
DWG. No. E 1218 74 8507 A

ISSUED FOR	DWN	APP'D	DESCRIPTION OF REVISION
QUOTATION 10-5-74	TH		
SECTIONAL 10-5-1	TH		
CONSTRUCTION 10-5-1	TH	A	10 GA. PL'S. ADDED NO CHANGES

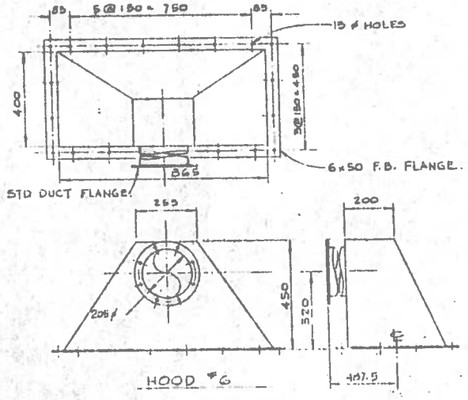
REFERENCE	DWG. No.
PIPING GENERAL ARRANGEMENT	1218-74-3708
STRUCT. STEEL ROOF PLAN	1218-74-3811

REFERENCE	DWG. No.
30" CONV. SLITTING INSTALLATION	1218-10-8509
1/4 CONV. 6 TO 7 TRANSF. HOUSE	1218-74-8416
DUST CONTROL STANDARDS	1218-74-8509

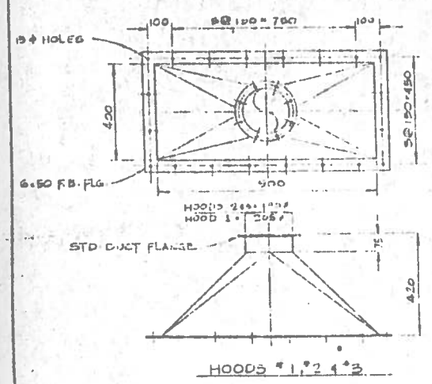
SCALE: AS NOTED



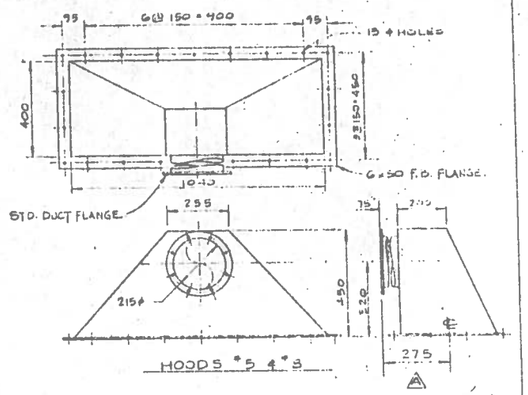
HOODS #4 & #7



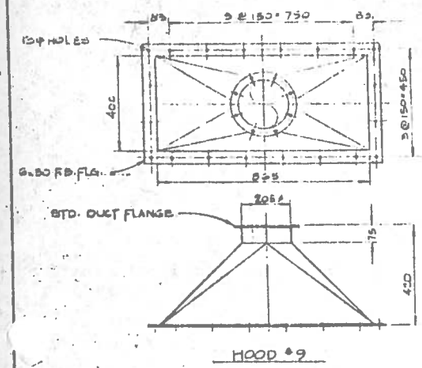
HOOD #6



HOODS #1, 2 & 3

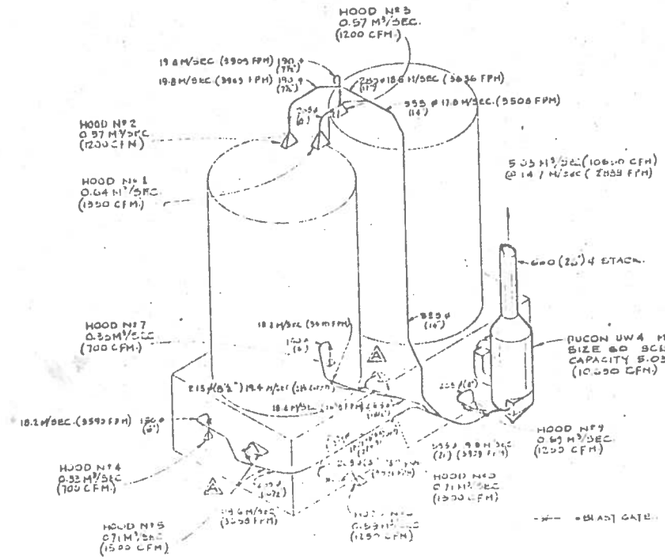


HOODS #5 & #8



HOOD #9

NOTE 1. ALL HOOD DETAILS SCALE 1:10



SCHEMATIC ARRANGEMENT

FOR GENERAL NOTES SEE REF. 1

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

FINE ORE BINS
DUST CONTROL
DETAILS & SCHEMATIC

WRIGHT ENGINEERS LIMITED
VANCOUVER — CAN

DWG. NO. E 1218 78 6503

ENGR.	APPROVAL	ISSUED FOR	DATE	DES.
AJ	NEW AM TN	QUOTATION 10-6-1	5/11	—
AJ	NEW RW DS	CONSTRUCTION 10-8-1	MAY 13/14	A

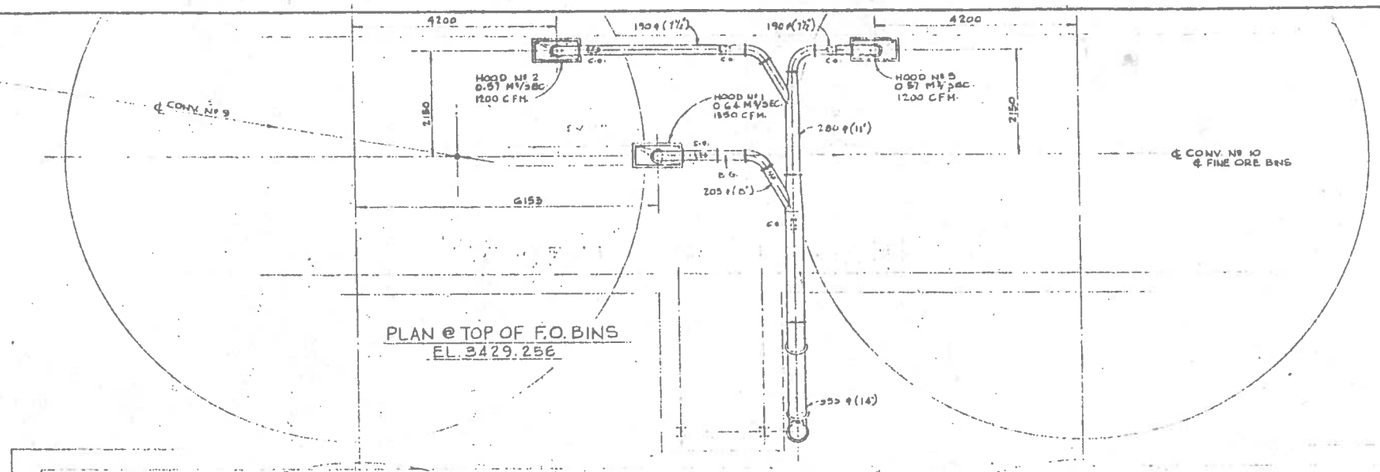
DESCRIPTION OF REVISION	WORK ORDER	ENGR.	APPROVAL
DIM WAS 775 & 825 & SCHEMATIC REVISED			

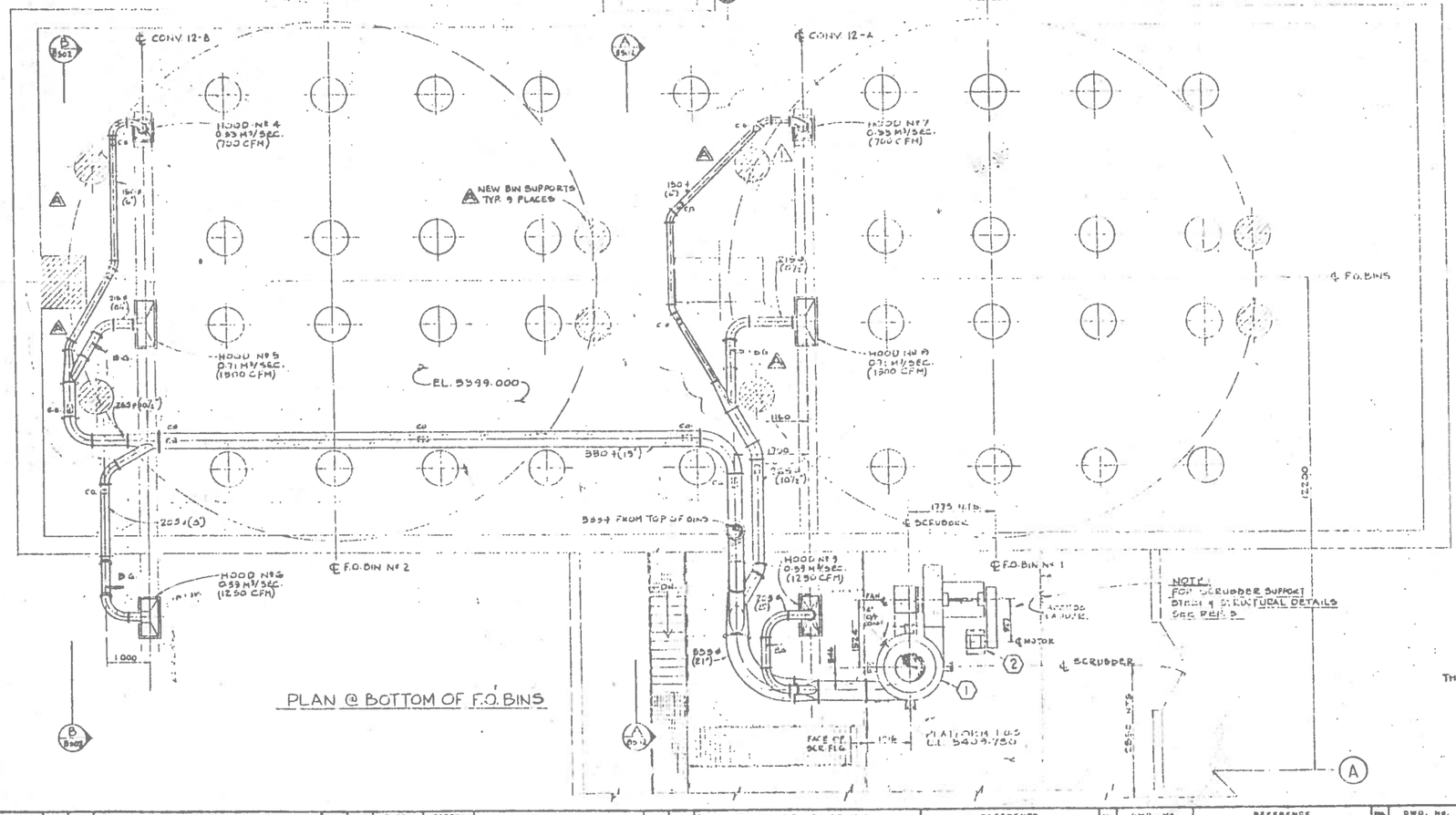
ISSUED FOR	DATE	DES.

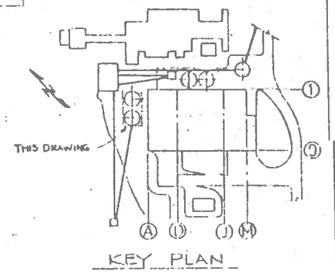
DESCRIPTION OF REVISION	REFERENCE

NO.	DWG. NO.	REFERENCE
11		
10		
9		
8		F.O.B. TOP & BOTTOM G/A'S

NO.	DWG. NO.	REFERENCE	NO.	DWG. NO.
7			3	1E-74-ES-5
6			2	1E-74-ES-4
5			1	1E-74-ES-3
4	6-78 6431			







EQUIPMENT SPECS.

(1) SCRUBBER: EQ.Nº 78-8-901
WESTMIN PO HW 0528

DUCON DYNAMIC SCRUBBER
SIZE 60, TYPE UW4, MODEL IV
RATED FOR 5.03 M³/SEC. (10650 CFM)
@ 1.241 kPa. (5" WG.) INLET STATIC
PRESSURE.
C/W. - INLET WEAR LINER
- GACUTE NA-62 NEOPRENE
ASPHALT LINING.
- INTEGRAL FAN & COUPL.
DRIVE, LESS MOTOR
- INLET WATER NOZZLES
- FAN/SCRUBBER INTER-
CONNECTING DUCTING.
FAN RPM: 1334 ± BHP 44.7

(2) MOTOR: EQ.Nº 78-115

50 HP 1800 RPM 575 V. 3PH 60 Hz.
TEFC. FR. 326-T.

NOTES:
UNLESS NOTED OTHERWISE ON
DRAWING, THE FOLLOWING APPLY:

1. ALL MATERIALS & WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPECIFICATIONS CONTRACT 10 & 1
2. ALL DUCT ELBOWS & BLAST GATES SHALL BE 3 SEGMENT LONG.
3. SCRUBBER, FAN & MOTOR SHALL BE SUPPLIED BY THE OWNER FOR INSTALLATION BY THE CONTRACTOR.
4. B.G. - DESIGNATES BLAST GATE
C.O. - DESIGNATES CLEAN-OUT
5. FOR DUST CONTROL SECTIONS, DETAILS & SCHEMATIC SEE REF. 1 & 2
6. FOR STANDARD BLAST GATES CLEAN-OUTS, FLANGES ETC. SEE REF. 3
7. DUCT PENETRATIONS OF EXTERNAL WALLS SHALL BE WEATHER PROOFED AND FLASHED BY CONTRACTOR.

ISSUED FOR	DATE	REV	DESCRIPTION OF REVISION
QUOTATION 10-9-1	10-9-1		
CONSTRUCTION 10-12-1	10-12-1	1	"HOLD" REMOVED ADDED 9 BIN SUPPORTS & REVISED DUCTING AS BUILT

REFERENCES	No.	DWG. No.
F.O.B. PLAN ELEV. SECT & DETAILS	9	218-78-5601
F.O.B. CONC. OUTLINE	10	218-78-3501
F.O.B. D.C. BUILDING - PLAN SECT DETS	8	218-10-3608
F.O.B. TERMINATION LEVELS G.A.	4	218-78-5401

REFERENCE	No.	DWG. No.
DUST CONTROL STANDARDS	3	[illegible]
F.O.B. DUST DUCT DETAILS	2	218-78-3502
F.O.B. DUST CONTROL SECT'S	1	218-78-3503

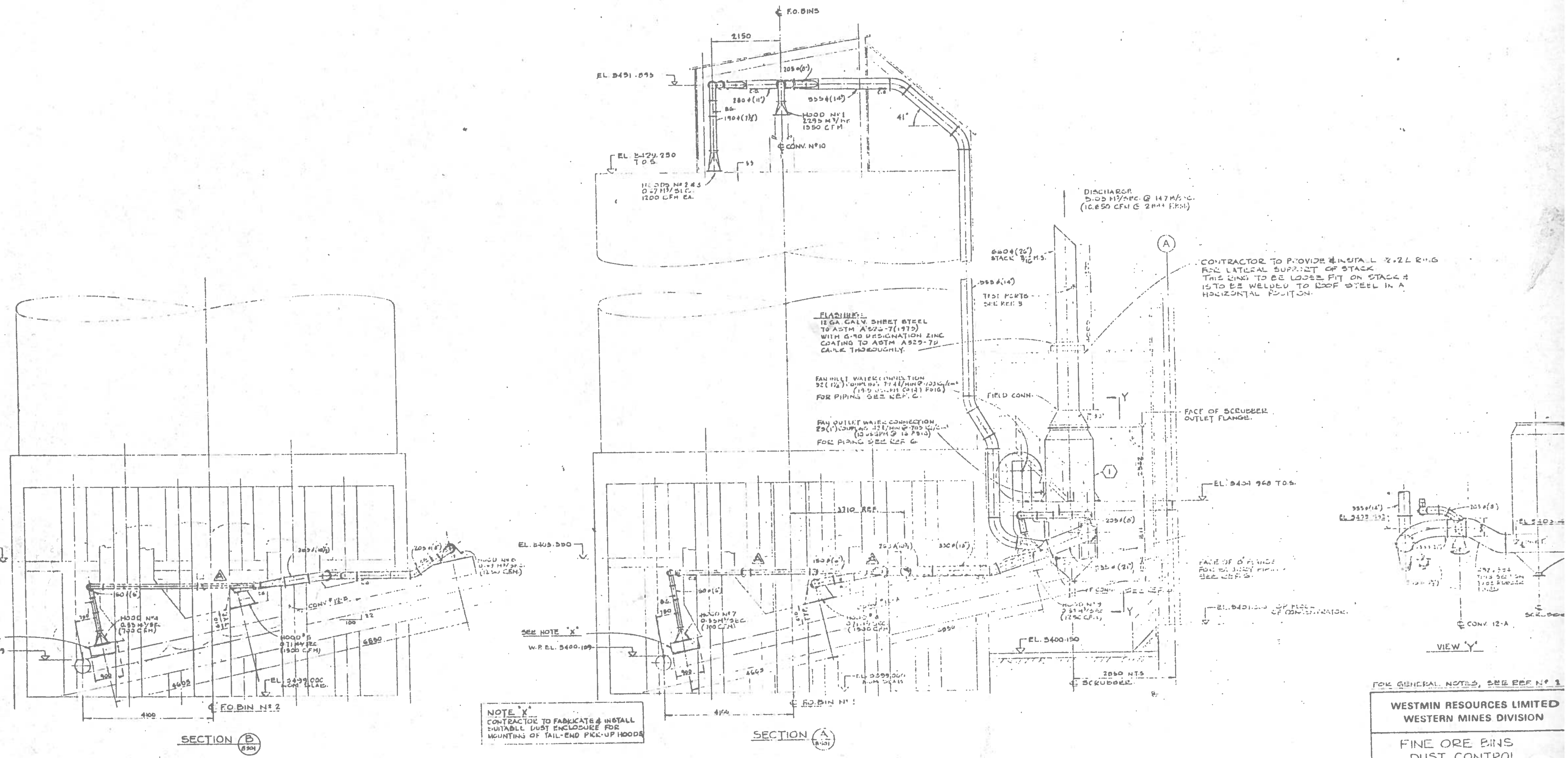
SCALE: 1:50

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

FINE ORE BINS
DUST CONTROL
PLANS

WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

DWG. No. E 1218 78 8501 A



NOTE "X"
CONTRACTOR TO FABRICATE & INSTALL SUITABLE DUST ENCLOSURE FOR MOUNTING OF TAIL-END PICK-UP HOODS

FOR GENERAL NOTES, SEE REF Nº 1

REV.	ISSUED FOR	DATE	REV.	DESCRIPTION OF REVISION
	QUOTATION 10-54			
	CONSTRUCTION 10-5-1		A	DUCTING REVISED

NO.	DWG. NO.	REFERENCE
11	1218-78-8501	F.O.B. PLAN ELEV. SECT. & DETAILS
10	1218-78-5701	F.O.B. PIPING G.A.
9	1218-78-3501	F.O.B. PLAN & EL. CONCRETE OUTLINE
8	1218-78-5405	F.O.B. TOP & BOTTOM LEVELS G.A.

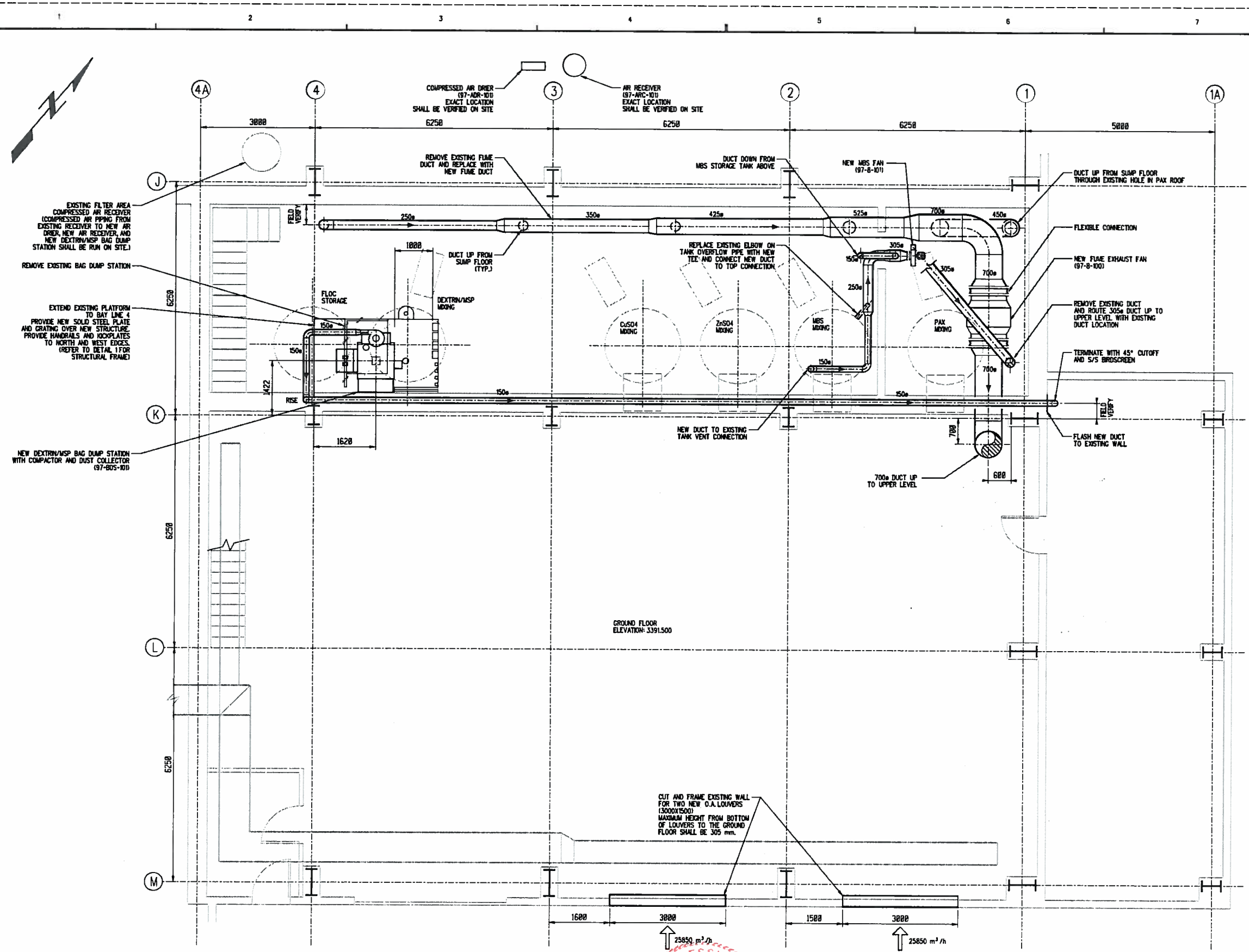
SCALE: 1:50

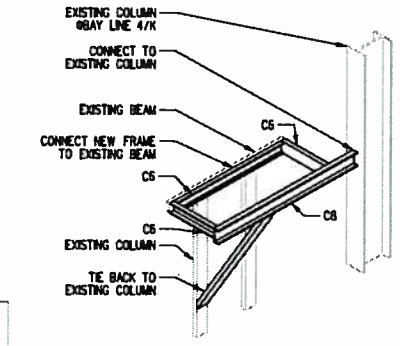
WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION

FINE ORE BINS
DUST CONTROL
SECTIONS

WRIGHT ENGINEERS LIMIT
VANCOUVER — CAN

DWG. NO. E 1218 78 8502





DETAIL 1
PLATFORM EXTENSION STRUCTURAL FRAME

DUCT LEGEND

250ø — ROUND DUCT AND SIZE

ROUND DUCT - TOWARDS, AWAY

SMOOTH RADIUS

NOTE:
1. THESE DRAWINGS ARE BASED UPON PRELIMINARY VENDOR INFORMATION AND NEED TO BE VERIFIED UPON RECEIPT OF CERTIFIED VENDOR DRAWINGS.
2. ALL DUCTING LOCATIONS TO BE VERIFIED BEFORE INSTALLATION.

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED
A	3MAR15	ISSUED FOR REVIEW	BD GH	GH
B	19MAR15	ISSUED FOR CLIENT REVIEW	BD GH	GH
0	26MAR15	ISSUED FOR CONSTRUCTION		

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED

REFERENCE DRAWING No.	REFERENCE DRAWINGS
-	-

PROFESSIONAL ENGINEER — X. F. HUANG — # 32094 — BRITISH COLUMBIA

nyrstar
MYRA FALLS, B.C.

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FLUOR.

DESIGNED BY B. DREW	DRAWN BY F. SONG		
CHECK DESIGN G.HUANG	CHECK DRAWING B.DREW		
LEAD ENGINEER/SPECIALIST G. HUANG	APPROVAL DATE 26MAR15		
AREA MANAGER	ENGINEERING MANAGER -		
PROJECT MANAGER B. DREW	APPROVAL DATE -		
CLIENT	APPROVAL DATE		

REAGENT AREA VENTILATION MODIFICATIONS - PHASE 1

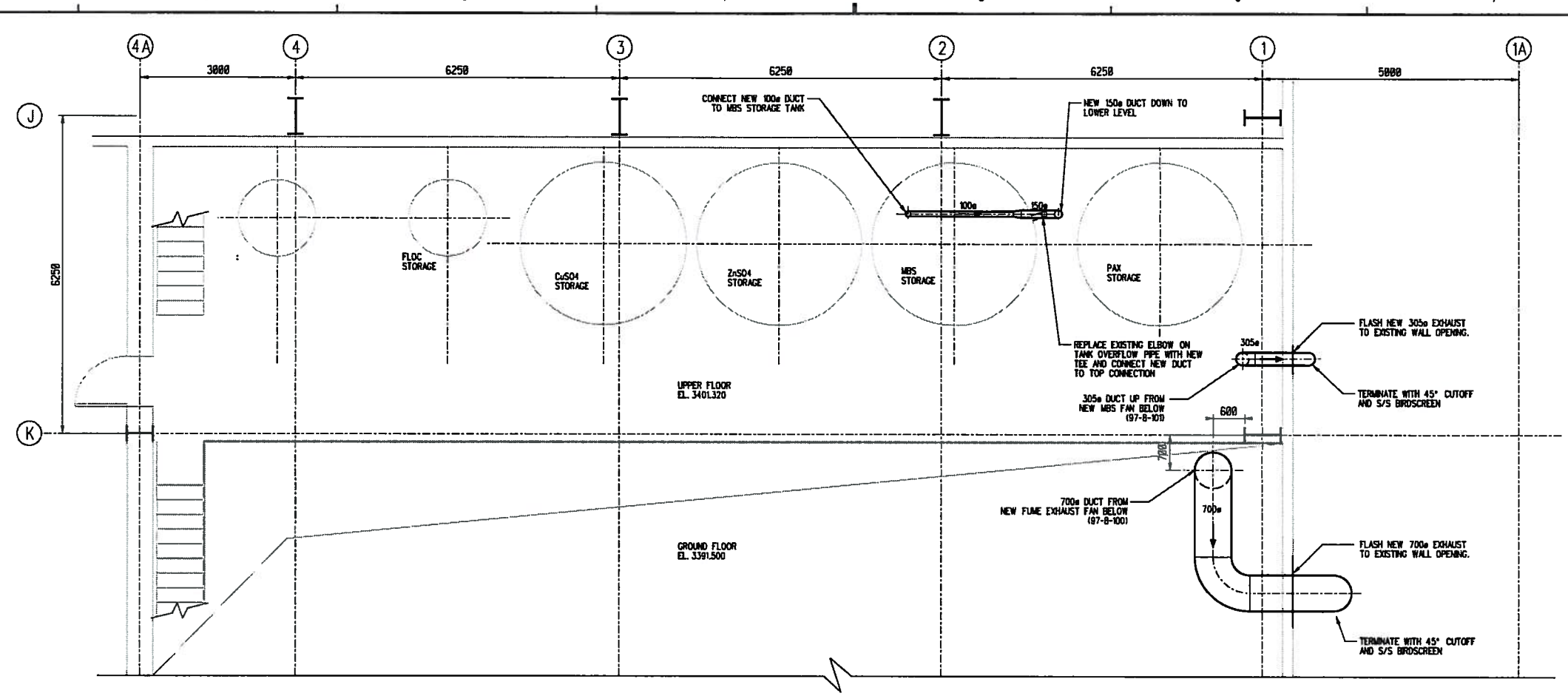
REAGENT AREA HEATING AND VENTILATION GROUND FLOOR PLAN

SCALE	DRAWING NUMBER	REV.
1:50	A9MV-97-235-C-1	0

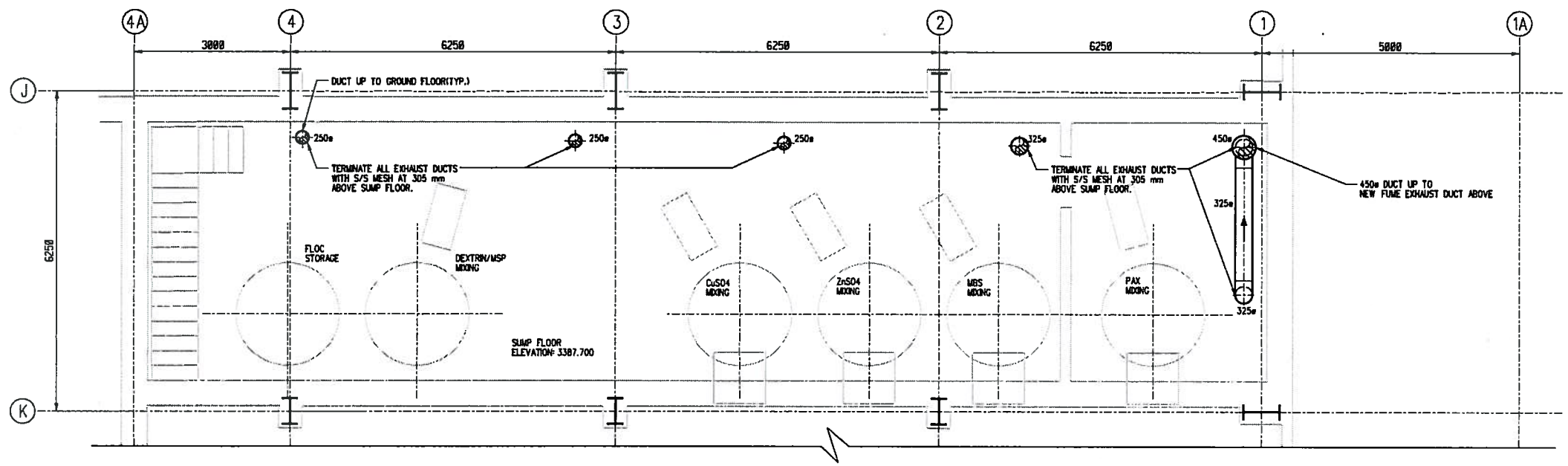
MANUAL CHANGES MADE - YES ☐ NO ☐ | DWG. FILE UPDATED - YES ☐ NO ☐ | MODEL UPDATED - YES ☐ NO ☐ △ | CADD FILE No. P:\CAD\ 235 \A9MV-97-235-C-1.DGN

▲ =DATE=TIME=

BABRPA1.DGN



UPPER FLOOR PLAN



SUMP FLOOR PLAN

NOTE:
1. THESE DRAWINGS ARE BASED UPON PRELIMINARY VENDOR INFORMATION AND NEED TO BE VERIFIED UPON RECEIPT OF CERTIFIED VENDOR DRAWINGS.
2. ALL DUCTING LOCATIONS TO BE VERIFIED BEFORE INSTALLATION.

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED	REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED
A	9MAR15	ISSUED FOR REVIEW	BD GH	GH					
B	19MAR15	ISSUED FOR CLIENT REVIEW	BD GH	GH					
0	26MAR15	ISSUED FOR CONSTRUCTION							

REFERENCE DRAWING No.	REFERENCE DRAWINGS
-	-

PROFESSIONAL ENGINEER — X.F. HUANG — # 32094 — JULY 31 — COLUMBIA — ENGINEER

nyrstar
MYRA FALLS, B.C.

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FLUOR.

DESIGNED BY B. DREW	DRAWN BY F. SONG		
CHECK DESIGN G.HUANG	CHECK DRAWING B.DREW		
LEAD ENGINEER/CONSULTANT C. HUANG	APPROVAL DATE 26MAR15		
AREA MANAGER	ENGINEERING MANAGER -		
PROJECT MANAGER B. DREW	APPROVAL DATE -		
CLIENT	APPROVAL DATE		

REAGENT AREA VENTILATION MODIFICATIONS - PHASE 1

REAGENT AREA
HEATING AND VENTILATION
UPPER FLOOR/SUMP FLOOR PLAN

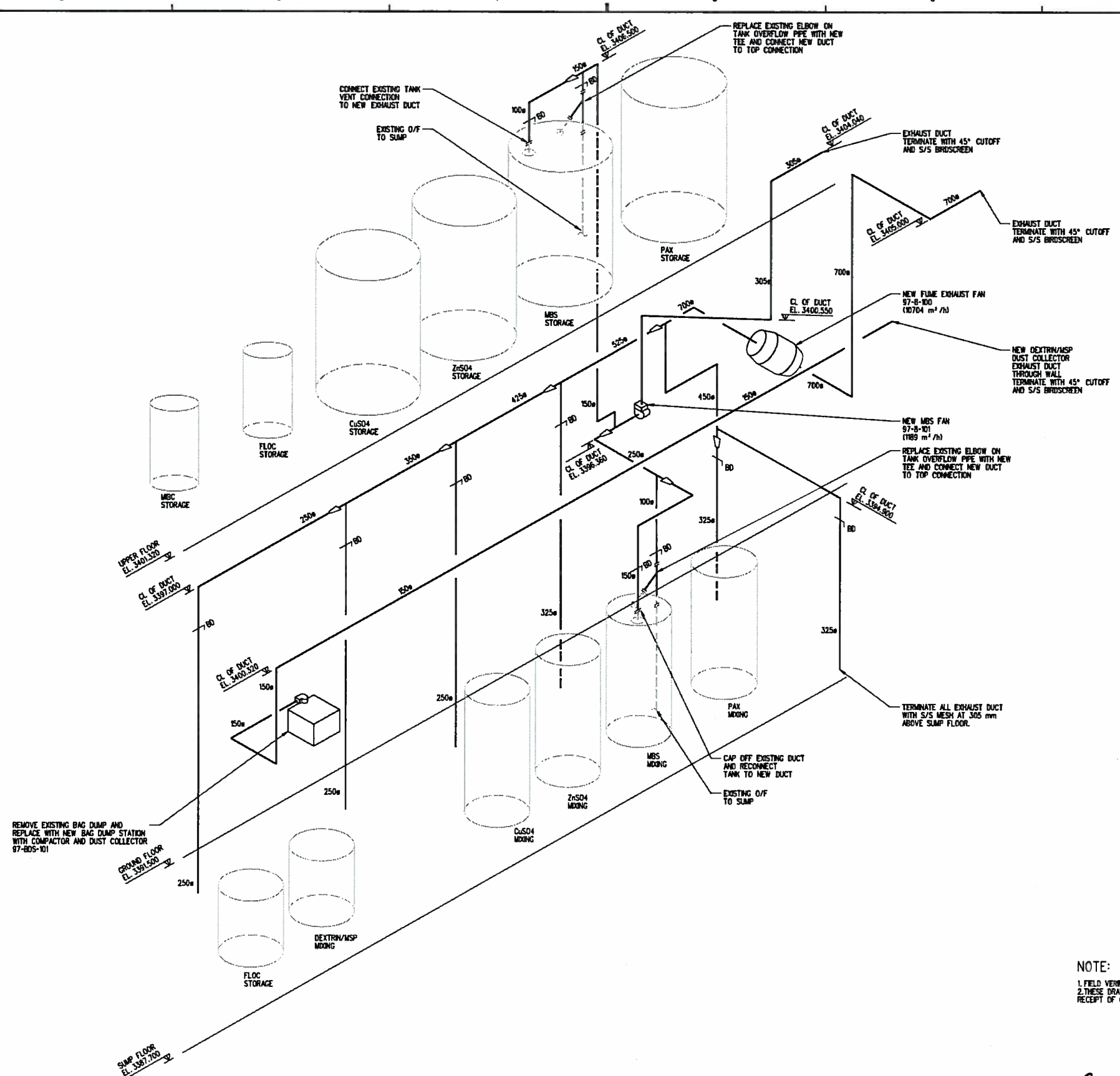
SCALE	DRAWING NUMBER	REV. NO.
1:50	A9MV-97-235-C-2	0

MANUAL CHANGES MADE - YES ☐ NO ☐ | DWG. FILE UPDATED - YES ☐ NO ☐ | MODEL UPDATED - YES ☐ NO ☐ △

CADD FILE No. P:\CAD\ 235 \A9MV-97-235-C-2.DGN

▲ •DATE•TIME•

BABRPA1.DGN



NOTE:

1. FIELD VERIFY LOCATION FOR NEW EQUIPMENT, DUCTWORK, AND ALL COMPONENTS BEFORE INSTALLATION.
2. THESE DRAWINGS ARE BASED UPON PRELIMINARY VENDOR INFORMATION AND NEED TO BE VERIFIED UPON RECEIPT OF CERTIFIED VENDOR DRAWINGS

REV	DATE	REVISION DESCRIPTION	DES. / CHK.	APPROVED
A	10MAR15	ISSUED FOR REVIEW	BD / GH	GH
B	19MAR15	ISSUED FOR CLIENT REVIEW	BD / GH	GH
0	26MAR15	ISSUED FOR CONSTRUCTION		

REV	DATE	REVISION DESCRIPTION	DES. / CHK.	APPROVED

REFERENCE DRAWING No.	REFERENCE DRAWINGS
-	-

REGISTERED PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA X. F. HUANG #32004

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nyrstar

MYRA FALLS, B.C.

FLUOR.

ENGINEER	B. DREW	DRAWN BY	F. SONG
CHECK DESIGN	G.HUANG	CHECK DRAWING	B.DREW
LEAD ENGINEER/SPECIALIST	G. HUANG	APPROVAL DATE	26MAR15
AREA MANAGER	-	ENGINEERING MANAGER	-
PROJECT MANAGER	B. DREW	APPROVAL DATE	-
CLIENT		APPROVAL DATE	

REAGENT AREA VENTILATION MODIFICATIONS - PHASE 1

REAGENT AREA HEATING AND VENTILATION DUCTWORK SCHEMATIC

SCALE	DRAWING NUMBER	REV.
N.T.S.	A9MV-97-235-C-3	0

CADD FILE No. P:\CAD\ 235 \A9MV-97-235-C-3.DGN

MANUAL CHANGES MADE - YES ☐ NO ☐ | DWG. FILE UPDATED - YES ☐ NO ☐ | MODEL UPDATED - YES ☐ NO ☐

*DATE*TIME*

B&BRPAT.DGN

EQUIPMENT SCHEDULES - PHASE 1 ONLY

EXHAUST FAN SCHEDULE

TAG NUMBER	DESCRIPTION	MATERIALS OF CONSTRUCTION	AIR FLOW RATE	EXTERNAL STATIC PRESSURE	POWER SUPPLY	ELECTRICAL CLASSIFICATION	MOTOR TYPE	MOTOR HP / RPM	COMMENTS / ACCESSORIES	MANUFACTURER / MODEL NUMBER	SUPPLIER / QUOTATION REFERENCE / DATE
97-B-100	FUME EXHAUST FAN, BIFURCATED FAN, DIRECT DRIVE, SPARK PROOF, MOUNTING FEET, VIBRATION ISOLATORS. S/S EXTENDED LUBE LINE. 304 S/S AIRSTREAM HARDWARE	FRP (HANDLES SO2)	2.95m3/s (6,244 CFM)	250 Pa (0.98" wc)	575/3/60	NONE	TEFC Mill & Chem	3 / 870	FLEXIBLE CONNECTIONS ON INLET AND DISCHARGE	HARTZEL A29B-366-E	OLYMPIC INTERNATIONAL AGENCIES / RG-0292R1 Feb 25th 2015
97-B-101	MBS FUME EXHAUST FAN, CENTRIFUGAL, BASE MOUNTED UTILITY, DIRECT DRIVE, SPARK PROOF, 304 S/S AIRSTREAM HARDWARE, ARGHAT CW 360 (upblast)	FRP (HANDLES SO2)	0.32m3/s (686 CFM)	190 Pa (0.75"wc)	575/3/60	NONE	TEFC Mill & Chem	0.5 / 1750	FLEXIBLE CONNECTIONS ON INLET AND DISCHARGE	HARTZEL A42-4-12-F100	OLYMPIC INTERNATIONAL AGENCIES / RG-0292R1 Feb 25th 2015

AIR PROVING TRANSMITTER SCHEDULE

TAG NUMBER	DESCRIPTION	MATERIALS OF CONSTRUCTION	LOW PRESSURE SIDE	HIGH PRESSURE SIDE	SIGNAL OUTPUT	ELECTRICAL CLASSIFICATION	MOTOR TYPE	MOTOR HP / RPM	COMMENTS / ACCESSORIES	MANUFACTURER / MODEL NUMBER	SUPPLIER / QUOTATION REFERENCE / DATE
PS-97-100	DELTA P TRANSMITTER - SUPPLIED LOOSE FOR FIELD INSTALLATION ONTO THE DISCHARGE DUCT OF FUME EXHAUST FAN 97-B-100	STAINLESS STEEL	AMBIENT	+25Pa	4-20mA	Class 2 Div 2	N/A	N/A	INTRINSICALLY SAFE. WELD FERRULE ONTO STAINLESS STEEL PLATE, AND ATTACH PLATE ONTO DUCTING. LOW SIDE OF TRANSMITTER IS OPEN TO ROOM PRESSURE	MENARDIPULSE PRO DP20T	TRANSCONTINENTAL ENGINEERED PRODUCTS MARCH 25 2015
PS-97-101	DELTA P TRANSMITTER - SUPPLIED LOOSE FOR FIELD INSTALLATION ONTO THE DISCHARGE DUCT OF MBS EXHAUST FAN 97-B-101	STAINLESS STEEL	AMBIENT	+25Pa	4-20mA	Class 2 Div 2	N/A	N/A	INTRINSICALLY SAFE. WELD FERRULE ONTO STAINLESS STEEL PLATE, AND ATTACH PLATE ONTO DUCTING. LOW SIDE OF TRANSMITTER IS OPEN TO ROOM PRESSURE	MENARDIPULSE PRO DP20T	TRANSCONTINENTAL ENGINEERED PRODUCTS MARCH 25 2015

BAG DUMP STATION SCHEDULE

TAG NUMBER	DESCRIPTION	MATERIALS OF CONSTRUCTION	AIR FLOW RATE	EXTERNAL STATIC PRESSURE	POWER SUPPLY	ELECTRICAL CLASIFICATION	MOTOR TYPE	MOTOR HP	COMMENTS / ACCESSORIES	MANUFACTURER / MODEL NUMBER	SUPPLIER / QUOTATION REFERENCE / DATE
97-BDS-101	DUMP STATION FOR 25kg DEXTRINE AND MSP BAGS. WITH INTEGRAL PNEUMATIC VERTICAL EMPTY BAG COMPACTOR, AND CARTRIDGE DUST COLLECTOR AND EXHAUST FAN	900X900, 10 GAUGE FOOD GRADE STAINLESS STEEL HOPPER WITH 2B MILL FINISH. STAINLESS STEEL EXHAUST FAN	0.19m3/s (400 cfm)	625 Pa (2.5"wc)	575/3/60	CLASS II DIV 2 GROUP G	TEFC	2	S/S HOPPER 10" DIAMETER DISCHARGE, PNEUMATIC VIBRATORS, BAR GRATE WITH BAG SLITTER, SUPPORT LEGS, INTEGRAL PNEUMATIC VERTICAL EMPTY BAG COMPACTOR, AND CARTRIDGE DUST COLLECTOR AND EXHAUST FAN, NEMA 4X CONTROL PANEL. ALL MOUNTED ON A COMMON BASE FRAME, INDICATOR LIGHTS, PHOTOHELIC GAUGE.	HAPMAN MODEL #36FL. WITH BAG COMPACTOR AND CARTRIDGE DUST COLLECTOR	HUB MARKETING LTD, HD-59776-2, 19th FEB 2015 - ALTERNATE SUPPLIER SPIROFLOW QUOTE 13228

COMPRESSED AIR DRIER AND AIR RECEIVER SCHEDULE

TAG NUMBER	DESCRIPTION	MATERIALS OF CONSTRUCTION	AIR FLOW RATE	EXTERNAL STATIC PRESSURE	POWER SUPPLY	ELECTRICAL CLASIFICATION	MOTOR TYPE	MOTOR HP	COMMENTS / ACCESSORIES	MANUFACTURER / MODEL NUMBER	SUPPLIER / QUOTATION REFERENCE / DATE
97-ADR-101	WALL MOUNTED COMPRESSED AIR DRIER, TWIN TOWER HEATLESS TYPE, SOLID STATE TIMER, DESICANT FILLED, DEWPOINT MINUS 40 °C	3/4" INLET AND OUTLET CONNECTIONS	0.024m3/s (50 Scfm)	N/A	120/1/60	NONE, NEMA 4	N/A	N/A	INCLUDE PRE-FILTER, AFTER FILTER, AND PURGE EXHAUST MUFFLER. ALL PREPIPED	PNEUMATIC PRODUCTS MODEL 900HD-F01	TRANSCONTINENTAL ENGINEERED PRODUCTS (TEP) MARCH 25, 2015
97-ARC-101	VERTICAL AIR RECEIVER, 0.227 m³/h (60 US GALLONS)	CARBON STEEL, ASME PRESSURE VESSEL	N/A	N/A	N/A	N/A	N/A	N/A	PRESSURE RELIEF VALVE	0.227 m³/h (60 GALLON)	TRANSCONTINENTAL ENGINEERED PRODUCTS (TEP) MARCH 25, 2015

OUTDOOR AIR INLET LOUVRE SCHEDULE

TAG NUMBER	DESCRIPTION	MATERIALS OF CONSTRUCTION	AIR FLOW RATE	EXTERNAL STATIC PRESSURE	POWER SUPPLY	ELECTRICAL CLASIFICATION	MOTOR TYPE	MOTOR HP	COMMENTS / ACCESSORIES	MANUFACTURER / MODEL NUMBER	SUPPLIER / QUOTATION REFERENCE / DATE
L-1	FIXED BLADE WALL LOUVRE, 3000X1500 HIGH X100 DEEP, REMOVABLE ALUMINUM	ALUMINUM, BAKED ENAMEL FINISH	N/A	N/A	N/A	N/A	N/A	N/A	49.5% FREE AREA, NO DAMPER	PRICE MODEL ZE445, AMCA RATED	EH PRICE LTD
L-2	FIXED BLADE WALL LOUVRE, 3000X1500 HIGH X100 DEEP, REMOVABLE ALUMINUM	ALUMINUM, BAKED ENAMEL FINISH	N/A	N/A	N/A	N/A	N/A	N/A	49.5% FREE AREA, NO DAMPER	PRICE MODEL ZE445, AMCA RATED	EH PRICE LTD

BACK DRAFT DAMPER SCHEDULE

TAG NUMBER	DESCRIPTION	MATERIALS OF CONSTRUCTION	LENGTH (mm)	WIDTH (mm)	COMMENTS / ACCESSORIES	MANUFACTURER / MODEL NUMBER
BDD-1	BACK DRAFT DAMPER FOR EXISTING WALL FAN 97-B-096, AIR FLOW RATE 32621 m³/h (19,200 CFM)	EXTRUDED ALUMINUM BLADES WITH EDGE SEALS, IN EXTRUDED ALUMINUM FRAME	1056	1056	TO MATCH EXISTING WALL FAN CANARM MODEL ADD 36. MOUNT ON FAN DISCHARGE WITH 45° DISCHARGE COWL WITH S/S BIRDSCREEN	CANARM PRICE MODEL S-E-32-42X42.

DUCTING SCHEDULE

TYPE	DESCRIPTION	MATERIALS OF CONSTRUCTION	COMMENTS / ACCESSORIES
S/S	316 STAINLESS STEEL DUST CONTROL DUCTING - ON DIRTY SIDE OF DUST COLLECTOR	14 GAUGE S/S, WELDED LONGITUDINAL SEAMS, (NOT SPIRAL) FLANGED AT 4m MAXIMUM LENGTHS	SMACNA CLASS 3 STANDARDS NEGATIVE PRESSURE OF 100mm wc. PROVIDE GASKETTED ACCESS DOORS ON ALL HORIZONTAL DUCTS AT 6m SPACING
S/S	316 STAINLESS STEEL DUST CONTROL DUCTING - ON CLEAN SIDE OF DUST COLLECTOR	22 GAUGE S/S SPIRAL	SMACNA CLASS 1 STANDARDS POSITIVE PRESSURE OF 50mm wc. PROVIDE DAMPERS FOR BALANCING AT EACH BRANCH
S/S	316 STAINLESS STEEL FUME EXHAUST DUCTING	22 GAUGE S/S SPIRAL	SMACNA CLASS 5 STANDARDS NEGATIVE PRESSURE OF 100mm wc. PROVIDE DAMPERS FOR BALANCING AT EACH BRANCH

GENERAL NOTES:

1.GENERAL

1.1. DISCONNECT AND REMOVE EXISTING COMPONENTS AS SHOWN ON THE DRAWINGS.

1.2. INSTALL ALL OWNER SUPPLIED EQUIPMENT IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND GOOD PRACTICE.

1.3. SUPPLY AND INSTALL ALL DUCTWORK, FITTINGS, FLEXIBLE CONNECTIONS, BALANCE DAMPERS, LOUVRES AND COWLS IN ACCORDANCE WITH THE LATEST EDITION OF SMACNA INDUSTRIAL DUCT CONSTRUCTION STANDARDS.

1.4. TEST, ADJUST AND BALANCE THE SYSTEM UPON COMPLETION OF THE SYSTEM INSTALLATION

1.5. SEAL, FLASH AND COUNTERFLASH WHERE DUCTING PASSES THROUGH EXTERIOR WALLS

2.COMPRESSED AIR PIPING

2.1. SUPPLY AND INSTALL THE COMPRESSED AIR PIPES, FITTINGS, AND ALL PIPING ACCESSORIES.

2.2. COMPRESSED AIR PIPING TO BE 10S STAINLESS STEEL, CONFORMING TO ASTM A312/312M, GRADE TP 316, AND ASME B36.19M

2.3. FITTINGS TO BE SOCKET WELDED, CONFORMING TO ASTM A182/182M, GRADE F 316, AND ASME B16.11

2.4. VALVES TO BE GLOBE TYPE, SOCKET WELDED END, STAINLESS STEEL CONFORMING TO ASTM A182/A182M, GRADE F 316.

2.5. ISOLATE OR REMOVE EQUIPMENT OR DEVICES FOR SYSTEM FLUSHING AND HYDROSTATIC AND LEAKAGE TESTES.

2.6. FLUSH THE COMPRESSED AIR PIPING SYSTEM AFTER THE SYSTEM INSTALLATION TO REMOVE ALL LOOSE DEBRIS AND THEN PRESSURIZE THE SYSTEM WITH CLEAN, OIL-FREE COMPRESSED AIR, CARBON DIOXIDE OR NITROGEN TO 125 PSIG FOR AT LEAST 10 MINUTES WITH NO PRESSURE DROP PERMITTED. THEN REDUCE THE PRESSURE TO 100 PSIG AND CHECK FOR LEAKS AND WEEPS.

REV	DATE	REVISION DESCRIPTION	DES.	CHK.	APPROVED
A	4MAR15	ISSUED FOR REVIEW	BD	GH	
B	19MAR15	ISSUED FOR CLIENT REVIEW	BD	GH	
0	26MAR15	ISSUED FOR CONSTRUCTION			

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED	REFERENCE DRAWING No.	REFERENCE DRAWINGS
					-	-

X. F. HUANG # 32094 ENGINEER

nyrstar

MYRA FALLS, B.C.

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FLUOR

DESIGN BY: D.DREW	DRAWN BY: F. SONG	REAGENT AREA VENTILATION MODIFICATIONS - PHASE 1	
CHECK DESIGN: G.HUANG	CHECK DRAWING: B.DREW		
LEAD ENGINEER/SPECIALIST: G. HUANG	APPROVAL DATE: 26MAR15	REAGENT AREA HEATING AND VENTILATION EQUIPMENT SCHEDULES	
AREA MANAGER:	ENGINEERING MANAGER: -		
PROJECT MANAGER: D.DREW	APPROVAL DATE: -		
CLIENT:	APPROVAL DATE:	SCALE: N.T.S.	DRAWING NUMBER: A9MV-97-235-C-4 REV: 0

▲ "DATE" "TIME"

MANUAL CHANGES MADE - YES ☐ NO ☐ | DWG. FILE UPDATED - YES ☐ NO ☐ | MODEL UPDATED - YES ☐ NO ☐ △

CADD FILE No. P:\CAD\ 235 \A9MV97-235-C-4.DGN

BABRPA1.DGN

ROOF

250ø THROUGH ROOF

200ø THROUGH ROOF

500ø

600ø

700ø

4,248 m³/h

4,248 m³/h

4,248 m³/h

WALL EXHAUST FAN (32,621 m³/h) 97-8-095

WALL EXHAUST FAN (32,621 m³/h) 97-8-096

REAGENT FUME FAN (1,189 m³/h) 97-8-003

REAGENT FUME FAN(2,209 m³/h) 97-8-001

100ø

75ø

1200X1200 EXHAUST COWL

FILTRATION AREA

UPPER FLOOR EL.:3401.320

MBC STORAGE

FLOC STORAGE

CuSO4 STORAGE

ZnSO4 STORAGE

MBS STORAGE

PAX STORAGE

TP3

925ø

TP1

SUPPLY GRILLES 782,650 m³/h

GAS FIRED MAKE-UP AIR UNIT 90-8-005

OUTDOOR AIR 67,690 m³/h

FLEXIBLE CONNECTION

WALL EXHAUST FAN (3,398 m³/h) 90-8-007

GENERAL EXHAUST FAN (27,184 m³/h) 90-8-006

WALL EXHAUST FAN 97-8-093

WALL EXHAUST FAN 97-8-094

500ø

600ø

500ø

TP2

300ø INLINE FAN

200ø

150ø

GAS FIRED UNIT HEATER

300ø FLEX

FEED HOPPERS (TYPICAL)

400x400

GROUND FLOOR EL.:3391.500

SUPPLY AIR FAN

SUMP FLOOR EL.:3387.700

SUMP TRENCH EL. 3386.550

FLOC STORAGE

DEXTRIN/MSP MIXING

FLOC MIXING

CuSO4 MIXING

ZnSO4 MIXING

MBS MIXING

PAX MIXING

PAX EXHAUST FAN 97-8-073

LEGEND

- GALVANIZED DUCTING
- PVC DUCTING
- FLEXIBLE DUCT
- TP TEST PORTS
- BALANCING DAMPER
- FLEXIBLE CONNECTION

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED
A	4MAR15	ISSUED FOR REVIEW	BD GH	
B	19MAR15	ISSUED FOR CLIENT REVIEW	BD GH	
0	26MAR15	ISSUED FOR CONSTRUCTION	BD	

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED

REFERENCE DRAWING No. -

REFERENCE DRAWINGS -

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA X. F. HUANG # 32094

•DATE•TIME•

nyrstar

MYRA FALLS, B.C.

FLUOR.

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DESIGN BY	E. DREW
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LEAD ENGINEER/CONSULT	C. HUANG
AREA MANAGER	
PROJECT MANAGER	E. DREW
CLIENT	
DRAWN BY	F. SONG
CHECK DRAWING	B. DREW
APPROVAL DATE	26MAR15
ENGINEERING MANAGER	-
APPROVAL DATE	-
APPROVAL DATE	

MANUAL CHANGES MADE - YES ☐ NO ☐ DWG. FILE UPDATED - YES ☐ NO ☐ MODEL UPDATED - YES ☐ NO ☐

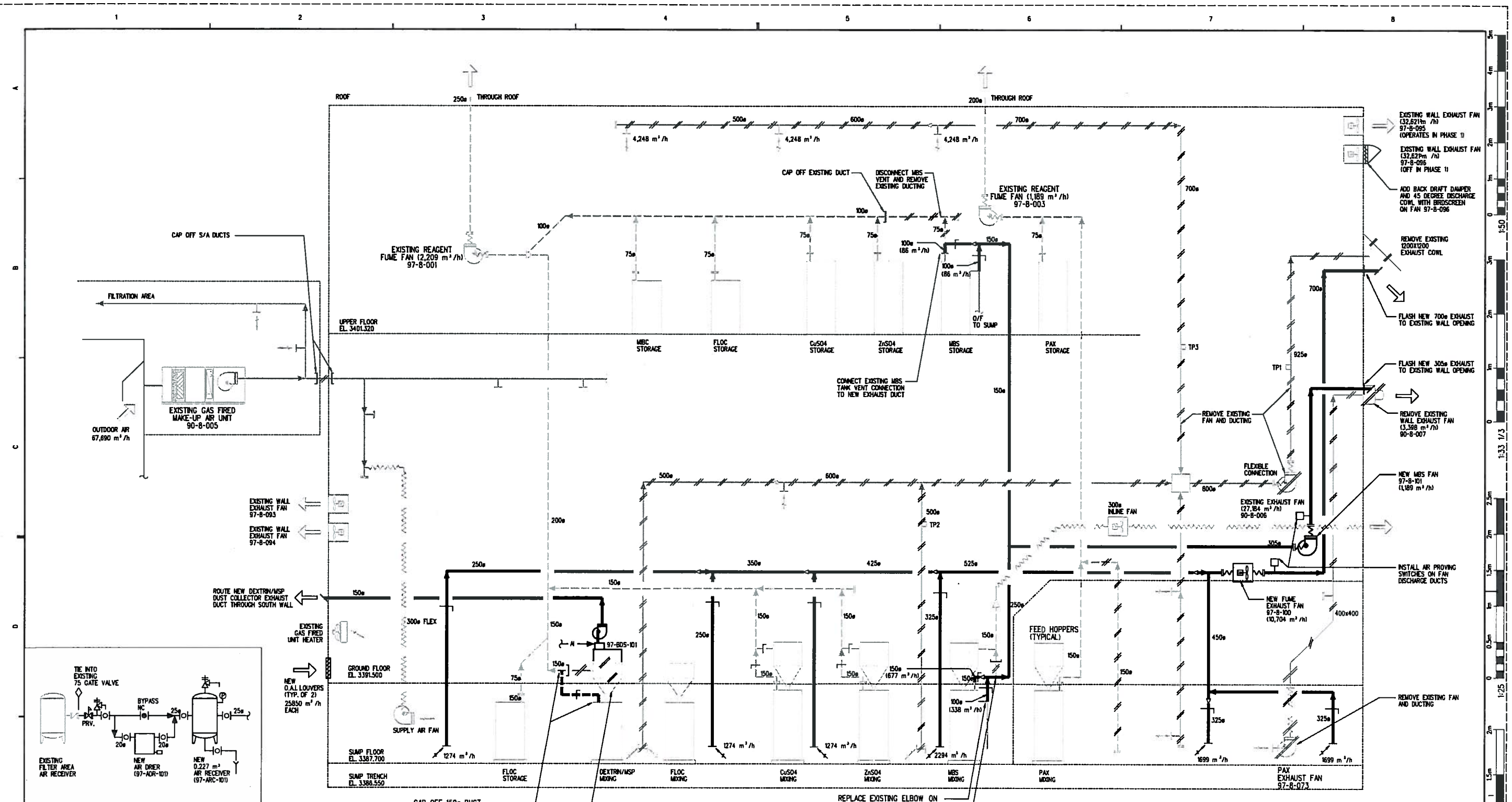
REAGENT AREA VENTILATION MODIFICATIONS - PHASE 1

REAGENT AREA HEATING AND VENTILATION FLOW DIAGRAM - EXISTING

SCALE N.T.S. DRAWING NUMBER A9MV-97-235-K-1 REV. 0

CADD FILE No. P:\CAD\ 235 \A9MV-97-235-K-1.DGN

B&BRPA1.DGN



COMPRESSED AIR PIPING

REV.	DATE	REVISION DESCRIPTION	DES.	CHK.	APPROVED
A	4MAR15	ISSUED FOR REVIEW	BD	GH	
B	10MAR15	RE-ISSUED FOR REVIEW	BD	GH	
C	19MAR15	ISSUED FOR CLIENT REVIEW	BD	GH	GH
0	26MAR15	ISSUED FOR CONSTRUCTION			

REV.	DATE	REVISION DESCRIPTION	DES. CHK.	APPROVED

REFERENCE DRAWING No.: -

REFERENCE DRAWINGS: -

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — X. F. HUANG # 32094

DATE • TIME

nyrstar

MYRA FALLS, B.C.

FLUOR

DESIGNED BY: B. DREW	DRAWN BY: F. SONG
CHECK DESIGN: G. FRANKE	CHECK DRAWING: B. DREW
LEAD ENGINEER/SPECIALIST: G. FRANKE	APPROVAL DATE: 26MAR15
AREA MANAGER: -	ENGINEERING MANAGER: -
PROJECT MANAGER: B. DREW	APPROVAL DATE: -
CLIENT:	APPROVAL DATE:

REAGENT AREA VENTILATION MODIFICATIONS - PHASE 1

REAGENT AREA HEATING AND VENTILATION FLOW DIAGRAM

SCALE: N.T.S. | DRAWING NUMBER: A9MV-97-235-K-2 | REV.: 0

MANUAL CHANGES MADE - YES ☐ NO ☐ | DWG. FILE UPDATED - YES ☐ NO ☐ | MODEL UPDATED - YES ☐ NO ☐ | CADD FILE No. P:\CAD\ 235 \A9MV-97-235-K-2.DGN

BABRPA1.DGN