Attachment D
Project Description

CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADSP	Alaska Dam Safety Program
ANCSA	Alaska Native Claims Settlement Act
ANFO	ammonium nitrate and fuel oil
BMPs	best management practices
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
H:V	horizontal:vertical (horizontal to vertical)
IDF	Inflow Design Flood
ISO	International Organization for Standardization
LGO	low-grade ore
MW	megawatts
NEPA	National Environmental Policy Act
NFK	North Fork Koktuli River
NPAG	Non-Potentially Acid Generating
OCS	Outer Continental Shelf
PAG	Potentially Acid Generating
PHABSIM	Physical Habitat Simulation System
PMF	Probable Maximum Flood
PMP	Probably Maximum Precipitation
ROW	right-of-way
SAG	semi-autogenous grinding
SFK	South Fork Koktuli River
TSF	Tailings Storage Facility
TSS	total suspended solids
USGS	U.S. Geological Survey
UTC	Upper Talarik Creek
WMP	Water Management Pond
WTP	Water Treatment Plant

1. PROJECT OVERVIEW

Pebble Limited Partnership (PLP) is proposing to develop the Pebble copper-gold-molybdenum porphyry deposit (Pebble Deposit) as an open-pit mine, with associated infrastructure, in southwest Alaska. This project description summarizes information about the environmental setting, engineered facilities and operations for the proposed Pebble Project (Project) from initial construction through closure and reclamation. It is intended to support the National Environmental Policy Act (NEPA) review process and other permitting efforts for the Project.

1.1. Pebble Project Summary Information[1]

- Project operating life of 20 years.
- A total of 1.2 billion tons of material mined over the life of the Project.
- Final pit dimensions of 6,500 feet in length, 5,500 feet in width, and 1,350 to 1,750 feet in depth.
- Mining rate up to 90 million tons per year.
- Milling rate up to 58 million tons per year.
- Annual copper-gold concentrate production of 600,000 tons.
- Annual molybdenum concentration production of 15,000 tons.
- Final tailings storage facility (TSF) capacity of 1.1 billion tons.
- Peak low grade ore (LGO) storage capacity of 330 million tons.
- Power plant generating capacity of 230 megawatts (MW).
- Project operating schedule of two 12-hour shifts per day for 365 days per year.
- An 83-mile transportation corridor from the mine site to a year-round port site located on Cook Inlet near the mouth of Amakdedori Creek consisting of:
    - A 30-mile private double-lane road from the mine site to a ferry terminal on the north shore of Iliamna Lake.
    - An 18-mile lake crossing utilizing an ice breaking ferry to a ferry terminal on the south shore of Iliamna Lake.
    - A 35-mile private double-lane road to the Amakdedori Port.
- Spur roads from the transportation corridor to the communities of Iliamna, Newhalen, and Kokhanok.

[1] Design criteria as presented are approximate and have been averaged and rounded as appropriate for ease of reference.

- A port facility and jetty with docking for both Handysize ships and supply barges.
    - Annual traffic of up to 25 concentrate vessels and 25 supply barges.

- A 188-mile gas pipeline from the Kenai Peninsula across Cook Inlet to the Project site with compressor stations on the Kenai Peninsula and at the Amakdedori Port.
- Employment of 850 to 2,000 personnel for operations and construction, respectively.

1.2. BACKGROUND

The Project is located on land acquired by the State of Alaska in 1974 via a three-way land swap with the federal government and Cook Inlet Region, Inc. The land was selected by the state specifically for its mineral development potential. The initial discovery of the Pebble Deposit was made in 1988 by Cominco Alaska, a division of Cominco Ltd. (Cominco). Cominco (later acquired by Teck Resources Limited) discontinued work on the project in 1997, and in 2001 the Pebble claims were optioned by a subsidiary of Northern Dynasty Minerals Ltd. (Northern Dynasty).

Northern Dynasty began exploring the property, with significant success, expanding the Pebble Deposit from one billion to four billion tons by the end of 2004. An extensive environmental baseline data collection program commenced in that year, as well as geotechnical investigation and preliminary engineering studies. In 2005, Northern Dynasty exercised its option to acquire the Project and in the same year discovered a significant, higher grade eastern extension to the deposit. Over the next seven years, the Pebble Deposit was expanded through drilling into one of the most significant copper-gold-molybdenum deposits discovered.

In 2007, Northern Dynasty formed PLP with another company and placed the Project into the partnership. Over the next six years, PLP continued to advance the Project through additional drilling, environmental data collection, and engineering studies. In 2013, the other company left PLP and it reverted to a wholly owned subsidiary of Northern Dynasty.

To date, more than one million feet of drilling has been conducted on the Pebble Deposit.

Product from mining this deposit can supply important mineral resources for alternative energy and other purposes of strategic national significance. The Pebble Deposit has significant regional economic importance for southwest Alaska and the entire state through the creation of high-wage jobs and training opportunities, supply and service contracts for local businesses, and government revenue.

1.3. Project Design Considerations

Plans for the design and operation of the Project have focused on the avoidance and minimization of environmental impacts to waterbodies, wetlands, wildlife and aquatic habitat, areas of cultural significance, and areas of known subsistence use and addressing stakeholder concerns. In addition to meeting or exceeding local, state, and federal regulatory requirements, the Project incorporates the following concepts into the design:

- The Project plan has been limited to mining the near-surface portion of the Pebble Deposit. This has significantly reduced the footprint of the open pit, TSF, and mine facilities, as well as eliminated the need for a permanent waste rock storage facility.
- The layout was designed to consolidate the majority of the site infrastructure in a single drainage–the North Fork Koktuli River (NFK)–and avoid placing waste rock or tailings in the Upper Talarik Creek (UTC) drainage.
- The transportation corridor incorporates a ferry crossing of Iliamna Lake to connect the mine site to a marine port on Cook Inlet, significantly limiting the total access road length and associated impacts relative to a longer access road around Iliamna Lake. The road alignment was further refined to avoid areas of known subsistence and recreational use and to minimize wetland impacts.
- A natural gas pipeline and gas-fired electrical generation are being used to power the Project, thereby removing the need to transport and store large amounts of diesel fuel for power generation.
- To address stakeholder concerns regarding the transportation and use of cyanide, there is no secondary recovery of gold from the pyritic tailings using a cyanide leach.

A design-for-closure philosophy was adopted by the Project so that the requirements for closure and post-closure site management were considered from the beginning of the Project.

- Segregation of the bulk and pyritic tailings storage cells was adopted to facilitate the physical closure of the TSF and the post-closure water management for the TSF.
- The lined LGO stockpile was used to store potentially acid generating (PAG) waste rock during operations (after which it will be backhauled to

the pit for sub-aqueous storage in the pit lake) to avoid the requirements for post-closure management of a PAG waste rock storage facility.

The Project will develop a comprehensive water management plan that strategically discharges surplus treated water to downgradient streams in a manner that significantly reduces the effect of flow changes on stream flow and fish habitat.

1.4. Project Areas

The Project is located in a sparsely populated region of southwest Alaska near Iliamna Lake, within the Lake and Peninsula and Kenai Peninsula boroughs (Figure 1-1). The Project comprises four primary areas: the mine site at the Pebble Deposit location, the port site at Amakdedori on Cook Inlet, the transportation corridor connecting these two sites, and a natural gas pipeline connecting to existing infrastructure on the Kenai Peninsula.

The transportation corridor is comprised of a road from the mine site to a ferry terminal on the north shore of Iliamna Lake and a ferry route across Iliamna Lake to a landing on the south shore near the village of Kokhanok. The road continues southeast to the port site. Additional surface roads will connect the mine site to the villages of Iliamna, Newhalen, and Kokhanok (Figure 1-2). The gas pipeline will tie in to existing gas supply infrastructure near Happy Valley, parallel the Sterling Highway south to Anchor Point, cross Cook Inlet, and parallel the transportation corridor to the mine site (Figure 1-1 and Figure 1-2).

The Bristol Bay watershed encompasses approximately 41,900 square miles and is defined by the Aleutian Range to the east and southeast, the Kuskokwim Mountains to the west, and a range of hills to the north that separate it from the Kuskokwim River watershed. The largest rivers that drain into Bristol Bay are the Nushagak and Kvichak rivers, which together drain 49 percent of the Bristol Bay watershed, or approximately 20,000 square miles (Figure 1-3).

1.4.1. Mine Site

The Pebble Deposit is located under rolling, permafrost-free terrain in the Iliamna region of southwest Alaska, approximately 200 miles southwest of Anchorage and 60 miles west of Cook Inlet. The closest communities are the villages of Iliamna, Newhalen, and Nondalton, each approximately 17 miles from the Pebble Deposit (Figure 1-2).

The fully developed mine site will include the open pit, TSF, LGO stockpile, overburden stockpiles, material sites, water management ponds (WMPs), milling and processing facilities, and supporting infrastructure such as the power plant, water treatment plants, camp facilities, and storage facilities (Figure 1-4).

The site is currently undeveloped and not served by any transportation or utility infrastructure.

1.4.2. Amakdedori Port

The port site (Figure 1-5) will be located near Amakdedori Creek on the western shore of Cook Inlet, approximately 190 miles southwest of Anchorage and approximately 95 miles southwest of Homer.

The port site will include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the Project. The shore-based facilities will include separate facilities for the receipt and storage of containers for concentrate and freight. Other facilities will include fuel storage and transfer facilities, power generation and distribution facilities, maintenance facilities, employee accommodations, and offices.

The natural gas pipeline from the Kenai Peninsula will come ashore at the Amakdedori Port. Natural gas will be distributed to the port generation station and to a compressor station for transfer to the mine site.

The marine component includes an earthen access causeway extending out to a marine jetty located in 15 feet of natural water depth. One side of the jetty will be occupied by a roll-on/roll-off barge access berth; a separate berth for Handysize bulk carriers will be located on the opposite side. A mooring and turning basin will be dredged to a 50-foot water depth at the jetty and connected with a dredge channel leading to natural 50-foot water depth.

The port site area is currently undeveloped and not served by any transportation or utility infrastructure.

1.4.3. Transportation Corridor

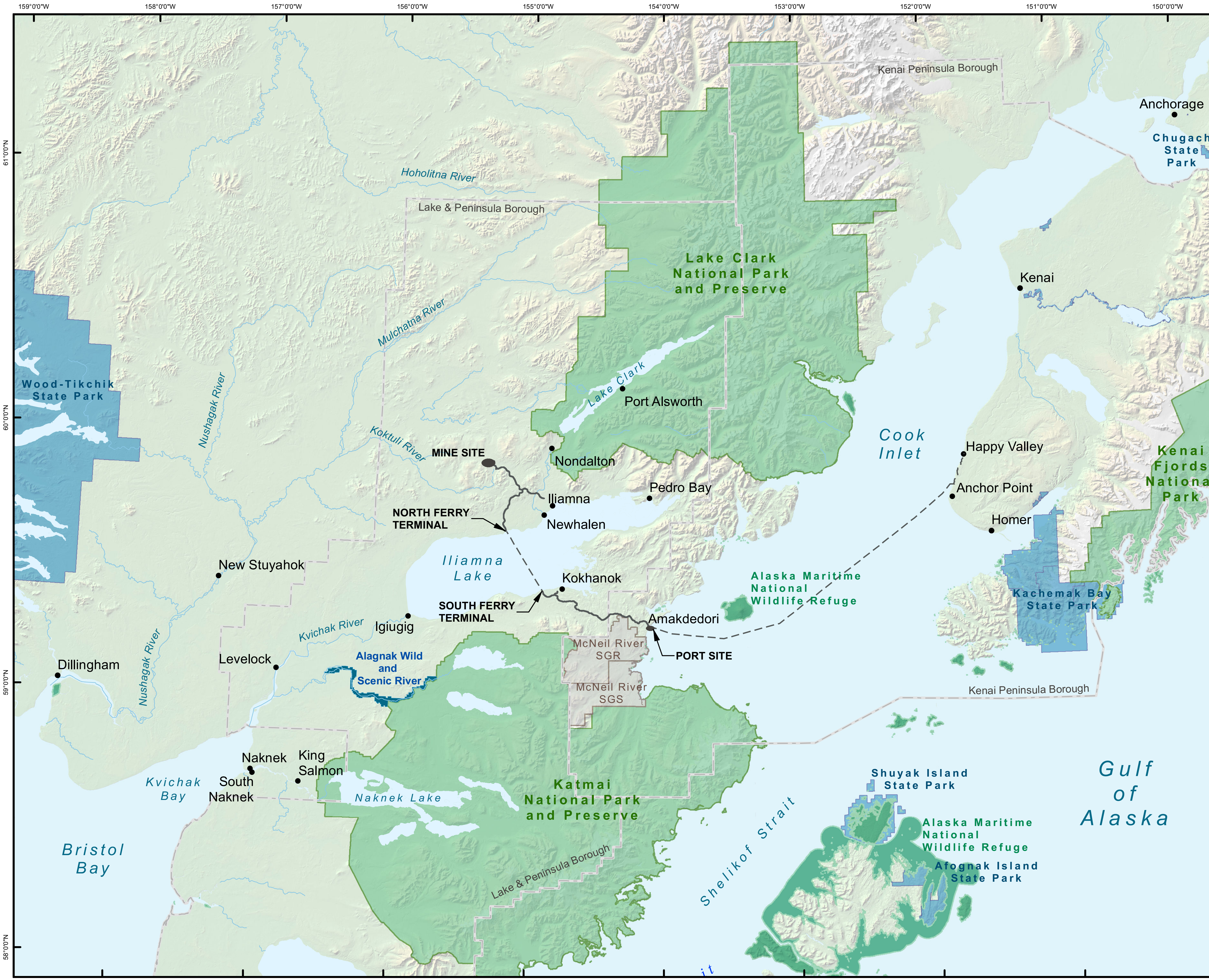
The transportation corridor, which will connect the mine site to the Amakdedori Port on Cook Inlet, has three main components (Figure 1-2):

- A private, double-lane road extending 30 miles south from the mine site to a ferry terminal on the north shore of Iliamna Lake;
- An ice-breaking ferry to transport materials, equipment, and concentrate 18 miles across Iliamna Lake to a ferry terminal on the south shore near the village of Kokhanok; and
- A private, double-lane road extending 35 miles southeast from the South Ferry Terminal to the Amakdedori Port on Cook Inlet.

Separate roads will connect the transportation corridor to the villages of Iliamna, Newhalen, and Kokhanok. Apart from a small network of local roads near the villages, the transportation corridor area is undeveloped.

1.4.4. Natural Gas Pipeline Corridor

Natural gas, sourced through the existing natural gas supply infrastructure for the Cook Inlet area, will be the primary energy source for the Pebble Project. The gas pipeline alignment (Figure 1-1) will connect to existing infrastructure near Happy Valley on the Kenai Peninsula and travel south, paralleling the Sterling Highway for 9 miles to a compressor station near Anchor Point. From the compressor station, the pipeline heads southwest across Cook Inlet for 60 miles, before turning west for 35 miles to a landfall at the Amakdedori Port. A second compressor station and offtake point will be located at the port site. The pipeline then follows the transportation corridor from the port to the mine site, including crossing Iliamna Lake on the lake bed.



THE pebble PARTNERSHIP

FIGURE 1-1

Regional Map

- Project Features
- Transportation Corridor
- Natural Gas Pipeline
- National Park
- National Wildlife Refuge
- Alaska State Park
- Wild and Scenic River
- State Game Refuge/Sactuary
- Borough Boundary

0 15 30 45 Miles

N

Scale 1:1,600,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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Version: 1	Author: HDR

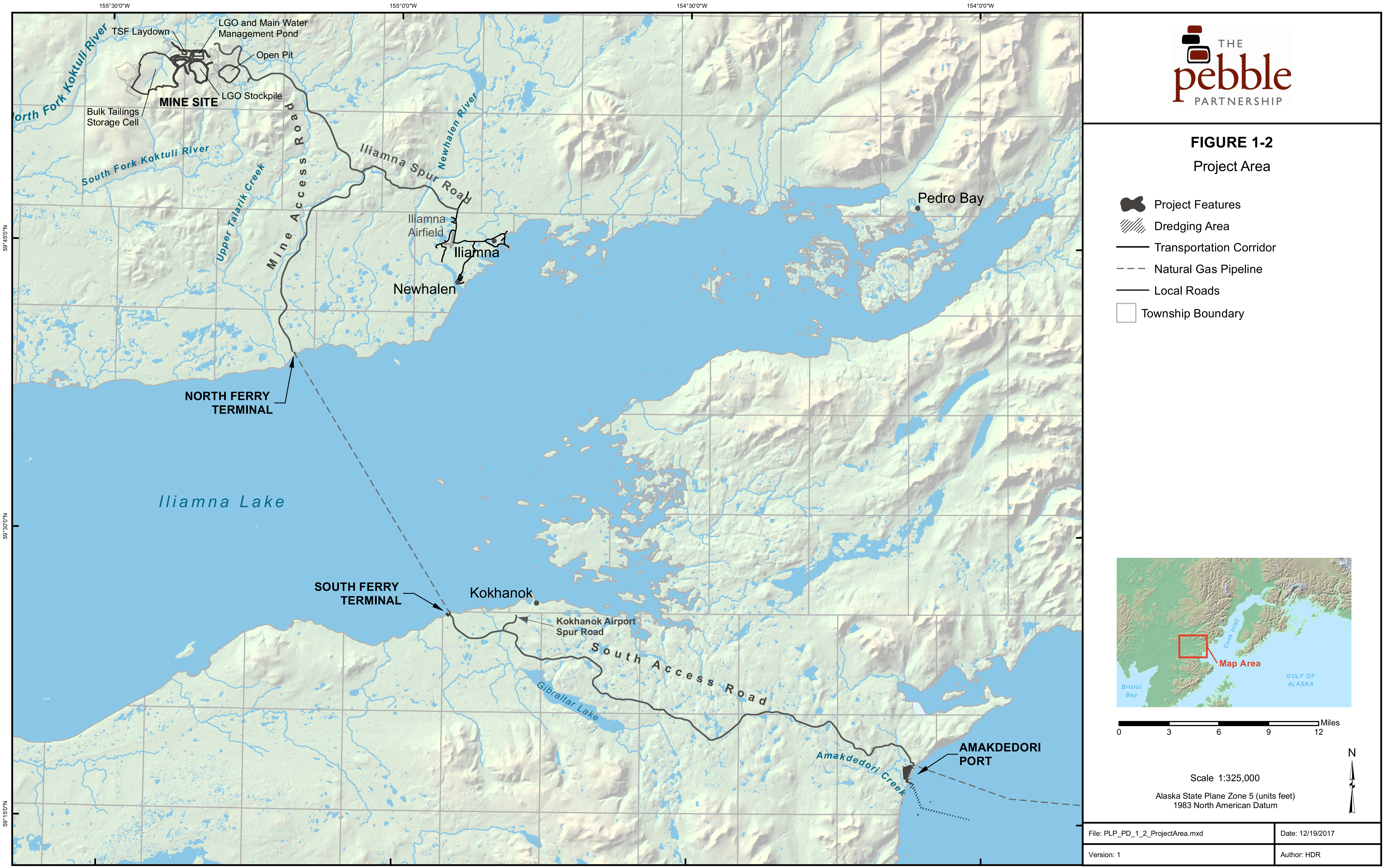

FIGURE 1-2
Project Area

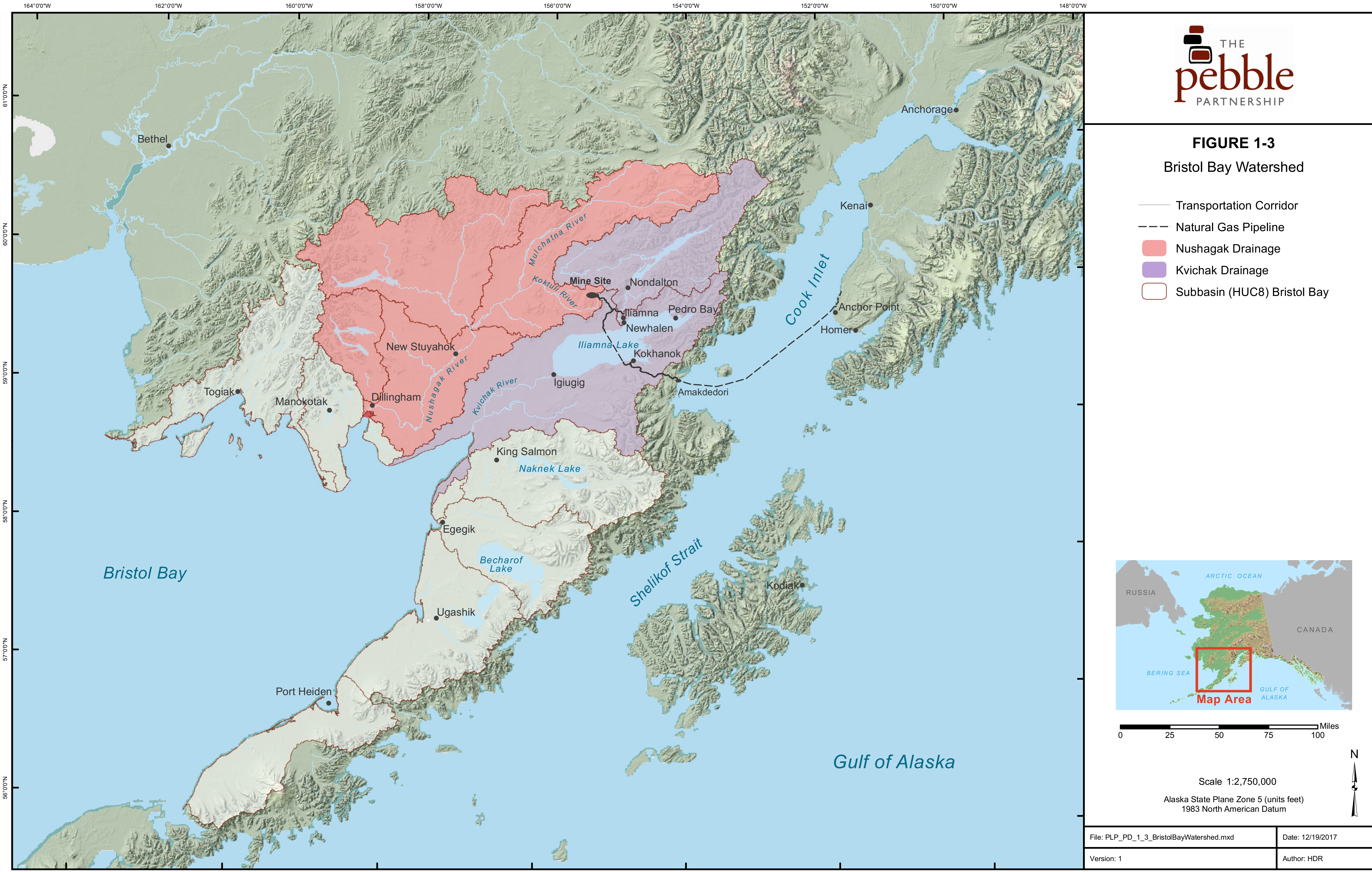

FIGURE 1-3
Bristol Bay Watershed

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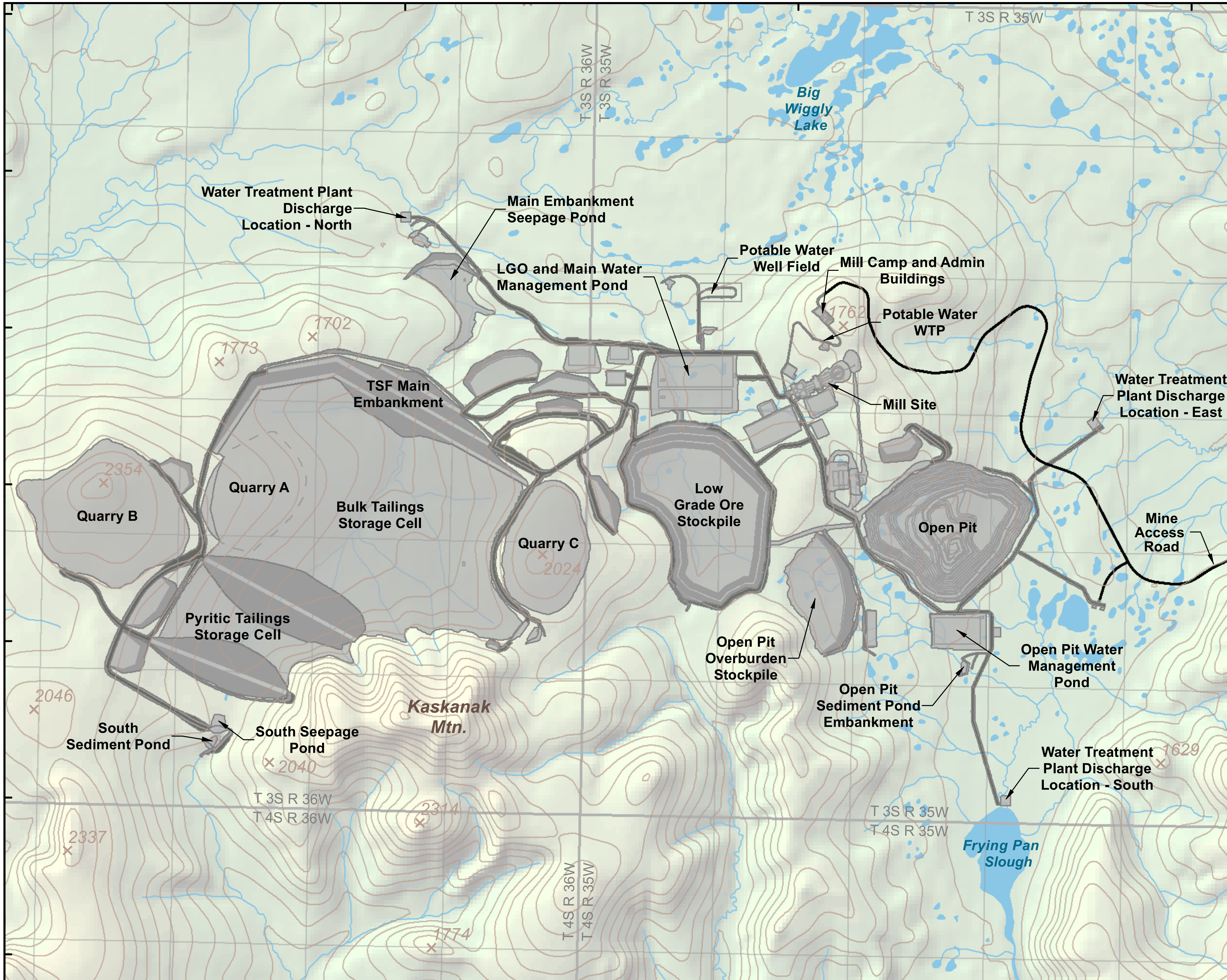
Version: 1 | Author: HDR

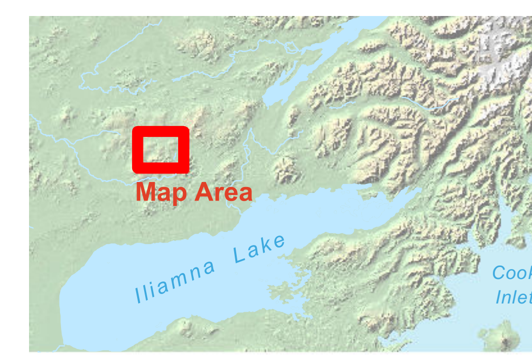


THE pebble PARTNERSHIP

FIGURE 1-4

Mine Site Map

- Mine Site Footprint
- Mine Site Access Road
- 50' Contour (Existing)
- Township Boundary
- Section Boundary



0 0.5 1 1.5 Miles

N

Scale 1:46,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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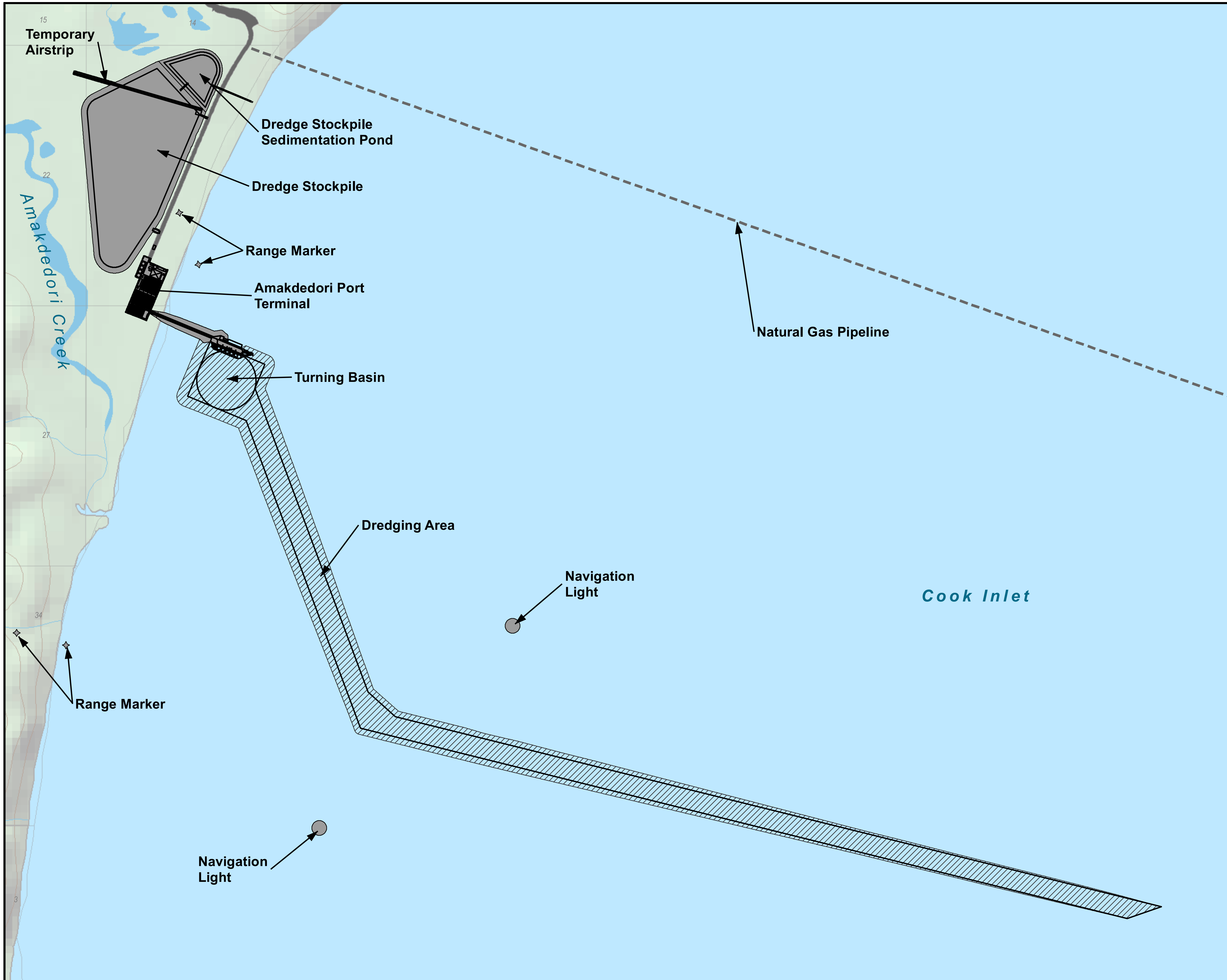

THE pebble PARTNERSHIP

FIGURE 1-5

Amakdedori Port Site

Port Site Features
Dredging Area
Transportation Corridor
Natural Gas Pipeline

0 1,000 2,000 3,000 4,000 Feet

N

Scale 1:24,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: PLP_PD_1_5_AmakdedoriPortSite.mxd	Date: 12/19/2017
Version: 1	Author: HDR

1.5. LAND OWNERSHIP AND MINERAL RIGHTS

The Pebble Deposit is located on patented state land specifically designated for mineral exploration and development. The Pebble Deposit straddles parts of three management units described in the Alaska Department of Natural Resources (ADNR) 2005 *Bristol Bay Area Plan* (amended 2013). These management units, known as R06-23 (Pebble), R06-24 (Pebble Streams), and R10-02 (Pebble 2), total 110,080 acres and are designated for minerals extraction. This designation allows for mineral exploration and development with oversight from ADNR. The management intent for all three units also stresses the need to protect the anadromous fish streams in the upper Koktuli River corridor and to minimize or avoid effects from mining on habitat and recreational activities near the upper reaches of UTC.

The Pebble Deposit lies within a 417-square-mile claim block held by subsidiaries of PLP and by a subsidiary of PLP's parent company, Northern Dynasty. Neither PLP nor Northern Dynasty currently owns surface rights associated with these mineral claims. All lands within the claim block are owned by the State of Alaska. Surface rights may be acquired from the state government once areas required for mine development have been determined and permits awarded.

The transportation corridor crosses both state land and land patented under the Alaska Native Claims Settlement Act (ANCSA). Further detail is provided in Section 2.2.

1.6. CLIMATE

The climate in the area of the Pebble Deposit/mine site is transitional. Winters are characterized by a continental climate as frozen waterbodies and sea ice in Bristol Bay create a land-like mass, while summers have a maritime climate due to the influence of the open water of Iliamna Lake and, to a lesser extent, the Bering Sea, Bristol Bay, and Cook Inlet. Mean monthly temperatures range from about 55 degrees Fahrenheit (°F) in summer to 2°F in winter. Precipitation in the NFK drainage averages approximately 57.4 inches per year and in the South Fork Koktuli River (SFK) drainage averages approximately 50.8 inches per year. About one-third of this precipitation falls as snow. The wettest months are August through October. White-out conditions and wind storms or periods of poor light/visibility can be expected in winter.

Winter weather systems, consisting of cool to cold saturated air, typically travel into the region from the Bering Sea (west), along the Aleutian Island chain (southwest) and the Gulf of Alaska (south), resulting in frequent clouds, rain, and snow. Less frequent incursions of frigid, stable Arctic air masses produce shorter periods of clear, but very cold conditions. During summer, warm air masses from interior Alaska can cause atmospheric instability, which results in cumulus clouds and thunderstorm activity.

1.7. Deposit Geology

The Pebble Deposit is hosted by Mesozoic, volcanically derived sedimentary rocks, called flysch, of the Kahiltna terrane, as well as a variety of intrusive igneous rocks emplaced into the flysch between approximately 99 and 90 million years ago during the mid-Cretaceous Period. Between 99 and 96 million years ago, early intrusions into the flysch comprised alkalic syenite to biotite pyroxenite bodies, along with subalkalic diorite and granodiorite sills. Kaskanak Suite intrusions were emplaced approximately 90 million years ago and are the most important igneous event in the area. The suite comprises a granodiorite batholith that is exposed west of, but extends beneath, the Pebble Deposit, as well as several smaller intrusive granodiorite apophyses that emanate from the underlying batholith; collectively these Kaskanak intrusions drove the large magmatic-hydrothermal system that formed the Pebble Deposit.

The Pebble Deposit is classified as a porphyry copper deposit and is hosted by the intrusive and sedimentary rock types described above. Copper, gold, molybdenum, and other metals were transported by hot fluids that emanated from the 90-million-year-old magmas as they cooled, and precipitated mostly as sulfide minerals in fractures, now preserved as veins, and as disseminations in the spaces between silicate minerals in the host rocks. The effects of the hot fluids are reflected by widespread hydrothermal alteration whereby some minerals originally present in host rocks were dissolved and replaced with suites of new minerals.

During the Late Cretaceous and Early Tertiary periods, the Pebble Deposit was uplifted by regional tectonic forces and eroded. The exposed deposit was rapidly covered by the Copper Lake Formation, a thick sequence of fine- to coarse-grained clastic sedimentary rocks and interbedded volcanic rocks. At a later point in the Tertiary Period, the eastern part of the Pebble Deposit was dropped up to 3,000 feet along normal faults into the East Graben, a structure that was progressively infilled by basalts, andesites, and subordinate clastic sediments as it grew. The Pebble Deposit and its host rocks were later tilted approximately 20 degrees to the east. The deposit was again uplifted in the later Tertiary Period, and its western part was scoured by Pleistocene glaciers that deposited a veneer of till, glacio-lacustrine, and outwash deposits that are mostly tens of feet thick or less, but which rarely are up to 300 feet thick in the vicinity of the Pebble Deposit. The present geometry of the Pebble Deposit comprises the West Zone, which is covered by thin glacial till and exposed in one small outcrop; the East Zone, which remains concealed by an eastward-thickening wedge of the Copper Lake Formation as well as overlying glacial till; and mineralization that extends an undetermined distance farther to the east but at great depth below the East Graben.

1.8. Resource

The current combined measured and indicated resource estimate for the total Pebble Deposit is approximately 7.1 billion tons containing 57 billion pounds of copper, 70 million ounces of gold, 344 million ounces of silver, and 3.46 billion pounds of molybdenum. In addition, the inferred component of the total deposit is approximately 4.9 billion tons, with 24.5 billion pounds of copper, 37 million ounces of gold, 170 million ounces of silver, and 2.2 billion pounds of molybdenum. The Pebble Deposit also contains important quantities of silver, palladium, and rhenium.

The Project will mine approximately 1.1 billion tons of mineralized material (measured, indicated, and inferred) over the 20-year mine life containing 6.7 billion pounds of copper, 353 pounds of molybdenum, and 11 million ounces of gold. The metal content of the reported total resource and the 20-year open pit concentrate production is presented in Table 1-1.

Table 1-1. Pebble Deposit Estimated Resource (Measured, Indicated, and Inferred)

	Total Deposit		20-Year Open Pit	
	Weight	Grade	Weight	Grade
Copper	80.6 Blbs	0.35%	6.7 Blbs	0.3%
Molybdenum	5.57 Blbs	235 ppm	353 Mlbs	158 ppm
Gold	107.3 Moz	0.32 g/t	10.7 Moz	0.3 g/t

Blbs: billion pounds
Moz: million ounces
ppm: parts per million
g/t: grams per ton

2. PROJECT SETTING

The environmental resources of the area surrounding the Pebble Deposit have been studied extensively by PLP. The *Pebble Project Environmental Baseline Document, 2004 through 2008*, which is available online at www.pebbleresearch.com, provides a complete report of environmental baseline studies conducted during those years. Pebble Project supplemental baseline data reports (2009-2013) provide data supplemental to the environmental baseline report and will accompany permit applications as appropriate.

2.1. MINE SITE

2.1.1. Physiography

The geographic location of the Pebble Deposit is described in Table 2-1.

Table 2-1. Pebble Deposit Geographic References

Item	Value
Pebble Deposit Centroid	59° 53' 51" N; 155° 18' 03" W
USGS Quadrangles	Iliamna D-6, D-7
Elevation:	
Minimum	775 ft amsl (SFK valley)
Maximum	2,760 ft amsl (Kaskanak Mountain)
Distance from:	
Cook Inlet	65 miles W
Iliamna Lake	16 miles N
Bristol Bay	100 miles W

amsl = above mean sea level
USGS = U.S. Geological Survey

The Pebble Deposit is located in the Nushagak-Big River Hills physiographic region. The area consists of low, rolling hills separated by wide, shallow valleys. Elevations range from approximately 775 feet in the SFK valley up to 2,760 feet on Kaskanak Mountain. Glacial and fluvial sediment of varying thickness covers most of the study area at elevations below approximately 1,400 feet, whereas the ridges and hills above 1,400 feet generally exhibit exposed bedrock or have thin veneers of surficial material. The hills tend to be moderately sloped with rounded tops. The valley bottoms are generally flat. No permafrost has been identified to date in the project area.

2.1.2. Ecology

The Pebble Deposit area is ecologically diverse, with rivers, tundra, marshy lowlands, and ponds. Much of the land is covered by alpine tundra, shrubs, wetland and scrub communities, or areas of mixed broadleaf and spruce trees, depending on elevation and location.

Rivers near the Pebble Deposit provide habitat for five species of anadromous Pacific salmon. Rainbow trout and other species of fish, such as Dolly Varden and arctic grayling, are also present. The streams in this area contain many features that support fish spawning and rearing, including complex off-channel habitats, river gravel that promotes spawning, beaver ponds, and combinations of run/glides and riffles. A higher diversity of species and abundance of fish, as well as the most spawning and rearing activity, is found in the lower and middle reaches of these streams, not in the headwater reaches at the Pebble Deposit site.

Various raptors and more than 40 species of water birds are found in the mine area, and 22 species have been confirmed as breeding there. The many species of mammals that inhabit this region, while ecologically and economically important, are not particularly abundant. There are moderate densities of brown bear and low densities of black bear, moose, coyotes, wolves, river otters, and wolverines. The mine site is within the historical range of the Mulchatna caribou herd, but radio telemetry and aerial transect surveys suggest that high-density use of the area occurs only during the summer post-calving season when caribou move through the western edge of the project area. No habitat in the mine area has been classified as high value for caribou.

2.1.3. Hydrology

The Pebble Deposit straddles the upper reaches of the SFK and UTC drainages (Figure 2-1). The headwaters of the NFK are immediately north of the Pebble Deposit. The SFK drains south from the Pebble Deposit area, and then west and northwest, where it joins the NFK, which flows west from the Pebble Deposit area. At the confluence, these streams form the Koktuli River, which flows into the Mulchatna River, a tributary to the Nushagak River. The Nushagak River flows into Bristol Bay near the city of Dillingham. Upper Talarik Creek flows south from the Pebble Deposit area and then southwest into Iliamna Lake, which is the source of the Kvichak River.

2.1.3.1 Koktuli River

The NFK and SFK are two of 24 tributaries of similar or larger size in the 315-mile-long Nushagak River system. The north and south forks of the Koktuli River flow for 36 and 40 miles, respectively, to the main stem Koktuli River. The Koktuli River flows for approximately 39 miles before entering the Mulchatna River, which flows another 44 miles before entering the Nushagak River. The Nushagak River flows about 110 miles before it empties into Bristol Bay southwest of Dillingham (Figure 1-1). The total distances from the NFK and SFK headwaters to Bristol Bay are 228 miles and 232 miles, respectively.

2.1.3.2 Kvichak River

The UTC drainage is in the 225-mile-long Kvichak River system. The headwaters of the Kvichak River system are approximately 109 miles northeast of the Pebble Deposit at the source of the Tlikakila River at Lake Clark Pass. UTC flows approximately 39 miles to Iliamna Lake (Figure 2-1). The lake empties into the Kvichak River, which flows approximately 70 miles to Bristol Bay. The total distance from the headwaters of UTC, across the lake, and to Bristol Bay is approximately 140 miles.

2.2. Transportation Corridor

The transportation corridor connects the Amakdedori Port to the mine site. It will include a private double-lane access road between the Amakdedori Port and the South Ferry Terminal on Iliamna Lake west of Kokhanok; a similar access road between the North Ferry Terminal on the north shore of Iliamna Lake and the mine site; and a purpose-built ice-breaking ferry connecting the two ferry terminals. The natural gas pipeline will parallel the transportation corridor from the port site to the mine site. Additional spur roads will be built to connect the access road to the villages of Iliamna, Newhalen, and Kokhanok. Approximately 65 percent of the corridor land is owned by the State of Alaska, with the remaining 35 percent divided among various ANCSA corporations, as shown in Table 2-2 and Figure 2-2.

Table 2-2. Transportation Corridor Land Ownership[a]

Land Ownership	Road Segments (Miles)	Percentage
Access Road	Total miles: 66	
State of Alaska	43	65
Alaska Peninsula Corporation	23	35
Iliamna Airport Spur	Total miles: 7	
State of Alaska	4	55
Iliamna Natives Limited	3	45
Iliamna Lake Crossing	Total Miles: 18	
State of Alaska	18	100
Kokhanok Airport Spur	Total miles: 1.5	
Alaska Peninsula Corporation	1.5	100
Total Road Miles	75	
Total Corridor Miles	93	

[a] Distances presented are approximate and have been rounded for ease of reference.

2.2.1. Physiography

The geographic location of the transportation corridor is described in Table 2-3.

Table 2-3. Transportation Corridor Geographic References

Item	Value
USGS Quadrangles	Iliamna B-3, B-4, B-5, B-6 Iliamna C-6 Iliamna D-6, D-7
Elevation:	
Minimum	Near sea level (Amakdedori Port)
Maximum	1,700 ft (leaving mine site)

The transportation corridor is located within three physiographic divisions: Nushagak-Big River Hills, Nushagak-Bristol Bay Lowlands, and Aleutian Range. The terrain includes a range of types, from flat to moderately undulating near the Pebble Deposit, gently sloping and colluvial terrain along the north shore of Iliamna Lake, and mountainside slopes to narrow valley bottoms through the Aleutian Range. No permafrost has been identified in the transportation corridor.

2.2.2. Ecology

Much of the land at lower elevations south of Iliamna Lake is covered by dwarf shrub and broadleaf forest communities. At higher elevations where shallow bedrock occurs, dwarf shrub and alder shrub communities are prevalent. Wetland habitats are common in depressional areas, valley bottoms, and on slope benches and include wet meadows and scrub-shrub communities. Vegetation communities within the transportation corridor north of Iliamna Lake primarily consist of dwarf shrub, spruce woodland, mixed broadleaf and spruce forest, and shrubs. Wetland habitats dominated by willow shrub communities are common on floodplains of streams, while wet meadows and mixed shrub wetlands are common at toe slopes where groundwater discharge occurs.

Rivers along the transportation corridor provide habitat for five species of anadromous Pacific salmon. Rainbow trout and other species of fish, such as Dolly Varden and arctic grayling, are also present.

Forest and wetland habitats in the transportation corridor support types of wildlife similar to those at the mine site. Brown bear density is somewhat higher in the transportation corridor, with densities increasing as the corridor approaches the coast. Black bears occur in very low densities along the transportation corridor. Small numbers of caribou from the Mulchatna herd may be found foraging at higher elevations following calving within the transportation corridor north of Iliamna Lake. The transportation corridor contains migratory stopover and breeding habitats for many species of songbirds, raptors, and waterfowl.

2.2.3. Hydrology

The 84-mile-long access corridor crosses numerous streams within the Bristol Bay and Cook Inlet watersheds. The corridor originates in the Nushagak watershed at the mine site and traverses the Kvichak watershed; both are within the greater Bristol Bay watershed. The corridor terminates in the Tuxedni-Kamishak Bays watershed of the greater Cook Inlet watershed.

2.3. AMAKDEDORI PORT

2.3.1. Physiography

The port site is located just north of the mouth of Amakdedori Creek on the shore of Cook Inlet in the northern part of the Aleutian Range physiographic division. Topography is generally flat with dunes located closer to the gravel beach shoreline of Cook Inlet. The port location is in the Iliamna B-3 USGS Quadrangle.

2.3.2. Ecology

The western shorelines from Kameshak Bay north to Iniskin Bay are composed of diverse habitats, including steep rocky cliffs, cobble or pebble beaches, and extensive sand/mud flats. Eelgrass is found at a number of locations and habitats; eelgrass, along with macroalgae, is an important substrate for spawning Pacific herring. Much of the land is well-drained and covered by dwarf shrub communities with inclusions of alder shrub and grass-herb communities. Wetland habitats consisting of wet meadows and shrub communities are limited to the northwestern extent of the port site where groundwater discharge occurs and areas within the floodplain of Amakdedori Creek.

Preliminary data gathered at Amakdedori beach in 2013 indicate that Pacific herring are the predominant species present in the nearshore environment, with smaller populations of Dolly Varden and pink salmon. The port site is located within critical habitat for the Cook Inlet Beluga Whale and the Northern Sea Otter Southwest Distinct Population Segment (DPS). Cook Inlet Beluga Whale critical habitat includes nearshore waters out to two nautical miles and comprise important foraging areas in fall and winter. Northern Sea Otter critical habitat includes foraging areas and escape habitat from marine mammal predators found in Kamishak Bay.

2.3.3. Hydrology

The Cook Inlet basin is an expansive watershed surrounding the 180-mile-long Cook Inlet waterbody. Covering more than 38,000 square miles of southern Alaska, it receives water from six major watersheds and many smaller ones. More than ten percent of the basin is covered by glaciers and suspended sediment loading in glacier fed rivers without lakes is significant, leading to a high suspended sediment load in portions of Cook Inlet.

Lower Cook Inlet is connected to the Pacific Ocean southwest through Shelikof Strait, and southeast by the Gulf of Alaska and demonstrates complex circulation on variable timescales. The region has the fourth largest tidal range in the world; tidal fluctuations in Kamishak Bay average 13 feet. When the tide drops from mean high to mean low water, the inlet loses almost 10 percent of its volume, and exposes approximately 8 percent of its surface area. Most of these tidally exposed areas are in the arms at the north end of Cook Inlet and along the west side of the waterbody.

2.4. Natural Gas Pipeline Corridor

The natural gas pipeline connects the mine site and the port site to the Cook Inlet gas supply infrastructure. It ties to an existing pipeline near Happy Valley on the Kenai Peninsula, before following an Alaska Department of Transportation and Public Facilities (ADOT&PF) right-of-way (ROW) south to the compressor station, which is also located on ADOT&PF land. The pipeline then crosses state and federal Outer Continental Shelf (OCS) waters in Cook Inlet to the Amakdedori Port before following the transportation corridor to the mine site (see Table 2-4).

Table 2-4. Natural Gas Pipeline Land Ownership[a]

Land Ownership	Road Segments (miles)	Percentage
Happy Valley to Cook Inlet	Total miles: 10	
State of Alaska	10	65
Cook Inlet Crossing	Total miles: 94	
State of Alaska	31	55
Federal Waters – Alaska OCS	63	45
Iliamna Lake Crossing	Total miles: 18	
State of Alaska	18	100
Transportation Corridor Parallels	Total miles: 66	
State of Alaska	43	65
Alaska Peninsula Corporation	23	35
Total Miles	188	

[a] Distances presented are approximate and have been rounded for ease of reference.

2.4.1. Physiography

The geographic location of the initial portion of the natural gas pipeline corridor is defined in Table 2-5. The remainder is the same as the transportation corridor.

Table 2-5. Natural Gas Pipeline Geographic References

Item	Value[a]
USGS Quadrangles	Iliamna B-2 Seldovia D-5
Elevation:	
Minimum	-230 ft
Maximum	1,700 ft

[a] All references in Table 2-3 apply to the natural gas pipeline, but are excluded from this table.

The pipeline is located in four physiographic regions, including the Nushagak-Big River Hills, the Nushagak-Bristol Bay Lowlands, the Aleutian Range, and the Cook Inlet-Susitna Lowlands. The terrain includes a range of types, from flat to moderately undulating near the Pebble Deposit/mine site, gently sloping and colluvial terrain along the north shore of Iliamna Lake, mountainside slopes to narrow valley bottoms through the Aleutian Range, and coastal lowlands around Cook Inlet. No permafrost has been identified in the pipeline corridor.

2.4.2. Ecology

The Cook Inlet region is composed of marine, coastal, and estuarine habitats. Pelagic waters within Cook Inlet are influenced by riverine and marine inputs resulting in salinity gradients and horizontal mixing throughout the inlet. Deeper waters of Cook Inlet are characterized by unconsolidated sediments on a smooth bottom and strong tidal currents. The variety of habitats in the region support lower trophic organisms, fish, shellfish, marine mammals, and birds. Fish and shellfish are important components of the Cook Inlet food web, as they feed on lower trophic organisms such as plankton, and serve as prey for other fish, birds, and marine mammals.

The Cook Inlet region is a migratory corridor and juvenile rearing area for all five species of Pacific salmon, Dolly Varden, and steelhead trout, which spawn in rivers and streams throughout the region. Nineteen marine mammal species known to occur in Cook Inlet, including the Cook Inlet Beluga whale, which use nearshore waters for feeding in fall and winter. A large seabird nesting colony lies within Kamishak Bay on the western shore of lower Cook Inlet. As outlined in section 2.3.2 coastal areas of western Cook Inlet, including Kamishak Bay, include critical habitat for the Cook Inlet beluga whale and the Cook Inlet northern sea otter.

2.4.3. Hydrology

See section 2.3.3 for a discussion of Cook Inlet hydrology.

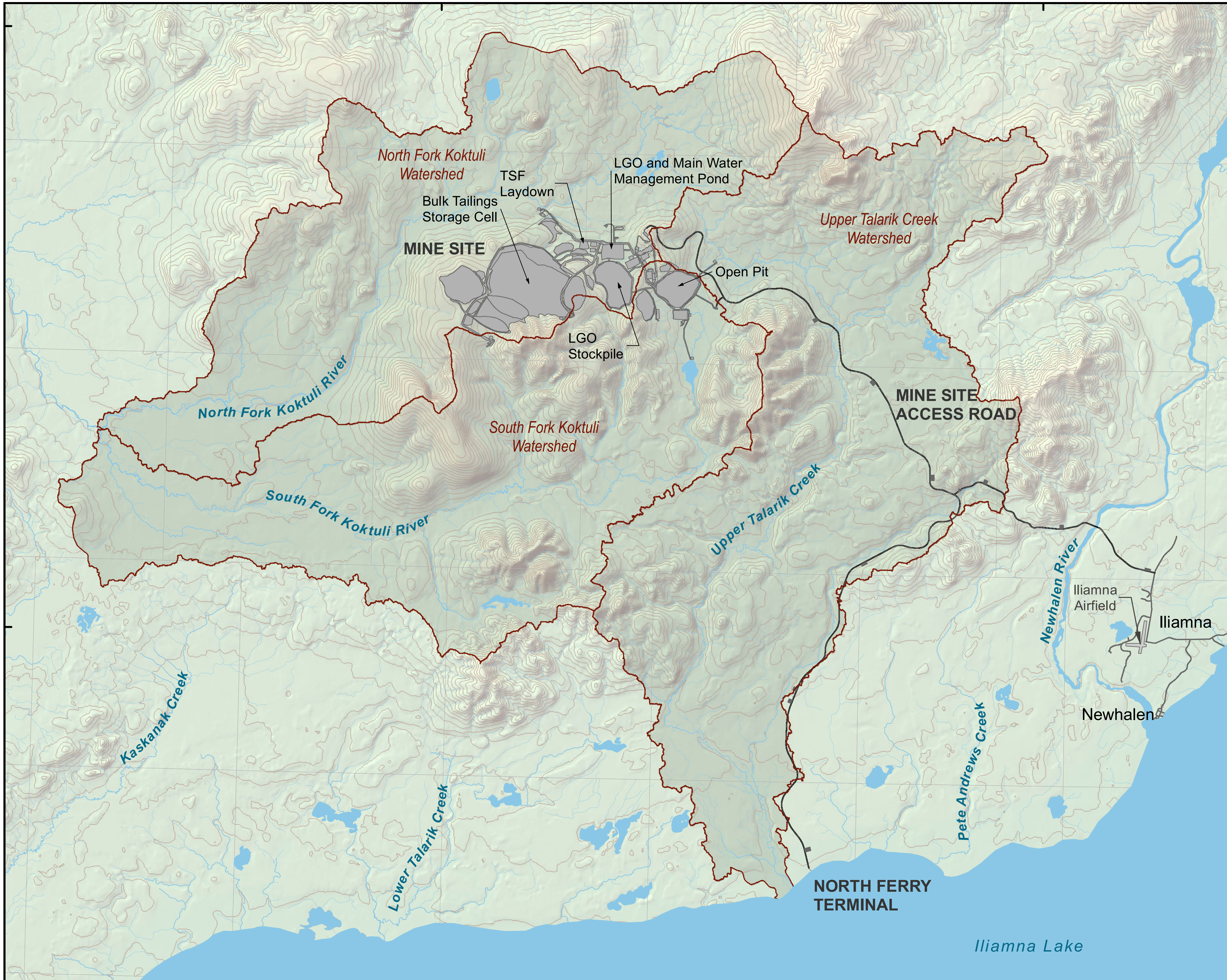

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FIGURE 2-1

Mine Site Hydrography

Project Features
Watershed Boundary
Access Road
Local Roads

Miles 0 2 4 6

N

Scale 1:180,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

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Version: 1	Author: HDR

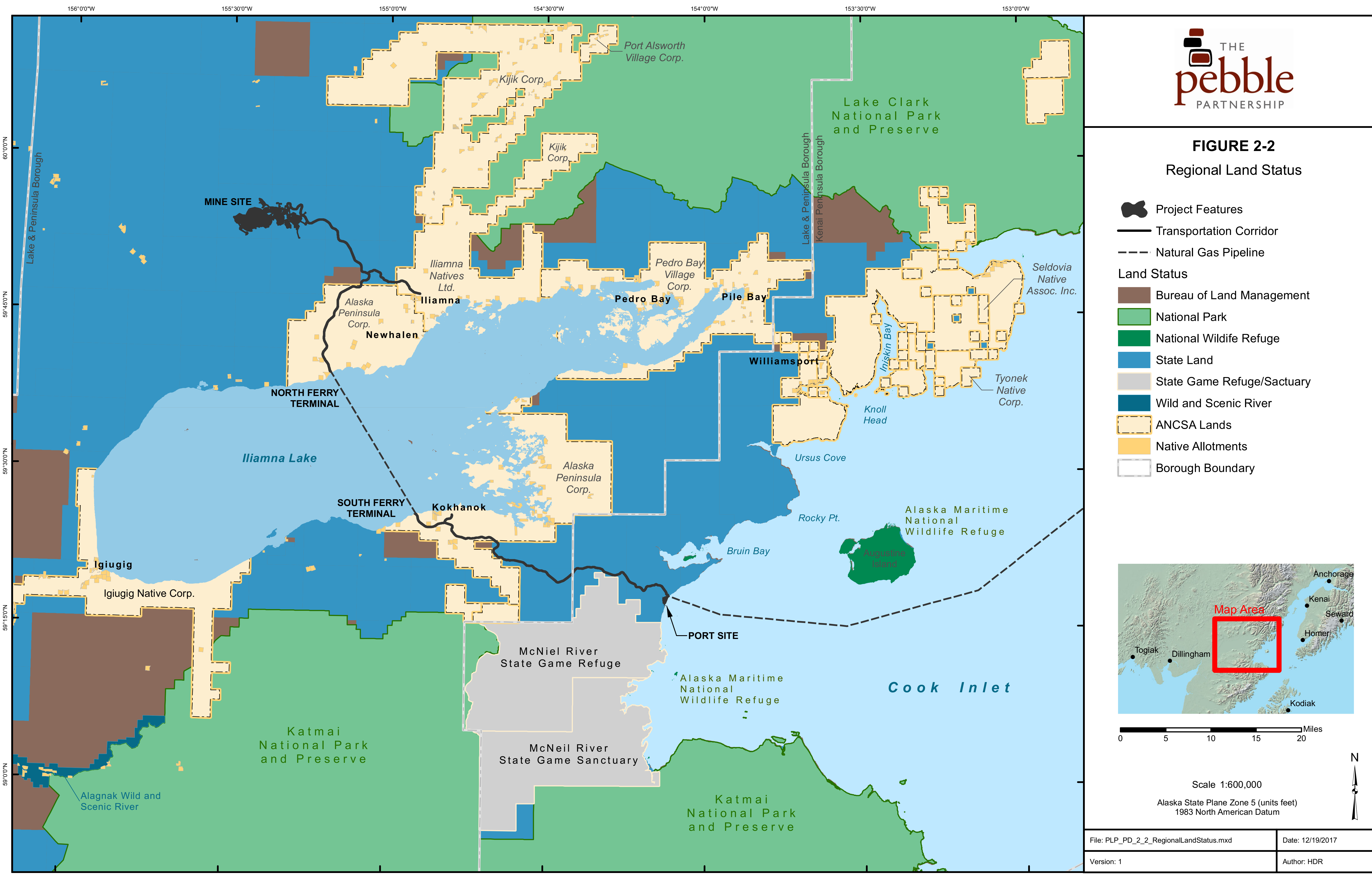

FIGURE 2-2

Regional Land Status

2.5. State and Federal Interest Lands

Several state and federally managed lands lie within a 100-mile radius of the mine site or Amakdedori Port (Figure 2-2). Two large national park units–Katmai National Park and Preserve, and Lake Clark National Park and Preserve–lie to the south and northeast of the mine site, respectively. Both parks straddle the Bristol Bay/Cook Inlet watershed divide, although most recreational use in both parks occurs in the Bristol Bay drainage, west of the divide. The Alagnak Wild and Scenic River flows west from Katmai National Park and Preserve and into the Kvichak River, which flows into Bristol Bay. The McNeil River State Game Refuge and Sanctuary, which lies north of Katmai National Park and Preserve, is in the Cook Inlet watershed. West of the mine site is Wood-Tikchik State Park, which is in the Bristol Bay watershed.

2.6. Local and Regional Communities

The Pebble Deposit is located in southwest Alaska's Lake and Peninsula Borough, home to an estimated 1,600 people in 18 local villages. Distances to various communities are shown in Figure 1-1. At more than 30,000 square miles, the Lake and Peninsula Borough is among the least densely populated boroughs or counties in the country. There are no roads into the borough, and few roads within it, contributing to an extremely high-cost of living and limited job and other economic opportunities for local residents.

The communities closest to the mine site are Nondalton, Iliamna, and Newhalen. Igiugig and Kokhanok, on the southern shore of Iliamna Lake, are also proximal to transportation infrastructure proposed for the Project. While PLP has generated employment for residents of villages throughout the Lake and Peninsula Borough and broader Bristol Bay region over the past decade, those communities surrounding Iliamna Lake have provided the greatest proportion of the local workforce.

With project infrastructure planned to connect the proposed mine site to the villages of Iliamna, Newhalen, and Kokhanok, residents of these and other communities are expected to continue to continue playing an important role in staffing the Project in the future.

The Bristol Bay Borough is the only other organized borough in the Bristol Bay region, with some 900 full-time residents in three villages. A significant portion of the Bristol Bay region is not contained within an organized borough; the Dillingham Census Area comprises 11 different communities. A total of about 7,500 people call the Bristol Bay region home, with the largest population centers in Dillingham, King Salmon, and Naknek.

Most Bristol Bay villages have fewer than 150–200 full-time residents. A majority of the population is of Alaska Native descent and Yup'ik or Dena'ina heritage. Virtually all of the region's residents participate to some degree in subsistence fishing, hunting, and gathering activities. Subsistence is central to Alaska Native culture and provides an important food source for local residents.

There are 13 incorporated first- and second-class cities in the Bristol Bay region, and 31 tribal entities recognized by the U.S. Bureau of Indian Affairs. There are also 24 Alaska Native Village Corporations created under the ANCSA, two of which – Alaska Peninsula Corporation and Iliamna Natives Limited – hold surface rights for significant areas of land near the Pebble Deposit and along its transportation infrastructure corridors.

The commercial fishing, guiding, and tourism-related sectors provide many jobs in the region, but the work is highly seasonal; year-round employment is the exception rather than the norm. A lack of employment and economic opportunity has contributed to a declining population in many Lake and Peninsula Borough and regional villages, resulting in the closure of several schools over the past decade.

2.7. Legal Description

The legal description of lands on which major project elements will be located is shown in Table 2-6. Sections are within the Seward Meridian Survey of the Public Land Survey System.

Table 2-6. Project Location (Public Land Survey System)

Range	Township	Section
14 West	3 South	7, 8, 18, 19, 30
15 West	3 South	25, 36
	4 South	1, 11, 12, 14, 15, 21, 22, 28, 29, 31, 32
16 West	5 South	1, 2, 10, 11, 15, 16, 17, 19, 20, 30
24 West	10 South	22, 23, 24, 27, 28, 29, 30
25 West	10 South	25, 32, 33, 34, 35, 36
26 West	10 South	31, 32, 33
28 West	10 South	19, 20, 26, 27, 28, 29, 31, 35, 36
29 West	10 South	6, 7, 8, 9, 10, 14, 15, 16, 17, 22, 23, 24, 26, 34, 35, 36
	11 South	2
30 West	9 South	31, 32, 33, 34
	10 South	1, 2, 3, 5, 6
31 West	9 South	31, 32
	10 South	1, 3, 4, 5, 10, 11, 12
32 West	9 South	15, 16, 17, 18, 22, 26, 27, 35, 36

Range	Township	Section
33 West	4 South	19, 27, 28, 29, 30, 34, 35
	8 South	18, 19, 20, 29, 32, 33
	9 South	2, 3, 6, 7, 8, 9, 10, 11, 13, 14
34 West	3 South	19, 29, 30, 32
	4 South	4, 5, 9, 10, 14, 15, 23, 24, 26, 32, 33, 34, 35
	6 South	30, 31
	7 South	5, 6, 8, 9, 16, 21, 22, 26, 27, 35
	8 South	1, 2, 12, 13
35 West	3 South	15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 33, 34
	5 South	1, 12, 13, 14, 22, 23, 26, 27, 34, 35
	6 South	2, 3, 10, 11, 14, 23, 24, 25
36 West	3 South	11, 12, 13, 14, 15, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 33, 34

3. PROJECT COMPONENTS AND OPERATIONS

This section describes the various project components and the operations associated with those components through the active life of the Project. Construction will last for approximately four years, followed by a commissioning period and 20 years of mineral processing. Mining pre-production will start during construction, and active mining from the pit will continue through the first 14 years of mineral processing. For the last six years of mineral processing, the mill will be fed from the LGO stockpile. Figure 1-4 shows the layout of the mine site, including the major facilities and site infrastructure.

3.1. SUMMARY PROJECT INFORMATION

A summary of mining and process related information is shown in Table 3-1.

Table 3-1. Summary Project Information[a]

Item	Value
General Operation	
Construction	4 years
Open pit mining	14 years
LGO stockpile processing	6 years
Total project operations	20 years
Daily schedule	24 hours
Annual schedule	365 days
Mine Operation	
Pre-production mined volume	30 million tons
Annual mining rate	90 million tons
Operations mined volume	1,200 million tons
Mine life strip ratio	0.1:1 (waste:mineralized material)
Open pit dimensions	6,500 x 5,500 ft, 1,330–1,750 ft deep
Process Operation	
Daily process rate	160,000 tons
Annual process volume	58 million tons
Copper-gold concentrate	600,000 tons per year
Molybdenum concentrate	15,000 tons per year
Pyritic Tailings Storage Cell	
Approximate capacity (solids)	135 million tons
South embankment (height)	250 feet

Item		Value
Bulk Tailings Storage Cell		
	Approximate capacity	950 million tons
	Main embankment (height)	600 feet
	Internal embankment (height)	420 feet
	East embankment (height)	60 feet
	South embankment (height)	350 feet

[a] Design criteria as presented are approximate and have been averaged and rounded as appropriate for ease of reference.

3.2. MINING

3.2.1. Methods and Phasing

The Pebble Mine will be a conventional drill, blast, truck, and shovel operation with an average mining rate of 90 million tons per year and an overall stripping ratio of 0.1 ton of waste per ton of mineralized material.

The open pit will be developed in stages, with each stage expanding the area and deepening the previous stage. The final dimensions of the open pit will be approximately 6,500 feet long and 5,500 feet wide, with depths between 1,330 and 1,750 feet.

Mining will occur in three phases: Preproduction, Production, and Stockpile Reclaim.

The mine operation will commence during the last year of the Preproduction Phase and extend for 14 years during the Production Phase. During this period, 1,100 million tons of mineralized rock and 100 million tons of waste rock will be mined. After the open pit is depleted, the process plant will be fed with mineralized material reclaimed from the LGO stockpile. Non-potentially acid generating (NPAG) waste rock will be used in construction of the tailings embankments or mine site roads. The PAG waste rock will be stored in the LGO stockpile until closure, when it will be back-hauled into the open pit. Fine- and coarse-grained soils will be stored southwest of the pit and north of the main TSF embankment and will be used for reclamation during mine closure.

The Preproduction Phase consists of dewatering the pit area and mining of non-economic materials overlying the mineralized material, to be stockpiled for initial process plant feed, from the initial stage of the open pit. Dewatering will begin approximately one year before the start of preproduction mining, which will last for one year. Approximately 30 million tons of material will be mined during this phase (Table 3-2).

Table 3-2. Mined Material—Preproduction Phase

Material Type	Quantity
Overburden	8 million tons
Mineralized material process plant feed	19 million tons
NPAG waste rock	2 million tons
PAG waste rock	1 million tons

The Production Phase encompasses the period during which economic-grade mineralized material will be fed to the metallurgical process plant that produces concentrates for shipment and sale. The Production Phase is planned to last for 20 years. Mineralized material will be mined for 14 years and be fed through the process plant at a rate of 160,000 tons/day. The open pit will be mined in a sequence of increasingly larger and deeper stages. As the mining rate will exceed the processing rate, surplus mineralized material, selected based on its relative value, will be stored on the LGO stockpile and later processed during the Stockpile Reclaim Phase. Approximately 1.2 billion tons of material are planned to be mined during the Production Phase (Table 3-3).

Table 3-3. Mined Material—Production Phase

Material Type	Quantity
Overburden	63 million tons
Mineralized material process plant feed	1,098 million tons
NPAG waste rock	15 million tons
PAG waste rock	27 million tons

The Stockpile Reclaim Phase will commence during the last year of the Production Phase and extend for an additional six years. During this phase, mining activity will be limited to reclaiming material from the LGO stockpile to feed through the process plant. The process rate will continue at 160,000 tons/day. At the end of this phase, the LGO stockpile will be depleted.

3.2.2. Blasting

Most open pit blasting will be conducted using emulsion blasting agents manufactured on site. In dry conditions, a blend of ammonium nitrate and fuel oil (ANFO) can be used as the blasting agent. However, most ammonium nitrate will be converted to an emulsion blasting agent because of its higher density and superior water resistance. Initial operations during the Preproduction Phase may use pre-packed emulsion blasting agents or a mobile bulk emulsion manufacturing plant. After the explosives plant is completed, the emulsion-based ANFO explosive will be used as the primary blasting agent.

The ANFO will be stored separately as a safety precaution. All explosive magazines will be constructed and operated to meet mine safety and health regulations. The ammonium nitrate solution will be mixed with diesel fuel and emulsifying agents in a mobile mixing unit on the mining bench where blasting is to take place. The emulsion will become a blasting agent only once it is sensitized using the sensitizing agent while in the drill hole.

Based on knowledge of the rock types in the Pebble Deposit, blasting will require an average powder factor of approximately 0.5 pound per ton of rock. Blasting events during the Preproduction Phase will occur approximately once per day. The frequency will increase during the Production Phase, with events occurring as often as twice per day.

3.2.3. Waste Rock and Overburden Storage

Waste rock is mined material with a mineral content below an economically recoverable level that is removed from the open pit, exposing the higher grade production material. Waste rock will be segregated by its potential to generate acid. NPAG waste rock will be used to construct various mine site structures, including TSF embankments, WMP embankments, and mine site roads. Waste rock that is potentially acid generating will be stored within the LGO stockpile until mine closure, when it will be back-hauled into the open pit. Quantities of material mined are outlined in Table 3-1 and Table 3-2 above.

During the Preproduction Phase, approximately 19 million tons of mineralized material will be removed from the open pit and stockpiled within the LGO stockpile. This material will be processed once the mill starts up.

Overburden is the unconsolidated material lying at the surface. At the Pebble Deposit, the overburden depth ranges from 0 to 140 feet. Overburden removal will commence during the Preproduction Phase and will recur periodically during the Production Phase at the start of each pit stage. The overburden will be segregated and stockpiled in a dedicated location southwest of the open pit. A berm built of non-mineralized rock will surround the overburden to contain the material and increase stability. Overburden materials deemed suitable will be used for construction. Fine- and coarse-grained soils suitable for plant growth will be stockpiled for later use as growth medium during reclamation. Growth medium stockpiles will be stored at various locations around the mine site and stabilized to minimize erosion potential.

3.2.4. Low Grade Ore Stockpile

The LGO stockpile will be used during the Preproduction and Production phases to store mineralized material, segregated on the basis of its relative value, and PAG waste rock mined from the open pit. The LGO stockpile will be placed on an engineered liner to control seepage losses through the stockpile.

The LGO stockpile will be progressively developed through the Production Phase, during which some stockpiled material will be reclaimed for feed to the process plant. At its peak, the LGO stockpile will contain approximately 330 million tons of mineralized material.

3.2.5. Equipment

The Project will use the most efficient mining equipment available in the production fleet to minimize fuel consumption per ton of rock moved. Most mining equipment will be diesel-powered. This production fleet will be supported by a fleet of smaller equipment for overburden removal and other specific tasks for which the larger units are not well-suited. Equipment requirements will increase over the life of the mine to reflect increased production volumes and longer cycle times for haul trucks as the pit is lowered (Table 3-4). All fleet equipment will be routinely maintained to ensure optimal performance and minimize the potential for spills and failures. Mobile equipment (haul trucks and wheel loaders) will be serviced in the truck shop; track-bound equipment (shovels, excavators, drills, and dozers) will be serviced in the field under appropriate spill prevention protocols.

Table 3-4. Production Phase Equipment

Equipment Unit	Class	Year 1 Quantity	Average Quantity	Peak Quantity
Electric Shovel	73 CY	2	3	4
Diesel Hydraulic Shovel	53 CY	1	1	1
Wheel Loader	53 CY	1	1	1
Electric Drill	12.25 in	1	2	3
Diesel Drill	12.25 in	1	1	1
Diesel Haul Truck	400 ton	8	22	36

CY = cubic yards

Electric shovels, each mounted on a base platform equipped with tracks, will be the primary equipment unit used to load blasted rock into haul trucks. Each electric shovel is capable of mining at a sustained rate of approximately 30 million tons per year. Diesel hydraulic shovels, due to their greater flexibility, will be used to augment excavation capacity, depending on the mining application.

Wheel loaders are highly mobile, can be rapidly deployed to specific mining conditions, and are highly flexible in their application. Diesel off-highway haul trucks will be used to transport the fragmented mineralized material to the crusher.

Track-mounted drill rigs are used to drill blast holes into the waste rock and mineralized material prior to blasting. Hole diameters will vary between 6 and 12 inches. Drill rigs may be either electrically powered, as is the case for the larger units, or diesel powered.

This equipment will be supported by a large fleet of ancillary equipment, including track and wheel dozers for surface preparation, graders for construction and road maintenance, water trucks for dust suppression, maintenance equipment, and light vehicles for personnel transport. Other equipment, such as lighting plants, will be used to improve operational safety and efficiency.

3.2.6. Mining Supplies and Materials

Fuel, lubricants, tires, and blasting agents (Table 3-5) will be the primary materials used in mining.

Table 3-5. Mining Supplies

Consumable	Use	Shipping
Diesel fuel	Vehicles and blasting	6,350-gallon ISO tank-containers
Lubricants	Vehicles and equipment	Drums and totes in containers
Ammonium nitrate prill	Blasting	Bulk containers
Primers, detonators, and detonating cord	Blasting	Specialized packaging as required
Blasting emulsion ingredients	Blasting	Specialized packaging as required
Packaged explosives	Blasting	Specialized packaging as required
Haulage truck & other tires	Vehicles	Bulk containers/break bulk
Ground-engaging tools	Drilling and loading	Bulk containers

ISO = International Organization for Standardization

3.3. Mineral Processing

Mineral processing facilities will be located at the mine site. Blasted mineralized material from the open pit will be fed to a crushing plant to reduce the maximum particle size to approximately six inches. This crushed material will be conveyed to a coarse ore stockpile, which in turn feeds a grinding plant within the process plant. In the grinding plant, semi-autogenous grinding (SAG) mills and ball mills further reduce the plant feed to the consistency of very fine sand. The next step is froth flotation, in which the copper and molybdenum minerals are separated from the remaining material to produce concentrates. The concentrates are then filtered for shipment.

Gravity concentrators will be placed at strategic locations to recover free gold, which will be shipped off site for refining.

The copper-gold concentrate will be loaded into covered bulk shipping containers; the molybdenum concentrate will be packaged in bulk bags and loaded into shipping containers. Other economically valuable minerals–palladium and rhenium–will be present in the concentrates and may be recovered at the refineries. Figure 3-1 shows the process flowsheet.

The concentrate containers will be transported by truck to the Amakdedori Port on Cook Inlet. The contents of the copper-gold concentrate containers will be directly unloaded into the holds of Handysize bulk carriers for shipment, while the molybdenum containers will be loaded directly onto barges or other ships.

Over the life of the Project, approximately 1.1 billion tons of mineralized material will be fed to the process plant at a rate of 160,000 tons/day. On average, the process plant will produce approximately 600,000 tons of copper-gold concentrate per year, containing approximately 287 million pounds of copper, 321,000 ounces of gold and 1.6 million ounces of silver, and approximately 15,000 tons of molybdenum concentrate, containing about 13 million pounds of molybdenum.

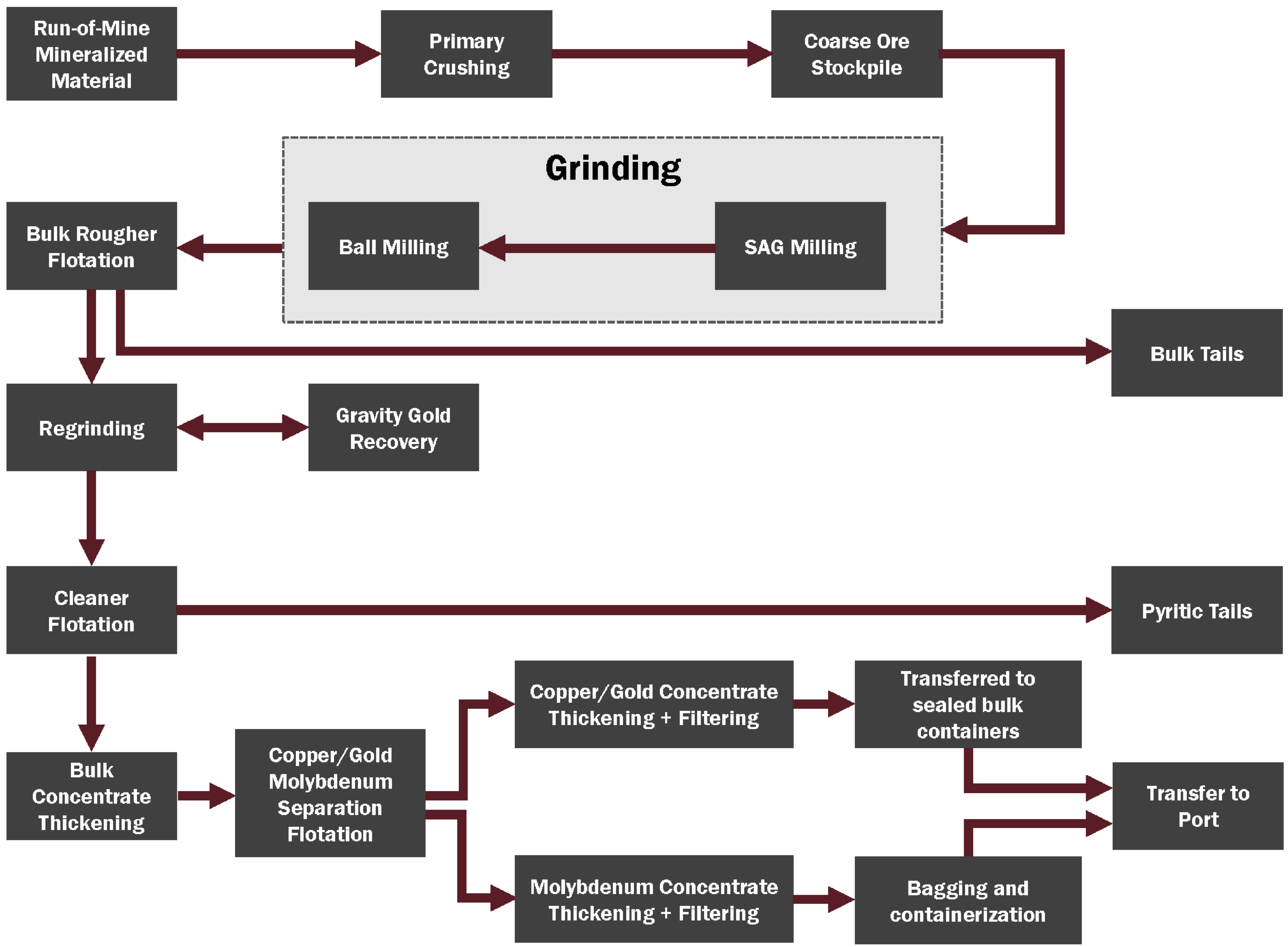

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FIGURE 3-1
Process Flow Sheet

File: PLP_PD_ProcessFlowSheet.mxd	Date: 12/15/2017
Version: 1	Author: HDR

3.3.1. Crushing

3.3.1.1 Primary Crushing

Mineralized material from the open pit or LGO stockpile will be delivered by 400-ton haul trucks to primary gyratory crushers located adjacent to the rim of the open pit. The crushers will reduce the mineralized material to a maximum size of six inches. The crushed mineralized material from both crushers is delivered via a single, covered, overland conveyor to the coarse ore stockpile.

3.3.1.2 Coarse Ore Stockpile

The coarse ore stockpile is contained within a covered steel frame building to minimize fugitive dust emissions and control mineralized material exposure to precipitation. The stockpile provides surge capacity between the crushers and the process plant, improving the efficiency of the latter and enabling it to operate if the feed from the crushers is not available.

The stockpiled material will be reclaimed by apron feeders mounted below the pile that deliver it onto two conveyor belts feeding the SAG mills. Baghouse-type dust collectors will be provided at each transfer point to control fugitive dust emissions. Water will be added to the process at the SAG mill, thereby eliminating the need for additional baghouses. A sump will be located in each reclaim tunnel to collect any excess water; however, such drainage is likely to be minimal, as it is preferable to handle coarse material dry to prevent freezing during cold conditions. An escape tunnel also will be provided for worker safety, with ventilation, as required.

3.3.2. Grinding

The primary grinding circuit will use two parallel, 40-foot-diameter SAG mills and associated ball mills to grind mineralized material to the finer consistency necessary to separate the valuable minerals. Steel balls are added to the SAG mill to aid in grinding the mineralized material. Coarse mineralized material, water, and lime are fed into the SAG mills and the mineralized material is retained within the SAG mills by grates until the particles reach a maximum size of one to two inches.

Discharge from each SAG mill will be screened to remove larger particles ranging from one to two inches ("pebbles") and sent to the ball mills. The large particles will be conveyed to the pebble-crushing facility where they will be crushed and re-introduced to the SAG mill.

The next grinding step is ball milling. Ball mills have a lower diameter-to-length ratio than SAG mills and use a higher percentage of smaller steel balls compared to SAG mills, allowing them to grind the feed to a finer size. Two ball mills will be matched with each SAG mill.

The slurry from the ball mills will be pumped into the hydro-cyclones, which separate the finer material from the larger material through centrifugal force. The slurry with the coarser material will be recycled back to the ball mills for additional grinding. The slurry containing the finer material will be pumped to the flotation cells. Grinding circuit slurry pH levels will be adjusted to 8.5 by adding lime slurry to minimize corrosion on the mill liners and promote efficient mixing prior to flotation.

3.3.3. Concentrate Production

Copper-gold and molybdenum concentrates will be produced via flotation, which will separate the metal sulfides from pyrite and non-economic minerals. Two tailings streams will be produced: bulk tailings and pyritic tailings.

3.3.3.1 Bulk Rougher Flotation

The rougher flotation circuit is designed to separate the sulfide minerals, predominantly copper, molybdenum, and iron sulfides (pyrite) within the process plant feed from the non-sulfide minerals. Slurry from the ball mills is split between two banks of bulk rougher flotation cells. Reagents added to the slurry promote mineral separation by inducing mineral particles to attach to air bubbles created by blowing air through the flotation cells. Additional reagents are added to promote froth bubble stability. This froth, with the mineral particles attached, rises to the surface and is collected as a bulk rougher concentrate for the next phase of flotation.

Bulk rougher concentrate slurry is then routed to the regrind circuit. Material that does not float – the bulk flotation tailings from which most of the sulfide minerals have been removed – will be pumped to two tailings thickeners.

3.3.3.2 Regrind

The bulk rougher concentrate is reground to sufficiently liberate minerals and enable the separation of the copper-molybdenum sulfide minerals from iron and other sulfides, thus producing concentrates with commercially acceptable grades. A gravity gold recovery circuit is attached to the regrind circuit to recover free gold that might otherwise be lost.

3.3.3.3 Cleaning

Reground bulk rougher concentrates will be upgraded through a two-stage cleaning process. The concentrate from the cleaning process will report to copper-molybdenum separation, while the tailings will report to the pyritic tailings thickener for thickening prior to pumping to the pyritic tailings storage cell in the TSF. The same reagents used in the rougher flotation circuit will be used in the cleaning circuit, with additional reagents used to aid in the suppression of gangue minerals. The cleaning stage is operated at an elevated pH—through lime addition—to suppress pyritic minerals, which would lower the grade of final concentrates.

3.3.3.4 Bulk Concentrate Thickener

Water will be removed from the bulk concentrate in a conventional thickener. This will remove as much of the bulk flotation reagents as possible before the slurry enters the copper-gold/molybdenum separation circuit, thus increasing separation process efficiency. Reagents will be recycled to the rougher process with the thickener overflow. The resulting slurry will contain 50 percent solids by weight and will go forward to copper-gold/molybdenum separation.

3.3.3.5 Copper-Gold/Molybdenum Separation Flotation

The final flotation process is designed to separate copper-gold and molybdenum concentrates by adding reagents. The concentrate from the separation stage is the molybdenum concentrate, while the tailings comprise the final copper-gold concentrate.

3.3.3.6 Concentrate Dewatering, Filtration, and Packaging

The upgraded copper-gold concentrate will be thickened to 55 percent solids by weight in a high-rate thickener. The thickener overflow will return to various circuits for use as process water. The thickener underflow will be fed to a pressure filter to reduce the moisture to approximately eight percent. The filter product will be conveyed to specialized bulk cargo containers with removable locking lids that prevent dust emissions and incidental spills while maintaining product quality through the logistics chain.

The molybdenum concentrate will be thickened in a high-rate thickener to 55 percent solids by weight. The thickener underflow will be pumped to the molybdenum concentrate filter press, where the moisture content will be reduced to 12 percent. The filtered concentrate will be further dewatered by a dryer to five percent moisture before being bagged, containerized, and shipped offshore.

3.3.4. Processing Reagents and Materials

Table 3-6 provides a list of commonly used reagents for this type of process, along with their typical packaging for transportation. The final reagent list will be determined during detailed design.

Table 3-6. Processing Reagents and Materials

Reagent	Use	Shipping/Preparation
Calcium Oxide (quick lime)	pH modifier; depresses pyrite in the copper-molybdenum flotation process.	Calcium oxide pebbles (80 percent) shipped in specially adapted 40-foot shipping containers. Pebbles will be crushed and mixed with water to form lime slurry at the lime plant.

Reagent	Use	Shipping/Preparation
Sodium Ethyl Xanthate	Copper collector; used in the rougher flotation circuit.	Pelletized reagent shipped in 1-ton bags. Mixed with process water to form 20 percent solution and stored in collector storage tank. Mix and storage tanks vented externally with fans.
Fuel Oil (Diesel)	Used in the flotation process.	Shipped in tanker trucks and stored in the main head tank in the copper-molybdenum concentrator area.
Sodium Hydrogen Sulfide (NaHS)	Copper depressant used in the copper-molybdenum separation processes.	Pelletized reagent shipped in 1-ton bags. Mixed with process water to form 20 percent solution and stored in the NaHS storage tank.
Carboxy Methyl Cellulose	Depressant; anionic polymer used to depress clay and related gangue material in the bulk cleaner flotation circuit.	Pelletized reagent shipped in 1-ton bags. Mixed with process water in the agitated dispersant tank to form 20 percent solution and stored in dispersant storage tank.
Methyl Isobutyl Carbinol	Frother; maintains air bubbles in the flotation circuits.	Shipped in 20-foot specialized ISO containers and stored in the frother storage tank.
Depressant (sodium silicate)	Clay or silica gangue mineral depressant used in the copper-molybdenum separation process.	Pelletized reagent shipped in 1-ton bags. Mixed with process water to form 20 percent solution and stored in the sodium silicate storage tank.
Anionic polyacrylamide	Thickener aid.	Pelletized reagent shipped in 1-ton bags. Vendor package preparation system composed of a bag breaking enclosure to contain dust, dry flocculent metering, and a wet jet system to combine treated water with the powdered flocculent in an agitated tank for maturation. Prepared in small batches and transferred to a flocculent storage tank.
Polyacrilic acid	Antiscalant for the lime production process.	Viscous pale amber liquid shipped in 35-cubic-foot specialized container tanks within protected rectangular framework.
Nitrogen	Nitrogen used in the molybdenum flotation circuit to depress copper sulfides.	Nitrogen will be provided by a vendor-supplied pressure swing adsorption nitrogen plant. This equipment separates nitrogen from air for use in the mineral-process plant.

3.3.5. Process Water Supply System

Process water will be drawn from the main WMP and the tailings thickener overflow streams. The primary process water source is the bulk tailings thickener overflow. Precipitation, runoff, and diverted water will be directed to runoff water ponds, and then to the mill site WMP. Some treated water will be diverted to the process for pump glands and other similar applications.

3.3.6. Tailings Production

Processing mineralized material to recover copper, gold, and molybdenum will produce two types of tailings: bulk flotation and pyritic. Bulk flotation tailings will be pumped to the bulk tailings thickener, where flocculant will be added as necessary to help the settling process. Tailings thickener underflow, at approximately 55 percent solids, will be pumped to the bulk tailings storage cell. The pyritic tailings will be thickened, mixed with WTP sludge, and pumped to the pyritic tailings storage cell. The overflow streams from each thickener will be returned to the process. Supernatant water in the pyritic tailings storage cell and bulk tailings storage cell will be reclaimed to the mill site WMP. Some of this water will be pumped to the process water tank for re-use in the process plant. The remaining water will be treated in the WTP and discharged.

3.4. Tailings Storage Facility

The TSF will be located within the NFK watershed (Figure 1-4). Total TSF capacity will be sufficient to store the 20-year mine life tailings volume (1.1 billion tons). Approximately 88 percent (950 million tons) of the tailings will be bulk tailings, and approximately 12 percent (135 million tons) will be pyritic tailings.

The TSF has separate cells for bulk and pyritic tailings and has four embankments: main, south, and east perimeter embankments and an internal embankment separating the bulk and pyritic tailings cells. The pyritic tailings will be stored in a lined cell between the internal and south embankments, and bulk tailings will be stored between the main, internal, and east embankments.

Starter embankments for the main, south and internal embankments will be constructed as part of initial TSF construction; east embankment construction will begin in year ten of operations. The main embankment will function as a permeable structure to maintain a depressed phreatic surface in the embankment and in the tailings mass in proximity to the embankment. A basin underdrain system will be constructed at various locations throughout the bulk cell basin to provide preferred drainage paths for seepage flows. The pyritic tailings cell will be a fully lined facility with subsurface drains to convey seepage to the north and south based on the topography.

The pyritic tailings cell will have a full water cover during operations, while the bulk tailings cell will have a relatively small supernatant pond, located away from the main embankment, to promote large tailings beach development upstream of the main embankment.

The TSF downstream embankment slopes will be maintained at approximately 2.6H:1V (horizontal:vertical), including buttresses established at the downstream toe of the main embankment. The final embankment crest elevation will be approximately 1,770 feet above sea level for the main, east, and internal embankments. The south embankment final crest elevation will be a minimum of five feet higher (1,775 feet above sea level) than the internal embankment. This safety precaution will ensure that any potential overflow would be directed to the much larger bulk tailings cell. Embankment heights, as measured from lowest downstream slope elevation, will be approximately 600 feet (main), 350 feet (south), 420 feet (internal), and 60 feet (east).

3.4.1. Siting Criteria

PLP conducted a multi-year, multi-disciplinary evaluation to select a TSF location that meets all engineering and environmental goals while allowing for cost-effective integration into the site waste and water management plans. During this evaluation, more than 35 tailings disposal options were tested against a range of siting criteria, including:

- **Minimize potential impact to environmental resources.** The selected site is within a valley supporting mixed uplands and wetland shrub/herbaceous shrub. The valley includes a tributary to the NFK that has experienced intermittent flows, with dry stretches extending two miles. Index counts indicate lower fish presence than at other locations. Potential impacts to waterfowl are likewise reduced by avoiding areas with high-value habitats for nesting, breeding, molting, or migration.
- **Provide adequate storage capacity.** The site will accommodate tailings within one catchment for the Project.
- **Reasonable proximity.** The site minimizes the distance to the process plant, which reduces power consumption and the overall project footprint.

3.4.2. Design Criteria

The TSF will be designed to meet or exceed the standards of the updated 2017 Guidelines for Cooperation with the Alaska Dam Safety Program (ADSP). The TSF will be designed to the standards of a Class 1 hazard potential dam, as required for all tailings dams in Alaska.

The final TSF design will incorporate the following:

- Permanent, secure, and total confinement of tailings solids within an engineered disposal facility.
- Control, collection, and recovery of tailings water from within the tailings impoundments for recycling to the process plant operations as process water, or treatment prior to discharge to the environment.
- Providing seepage collection systems below the impoundment structures to prevent adverse downstream water quality impacts.
- The inclusion of freeboard to contain the entire volume of the Inflow Design Flood (IDF) above the tailings beach. The maximum operating pond will not flood the entire tailings beach.
- Limiting the volume of stored water within the bulk tailings cell and keeping the operating pond away from the dam face.
- The consideration of long-term closure management at all stages of the TSF design.
- The inclusion of monitoring instrumentation for all aspects of the facility during operations and after closure.
- The design includes flattened slopes to increase the static factor of safety.

3.4.3. Tailings Deposition

Each tailings stream will be delivered to the TSF using two pump stations, one located in the process plant and one booster station positioned approximately mid-way along the pipeline route. The bulk tailings will be discharged via spigots spaced at regular intervals along the interior perimeter of the bulk tailings cell to promote beach development, which will allow the supernatant pond to be maintained away from the main embankment.

Pyritic tailings from the cleaner scavenger flotation circuit will be discharged into the pyritic tailings cell at sub-aqueous discharge points. The sub-aqueous discharge is necessary to prevent oxidation and potential acid generation.

3.4.4. Construction

A “Certificate of Approval to Construct a Dam” is required from the ADSP for the construction of a TSF. The certificate will include any special conditions or limitations on the construction.

The TSF embankments will be constructed using earth- and rockfill materials, including NPAG waste rock excavated from the open pit. A plan view and typical sections for the four embankments are shown in Figure 3-2 and Figure 3-3. The material for the starter embankments will be sourced from excavations required at the embankment locations and from a quarry located within the impoundment area. The embankments will be raised progressively during the mine life. After the quarry within the impoundment is inundated with tailings, material will be sourced from two quarries immediately west and east of the impoundment.

3.4.4.1 Main Embankment

The main embankment will be constructed using the centerline construction method with local borrow materials. The centerline construction method provides a high level of embankment stability while reducing the embankment material requirements associated with downstream embankments.

The embankment foundation will be prepared by removing overburden materials to competent bedrock prior to the placing structural fill materials. Construction begins with a cofferdam to capture upstream runoff during starter embankment construction. The starter embankment will be constructed to a height of approximately 275 feet and provide capacity to store tailings for the first 24 months of operation.

The earthfill/rockfill embankment will include engineered filter zones and a crushed or processed aggregate drain at the topographic low point. This drain will provide a preferable seepage path from the tailings mass to downstream of the embankment toe. Additional underdrains running parallel to the embankment will allow for drainage of seepage collected along the embankment.

3.4.4.2 East Embankment

East embankment construction will commence in approximately year 10. The embankment base will be excavated to bedrock and anchored to an underlying subsurface grout curtain via a concrete plinth. The embankment will be constructed with select overburden and quarried rockfill materials using the centerline construction method, and will incorporate a low permeability core zone and engineered filters to minimize seepage through the embankment.

3.4.4.3 South Embankment

The south embankment will be constructed using the downstream construction method to facilitate lining of the upstream face, which is constructed at a 3H:1V slope. Overburden materials will be removed to competent bedrock below the embankment. The upstream slope of the south embankment, and entire pyritic tailings cell, will be fully lined for seepage containment. The embankment will be constructed using select borrow materials and include a liner bedding layer on the upstream slope (and over the entire internal basin). Basin underdrains will collect and convey any seepage to the downstream seepage collection pond.

3.4.4.4 Internal Embankment

The internal embankment will provide the northern confinement for the pyritic tailings cell and separate it from the bulk tailings cell. The embankment foundation will be prepared by removing overburden materials to competent bedrock. The north and south slopes of the internal embankment will be constructed at 3H:1V and will include a liner bedding layer and liner for seepage containment. Embankment construction will be completed using select materials from the overburden excavation and local quarries. Initial construction will be to full width to allow embankment raises to be completed as tailings are deposited on both sides.

3.4.4.5 Embankment Lifts

Embankments will be constructed in stages throughout the life of the Project, with each stage providing the required capacity until the next stage is completed. A ‘Certificate of Approval to Modify a Dam’ is required from the ADSP for each construction lift. Planned embankment raises will be evaluated each year and sized according to a review of the process plant throughput, actual tailings settled densities (TSF ponds are typically sounded to establish the size of the supernatant pond and the density of the deposited tailings in the TSF), and water storage requirements.

3.4.5. Freeboard Allowance

All stages of embankment design include a freeboard allowance above the maximum operating TSF pond level and tailings beach. The freeboard allowance includes containment of the IDF and wave run-up protection, as well as an allowance for post-seismic embankment settlement. The IDF for the facility has been selected as the Probable Maximum Flood (PMF).

The embankment freeboard requirements will be reviewed as part of each dam lift and dam safety review, and will be adjusted, as required to reflect actual mine water management conditions.

3.4.6. Surface Water

The IDF is the primary hydrologic input to the TSF design. The IDF for the TSF is the PMF. The design PMF volume is based on the 72-hour Probable Maximum Precipitation (PMP) event, plus the snow water equivalent from a 1-in-10-year snowpack. Available storage, or freeboard, will always be maintained within the TSF cells to account for the IDF. Maximum operating conditions will not encroach on the freeboard allowance. Pumps located at the bulk tailings cell supernatant pond will control the water level by transferring excess water to either the seepage control pond or the main WMP.

The pyritic tailings cell will be a fully lined, water retention facility. The primary means of controlling the water level within this pond will be by pumping from this cell to the bulk tailings cell or to the seepage control pond. The south embankment elevation will be maintained above that of the internal embankment to ensure that all water is contained within the overall TSF.

3.4.7. Seepage

The main embankment will be designed to promote seepage to the seepage control pond, thereby minimizing the volume of water contained within the impoundment.

For the other embankments, seepage controls will include grout curtains, liners, and low-permeability zones. The low-permeability zones, in conjunction with the low-permeability tailings mass, will function as the primary seepage control barriers of the internal and east embankments.

The seepage management system will also include seepage control measures downstream of the TSF embankments. These include seepage recycle ponds with grout curtains and low-permeability core zones, and downstream monitoring wells. Embankment runoff and TSF seepage collecting in the downstream seepage recycle ponds will ultimately be transferred to a WMP to be used in mining operations. Surplus water from the WMPs will be treated to achieve discharge standards and then released to the environment.

3.5. Mine Site Infrastructure

Due to the remote location and the absence of existing infrastructure, the Project will be required to provide basic infrastructure, as well as the support facilities typically associated with mining operations. These facilities require reasonable access from the Pebble Deposit, and they have been situated foremost for stability and safety. Figure 1-4 shows the mine site layout.

3.5.1. Power Generation and Distribution

There is no existing power infrastructure in the Project vicinity. All required generating capacity, distribution infrastructure, and backup power will be developed by the Project.

To meet the projected power requirement while providing sufficient peaking capacity and N+1 redundancy (one generating unit held in reserve for maintenance or emergency use) will require a plant with an installed nameplate capacity of 230 MW. The plant will use high-efficiency combustion turbine or reciprocating engine generators operating in a combined-cycle configuration. The units would be fired by natural gas provided to the site via pipeline. Design-appropriate controls will be used to manage airborne emissions and meet Alaska Department of Environmental Conservation (ADEC) air quality criteria and best management practices (BMPs). Unused waste heat will be rejected through a closed-loop, water cooled system that circulates water through the steam condenser to a mechanical draft cooling tower.

The various mine load centers would be serviced by a 69-kilovolt distribution system using a gas-insulated switchgear system located at the power plant.

Emergency backup power for the mine site will be provided by both standby and prime-rated diesel generators connected into electrical equipment at areas where power is required to ensure personnel safety, avoid the release of contaminants to the environment, and allow for the managed shutdown and/or ongoing operation of process-related equipment.

3.5.2. Heating

Waste heat from the power plant will be used to heat mine site buildings and supply process heating to the water treatment plant. Low-pressure steam, via heat exchangers, will heat a closed-loop glycol system that distributes heat to various buildings. Warm water from the steam condenser discharge will be routed to the water treatment plant to provide process heating.

3.5.3. Shops

The truck shop complex will house a light-vehicle maintenance garage, a heavy-duty shop that can accommodate 400-ton trucks, a truck wash building, a tire shop and a fabrication and welding shop. The layout is designed to maintain optimal traffic flow and minimize the overall complex footprint. An oil-water separation system will be designed for water collected from the wash facility and floor drains.

3.5.4. On-site Access Roads

There will be several access roads within the mine site area, including a road from the gatehouse to the mine site and secondary roads linking with the various facilities around the mine. Roads will be sized according to the operating requirements and the types of equipment using them.

3.5.5. Personnel Camp

The first camp to be constructed at the mine site will be a 250-person fabric-type camp to support early site construction activities and throughout the Preproduction Phase as required for seasonal peak overflows. The main construction camp will be built in a double-occupancy configuration to accommodate 1,700 workers. This facility will later be refurbished for 850 permanent single-occupancy rooms for the operations phase. The camp will include dormitories, kitchen and dining facilities, incinerator, recreation facilities, check-in and check-out areas, administrative offices and first aid facilities.

The mine will operate on a fly-in, fly-out basis, except for those personnel residing in the communities connected to the access road corridor. Non-resident personnel will be flown in and out of the Iliamna Airport and transported to the site by road.

Workers will remain on site throughout their work period. Site rules will prohibit hunting, fishing, or gathering while on site to minimize impacts on local subsistence resources.

3.5.6. Potable Water Supply

A series of groundwater wells located north of the mine site will supply potable water to the mine site. Preliminary tests indicate that minimal water treatment will be required. Treatment will likely include multimedia filtration, chlorination with sodium hypochlorite, and pH adjustment with sodium hydroxide. The treatment plants will be designed to meet federal and state drinking water quality standards.

Potable water will be distributed through a pump and piping network to supply fresh water to holding tanks at the personnel camp and process plant. Holding tank capacity will be sufficient for a 24-hour supply. Diesel-fired backup pumps will also be installed to provide potable water during an electrical outage.

3.5.7. Communications

Communications to site will be via fiber optic cable with satellite backup for critical systems. The fiber optic cable will connect to existing fiber optic infrastructure in the region or a dedicated fiber optic cable laid in conjunction with the gas pipeline.

The process plant communication system will use a dedicated ethernet network to support mine process control system communications. A separate network will connect various main components of the fire-detection and alarming system. Closed-circuit television, access control, and voice over internet protocol telephone systems will be integrated with the local area network. Mine operations will use two-way radios, cell phones, and similar equipment for communications.

3.5.8. Laboratories

Two laboratories will operate at the mine site during the Production Phase.

Staff affiliated with the process plant will operate the metallurgical laboratory to support process plant operations. This work will include routine operations support tests to confirm the metallurgical response of near-term plant feed, and development analysis to evaluate alternate treatment strategies. The laboratory will use state-of-the-art equipment and have fully equipped facilities for sample receiving and storage, sample preparation, and flotation.

The assay laboratory will be equipped with the necessary analytical instruments to provide routine assays to support mine and process plant operations. Some environmental samples will also be tested in this laboratory, although many of these samples will likely be submitted to external, third party laboratories.

Each laboratory will be equipped with fume hoods (with exhaust treatment, if required) and drains connected to a central receiving tank. Chemical wastes will be disposed of in accordance with all applicable laws and regulations.

3.5.9. Fire and Emergency Response

The mine and Amakdedori Port sites and both ferry terminals will be equipped for fire and emergency response. Water for fire suppression will be stored within the freshwater supply tanks at the mine and port and distributed via an insulated pipeline system that meets all pertinent code requirements. A fire truck and ambulance will be located at the mine site. An ambulance will be located at the Amakdedori Port and a pump truck will be used to deliver fire suppression water. A senior member of the safety and health management team, with appropriate training and experience, will have designated responsibility for emergency response. Emergency response teams at the mine and Amakdedori Port sites will be staffed by volunteers and will be trained in fire suppression and mine rescue in accordance with regulations.

Both the mine and Amakdedori Port site will be staffed with an emergency medical technician to provide advanced medical care; appropriate facilities will be established at both locations. As necessary, this person may draw on the capabilities of the existing clinic in Iliamna. Arrangements will be made in advance for emergency evacuation via the airports in Iliamna and Kokhanok. Designated locations for helicopter pads will be defined at the mine and Amakdedori Port sites.

Equipment will be installed at the mine site, Amakdedori Port, and the two ferry terminals to deal with oil spills; crews will be appropriately trained for such response.

3.6. Material Management and Supply

General supplies and bulk reagents will typically be stored in, or adjacent to, the areas where they will be used. The location of the explosives storage and emulsion manufacturing plant is based on the need to minimize transfer distances and to provide a safety buffer between the explosives plant and other facilities. Descriptions of mining and process related supplies are provided in Table 3-5 and Table 3-6. Average annual quantities of fuel, mining, milling, and miscellaneous consumables are listed in Table 3-7.

Table 3-7. Supply Quantities

Supply	Average Annual Quantity
Fuel	16 million gallons
Ammonium Nitrate	25,000 tons
Grinding Media, Reagents, and Miscellaneous Supplies	250,000 tons

3.6.1. Diesel Fuel

Diesel fuel to support the mining operation, as well as the trucking and ferry logistics systems, will be imported to the Amakdedori Port using coastal tanker vessels or barges. The expected maximum parcel size for delivery is four million gallons, which will allow for extended periods between shipments in winter months. The Amakdedori Port will accommodate sufficient bulk fuel storage to provide one month of buffer and allow for the offloading of bulk fuel carriers.

Diesel fuel will be transferred from the Amakdedori Port to the mine site using ISO tank-container units, which have a capacity of 6,350 gallons. These units will be loaded at the port and transported by truck and ferry to the mine site. These tank-containers will also be used for local fuel distribution at the ferry terminal sites and for fuelling the ferry itself. Additional containers will be stored at the mine site and ferry terminals to provide for a fuel reserve in the event of a supply disruption.

The main mine site fuel storage area will contain fuel tanks in a dual-lined and bermed area designed to meet regulatory requirements. Sump and truck pump-out facilities will be installed to handle any spills. There will also be pump systems for delivering fuel to the rest of the mine site. Dispensing lines will have automatic shutoff devices, and spill response supplies will be stored and maintained on site wherever fuel will be dispensed.

Fuel will be dispensed to a pump house located in a fuel storage area for fueling light vehicles. It will also be dispensed to the fuel tanks in the truck shop complex, which are used for fueling mining equipment. These tanks will also be in a lined and bermed secondary containment area.

3.6.2. Lubricants

Lubricants will be packaged in drums and/or totes and stored on site within a secondary containment area.

3.6.3. Explosives

The materials used to manufacture blasting agents include ammonium nitrate prill, fuel oil, emulsifying agents, and sensitizing agents (gaseous). The containers used to transport the prill will be offloaded, using a container tilter, to a bucket elevator, which will unload the prill to three silos, each sized for 150,000 pounds. As a safety precaution, ammonium nitrate prill will be stored and prepared for use at a location approximately 0.75 mile southeast of the final pit rim. Electrical delay detonators and primers will be stored in the same general area, but in a separate magazine located apart from each other and separate from the prill. All facilities will be constructed and operated to meet mine safety and health regulations as set forth in 30 CFR 77.1301.

Other explosives required for the mining operation include detonating cord, which connects to each blast hole and fires a detonator, initiating the explosion in each blast hole. The detonators, in turn, fire explosive primers, which propagate the explosion to the blasting agent. Small amounts of pre-packaged blasting agents and minor amounts of other explosives may be used for specific purposes.

3.6.4. Reagents

Reagents will arrive at the mine site by truck in 20- or 40-ton containers, depending on the reagent. They will be stored in a secure bulk reagent storage area and segregated according to compatible characteristics. The reagent storage area will be sufficient to maintain a two-month supply at the mine site. As needed, reagents will be loaded onto a truck and delivered to the appropriate reagent receiving area.

Reagents will be used in very low concentrations throughout the mineral processing plant and are primarily consumed in the process; low residual reagent quantities remain in the tailings stream and will be disposed in the TSF where they will be diluted and decompose.

The metallurgical and assay laboratories will also use small amounts of reagents. Any hazardous reagents imported for testing will be transported, handled, stored, reported, and disposed of as required by law, in accordance with manufacturers' instructions, and consistent with industry best practices.

3.7. WASTE MANAGEMENT AND DISPOSAL

3.7.1. Used or Damaged Parts

Used tires and rubber products will be reused to the extent practicable. Additional used tires, along with other damaged parts and worn pipes, will be packaged and back-loaded into empty containers for shipment and disposal off site. Wood pallets and packaging will be incinerated with domestic waste. Scrap steel, such as broken grinding balls and used mill liners, truck body liners and ground engaging tools, will be shipped off-site to appropriate disposal sites.

3.7.2. Laboratory Waste

Most inorganic aqueous wastes from the metallurgical and assay laboratories will be collected in a sump, with the remainder routed to the domestic sewage treatment plant. Fugitive organics will be skimmed from the surface of the sump prior to discharging the aqueous portion to the LGO and main WMP. Generally, non-aqueous waste will be collected in specific and separate bulk containers before being returned to an appropriate place in the plant. If there is no suitable place in the main plant, it will be sent to the general waste storage area where it will be packaged and sent off site for disposal at an appropriate facility.

3.7.3. Waste Oils

Waste oil will be reused as fuel in used oil heaters to augment heating in the truck shop and/or other buildings on site. Waste oils not suitable for burning, including lubricants, will be collected into drums, sealed, and stored in containers for shipment to be recycled or disposed of off-site at an approved facility.

3.7.4. Truck Wash Wastewater

Water from the truck wash will be routed to the TSF. Water in the TSF will be either recycled within the mill and processing plant or treated and discharged.

3.7.5. Reagent Packaging

Reagent packaging will include wooden boxes, bulk poly-propylene containers, bulk bags, laboratory packaging, and/or glass containers. Spent reagent packaging will be evaluated against applicable regulations, permits and health and safety plans for possible incineration in the on-site incinerator. Glass containers will be rinsed and packed for removal and disposal off site. Broken sharp products will be collected and packaged appropriately for removal and disposal off site.

3.7.6. Hazardous Waste

Miscellaneous hazardous wastes that may accumulate on site, such as paint, used solvents, and empty reagent containers with residual chemicals, will be managed and shipped off site to approved facilities according to applicable BMPs and regulations.

3.7.7. Nuclear Instrumentation

Nuclear instrumentation such as densitometers will be shipped off site to approved facilities in accordance with applicable BMPs and regulations.

3.7.8. Domestic Refuse

Domestic refuse from the camp kitchen, living quarters, and administration block will be disposed of on site in a permitted landfill, or shipped off-site to appropriate disposal sites. Some wastes, including putrescible wastes, will be incinerated on site, and the remaining ashes will be disposed of in accordance with applicable BMPs and regulations.

3.7.9. Sewage and Domestic Wastewater Disposal

Separate sewage treatment plants will be located at the camp and the process plant. Plans for each plant will be reviewed and approved by ADEC prior to construction.

Personnel accommodations will produce grey water from the kitchen, showers, and laundry facilities that will be treated in a water treatment plant (WTP). The WTP will be designed to remove biological oxygen demand, total suspended solids (TSS), total phosphate, total nitrogen, and ammonia to meet ADEC domestic waste-discharge criteria. Treated water will be discharged to the TSF.

The process plant sewage WTP will receive effluent that may have metallic residues from the workers' change house and associated laundry. This WTP will be designed for metals removal in addition to biological oxygen demand, TSS, total phosphate, total nitrogen, and ammonia to meet ADEC domestic waste-discharge criteria. The treated water will be discharged to the TSF.

Sludge from both plants will be stabilized and disposed of on site.

3.8. TRANSPORTATION CORRIDOR

The location of the Pebble Project mine site is physically separated from the marine terminal location by Iliamna Lake, which is roughly 75 miles long and up to 20 miles across, with no existing roadway networks around it. To avoid the environmental impact of constructing new roads around the lake, an all-season ice-breaking ferry will be used to cross the lake between ferry landings on each shore, which are connected to the mine site and Amakdedori Port by access roads.

The transportation corridor was designed to avoid wetlands where feasible, minimize disturbance area, minimize stream crossings, avoid geological and avalanche hazards, avoid culturally significant sites, minimize effects on subsistence hunting and gathering, optimize the alignment for the best soil and geotechnical conditions, and minimize road grades.

The main access road will run southward from the mine site to the north shore of Iliamna Lake. Ferry terminals will be located on the north and south shores. From the south shore of the lake, the access road will run to the marine port site on Cook Inlet at Amakdedori. Spur roads will connect to the villages of Iliamna, Newhalen, and Kokhanok (Figure 1-2).

3.8.1. Road Design

The main access road will be a private 30-foot-wide gravel road, which will enable two-way traffic, and will be capable of supporting anticipated development and operational activities during construction and truck haulage of concentrate from the mine to the port.

The access roads will include eight bridges, six of which will be single-span, two-lane bridges that range in length from approximately 90 to 170 feet. There will be one large (550 feet) multi-span, two-lane bridge across the Newhalen River and one large (455 feet) multi-span, two-lane bridge across the Gibraltar River. Road culverts at stream crossings are divided into categories based on whether the streams are fish bearing. Culverts at streams without fish will be designed and sized for drainage only, in accordance with ADOT&PF standards. Culverts at streams with fish will be designed and sized for fish passage in accordance with ADOT&PF and Alaska Department of Fish and Game (ADF&G) standards.

A natural gas pipeline and fiber optic cable will be buried adjacent to the main access road. For river crossings, the gas pipeline will either use horizontal directional drilling or be attached to the bridge structures.

3.8.2. Iliamna Lake Ferry

A custom designed ferry will transit Iliamna Lake between the North and South Ferry Terminals, carrying inbound supplies from the Amakdedori Port to the mine site and returning with copper-gold and molybdenum concentrates, backhauled waste, and empty containers. The one-way ferry trip is about 18 miles and will take approximately 3 hours to complete in ice conditions, or 1.5 hours in open water. On average, one round trip per day across the lake will be required.

The vessel is designed to operate year-round, in all ice conditions. Cargo will be carried on the vessel deck. The vessel is symmetrical forward and aft with two icebreaking bows, allowing operation in open water or ice in either direction without the need to turn the vessel around at each terminal. Each bow will be fitted with a ramp that provides access to shore. The diesel-electric propulsion system has four azimuthing propellers providing 100 percent thrust over a full 360 degrees, which will provide propulsion, station keeping in all wind conditions, and ice management (clearing ice away from the hull) when needed. Accommodation for 12 crew members is included on the vessel.

The generator engines comply with the highest applicable U.S. Environmental Protection Agency (EPA) emission standards. The hull is subdivided by watertight bulkheads so that even if one compartment is damaged and flooded, the vessel will remain afloat, upright and stable, and operational, capable to return to shore facilities for repairs. Fuel and other potential contaminants will be stored in tanks inside the hull and away from the shell to prevent spills in the unlikely event of damage to any of the hull's compartments.

Bilge water will be pumped through oil-water separation equipment installed on the vessel and then discharged back to Iliamna Lake. The sludge from the system will be transferred to a shore storage tank and ultimately transported to the mine site for disposal in the mine site incinerator.

The ferry terminals will initially serve as trans-shipment points for construction barge traffic across Iliamna Lake, using small temporary barges until the ferry is assembled. The south ferry terminal site includes the ferry assembly site. The ferry will be assembled from pre-fabricated components barged to the Amakdedori Port and then transported across the road. The vessel will be assembled in a cradle that rests on a series of heavy rails. Once assembled, the cradle will be pushed along the rails into the lake until the ferry floats away. The cradle will then be retrieved. The assembly site will remain intact to enable regular vessel surveys and maintenance as required.

The permanent facilities at the ferry terminals include container handling and storage facilities, office and maintenance buildings, and local power supply. Each ferry terminal facility will have space for a minimum of two days of storage of the average concentrate container traffic. The patio surface will be finished as semi-permeable gravel. An access ramp will be built out from shore as a rock and aggregate causeway structure to provide approximately 40 feet of roadway surface for trucks and forklifts to access the ferry.

During normal operations the ferry will be moored with a pair of lines to bollards at the end of the causeway. The vessel drive equipment will maintain the ferry in place during loading and unloading, even during high wind conditions. When the ferry is parked it will be moored to a set of buoys outside of the causeway.. The design of these structures will allow for the engines to be turned off while also maintaining vessel security.

3.8.3. Transportation Corridor Traffic

To facilitate efficient cargo movement and optimize ferry space, most material will be transported in shipping containers. At each ferry terminal, a container yard with forklift trucks will be provided to stage empty and loaded containers for loading on/off the ferry, and truck transfer. Some cargo will be handled as break-bulk if it does not fit into containers.

Inbound Project cargo and consumables will be transported using standard ISO containers for ocean freight (either 20- or 40-foot size). Diesel fuel will be transferred from the Amakdedori Port to the mine site using ISO tank-container units, which have a capacity of 6,350 gallons. Copper-gold concentrate will be loaded into specialized bulk cargo containers, each containing about 38 tons of concentrate, with removable locking lids. Truck/trailer units will be designed to haul up to three loaded containers per trip.

Daily transportation of concentrate, fuel, reagents and consumables will require up to 35 round trips per day for each leg of the road, including three loads of fuel per day. The ferry will require one round trip across the lake per day.

3.9. Amakdedori Port

Incoming supplies such as equipment, reagents, and fuel will be barged to the Amakdedori Port and then transported by truck to the mine site. To a lesser extent, some supplies, such as perishable food, may be transported by air to the Iliamna Airport and trucked to the mine site. The Amakdedori Port will be constructed to enable direct loading of the concentrate to Handysize bulk carriers. The layout of the port is shown in Figure 1-5.

3.9.1. Port Design

The Amakdedori Port will include shore-based facilities to receive and store containers and fuel, as well as two, 2-MW natural gas power generators with an emergency diesel generator, a natural gas compressor station, maintenance facilities, employee accommodations, and offices. The shore-based complex will be constructed on an engineered fill patio, with the elevation set to address tidal surge from major storms and potential tsunamis.

The marine component includes an earthen access causeway extending out to a marine jetty located in 15 feet of natural water depth. On one side will be a roll-on/roll-off barge access berth and a separate berth on the opposite side for Handysize bulk carriers. The jetty is expected to be constructed as a sheet pile cell structure filled with granular material. The main jetty for ships up to 40,000 dead weight tons in size will be 700 feet in length and equipped with marine fenders and mooring bollards to secure the vessel alongside. The opposite side of the jetty will have a roll-on/roll-off barge berth and floating access ramp to accommodate barges up to 400 by 100 feet for container service. A floating dock, on the jetty but separate from the cargo handling berths, will be provided for ice-breaking tug moorage.

A dredged channel is required to access the berth for Handysize ships. The channel will be dredged to 50 feet below the low-low water line to allow for the required under-keel clearance for the design ship and will be 400 feet wide at the bottom. In the area near the berth, a 1,200-foot diameter (minimum) turning basin will be provided for ships to safely navigate in and out of the berth.

The dredged material will be used to construct the jetty, causeway, and/or the main terminal patio area, if suitable. Excess dredgeate will be stored in an impoundment adjacent to the port facilities. Annual maintenance dredging will be required through the life of the port facility.

3.9.2. Port Operations

Copper-gold concentrates will be transported from the mine site to the Amakdedori Port by truck in covered bulk cargo containers and stored between vessel sailings on a dedicated laydown pad adjacent to the jetty. The containers will be transported by truck over the jetty to alongside the bulk carriers, and then lifted by crane into the open hold of the receiving ship. Once inside the hold, the container lid will be opened and turned upside down to unload the concentrate into the ship's hold. The container will be lowered as close as possible to the bottom of the hold to minimize the drop distance and the potential for dust generation during ship loading. The bulk carrier ships will transport the concentrate to out of state smelters. This containerized bulk handling system minimizes dust emissions and the risk of spills.

The empty containers will be cleaned of any residue on the outside while at the port, and then returned to the laydown pad. They will then be returned to the mine site and reused for transporting concentrate.

Up to 25 Handysize ships will be required annually to transport concentrate. Up to 30 marine line-haul barge loads of supplies and consumables will be required annually. Two ice-breaking tug boats will be used to support marine facility operations.

3.10. Natural Gas Pipeline

Natural gas will be supplied to the Amakdedori Port and the mine site by pipeline (Figure 1-1). The pipeline will connect to the existing gas pipeline infrastructure near Happy Valley on the Kenai Peninsula and will be designed to provide a gross flow rate of 50 million standard cubic feet per day. A fiber optic cable will be ploughed in, or buried in a shallow trench, adjacent to the pipeline.

A metering station will be constructed at the offtake point and the pipeline will then follow the ADOT&PF ROW south along the Sterling Highway for nine miles to a gas-fired compressor station located on State of Alaska lands north of Anchor Point. The steel pipeline will be buried under 36 inches of cover and designed to meet all required codes, and will be a nominal 10 inches in diameter.

The compressor station will feed a 94-mile subsea pipeline that will be constructed using heavy wall nominal 12-inch-diameter pipe designed to have negative buoyancy and provide erosion protection against tidal currents. Horizontal directional drilling will be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards. From this point, the pipe will be installed in a trench sufficiently deep to ensure that the top of the pipe is below the ground surface. When the water depth exceeds 200 feet, the pipe will be laid on the sea floor.

The pipeline will come ashore at the Amakdedori Port, where natural gas will be fed to the port site power station and used for site heating. A second gas-fired compressor station will be located at the port site. The distance from the Amakdedori Port to the mine site is approximately 81 miles and will consist of three sections. The first section will follow the access road to the South Ferry Terminal. The pipeline will be buried in a trench adjacent to the road prism. The pipe design for this section will be similar to that between Happy Valley and Anchor Point. At the South Ferry Terminal, gas will be fed from the pipeline to the facilities for power supply and facility heat. At this point, the pipeline will enter Iliamna Lake for the next section, an approximate 18-mile lake crossing. The design of this section of the pipe, transitions, and burial will be similar to the Cook Inlet crossing. The pipeline will come ashore at the North Ferry Terminal.

Natural gas will be used to provide power and heat at ferry terminal facilities. From this point, the pipeline will follow the road route 28 miles to the mine site, with a design like the section south of Iliamna Lake.

Long-term corrosion protection and control will be provided by an external coating on the pipeline and components, combined with an impressed current and/or galvanic current cathodic protection system. The cathodic protection system will be installed and activated, as soon as is practical, after pipe installation to maximize the effect of corrosion protection. Anode bed and rectifier locations will be determined based on specific local conditions and field observations. Metering stations and pig launching and receiving facilities would be located at the compressor stations and offtake points as appropriate. Mainline sectionalizing valves will be installed as required by code, with a spacing of no more than 20 miles for the onshore sections of the pipeline.

4. WATER MANAGEMENT

PLP recognizes the importance of effectively managing water resources in the area surrounding the Pebble Deposit and will implement a comprehensive water management program that will minimize impacts to water flow and quality, and will minimize and mitigate impacts associated with all waters affected or used by the Project.

4.1. MINE SITE

The main objective of water management at the mine site is to manage, in an environmentally responsible manner, water that originates within the project area while providing an adequate water supply for operations. A primary design consideration is to ensure that all contact water that requires treatment prior to release to the environment will be effectively managed. This includes carefully assessing the Project facility layout, process requirements, area topography, hydrometeorology, aquatic habitat/resources, and regulatory discharge requirements for managing surplus water

All runoff water contacting the facilities at the mine site and water pumped from the open pit will be captured to protect the overall downstream water quality. The ultimate Project design will incorporate a detailed analysis of water collection and management, including quantity and quality estimates, water treatment options, water management facility design, and strategic discharge of treated water. The water management plan will enable the plant to operate without requiring additional water from off-site sources. Mine site water management systems will be designed for the entire life cycle of the Project, from initial construction through the preproduction phase, operation, and closure.

4.1.1. Water Balance Model

The foundation of the water management program is the water balance. The Pebble Water Balance Model is comprised of three primary modules: the Watershed Module, the Groundwater Module, and the Mine Plan Module. These three modules, which are all numerical water balance models, are very different, yet complementary. They collectively provide the means of quantifying the numerous water flows in the streams, in the ground, and in the various pipes, ponds, and mine structures associated with the mine development. The Watershed Module focuses on water flows throughout the NFK, SFK, and UTC drainages. The Groundwater Module focuses on the detailed simulation and understanding of groundwater flows within those drainages, and serves to inform the watershed module, and vice versa. The Mine Plan Module focuses on mine site water inflows and uses.

Complementing the water balance modules is an instream fish habitat-flow model, which was used to assess the effects of changes in water flow to the fish habitat in the adjacent streams.

4.1.1.1 Watershed Module

The Watershed Module for the NFK, SFK, and UTC drainages considers both surface and groundwater. This module incorporates all key components of the hydrologic cycle, including precipitation as rain and snow, evaporation, sublimation, runoff, surface storage, and groundwater recharge, discharge, and storage. The primary input is monthly precipitation and temperature data collected at the Iliamna Airport from 1942 through 2009. The model was calibrated to measured site flow data collected at various locations in all three drainages over a nine-year period. The Watershed Module also provided input for the instream fish habitat-flow model, as well as the initial boundary parameters associated with groundwater recharge and runoff conditions for the groundwater module.

4.1.1.2 Groundwater Module

The Groundwater Module focuses on the sub-surface movement of water within the NFK, SFK, and UTC drainages. It models hydrogeological conditions in a more sophisticated and detailed manner than the Watershed Module, and its outputs provide a check of reasonableness for the Watershed Module. In addition, the Groundwater Module simulates groundwater flow rates and groundwater-surface water interactions throughout the study area, whereas the Watershed Module considers surface and groundwater flow rates only at the streamflow gaging stations.

4.1.1.3 Mine Plan Module

The Mine Plan Module focuses on water movement within the Pebble Project footprint area. The Mine Plan Module is a site-wide water balance and considers all mine facilities including the TSF, open pit, process plant, LGO stockpile, and the WMPs. This module tracks water movement throughout the Pebble Project footprint area including runoff from the mine facilities, water contained in the ore, groundwater inflows, evaporation and water stored in the tailings voids.

The Mine Plan Module is used to predict the flow regime on the mine site and whether there is a water surplus or deficit. It will also be used to estimate the water storage capacity requirements for the mine under normal operating conditions.

4.1.1.4 Physical Habitat Simulation System (PHABSIM) Instream-flow Model

The PHABSIM model is an integral component of the site water balance design and is used to determine the most effective way of releasing the treated contact water that is surplus to the project needs. This model assesses the effects of changes in water flow to the instream fish habitat in streams downstream of the project site. It quantifies the areal extent of specific habitat changes that result from changes in flow throughout the year:

- for each of the three streams in the area (NFK, SFK, and UTC),
- at multiple locations throughout the whole length of each stream,
- for different salmon and resident fish species within each stream, and
- for different life history stages of each species.

Output from the model, together with a consideration of site-specific fish production limiting factors, will be used to inform and optimize the discharge of water from the site to minimize the effects of reduced flow and/or enhance instream fish habitat below the discharge points.

4.1.2. Preproduction Phase

The water management and sediment control plan during the preproduction phase consists of multiple aspects that will focus on minimizing contact water volumes. Runoff and associated sediment control measures will be managed with BMPs and adaptive control strategies. Where water cannot be diverted, it will be collected, treated, and discharged.

4.1.2.1 Water Management Plan

The water management plan during the Preproduction Phase can be summarized as follows:

- Water diversion, collection, and treatment systems will be installed around the site to address the effect of construction ground disturbance.

- Water management and sediment control structural BMPs, including temporary settling basins and silt fences, will be installed to accommodate the initial mine site construction.

- Among the first permanent facilities to be constructed will be the water management structures that will be maintained for use in adaptive management during operations, such as diversion and runoff collection ditches to minimize water contact with disturbed surfaces, and sediment control measures such as settling ponds to stop sediment from reaching downstream water courses.

- Preproduction Phase mining cannot commence until the water table in the open pit area has been lowered by groundwater pumping. The open pit dewatering system will be installed prior to Preproduction Phase mining to provide sufficient time to draw down the water table in the area. This will allow uninterrupted overburden removal in preparation for production mining of mineralized material. A series of dewatering wells will be drilled into and around the perimeter of the open pit, with the exact well number and location determined by testing the overburden aquifers. The number of wells will include an allowance for wells with poor or no water yields and wells lost through sanding, equipment loss, or other interference with water production. Pump sizes for each well will be based on well-specific yields. Water will be discharged to the environment if it meets water quality criteria; otherwise, it will be treated in a modular water treatment plant prior to discharge.

Design considerations for the Preproduction Phase water management structures include the following:

- Diversion channels, berms, and collection ditches, will be sized for the 100-year, 24-hour rainfall event.
- Diversion channels, berms, and collection ditches will be constructed with erosion-control features, such as geotextile or riprap lining, as appropriate, for site-specific condition. Energy dissipation structures, such as spill basins or similar control measures, will be included where required to reduce erosion at the outlets of the diversion channels and collection ditches.
- Sediment control ponds will be sized to treat the 10-year, 24-hour rainfall event and to safely manage the 200-year, 24-hour rainfall event.
- Water management and sediment control ponds will be constructed using non-PAG rock and earthen fill embankments.
- A temporary cofferdam will be constructed upstream of the main TSF embankment to manage water during the initial construction phase. Runoff from the undisturbed upstream catchment will be collected behind the cofferdam will be pumped downstream of all construction activities and released within the same watershed.

4.1.2.2 Water Treatment

Minimal water storage will be available on site until initial construction activities are completed. Therefore, prior to completion of the TSF embankments and water management structures, all water that does not meet water quality standards will be treated and released. Water from the following sources and activities are expected to require treatment prior to release:

- Preproduction Phase pit dewatering (dewatering of the overburden aquifer near the pit may require treatment).

- Water, primarily from precipitation, accumulating in the open pit during Preproduction Phase mining.
- Runoff from TSF embankment construction.
- Runoff from excavation for site infrastructure such as the process plant, camps, power plant, or storage areas will be routed to settling ponds prior to release.
- Prior to the operations WTPs being brought on-line, modular WTPs will be used to treat contact water that does not meet discharge requirements.

4.1.3. Production Phase

The water management and sediment control plan during the Production Phase focuses on minimizing contact water. Runoff and associated sediment control measures will be managed with BMPs and adaptive control strategies. Where water cannot be diverted, it will be collected for use in the mining process or treated and discharged.

4.1.3.1 Water Management Plan

The water management plan during the Production Phase can be summarized as follows (Figure 4-1 shows a simplified schematic of the site water balance):

- Water collected from the pit dewatering wells and the open pit will be pumped to the open pit water management pond (WMP). From there, water will be pumped to the open pit WTP for treatment and discharge. WTP sludge will be directed to the process plant where it will be added to the pyritic tailings storage cell via the pyritic tailings slurry line.

- Bulk and pyritic tailings slurry from the mill will be directed to the bulk tailings storage cell and the pyritic tailings storage cell, respectively. Additionally, precipitation and runoff water will collect in the TSF. The bulk tailings cell will maintain a small operating pond while the pyritic tailings will remain fully submerged in the pyritic tailings cell. Excess water from the pyritic tailings cell will be pumped to the bulk tailings cell.

- The main TSF embankment will operate as a flow-through facility. Water collecting in the bulk tailings storage cell will flow through the embankment to the main embankment seepage collection pond. From there, water will either be directed to the main WMP for use in the mill or to the main WTP for treatment and discharge. Any excess surface water in the bulk tailings storage cell will be similarly managed.

- Contact water will be pumped to the main WMP. Water treatment by-product sludge and reject water will be directed to the process plant and added to the pyritic tailings storage cell via the pyritic tailings slurry line. A portion of the treated water from the main WTP will be returned for use in the process plant and power plant cooling towers.

- Water flowing from the LGO stockpile and additional site runoff water will be collected in a pond adjacent to the LGO stockpile and either returned to the process plant or treated in the main WTP and discharged.
- A water surplus for the Production Phase is anticipated under normal and wetter than normal climatic conditions. Although the mine site will have a water surplus, the water volume available to discharge will be less than the pre-mine flows within the mine footprint as some water will be consumed in the tailings voids and some will be lost to evaporation and other minor uses. The site water surplus will vary during operations as the mine footprint expands and additional site runoff is collected. The annual average surplus is estimated at approximately 39 cubic feet per second (cfs) for the maximum mine site footprint. Surplus water will be treated and discharged throughout the year.
- The accuracy of water balance models is limited by many factors, including the stochastic nature of the inputs and the potential effects of climate change. In recognition of these limitations, an adaptive water management strategy is planned. Adaptive water management includes the ability to provide additional temporary water storage capacity in the TSF, to provide surplus storage capacity within the WMPs, and to provide for expansion of the WTP treatment rate by building in excess capacity. In addition to the redundancy built into the pumping and treatment systems, additional storage capacity is available under extreme flood conditions by directing water to the open pit, allowing it to flood until the pumping and treatment systems can restore the water stored in the system to its design level.
- A comprehensive water management system will be implemented to monitor water quantity and quality. All discharged waters will be monitored for compliance with state and federal permit requirements. Water from both water treatment plants will be strategically discharged to optimize fish habitat in the downstream reaches of nearby streams. Discharge locations for the treated water have been identified in the NFK, SFK, and UTC. The treated water discharge will be distributed to these locations in a manner that best optimizes downstream aquatic habitat conditions. Optimal conditions will be determined using a Physical Habitat Simulation System (PHABSIM) habitat instream-flow model and in

accordance with ADEC and Alaska Department of Fish and Game (ADF&G) permit conditions.

Design considerations for the Production Phase water management include the following elements:

- Diversion channels, berms, and collection ditches will be sized for the 100-year, 24-hour rainfall event.
- Diversion channels, berms, and collection ditches will be constructed with erosion-control features, such as geotextile or riprap lining, as appropriate, for site-specific conditions. Energy dissipation structures, such as spill basins or similar control measures, will be included where required to reduce erosion at the outlets of the diversion channels and collection ditches.
- Sediment control ponds will be sized to treat the 10-year, 24-hour storm event and to safely manage the 100-year, 24-hour rainfall event.
- Water management and sediment control ponds will be constructed using non-mineralized rock and earthen fill embankments.
- IDF for all WMPs will be the 100-year, 24-hour rainfall event; IDF for the TSF will be the 24-hour PMP.
- Surplus water will be treated to meet the specified water quality criteria prior to discharge.

Water collection, management, and transfer will be accomplished through a system of water management channels, ponds, and pump and pipeline configurations. These systems will be designed to handle the large flows that occur during spring freshet and late summer/fall rains. Spare parts for pump systems will be maintained on site to maintain continuous and effective water management. Leak detection systems that report to a central control system will be employed, as will monitoring systems to control pump cycling, high and low water-level switches, no-flow (or low-flow) alarms, vibration overheating alarms, and other systems as appropriate to monitor water management systems.

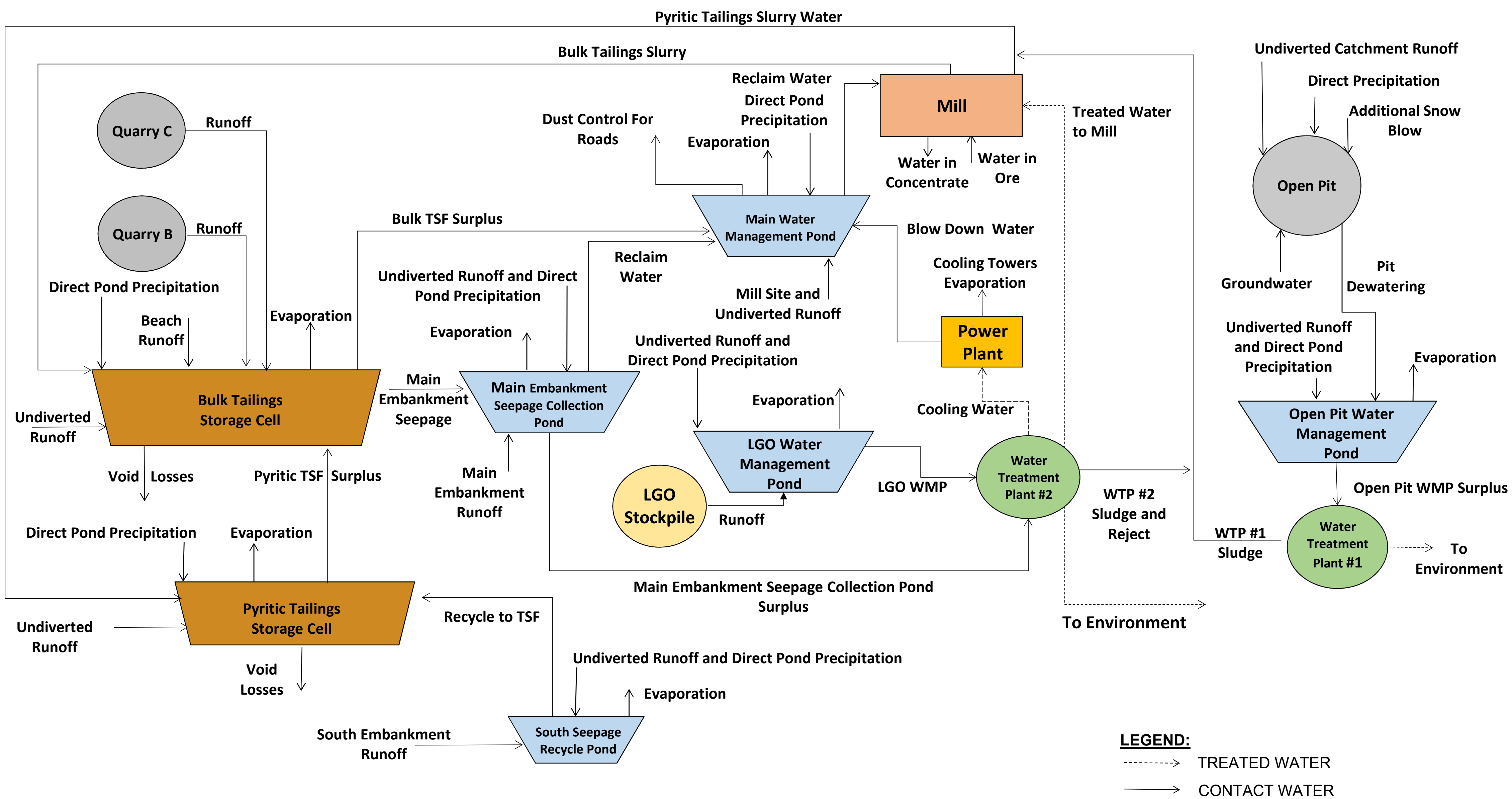

FIGURE 4-1

Schematic Water Balance

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Version: 1 | Author: HDR

4.1.3.2 Water Treatment

Water collected around the mine area and Amakdedori Port site will require treatment prior to discharge to the environment. Treatment methods will include a mixture of settling for sediment removal, chemical additions to precipitate trace elements, filtration, reverse osmosis, and evaporation to meet final discharge criteria.

The mine area will have two water treatment plants: the main WTP and the open pit WTP. Both will be constructed with multiple, independent treatment trains, which will enable ongoing water treatment during mechanical interruption of any one train.

Main Water Treatment Plant

The main WTP will treat water from the main embankment seepage pond and the LGO stockpile WMP. Figure 4-2 shows a simplified schematic of the treatment process. Key treatment steps occur in the following sequence:

1. Dissolved metals will be oxidized with air, ferric sulfate, and potassium permanganate, followed by co-precipitation with lime. Flocculators/clarifiers will be used to separate out the co-precipitated solids.
2. The clarified water will flow into a membrane feed tank, where sodium hydrogen sulfide or an organosulfide will be added to complete the precipitation process. Supplemental lime and sulfuric acid will be added as needed to maintain the water pH for optimal precipitation and membrane feed.
3. Ultrafiltration membranes will be used to filter precipitated metals and protect downstream high-pressure membranes.
4. High-pressure membranes (either nanofiltration, reverse osmosis, or combination) will provide additional metals removal as well as removal of calcium, magnesium, and sulfate. Filtrate from the high-pressure membranes may require alkalinity adjustment prior to discharge.
5. Reject from the high-pressure membranes will have a high concentration of sulfate and other divalent ions. To prevent overloading the mine water balance with sulfate, some sulfate must be removed from the reject before disposal in the TSF. Sulfate will be removed with a multi-stage calcium sulfate precipitation process. Precipitated calcium sulfate solids are disposed of in the TSF.
6. Decant from the calcium sulfate precipitation process will contain high levels of selenium, nitrate, sodium, and potassium. It will be necessary to split the decant stream to treat selenium and nitrate separately from sodium and potassium as follows:

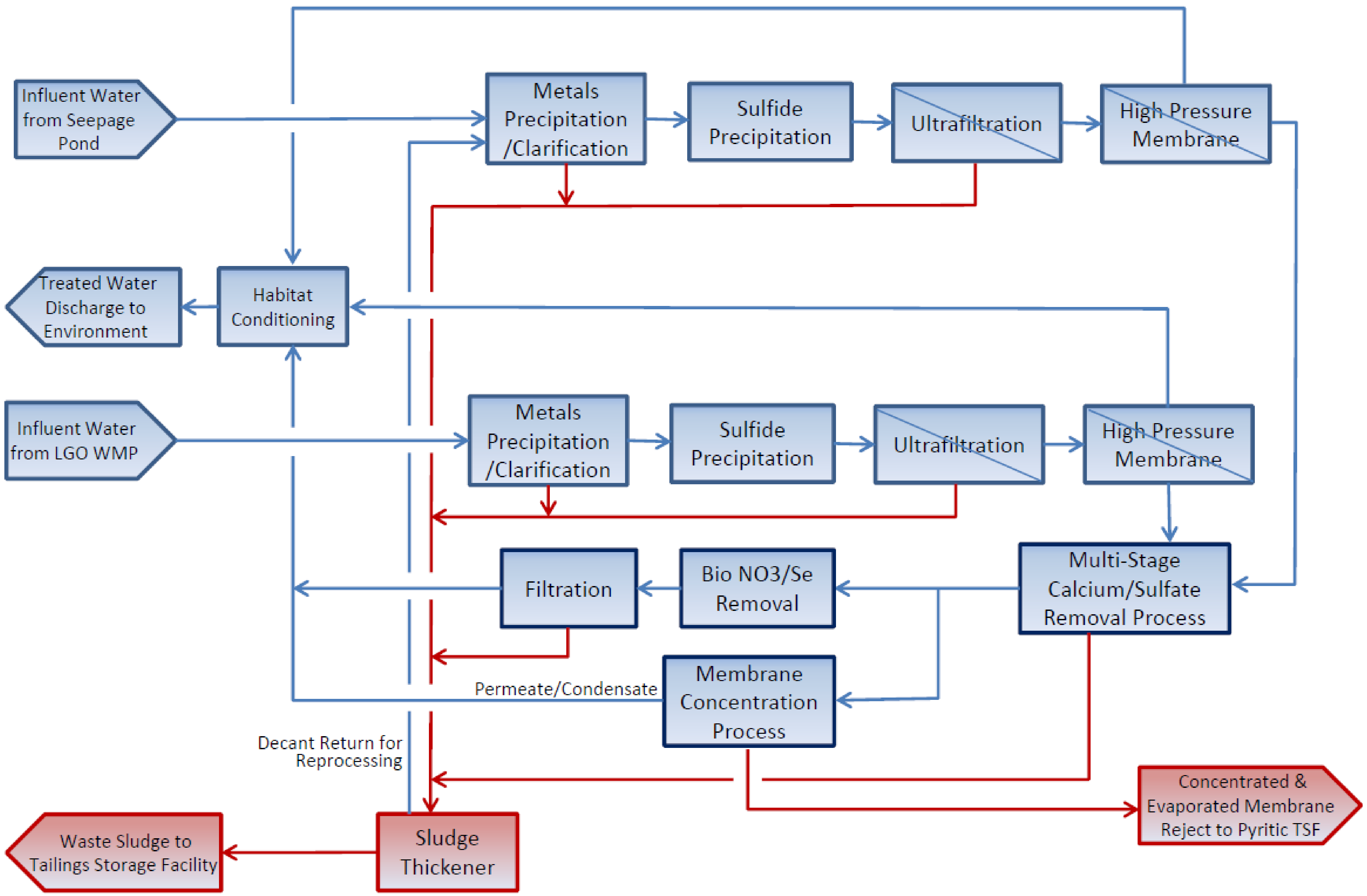
a. Approximately half of the decant stream will be sent to a biological reactor to remove selenium and nitrate followed by filtration. The filtrate is blended with treated water from the high-pressure membranes (step 4) for discharge.

b. The remainder of the decant stream will be sent to a multi-stage reverse osmosis system to remove sodium and potassium. Reverse osmosis filtrate is blended with treated water from the high-pressure membranes (step 4) for discharge. Concentrated reverse osmosis reject is sent to an evaporator to remove sodium and potassium as a solid. The evaporate is condensed and the condensate blended with treated water from the high-pressure membranes (step 4) for discharge.

Open Pit Water Treatment Plant

The open pit WTP will treat water from the open pit WMP with treatment plant processes commonly used in the mining industry around the world. Figure 4-3 shows a simplified schematic of the treatment process. Major treatment steps are outlined in sequence below.

1. Dissolved metals will be oxidized with potassium permanganate, followed by co-precipitation with ferric chloride. Sodium hydroxide and hydrochloric acid will be added as needed to maintain the water pH for optimal precipitation. Flocculators/clarifiers will be used to separate out the co-precipitated solids.
2. Clarified water will then be treated with sodium hydrogen sulfide, sodium hydroxide, and ferrous sulfate to further co-precipitate remaining metals under reducing conditions.
3. Water from the sulfide reaction tanks will be filtered to remove precipitated metals. The filtered water will be suitable for discharge.
4. Clarifier solids and filter backwash will be thickened and transferred to the TSF.



THE pebble PARTNERSHIP

FIGURE 4-2

Main Water Treatment Plant Process Schematic

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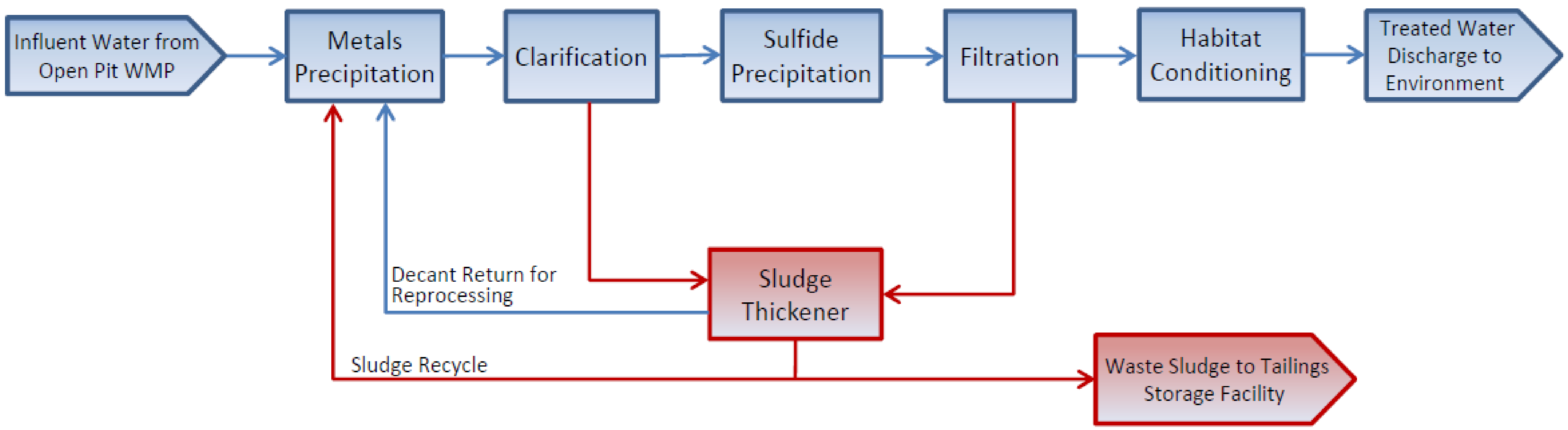
Version: 1	Author: HDR



THE pebble PARTNERSHIP

FIGURE 4-3

Open Pit Water Treatment Plant Process Schematic

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4.1.4. Closure/Post-Closure Phase

Closure and post-closure water management addresses both the immediate physical closure of the site and associated reclamation activities, as well as the long-term post-closure period and associated maintenance and monitoring activities. Additional details on reclamation and closure are provided in Section 6.

4.1.4.1 Water Management Plan

The water management plan during the closure and post-closure phases can be summarized as follows:

- Once mining in the open pit stops, dewatering will stop, and the open pit will begin to flood.
- Once milling operations stop, the physical site reclamation will commence. Surface runoff from the reclaimed areas will be collected and either treated in the WTPs or directed to the pit lake until the runoff is found to be suitable for direct discharge.
- Free water will be pumped from the bulk tailings surface, which will be graded and revegetated to direct surface runoff toward the closure spillway. The pyritic tailings will remain sub-aqueous to prevent oxidation and potential acid generation. Seepage water from the embankment seepage collection systems will be collected and either treated in the WTPs or directed to the pit lake until it is found to be suitable for direct discharge.
- The pit will continue to fill until the pit lake is formed. Surface runoff from the walls may result in metal leaching. Water quality is expected to be acidic with elevated metals due to overall oxidation of the open pit walls. Pit lake water quality will be monitored, and appropriate precautions will be taken to manage wildlife activity on the lake. Once the level of the pit lake has risen to about 890 feet elevation, water will be pumped from the pit, treated as required, and discharged to the environment. By maintaining the water level at least 50 feet below the elevation in which groundwater flows out of the open pit, upset conditions resulting in an unplanned discharge can be avoided, as there will be sufficient time to address any problems with the WTP before flows reverse.

4.1.4.2 Water Treatment

Water treatment during this phase will use the existing WTPs as needed. Water quality will be closely monitored, and changes and adjustments to the treatment process will be made as needed. The reclamation and closure bond package will include provisions for periodic replacement of water treatment facilities and ongoing operating and monitoring costs over the long-term, post-closure period.

4.2. AMAKDEDORI PORT

The WTP at the Amakdedori Port will treat surface runoff from the port facilities, including truck wash bays. The treatment process will include dissolved metal oxidation using potassium permanganate, followed by co-precipitation with ferric chloride. Water from the co-precipitated solids will flow into flocculators/clarifiers to separate out solids. The clarified water will then be treated with sodium hydrogen sulfide, sodium hydroxide and ferrous sulfate to further co-precipitate remaining metals under reducing conditions. The solids that are removed will be thickened and disposed of appropriately. The treated water will be suitable for discharge.

A potable WTP and a sewage treatment plant will also be located at the port site.

5. PROJECT CONSTRUCTION

The Project will take approximately four years to construct. Construction will occur on the four main project components–mine site, transportation corridor, Amakdedori Port, and natural gas line across Cook Inlet, with the focus shifting between these components depending on the stage of construction. Several temporary elements will be built during the Preproduction Phase to facilitate construction of the permanent facilities. These temporary facilities will be either repurposed or removed and reclaimed when construction is complete.

5.1. CONSTRUCTION OVERVIEW

5.1.1. Site Access

Key first steps will be to establish transportation infrastructure to access the site, to install those environmental protection systems that will service the Preproduction Phase, and to construct temporary facilities that enable the construction crews to live and work at the sites.

The initial construction effort will be at the Amakdedori Port. A beachhead will be established using small landing craft style barges for access. As described more fully below, it will consist of a temporary camp, environmental protection features, the port site airstrip, and service facilities. Temporary diesel generators will be used for power supply. While this work is underway, crews will be housed on vessels moored near the site.

A temporary road will be constructed within the permanent alignment from the established beachhead to the first material site, approximately three miles from the port site. This material will be used to expand the pads for temporary and permanent facilities and to construct the impoundment for the dredged materials. With this latter impoundment in place, off-shore dredging will commence. Pioneer road construction will continue during this phase, extending the road toward the South Ferry Terminal near Kokhanok.

Larger equipment will be landed once the completed jetty is in place, allowing full-scale road construction to commence. The goal will be to establish a connection to the south shore of Iliamna Lake to facilitate construction of a temporary barge landing site near Kokhanok and to build the road to the east abutment of the crossing of the Gibraltar River.

With access gained to Iliamna Lake, small barging equipment will be used on the lake to establish beachheads at the two ferry terminal sites, in a process similar to the one used at the Amakdedori Port. Commercial operators utilizing existing access through

Pile Bay at the east of Iliamna Lake and the road connecting to Williamsport on Cook Inlet may be used to support the beachheads.

The beachheads at the ferry terminal sites will enable road construction to advance from those points. Temporary bridges will be used at the smaller crossings, while the major crossings at the Gibraltar River and the Newhalen River will have to be constructed to their full size because of the spans required. These larger spans will be completed during the second construction year.

Initial access to the mine site should be complete within one year.

A key component of the construction plan is to establish year-round access across Iliamna Lake using the permanent ice-breaking ferry. Fabrication of the ferry components will commence off-site early in the Preproduction Phase. Once the South Ferry Terminal has been established, preparation of the ferry construction facility will begin and the pre-fabricated components will be delivered to site. The goal is to have the ferry constructed and launched during the second construction year.

5.1.2. Port Dredging

Geotechnical information on the sub-bottom soil profiles is not currently available for this area, but on-shore geophysical information suggests that sufficient depth of sand and gravel exist in the bay to allow this dredging to be completed without having to excavate any hard rock. Dredging will be performed using hydraulic or mechanical methods, depending on geotechnical characteristics. Dredging and dredge material transport and placement will be designed and performed in accordance with U.S. Army Corps of Engineers (USACE) Engineering Manual 1110-2-5025. Dredging is expected to be completed accomplished over a two-year period.

While the exact composition of the dredged material is not currently known, some of this material could be beneficially used in the construction of either the jetty and causeway, or the main terminal patio area. All unused dredge material will be disposed of in a stockpile on the upland area behind the marine terminal. Dredged material will be transported to the stockpile and beneficial use sites by mechanical means or pumping and pipeline depending on geotechnical characteristics.

The dredge stockpile will be constructed by first excavating a containment area of approximately 170 acres. Excavated material will be used to construct containment berms around the stockpile area and berms within the area to create a sedimentation pond and to control the placement and consolidation of dredge material.

Water that separates from the dredged material will be contained within the active material placement zone for initial settling. As the water volume in the placement area increases, cleaner water from the surface will overtop an adjustable weir at an intermediate outlet structure. Water that overtops the weir will enter transfer pipes that will be buried in the berm between the material placement zone and the sedimentation pond. The transfer pipes will convey the water by gravity flow into the sedimentation pond.

The sedimentation pond will provide final sediment settling through the water column thereby reducing turbidity prior to final discharge. Clean water from the sedimentation pond surface will be discharged into marine waters through an adjustable weir, outlet structure, and outfall pipes. The outfall pipes will be sized and numbered to match the dredging operation and precipitation on the stockpile area. It is expected that there will be two to four parallel outfall pipes that may range in diameter from 36 to 48 inches. The outfall pipes will be approximately 1,000 feet long from the outlet structure to mean lower low water (MLLW). The outfall pipes will be buried under the access road and beach until becoming fully exposed approximately at the MLLW elevation. A splash pad of riprap will be constructed at the outfall pipe outlets to prevent erosion.

Maintenance dredging of the port area will be required over the life of the project, and allowance for placement of that additional dredged material has been made in sizing the stockpile.

5.1.3. Mine Site

Construction activities will commence at the mine site with completion of the initial access and the construction of temporary accommodation and service facilities. Earthworks will be the primary initial activity. The level of this activity will expand over the next year, with structure construction commencing as the associated earthworks are complete. The focus will be on establishing the process and power plant sites, the LGO stockpile, and the TSF. Support facilities, such as accommodations, fuel storage, and power generation, will expand as the site activity increases. Laydown areas and access roads for construction will be placed within the future footprint of the open pit to minimize impacts.

Following on from this, process plant and power plant foundations will be well advanced and equipment deliveries commenced. The accommodations facility will be completed for construction and access roads built. The initial TSF main embankment construction will be well advanced, with the goal of ensuring that at least one year's worth of water is collected to facilitate process plant startup.

The later construction years will entail significant activity at the site. During this period, the TSF main embankment will be completed, the process plant building erected, and the LGO stockpile foundation and liner installed. The WTPs will be ready for initial use and the power plant construction advanced. The initial open pit development will commence with mine service facilities constructed and initial pit dewatering systems installed and operating. Production mining equipment will be delivered and commissioned as required. WMPs will be constructed during the third year.

A major activity during the final year of construction will be the open pit Preproduction Phase mining. The remaining process and power plant construction will be completed, as will the remaining embankments in the TSF.

5.1.4. Gas Pipeline

The natural gas line installation will be the other major activity occurring during the second and third construction years. Three separate centers will comprise this endeavor: the onshore line and compressor station on the Kenai Peninsula, the marine section between the Kenai Peninsula and the Amakdedori Port, and the overland/Iliamna Lake section paralleling the access road. These activities can generally proceed independently of each other, with a target of having natural gas to the mine site by the end of the third construction year.

5.2. Commissioning Overview

Following construction, the process plant undergoes the following activities to transfer the project from a construction site to a fully operational process plant.

5.2.1. Construction Completion

In the lead up to the completion of the construction phases, pipelines will be pressure tested and all mechanical, civil, structural and electrical installations will be checked to ensure that they are installed according to design and can operate safely. The completions process includes structured and rigorous Quality Assessment and Quality Control procedures to resolve any remaining construction issues prior to pre-commissioning.

5.2.2. Pre-commissioning

This phase involves the testing and inspection of individual plant sub-systems, and associated equipment and facilities to confirm that they are safe and ready for the wet commissioning stage. This includes things such as motor rotations, testing and energisation of power and control systems, field instrument calibrations and adjustments, verification of safety devices and alarms, and first fills of lubricants. Testing of safety systems may involve unit process emergency procedures and live testing.

5.2.3. Wet Commissioning

During wet commissioning, plant operations are simulated, using water where applicable, to test equipment, piping, instrumentation and control systems, and interlocking to the maximum extent possible prior to the introduction of mineralized material. The water testing will check that fluid systems perform to their design intent and meet their design specifications prior to the introduction of mineralized material during process commissioning.

5.2.4. Process Commissioning

This phase comprises the initial operation of the plant facilities using mineralized material and process reagents. The objective is to have the process plant operating in a steady and consistent manner prior to the ramp-up phase. During this phase, differing results or any unforeseen issues with the scale up from test work to full-scale operation of the process plant will be identified. During this phase, plant or infrastructure modifications, or process reconfiguration, may be required to improve the process or enhance efficiency.

5.2.5. Ramp Up

The ramp-up phase may last several months, during which the process plant will be ramped up to its full design capacity and performance levels. This phase may also entail infrastructure modifications or process reconfiguration as identified by the commissioning and operations teams.

5.3. Temporary Facilities

Many of the facilities installed during initial construction activities will be converted to permanent use. However, a number of these will be decommissioned and removed during or following construction.

The initial construction camps at the Amakdedori Port and mine site will likely be fabric-covered or transportable facilities. The construction camp at the mine will be located near the mill laydown area. The construction camp at the port will be located in an area that will be used for port operations and will not require a separate footprint. The Amakdedori Port temporary camp will house the crews for the pioneer road construction. Once the road is through to Iliamna Lake, the existing camp at Kokhanok will be utilized for road crews and for the crew establishing the ferry landings.

Temporary camps will be established at the ferry landings to support road construction and, at the south ferry landing, assembly of the ferry. These camps will remain in place until the natural gas line construction is complete. The north ferry landing camp will likely be augmented using existing facilities in Iliamna and Newhalen. During the exploration phase, PLP employed more than 200 staff in Iliamna/Newhalen in these existing accommodations. Until the access road crossing the Newhalen River is complete, the crews will be shuttled to their workplaces by boat or by helicopter.

The temporary construction camp at the mine site will be expanded during the initial phase of construction at this location. Construction crews will utilize this camp and the permanent accommodations complex when it is complete. As construction is completed and crew sizes reduce, they will transition to the temporary camp only.

This will enable the accommodations complex to be refurbished to single-room occupancy for the mine operations staff.

All temporary construction facilities will be removed after construction, and the sites, unless being used for permanent facilities, will be reclaimed.

5.4. Environmental Protections During Construction

5.4.1. Stormwater

Stormwater runoff will be properly controlled at all construction sites using structural and non-structural BMPs. No construction will begin without the appropriate ADEC discharge permit and coverage under an approved stormwater pollution prevention plan. Routine inspections and monitoring will ensure the proper functioning of all stormwater BMPs throughout the construction period.

5.4.2. Fuel Management

Fuel management will include appropriate containment and practices, in accordance with ADEC regulations and an approved facility response plan. Construction equipment and construction-camp power generation will use diesel fuel. Diesel storage will include a variety of tank types and sizes ranging from approximately 10,000 to 50,000 gallons. Aviation fuel for helicopters will be stored at the mine site, Amakdedori Port, and other satellite locations as necessary. Fuel will be distributed to the smaller camps and individual work sites from the main storage locations by fuel truck.

5.4.3. Wildlife Management

Protocols will be developed with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to protect marine mammals from high noise-generating activities at the port sites. Observers will be employed to determine marine mammal presence during construction, and mitigation measures will be established by the appropriate regulatory agency through the permitting process. The U.S. Fish and Wildlife's national bald eagle management guidelines will be followed to minimize any potential for disturbance or impacts. A nest relocation or non-purposeful take permit will be requested only when work cannot be limited in the vicinity of a protected nest.

5.4.3.1 Environmental Construction Windows

Work in anadromous fish streams and in Iliamna Lake will comply with Anadromous Fish Act regulations and ADF&G guidance. Resident fish will require site-specific protections under the Alaska Fish Passage Act. Stream surveys conducted as part of the environmental baseline studies will inform the establishment of permit conditions. Mitigation measures will be determined during the permitting process.

Ground-clearing activities will be conducted prior to construction work and will be timed to avoid bird-nesting periods in accordance with the U.S. Fish and Wildlife Service's Migratory Bird Treaty Act guidance. Nesting periods are generally spring and summer, but vary according to habitats and species.

5.4.3.2 Helicopter Protocols

PLP protocols to ensure that helicopters and fixed-wing planes do not harass wildlife have been well established during the exploration phase of the project. These protocols, listed below, will remain in place throughout construction and the life of the mine.

- Do not harass or pursue wildlife.
- Fly 500 feet above ground level or higher when possible and safe to do so.
- When wildlife (especially bears, caribou, moose, wolves, raptor nests, flocks of waterfowl, seabirds, or marine mammals) are observed, avoid flying directly overhead and maximize lateral distance as quickly as possible.

5.4.3.3 Hunting and Fishing Restrictions

PLP employees and contractors will not be allowed to fish, hunt, or gather while on their work rotation during the construction and operation of the Pebble Project facilities.

6. CLOSURE AND RECLAMATION

PLP's core operating principles are governed by a commitment to conduct all mining operations, including reclamation and closure, in a manner that adheres to socially and environmentally responsible stewardship while maximizing benefits to state and local stakeholders. PLP has adopted a philosophy of "design for closure" in the development of the Project that incorporates closure and long-term post-closure water management considerations into all aspects of the project design to ensure that all regulatory requirements, as well as private landowner obligations, are met at closure.

Considerations incorporated into the project design include:

- Separate tailings cells for bulk and pyritic tails will be used to facilitate the physical closure and post-closure water management for the TSF.
- The LGO stockpile will be used for the storage of PAG waste rock during operations and placement of any remaining PAG waste rock back into the pit to avoid the need for a PAG waste rock storage facility.
- Quarried and waste rock will be geochemically tested prior to being used in construction to avoid the potential for contaminated drainage during operations and post-closure.
- Topsoil and overburden will be salvaged during construction for use as growth medium during reclamation.
- TSF embankment slopes will be 2.6H:1V to provide long-term stability and facilitate the placement of growth medium.
- The overall project footprint will be minimized to facilitate physical closure and post-closure water management.

Reclamation and closure of the Project falls under the jurisdiction of the ADNR Division of Mining, Land, and Water, and the ADEC. The Alaska Reclamation Act (Alaska Statute 27.19) is administered by the ADNR; it applies to state, federal, municipal, and private land and water subject to mining operations. Except as provided in an exemption for small operations, a miner may not engage in a mining operation until the ADNR has approved a reclamation plan for the operation. The landowner participates in the planning process with regard to determining and concurring with the designated post-mining land use.

6.1. PHYSICAL RECLAMATION AND CLOSURE

The physical site closure work will commence as mining operations and, later, LGO stockpile reclaim and milling operations end.

- Active mining in the open pit will stop after 14 years, pit dewatering will stop, and the pit will begin to flood.
- Six years later, LGO stockpile reclaim and milling will stop, and removal of the mill and supporting infrastructure not required for closure and reclamation of the TSF will begin.
- Once physical closure activities are completed, site access infrastructure will be reconfigured to support long-term post closure activities.

All mill and support facilities not required for post-closure, including the LGO stockpile liner, will be dismantled and removed. Concrete pads and foundations will be broken up so that they do not act as an impermeable impediment to water flows. Inert materials will be disposed of in an on-site monofill that will be sited within the disturbed footprint, while others will be shipped off site for disposal as appropriate. Disturbed areas will be recontoured, graded, ripped, and scarified. Top soil and growth media will be placed as needed, and sites will be seeded for revegetation. Surface runoff from the disturbed areas will be collected and either treated in the WTPs or directed to the pit lake until it is found to be suitable for direct discharge to the downstream drainages.

A spillway will be constructed from the TSF to control water levels within the impoundment. Late in the operating phase, tails in the bulk TSF will be spigoted to allow for surface drainage toward the closure spillway. As milling operations cease, free water will be pumped from the surface of the bulk tails, and they will be allowed to consolidate until the surface is suitable for equipment traffic on the surface. The tails will be regraded as needed to facilitate drainage and topsoil, and growth media will be placed over the surface of the tails prior to seeding for revegetation. Topsoil and growth media will also be placed on the tailings embankments prior to seeding for revegetation.

The pyritic tailings must remain sub-aqueous to prevent oxidation and potential acid generation. A layer of rock and/or bulk tailings will be placed over the top of the pyritic tailings. This layer will be of sufficient thickness to allow for the phreatic surface to be managed by active pumping using sumps, such that the pyritic tails remain inundated, while the surface has no free water. Topsoil and growth media will be placed on the surface prior to reseeding for vegetation. Seepage water from the embankment seepage collection systems will be collected and either treated in the WTPs or directed to the pit lake until it is found to be suitable for direct discharge to the downstream drainages.

The road system will be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. The Iliamna Lake ferry facilities will be removed, and all supplies will be transported across the lake utilizing a summer barging operation. The Amakdedori Port facilities will be removed, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. Channel dredging will cease after concentrate shipping stops. The natural gas pipeline will be retained until such time as it is no longer required to provide energy to the project site. If no longer required, the pipeline will be pigged and cleaned before being abandoned in place. Surface facilities associated with the pipeline will be removed and reclaimed.

6.2. Post-Closure Management

The pit lake will continue to fill for a period of several decades post-closure. Surface runoff from the walls will result in leaching of accumulated metals from the walls. Water quality is expected to be acidic with elevated metals due to overall oxidation of the pit walls. Pit lake water quality will be monitored, and appropriate precautions will be taken to manage wildlife activity on the lake. Once the level of the pit lake has risen to about 890 feet elevation, water will be pumped from the pit, treated as required, and discharged to the environment. By maintaining the water level at this elevation, which is at least 50 feet below the elevation at which groundwater flow would be directed outward from the open pit, upset conditions resulting in an unplanned discharge can be avoided, as there will be sufficient time to address any problems with the WTP before flows reverse.

Long-term discharge from the TSF seepage collection systems and surface runoff from disturbed areas found not suitable for direct discharge will either be directly treated in the site WTPs or be pumped to the pit lake.

6.3. Financial Assurance

Prior to commencing construction, the Project Reclamation and Closure Plan approval and associated financial assurance mechanisms will need to be in place. The Reclamation and Closure Plan and financial assurance obligations will be updated on a 5-year cycle in accordance with regulatory requirements to address any changes in closure and post-closure requirements and cost obligations.

A detailed reclamation and closure cost model will be developed that will address all costs required for both the physical closure of the Project and the funding of long-term post closure monitoring, water treatment, and site maintenance. The estimate will include the costs of closure planning and design, and mobilization of third-party equipment to site; detailed estimates of equipment and labor requirements for physical closure; capital, sustaining capital, and operating costs for water treatment and other long-term post-closure operations; and appropriate indirect costs and contingencies developed following ADNR guidance.

7. ENVIRONMENTAL PERMITTING

Numerous environmental permits and plans will be required by federal, state, and local agencies. PLP will work with applicable permitting agencies and the State of Alaska large mine permitting team to provide complete permit applications in an orderly manner.

Because the Pebble Project involves a federal permit–U.S. Army Corps of Engineers Section 404/10 permit for the filling of wetlands and placement of structures in navigable waters–the provisions of NEPA will apply to this Project. There are provisions within NEPA, as well as within the permitting processes for many of the individual permits, that will provide for public review and comment on the Project.

Table 7-1 lists the types of permits that are expected to be required for the Pebble Project. Multiple permits of certain types may have to be applied for to accommodate the full scope of facilities.

Table 7-1. Environmental Permits Required for the Pebble Project

Agency	Approval Type	Project-related Examples
Federal		
BATF	License to Transport Explosives	Construction explosives acquisition and use
	Permit and License for Use of Explosives	Construction explosives acquisition and use
BSEE	Right-of-Way Authorization for Natural Gas Pipeline	Subsea natural gas pipeline in OCS waters
DHS	Airport Security Operations Plan	Iliamna Airport
	Port Facility Security Coordinator Certification	Port site
	Port Security Operations Plan	Port site
EPA	Facility Response Plan	Fuel storage facilities
	RCRA Registration for Identification Number	Storage and disposal of hazardous wastes
	Spill Prevention, Control, and Countermeasure (SPCC) Plan	Fuel storage facilities
FAA	Notice of Controlled Firing Area for Blasting	Construction and mining blasting activity
FCC	Radio License	Radios

Agency	Approval Type	Project-related Examples
MSHA	Mine Identification Number	Mine site
	Notification of Legal Identity	Mine site
NMFS	Magnuson-Stevens Fishery Conservation and Management Act Consultation documentation	Necessary in areas where mine, road, or port site activity affect essential fish habitat
USACE	Clean Water Act Section 404 permit for Discharge of Dredge or Fill Material into Waters of the U.S.	Fill into wetlands for a variety of facilities at the mine, road, pipelines, port site
	Rivers and Harbors Act Section 10 Construction of any structure in or over any Navigable Waters of the U.S.	Road bridges and causeway; port site docking and ship-loading facilities and maintenance dredging.
USCG	Clean Water Act Section 10 Permit for construction of any structure in or over any Navigable Water of the U.S.	Road bridges and causeway; port site docking and ship-loading facilities and maintenance dredging
	Facility Response Plan	Fuel storage facilities
	Fuel Offloading Plan; Person in Charge Certification	Offloading fuel from barges at the port
	Hazardous Cargo Offloading Plan; Port Operations Manual Approval	Offloading hazardous cargo from ships
	Navigation Lighting and Marking Aids Permit	Port facilities
	Rivers and Harbors Act Section 9 Construction Permit for a Bridge or Causeway across Navigable Waters	Bridges along road
USDOT	Registration for Identification Number to Transport Hazardous Wastes	Transport of hazardous wastes along road and to approved disposal site
USFWS	Bald and Golden Eagle Protection Act Programmatic Take Permit	May be necessary in areas where mine, road, or port site activity may disturb eagles
	Migratory Bird Treaty Act Consultation documentation	May be necessary in areas where mine, road, or port site activity may disturb migratory birds

Agency	Approval Type	Project-related Examples
USFWS/NMFS	Endangered Species Act Incidental Take Authorization	May be necessary at the port site and for sub-sea pipeline construction where activities could disturb northern sea otter, Beluga whale, Steller sea lion, Steller's eider
	Marine Mammal Protection Act Incidental Take Authorization; Letter of Authorization	May be necessary at port site where activities could disturb northern sea otter, Beluga whale, Steller sea lion, harbor seal, Dall's porpoise
State		
ADEC	Alaska Solid Waste Program Integrated Waste Management Permit/Plan Approval	Tailings disposal, waste rock disposal, landfills
	Alaska Solid Waste Program Solid Waste Disposal Permit; Open Burn Permit	Tailings disposal, waste rock disposal, landfills
	Approval to Construct and Operate a Public Water Supply System	Mine and port, and construction camps
	Clean Air Act Air Quality Control Permit to Construct and Operate – Prevention of Significant Deterioration	Power plant and other non-mobile air emissions; fugitive dust; applicable to mine, road, and port
ADEC	Clean Air Act Title V Operating Permit	Power plant and other non-mobile air emissions; fugitive dust; applicable to mine, road, and port
	Clean Water Act Section 402 Alaska Pollutant Discharge Elimination System Water Discharge Permit	"End of Pipe" water discharges from water treatment plants at the mine, along with domestic water treatment plants at the mine and port
	Clean Water Act Section 402 Stormwater Construction and Operation Permit Stormwater Discharge Pollution Prevention Plan	Surface water runoff discharges at mine, road, and port site
	Food Sanitation Permit	Mine and port, and construction camps
	Oil Discharge Prevention and Contingency Plan (ODPCP or "C" Plan)	Fuel storage facilities

Agency	Approval Type	Project-related Examples
ADF&G	Fish collection permits for monitoring	May be necessary for long-term monitoring
	Fish Habitat Permit	Water withdrawal in an anadromous fish waterbody, stream diversion, installation of culverts and bridges
ADNR	Alaska Dam Safety Program Certificate of Approval to Construct a Dam	Tailings dam, seepage control dams
	Alaska Dam Safety Program Certificate of Approval to Operate a Dam	Tailings dam, seepage control dams
	Lease of other State Lands	Any miscellaneous other state lands to be used by the Pebble Project – none identified at this time
	Material Sale on State Land	Materials removed from quarry sites for construction
	Mill Site Permit	All facilities on state lands
	Mining license	All facilities on state lands
	Miscellaneous Land Use Permit	All facilities on state lands
	National Historic Preservation Act Section 106 Review	Area of Potential Effect
	Pipeline Right-of-Way permit	Natural gas pipeline between the mine and port and in state waters
	Powerline Right-of-Way permit	Powerlines to support electric power distribution
	Road Right-of-Way permit	Road between mine and port site
	Temporary Water Use Permit; Permit to Appropriate Water	Surface and groundwater flow reductions
	Tidelands Lease	Port structures below high tide line
	Upland Mining Lease	All facilities on state lands
ADOL	Certificate of Inspection for Fired and Unfired Pressure Vessels	
ADOT&PF	Driveway Permit	Road
ADOT&PF	Utility Permit on Right-of-Way	Natural gas pipeline on the Kenai Peninsula

Agency	Approval Type	Project-related Examples
ADPS	Approval to Transport Hazardous Materials	Transport of hazardous materials along the road
	Life and Fire Safety Plan Check	Mine and port
	State Fire Marshall Plan Review Certificate of Approval	For each individual building
Local		
KPB	Conditional Use Permit	
	Floodplain Development Permit	
	Multi-Agency Permit Application	
L&PB	Lake and Peninsula Borough Development Permit	Mine and road area within the Lake and Peninsula Borough

ADEC = Alaska Department of Environmental Conservation
ADF&G = Alaska Department of Fish and Game
ADOT/PF = Alaska Department of Transportation and Public Facilities
ADPS = Alaska Department of Public Safety
BATF = U.S. Bureau of Alcohol, Tobacco, and Firearms
DHS = U.S. Department of Homeland Security
EPA = U.S. Environmental Protection Agency
FAA = Federal Aviation Administration
FCC = Federal Communications Commission
FERC = Federal Energy Regulatory Commission
L&PB = Lake and Peninsula Borough
MSHA = U.S. Mine Safety and Health Administration
NMFS = National Marine Fisheries Service
RCRA = Resource Conservation and Recovery Act
SHPO = State Historic Preservation Officer
USACE = U.S. Army Corps of Engineers
USCG = U.S. Coast Guard
USDOT = U.S. Department of Transportation
USFWS = U.S. Fish and Wildlife Service