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Memorandum

To:	Brad Ryan, Director of Public Facilities, Haines Borough
From:	John Daley PE, R&M Consultants, Inc.
Subject:	Mine concentrate export at Lutak Dock
Date:	December 12, 2016
Project #:	2443.01

As part of the Lutak Dock Design and Development Project R&M was directed to investigate the potential for including mineral export infrastructure at the Lutak Dock site. This memo outlines some of the basic components of a typical mineral export facility.

Our study is based on a hypothetical / conceptual scenario of the development and operation of the Palmer Mine. Many of the conceptual design features are modeled after the terminal in Skagway and include a number of items resulting from lessons learned from the operation of that facility over time, particularly in regards to efficient operation and environmental regulation compliance.

Key findings include:

- There is a requirement for a large concentrate storage building (CSB) and related support facilities near the dock. Due to environmental regulations all receiving, stockpiling, handling, and reclaiming of the mineral concentrates must be done indoors in a controlled environment.
- In order to accommodate the CSB and related operations additional uplands near the Lutak Dock would need to be developed. The total size of this could be 7 to 10 acres. It will not fit at the current dock site which has just over 4 acres. The concentrate storage building and related operations would fit at the former US Army fuel tank farm site.
- Mineral export would require a ship loader and a berth sufficient for Handimax bulk cargo vessels. Such a berth could be provided at Lutak Dock with a series of mooring and berthing dolphins.

Conceptual Requirements for a Haines Ore Terminal

Mine/ Mill

The mine is assumed to be the Palmer Mine located at about Mile 35 of the Haines Highway. Palmer is anticipated to produce copper, zinc, gold and silver. Ore from the mine will be moved to the on-site Mill which will employ equipment for crushing, grinding, particle separation and flotation processes to produce copper and zinc concentrate. The copper and zinc concentrates

separated by flotation would be dried using filter presses then be stockpiled in a storage building in segregated product piles.

Concentrate Storage at the Mine/Mill

The concentrate storage building would provide full containment of the concentrates and allow separation of the product by type. The stock piles would be allowed to build to allow uniform shipment of concentrates by truck/trailer to Haines Ore Terminal over project and public roads.

Transportation Corridor from Mill to Ore Terminal

The transportation corridor would be the access road from the Palmer Mill to the Haines Highway, thence along the Haines Highway to the Lutak Road. The corridor would continue along the Lutak Road from Haines to an Ore Terminal providing storage and ship loading facilities in the vicinity of the Lutak Dock. The corridor crosses streams along the route that will receive drainage from the roadway.

Ore Terminal Location Options

A site providing 7 to 10 acres of usable area is needed to accommodate the various support buildings and facilities and the Concentrate Storage Building of the Ore Terminal, not including the Ship Loader and associated dock/mooring dolphins. Options identified to date for ore terminal siting include the former US Army Fuel Tank Farm site at Tanani Point, the uplands area to the South of the Lutak Dock and an industrial site up Lutak Inlet to the west of the Lutak Dock.

Concentrate Storage Building - General Description

The Concentrate Storage Building (CSB) is a long, rectangular building covering a concentrate storage area. The building would be about 200 feet wide and 400 to 760 feet long. A truck shed is constructed along one side of the CSB to allow receiving concentrates for stock piling and a Reclaim Conveyor gallery along the other side of the CSB to house the Reclaim Conveyor for the ship loading operation.

Features associated with the CSB and related support facilities include:

- Access Driveways
- Yard – parking and maneuvering
- Concentrate Storage Building (CSB)
- Concentrate Receiving/Unloading Shed
- Offices
- Laboratory
- Crew Support Facility
- Warehouse
- Shop
- Conveyor System
- Equipment Wash Facility
- Water Treatment (industrial waste water)
- Domestic Waste Water Treatment

- Truck Scales on Access Road if Scales not Provided at Mine

Ore Transport, Receiving, Handling and Shipping

The concentrate will be loaded in the haul units by frontend loaders at the Mine/Mill and trucked to the Haines Ore Terminal. Based on the output estimated for the Palmer Mine by Constantine Minerals Ltd, it is estimated the amount of concentrate produced daily will be around 500 tonnes in aggregate of copper and zinc including values and trace minerals. It is estimated that ten to twelve loads of concentrate would be transported and delivered to the CSB each day on average. The ore terminal would be sized to stock pile the copper and zinc in separate areas and allow the stockpiles to accumulate to the tonnage desired for shipping. There are two possibilities for shipping the concentrates, one is to ship only copper or zinc on a particular ship and the other is to ship both products on the same ship in separate holds.

Concentrates delivered from the mine could be a single product (copper or zinc) or both products (copper and zinc) at a time. Trucks comprising a tractor towing two semi side dump trailers in tandem is the most likely transport option from the standpoint of practicality and proven performance in the haul from Minto Mine in the Yukon to Skagway the past several years. Each dump trailer has an electric tarp that is deployed over the load for the trip from the mine to the ore terminal. The side dumps would dump over a parapet wall into the concentrate storage area. It would be practical to have two dumping bays to allow each product to be separately dumped in its' specific receiving area. This would reduce the comingling problem that would occur if both products were dumped into the same area.

The process within the Concentrate Storage Building (CSB) is to receive the product from the truck unloading "dump" bays, take the product away from the dumped contents of the side dumpers by a frontend loader, tram the material to the stacking area for each material and build the storage pile by stacking with frontend loaders. The stockpile of product is stacked to the height (8 to 16 feet) required and left in storage until a ship load is accumulated and a ship calls for the product.

When the concentrate haulers complete their dumping operation in the Receiving Shed, the tractor and both semitrailers exit the unloading shed over an undercarriage pressure spray wash area with a floor grating and then depart the ore terminal. The interior of the trailer dump boxes is not washed but is tarped in for the trip back to the mine.

Reclaiming and Ship Loading

The frontend loaders are used to reclaim the material from the CSB stockpile and tram it to reclaim conveyor feed points where the material is dumped on to a belt feeder installed below the grade of the concentrate storage floor. The belt feeders charge the main reclaim conveyor which carries the material to the outlet end of the building where the material is fed to a transfer conveyor to the ship loading facility where the bulk carrier is berthed and a ship loader places the material in designated holds of the ship. Note that the transfer conveyor, ship loader conveyor and loading spout are all fully enclosed for dust control and water control.

Key points include:

- Ship Loader conveyor is fully enclosed
- Ship Loader can be slewed and the spout is articulated to allow loading ship hold uniformly; precludes trim dozer use
- The ship loader and dock must be Suitable for 12,000 through 40,000 dwt bulk carriers. (Note; dwt refers to dead weight tons a measures of the cargo capacity of the vessel.)

Table 1 summarizes the key dimensions of the design ships.

Table 1 Key Dimensions of Design Ships

Dimensions	Ship Size (dwt)		
	12,000	35,000	45,000
Length Overall (ft)	426	625	722
Beam (ft)	66	88	100
Moulded Depth (ft)	37	50	58
Loaded Draft (ft)	27	34	42
Number of Hatches	4	6	6
Hatch coverage length (ft)	308	446	518

Environmental Concerns

There are dust emissions and water contamination by exposure to the concentrates. Dust control equipment and water treatment and fuel and chemical spills need to be addressed in designing and operating an ore terminal and the transportation equipment and the haul corridor. The concerns include the following:

- Prevent tracking of concentrate residual along the haul corridor
- Immediate attention to any spills during transport including concentrates, fuel, oil, lubricants and chemicals used at the mine.
- Prevent tracking of concentrate residual from the CSB receiving area and the CSB storage area and Conveyor galleries.
- Prevent fugitive dust emissions from the CSB, conveyors, transfer points and dump points and from the buildings and enclosures during cleanup between products being loaded.
- Prevent fugitive dust escaping the haul units.

- Minimize water intrusion into the CSB receiving and storage areas and conveyor galleries.
- Collect all non-domestic waste water from within physically contained areas of CSB, conveyors and ship loader and filter and treat the water to meet ADEC requirements.
- Collect and dispose of surface drainage around the ore terminal from access roads and yards; this could include collection, treatment and final disposal depending on how well contamination is dealt with in the Best Management practices of the Ore Terminal physical facilities.

Attachments:

Process diagram

Info-graphic

MINE

ORE PROCESSING FACILITY
- Crushing
- Grinding
- Flotation
- Concentrate Thickening and Filtering

Copper

Zinc

STOCK PILE CONCENTRATES
- Stock Piling Concentrates for Trucking in Enclosed Storage Building
- Separate Stock Piles for Cu and Zn

Copper

Zinc

TRUCKING TO BULK SHIPPING FACILITY
- Mine Access Road to Haines Highway
- Haines Highway to Lutak Ore Terminal
- Hauling by Semi Doubles Side Dumpers or by Semi Doubles Flats with Ore Pots
- Each Container in Transport can Contain Different Product
- Weigh Truck/Trailer Rigs by Scales at Loading Area of Mine or at Ore Terminal

LUTAK ORE TERMINAL
- Weigh incoming Loads on Truck Scales Along Entry Driveway if Not Weighed at Mine.
- Enter Enclosed, Dust Controlled Truck Unloading Shed Attached to Concentrate Storage Building (CSB).
- Dump Concentrates into Receiving Area of CSB.

NOTE-
If pots used for transport, receiving at Lutak Ore Terminal will require large Fork Lift with rotational capability in forks

TRUCK RETURN TO MINE

CONCENTRATE RECEIVING AND STACKING
- Concentrates Receivied are Taken Away From Receiving Area by Front End Loader (FEL)
- Concentrates Carried to Concentrate Storage Area and Stacked in Designated Areas by FE
- CSB Provided With Dust/Emmissions Control
- CSB Provide With Drainage Water Collection and Treatment

TRUCK WASHING
- Truck Wash Area at Exit From Unloading Shed
- Spray Bars for Side and Undercarriage Wash.
- Wash Water Collected , Filtered and Recycled
- Solids Returned to Ore Storage

NOTE-
- Single Product Conveyors
- Clean Conveyors Between Products to Avoid Cross-Contamination

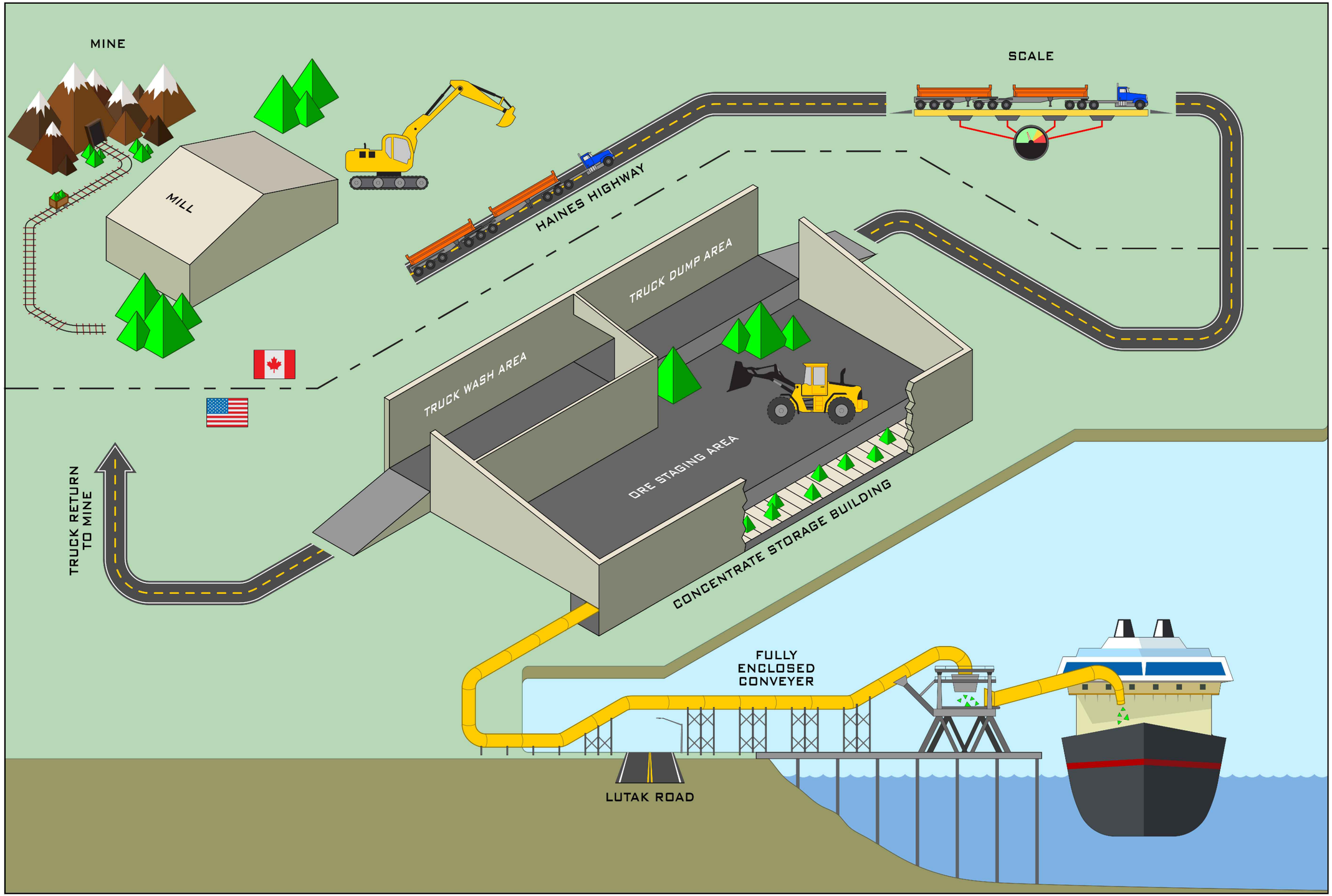
CSB STORAGE AREA
- Divided into specific prodect areas by large moveable dividers
- Storage Area sized for largest amount to be stockpiled for shipping

CONCENTRATE RECLAIM
- Reclaim Conveyor Below CSB Floor Level
- Fed by Belt Feeders From Stock Pile in CSB
- Concentrate Moved to Reclaim Conveyor by FEL
- Dust Control at Each Belt Feeder Drop to Reclaim Conveyor
- Solids Returned to Ore Storage
- Drainage Water Collection and Treatment

SAMPLING DURING LOADOUT
- Sample Recover Station at Reclaim Discharge Point
- Laboratory Facilities incl Ovens and Scales

SHIP LOADING
- Concentrate Moved to Reclaim Conveyor by FEL
- Reclaim Belt Delivers Concentrate to Transfer Conveyor
- Transfer Conveyor Moves Concentrates to Ship Loader
- Ship Loader Discharges Concentrates Into Bulk Carrier; Ship Loader Conveyor and Spout Fully Enclosed for Dust Control; Spout Articulated to Disribute Concentrate Uniformly Throughout Hold

PROJECT NAME: LUTAK ORE TERMINAL PROJ NO.: R&M 2443.01
DESCRIPTION: PROCESS FLOW DIAGRAM - ROUGH ORE TO CONCENTRATE TO STORAGE AND LOADOUT TO SHIP
PREPARED BY: JKM Date: 11/23/16 CHECKED BY: Date:
REVISED BY: Date: REV CHK'D BY Date:



DRAFT CONCEPT NOT FOR CONSTRUCTION

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Haines Borough

LUTAK DOCK STUDY

No.	Description	Date

Drawn By: PMH
Checked By: JD/DA
Date: DEC 1, 2016
Phase: MINING INFOGRAPHIC
Project No: 2443.01
SHEET TITLE: NOTES
SHEET NO: 1 OF 1
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